Intervention Monitoring
Millewa Forest

2015-16

Office of Environment & Heritage
NSW National Parks & Wildlife Service
Australian Government
MURRAY–DARLING BASIN AUTHORITY

Report Title:	Intervention Monitoring in Millewa Forest, 2015-16
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Front cover photo:	Moira Grass on the eastern edge of Moira Lake, spring 2015 (Ali Borrell, NSW Parks)

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ACRONYMS

CEWH: Commonwealth Environmental Water Holders

CSIRO: Commonwealth Scientific and Industrial Research Organisation

DO: Dissolved Oxygen

DOC: Dissolved Organic Carbon

EWKR: Environmental Water Knowledge and Research Project

GL: Gigalitres

IS: Icon Site

MDBA: Murray Darling Basin Authority

ML/d: Megalitres per day

OEH: Office of Environment and Heritage

TLM: The Living Murray

VEWH: Victorian Environmental Water Holder

Summary

In the 2015-16 watering year, more than 366 GL of environmental water was delivered as part of a multi-site watering event along the Murray River. A portion of this water was delivered to Millewa Forest, with flows into the forest commencing in late June and continuing through to late January. 52 GL of the water was contributed by 'The Living Murray' program (TLM), 48 GL by the Commonwealth Environmental Water Holder (CEWH) (losses accounted for from the whole of event flow) and 6 GL by the Office of Environmental and Heritage (OEH). The primary aim of the environmental water delivery to Millewa was to achieve outcomes on forest's floodplain marshes, specifically aiming to promote the growth and expansion of the current moira grass (*Pseudoraphis spinescens)* stands. The depth of inundation and water quality across the floodplain were monitored. Secondary outcomes due to the inundation of wetlands across Millewa included a small colonial waterbird-breeding event, in which Australian white ibis (*Threskiornis molucca*), straw-necked ibis (*Threskiornis spinicollis*), Eastern great egrets (*Ardea modesta*), little pied cormorants (*Microcarbo melanoleucos*), and Australasian darters (*Anhinga novaehollandiae)* were recorded nesting (see report: OEH 2016).

Introduction

The Barmah–Millewa Forest is located in the central Murray Valley between the towns of Tocumwal, Deniliquin and Echuca. The forest is one of the icon sites (IS) under the Murray Darling Basin Authority's 'The Living Murray' program. The IS totals 66,600 ha in size. The Millewa portion of the icon site is reserved as the Murray Valley National and Regional Parks comprising of the Millewa, Moira and Gulpa Island precincts (hereafter called Millewa Forest). Millewa Forest covers an area of 41,957 ha and consists of Inland Riverine Forests, Inland Floodplain Woodlands, Floodplain Transition Woodlands, Riverine Sandhill Woodlands and Inland Floodplain Swamps (Keith, 2004).

Throughout the 2015-16 watering period, intervention monitoring in Millewa included:

- monitoring the depth of water at strategic points across Millewa Forest;
- mapping the area inundated by environmental flows;
- recording water quality which included measuring dissolved oxygen and temperature at selected sites discharging water into the main river channels off the floodplain; and
- photo points were also used as a means of monitoring vegetation responses to inundation within the wetlands. Sites were selected to monitor Moira grass response which involved a measuring the lengths of Moira grass stems, if present.

Water quality is monitored for parameters such as temperature and dissolved oxygen. Poor water quality can have adverse impacts on aquatic biota in Millewa Forest and in the Murray River downstream of Millewa. The development of hypoxic blackwater events has the potential to cause the death of native fish and crustaceans. Monitoring of water quality allows changes to be recorded and management practices informed from results.

Blackwater occurs naturally, and is a function of nutrients leaching from organic matter (usually leaf litter) on the forest floor. This can occur as a result of prolonged inundation of the floodplain, leading to leached dissolved organic carbon (DOC) being introduced into the water column (Whitworth at el, 2012). The introduction of DOC to the water column is an important function of flooding, providing a variety of benefits to aquatic biota in the receiving waters (Murray and Edward Rivers). However, high concentrations of DOC accompanied by high temperatures can lead to DOC respiration, which can cause a fall in dissolved oxygen, creating hypoxic conditions (water with very low oxygen). Hypoxic water only occurs when the dissolved oxygen (DO) falls below a level that can no longer support aquatic biota, producing lethal conditions (Whitworth et al, 2012). This occurred on a wide scale in the Murray in 2010-11, after a decade of drought and large floods triggered a widespread hypoxia event affecting a 2000 km section of the Murray River for the duration of the flooding (Childs et al, 2012). Water quality and depth monitoring has been implemented each watering year since the event occurred in 2010-11 across a range of sites in Millewa (Figure 1).

Aims & Objectives

The major objectives of environmental watering in 2015-16 were:

- Use low flows (<15,000ML/d) to preserve certain characteristics of the IS and Ramsar wetlands, in particular floodplain marshes and river red gum forests (critical wetland vegetation categories).
- Achieve sufficient water depths to promote the growth of moira grass in Barmah-Millewa forest.
- Promote floodplain connectivity to support large bodied native fish movement such as Murray Cod (*Maccullochella peelii peelii)* and Trout Cod (*Maccullochella macquariensis)*
- Provide suitable habitat and resources for water birds.
- Monitor water quality discharging from the forest floodplain into the Edward and Murray River and ensure measures are taken if levels fall below an appropriate level (>2.0 mg/L), and adequate dilution is not occurring.

Background & Justification

In 2010-11 a large scale black water event occurred on the River Murray, affecting a 2000 km stretch of river (Childs et al, 2012). The event occurred after a long period of drought, where large leaf litter loads accumulated on the floodplain. High levels of leaf litter, accompanied by a large flooding event and warm temperatures lead to respiration of dissolved organic carbon in the water column which resulted in hypoxic black water (Whitworth et al, 2012). This is water with low oxygen levels that can have fatal effects on aquatic biota. As this is a natural event, measures can only be taken to reduce the risk to some extent. These include delivering water in cooler months to flush excess leaf litter from the forest floor.

Water quality monitoring was conducted during the portion of the event when environmental water returned to the main river channels. Water quality testing is conducted to ensure that the water being discharged from the Millewa forest floodplain into the main river channels is of a quality that does not pose a risk to the overall water quality of the system.

A primary outcome of environmental water delivery to Millewa forest was to promote the growth of moira grass on the marsh plains. Millewa's marsh plains are highly diverse plains, supporting flood-dependant and flood-tolerant vegetation that respond to inundation. Moira grass is one such species and has been identified as largely depleted, with a decrease of at least 574 ha occurring since 1945 in the Moira precinct (Maguire, 2013). This change has occurred as river red gums have encroached on areas previously dominated by Moira grass (Maguire, 2013). River red gum encroachment can largely be attributed to a highly altered watering regime, decreasing the time and frequency that the floodplain marsh plain is inundated which allows for the successful germination of high numbers of river red gums.

Work undertaken

Intervention monitoring undertaken as part of the flow surveillance this watering year included:

- recording the depth of water at gauges across Millewa;
- testing water quality at pivotal points where water was draining from the floodplain; and
- Established photo points to monitor the impact of environmental water in the forest.

Water depth and quality was tested weekly from the 10/08/15 to the 11/12/16 for the duration of environmental water delivery into Millewa forest. Intervals of data collection varied depending on accessibility. Depths were measured using water depth gauges installed by NSW National Parks and Wildlife Service across Millewa forest (Figure 1). Sites tested for water quality were chosen at critical points where water is discharged from the forest into the Edward and Murray Rivers and Gulpa Creek.

Inundation extent was also recorded using satellite mapping. This was conducted using satellite imagery attained from the peak of the event and was completed by Water Wetlands and Coast Science branch, Office of Environment and Heritage (OEH). A detailed report is under preparation by the science branch on the mapping that was completed and further information will be available at the close of the water year. The modelling of flow events that

occurred allows comparison and evaluation of modelled predictions to be made. The MDBA modelled the inundation in Barmah-Millewa in the 2015-16 event. The satellite mapping undertaken allowed comparisons to be made between the modelled flows for the event and the actual flows received in the Barmah-Millewa Forest, as seen from aerial imagery.

Water quality was recorded using a handheld Hydrolab Quanta water quality sensor which measured dissolved oxygen, temperature, pH and electrical conductivity. These parameters are commonly used to determine water quality. Temperature is an important factor which can influence the level of dissolved oxygen in the water column. Dissolved oxygen is largely affected by temperature, and increasing temperatures can result in low levels of dissolved oxygen. By monitoring the temperature and dissolved oxygen levels water quality impacts can be predicted, allowing plans to be put in place if the risk of black water is deemed likely. Results were entered into a spreadsheet and observations were reported to the Barmah-Millewa Operations Advisory Group weekly. Records were also provided to the Murray Dissolved Oxygen Group, as required.

To monitor the impact of watering on Moira grass outcomes, sites were monitored on the south-eastern edge of Moira Lake and on Porter's plain. The methodology used to measure the moira grass is a standardised methodology used in Barmah Forest, devised by the Goulburn Broken Catchment Management Authority. Ten plants were measured per visit and were chosen at random. A tape measure was used to measure the length of the grass from the base to the tip, pulling the grass ends to the very end of the main stem. The depth of water was also recorded and a photo taken at each visit to track the growth of moira grass stems (Appendix C). Moira grass was only found to be growing at the Moira lake site, and was not recorded on Porter's plain during the 2015/16 monitoring program.

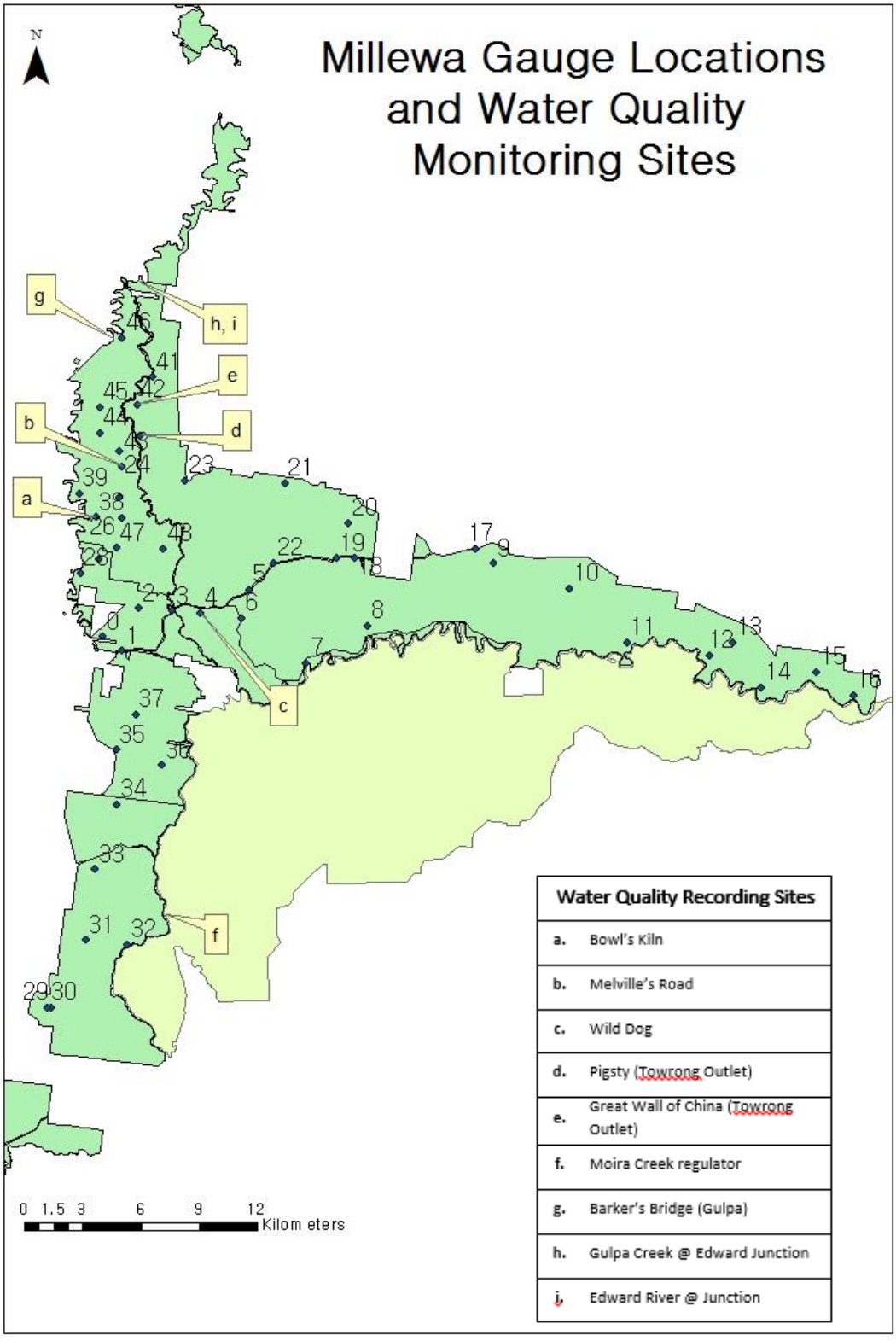

Figure 1: Gauge and water quality locations in Millewa. Gauge location details in Appendix B.

Results

Water Depth and Quality

The two major floodplain marshes where Moira grass is present, Moira Lake and Porter's Plain were inundated for over five months as a result of the environmental water flows. The maximum depth achieved at Moira Lake was 1.19m and the maximum depth at Porter's Plain was 0.64m. The water depths across all the sites can be seen in Appendix B.

Dissolved oxygen dropped to levels >4mg/L in early October, as temperatures increased. It continued to drop to below 2mg/L in November at sites that discharged water from the floodplain such as Bowl's Kiln and Wild Dog Creek. Monitoring the DO of creeks discharging water from the floodplain allows changes to be identified and management plans put in place if required.

A drop in DO values occurred as water temperatures increased as demonstrated in Figure 2. The sites where low DO's was recorded were discharging low volumes of water, posing a negligible risk as this water was diluted by much larger flows in Gulpa Creek, Edward and Murray Rivers. Although not measured, it is assumed that the return flows from the floodplain were providing a good source of DOC to these streams. The sites where larger volumes of water moved off the floodplain (Moira Lake and Gulpa Creek) maintained stable DO levels throughout the monitoring period, with decreases evident heading into mid-December. All values recorded over the monitoring period are presented in Appendix B.

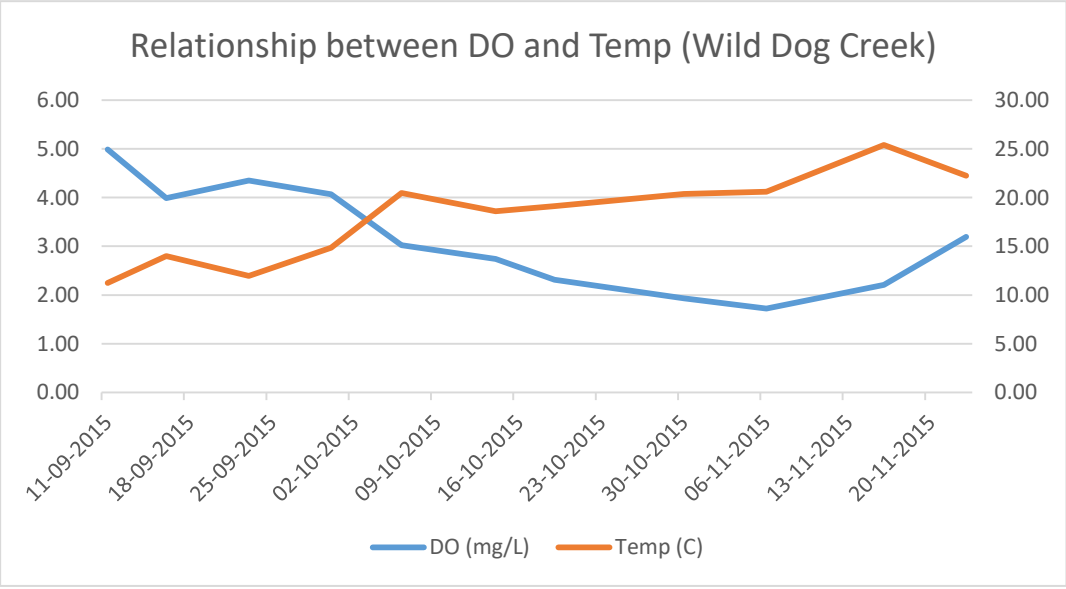

Figure 2: The relationship between dissolved oxygen levels and water temperatures recorded at Wild Dog Creek over the spring reporting period. Wild Dog creek is a prominent drainage line which discharges water from the floodplain of Millewa Forest, into the Edward River.

Moira Grass Monitoring

The two major moira grass areas in Millewa, Porter's plain and Moira Lake were inundated for over five months. The maximum depth achieved at Moira Lake was 1.19m and the maximum depth at Porter's Plain was 0.64m. The water depths achieved over the entire watering period are in Appendix A.

The sites selected for monitoring were Porter's Plain and Moira Lake. The Porter's Plain site was monitored throughout the event and site photos can be seen in Appendix C. No moira grass was found growing on Porter's plain this year. Open plains have reduced in area in Millewa over the last 40 years and moira grass has most likely been highly affected by this (Owen, 2013). However, due to river red gum encroachment, altered hydrology and previous heavy grazing, substantial stands of moira grass are no longer prevalent.

The moira grass monitoring point on the periphery of Moira Lake (314918E/6019210N), was selected based on the success of moira grass at this site in the 2014 natural flooding event. The location was accessible by boat on the south western edge of Moira Lake. The initial response of moira grass at the site was slow and the cover was sparse. However, moira grass also established on the edges of Moira private irrigation channel as the water receded, and an additional site was located on the eastern edge of Moira Lake after the environmental watering event was completed.

Figure 3: Moira grass monitoring site, on the south western edge of Moira Lake (03149181E/6019210N) Photo 1 (taken on 6 February 2014) and Photo 2 (taken on the 13th of March 2016).

The monitoring conducted involved recording the length of moira grass stems from randomly selected moira grass plants. The selected site exhibited a significant period of growth from October to November, as water temperature increased. Figure 3 shows a comparison of the site in February 2014 and in March 2016.

An increase in the extent of giant rush (*Juncus ingens)* can be seen in Figure 3 *(*photo 2), indicating increased encroachment over time. In 2014, the moira grass stand exhibits a much higher degree of uniformity (photo 1) than in 2016 (photo 2) and is also much longer. Photo 2 was taken slightly later in the year, which could account for the shorter length of plants as water levels drop and stems became desiccated. Decreasing water levels could also provide increased opportunities for grazing, as access for grazing animals (e.g. kangaroos) is improved. Also, differing watering regimes (the depth, duration of inundation, water temperature) could also account for the difference in the two photos by influencing the length of moira grass stems and its dominance in the ground layer. The conditions

(water regime) in 2016 may not have favoured moira grass. The presence of a number of other water-dependant/tolerant species such as water pepper (*Persicaria* sp.*)* and swamp wallaby grass (*Amphibromus* sp.*)* possibly indicates that the 2016 water regime was more favourable for these species than for moira grass (Figure 3).

Varying conditions across wetlands may influence the growing regime of moira grass resulting different responses on the same wetland. A much more positive response was seen on the eastern side of Moira Lake. Here the moira grass stand was much more extensive, and uniform with good length (Figure 4). This could be attributed to a range of factors and could be linked to more optimal inundation period (better depth and duration), slower draw down period and a decreased grazing pressure. However flowering was also not evident at this site at the time of the site visit.

Figure 4: Moira grass on the eastern perimeter of Moira Lake (20/01/2016)

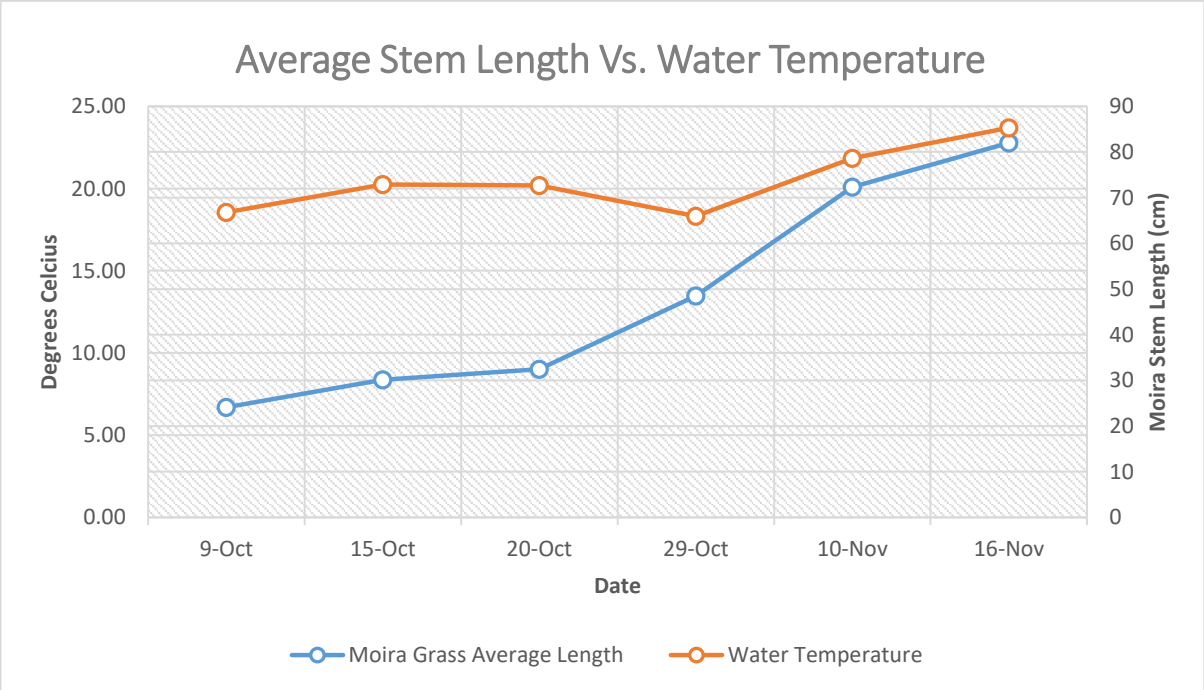

Figure 5: Average stem length over time of moira grass recorded on the southern western edge of Moira Lake, with recorded water temperature. As water temperature increased towards the end of November, there was a corresponding increase in Moira grass growth.

Figure 5 (above) shows the relationship between stem length and temperature for the moira grass measured in the monitoring site in Moira Lake. As water temperature increased in mid-November, an increase in moira grass stem length was also recorded. Ward (1991) showed that moira grass growth increased exponential throughout mid-October to mid-November. This may mean that trend of increased growth was not maintained at such a rate, after the period monitored. It can be seen in Figure 5, that with slightly higher temperatures in November, moira grass responded positively. Lengths of stems can be seen in **Table 1**.

It has been found that moira grass seeds have low rates of viability (Nielson & Durant, 2015). Due to a lack of dispersal provided from seeds, the growth of moira grass stands is predominantly a result of vegetative propagation. Achieving a good length of moira grass plant stems (i.e. >one meter) may be vital to increasing stand extent. As the moira grass stems settle on the ground following water recession the nodes on the stems to form the basis for new plants. This forms a thick 'thatch' and potentially is good habitat for invertebrates, small mammals, birds and reptiles.

Moira Lake Moira Grass Stem Lengths						
Sample	9-Oct	15-Oct	20-Oct	29-Oct	10-Nov	16-Nov
1	16	30	40.5	29.5	72	89.5
2	18.8	38	30.5	67.3	61	71
3	24.1	24.6	63	64.2	81	47.5
4	21.5	22.7	33	53	66	60
5	25.5	26.4	23	35.2	63	91.2
6	28	33.4	26	36.7	83	101
7	31	24.5	42.5	67.1	82	72
8	39	34.6	23	73.2	81	109
9	19	26.8	23.3	28.6	77	105
10	18.5	40.45	20	30.2	57	73.5
Water Depth	26cm			45cm	55cm	19cm
Average	24.14	30.145	32.48	48.5	72.3	81.97

Table 1: Stem lengths (cm) of moira grass recorded at the Moira Lake monitoring site.

The 2015/16 moira grass monitoring showed that the growth period increased as water temperatures increased in mid-October to mid-November. As monitoring was not continued after the cessation of environmental water delivery, it is unknown at what rate growth continued. It is predicted that the main growth period (expansion of the grass) appears to occur once water draw down has occurred.

As water recedes and areas become exposed, moira grass abundance is able to be identified more readily and its success evaluated. Future monitoring should continue into the summer, and throughout the water draw down period to gather additional information on moira grass growth. This monitoring would provide additional information on stand uniformity, percentage cover and thatch depth. This could provide additional information on the success of the watering event and how to achieve good moira grass growth and expansion.

Inundation Extent Mapping

Satellite mapping of the extent of inundation during the watering event was undertaken by Water Wetlands and Coast Science branch, Office of Environment and Heritage (OEH). The satellite images taken from the 5th of September to the 8th of November were used to map the flood extent (Figure 6). Flows from Yarrawonga over this period ranged from 10 022ML/d to 15 254ML/d. The peak flow from Yarrawonga Weir for the event was on the 6th of August at 16 313ML/d.

The satellite mapping calculated that a total of 7 801ha in Millewa was inundated (18.6% of its total area). Over the whole of Barmah-Millewa Forest, 21% of the forest was inundated covering an area of 14 506ha (Heath et al, 2015). The map produced was validated through on-ground water gauge monitoring data and visual inspections. There are some small discrepancies present, such as some runners in the eastern end of Millewa that haven't been identified. However, as a broad overview the mapping of the event was reasonably accurate and gave a good indication of the inundation that we can achieve under the flow conditions received.

Figure 6 and Figure 7 show two different methods of mapping inundation in Barmah-Millewa forest. Over the period in which the images were attained, four of Millewa's regulators were open, including Mary Ada, Millewa's largest regulator delivering water into the forest. The Gulpa Creek had flows between 642ML/d and 851ML/d over this time resulting in overbank flows, and the Edward (at the offtake) ran from 1525 – 1625ML/d.

The satellite imagery mapped the event and calculated a cumulative area prediction that was inundated over this time (Table 2). It calculated more hectares inundated in Millewa then Barmah, however the inundation in Millewa is a smaller percentage of the total forest than the inundation in Barmah.

Mapped	Area Inundated (ha)	% Inundated
Millewa	7801	19
Barmah	6705	22
Total	14506	21

Table 2: Barmah-Millewa satellite imagery inundation mapping for the event 2015-16 (Heath et al, 2015).

The MDBA modelling takes into account elevation, and uses inputs such as the gauge heights recorded in the forest and also regulator operations. Table 3 shows total areas (hectares) inundated across Barmah Millewa. This modelling shows water pushing out over the floodplain slowly in Millewa over the three months (after the peak of the flow had passed) and Barmah receiving more water across the floodplain early on in the event but receded quickly.

	September Area (ha)	October Area (ha)	November Area(ha)
Millewa	5058	5161	5307
Barmah	9029	7201	5285
Total	14087	12362	10592

Table 3: Inundation derived from MDBA modelling, showing the changes in floodplain inundation over the time in which environmental water was delivered to the site (MDBA, 2016)

The two different methods achieved similar total areas of inundation, however the split between the two sides varied considerably. It appears that inundation in the eastern end of Barmah was not picked up via the satellite imagery but was by the MDBA modelling. This could possibly account for some of difference in the area inundated in Barmah Forest.

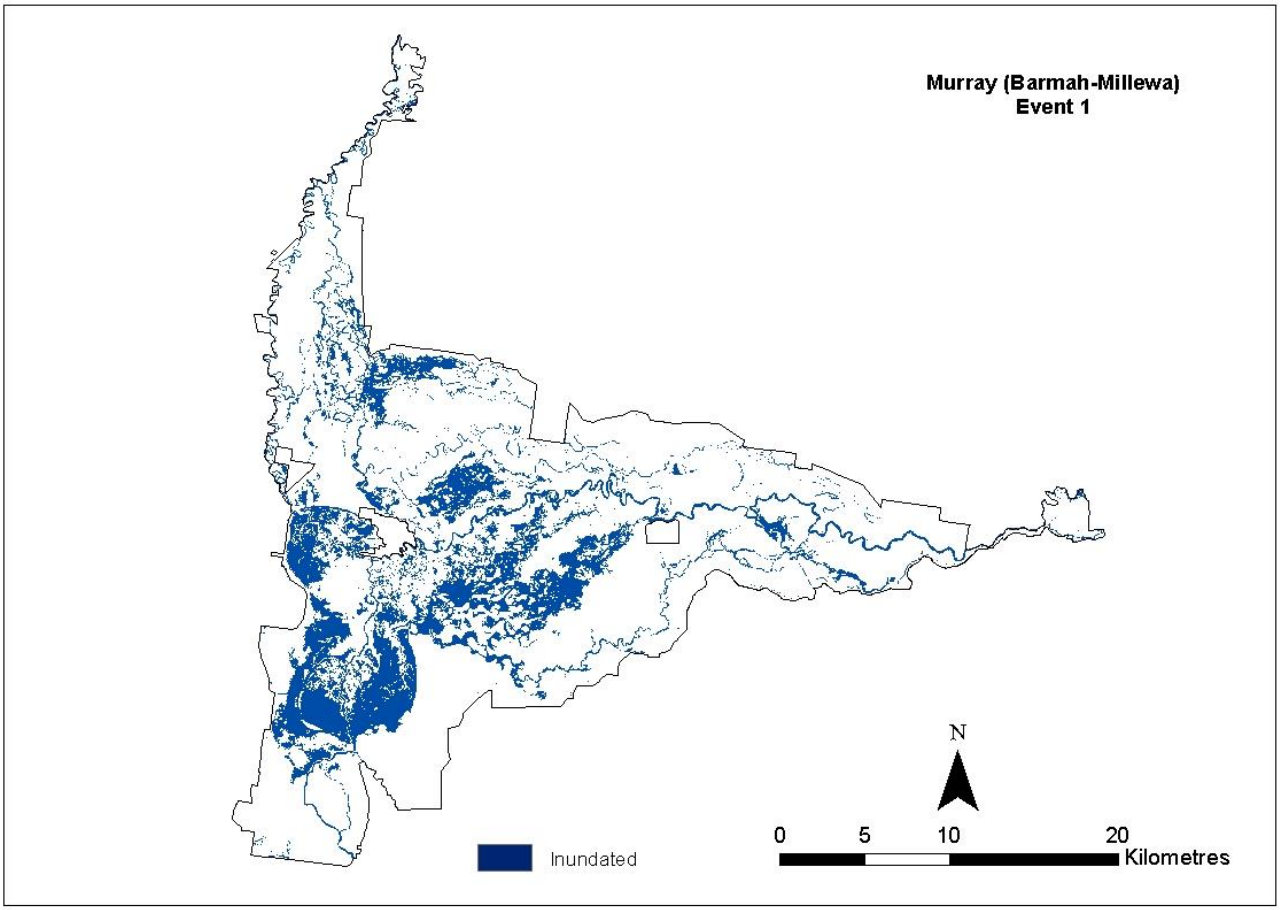

Figure 7: Satellite mapping of Barmah-Millewa Forest inundation during the 2015-16 watering event.

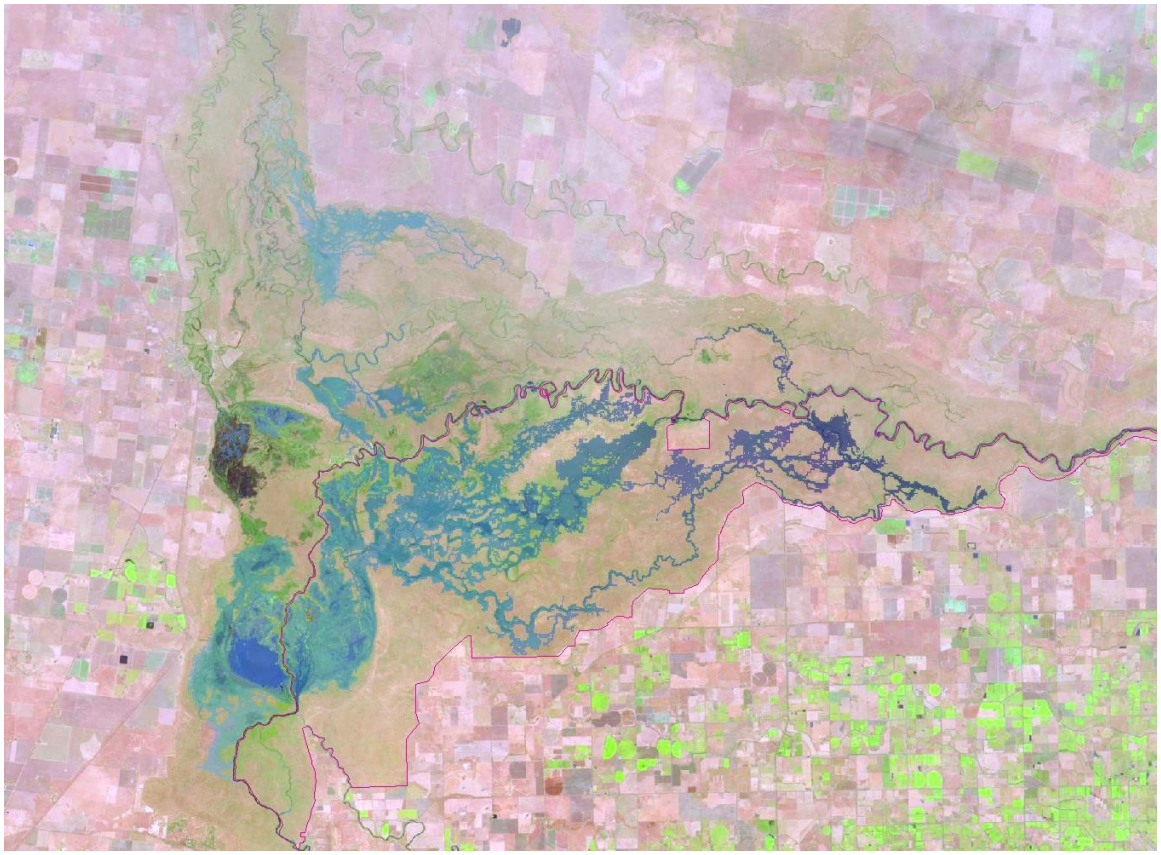

Figure 6: Modelled flows in Barmah-Millewa for the 2015/16 environmental watering event.

Conclusions/Recommendations

- Water depth and extent monitoring provided valuable information which was able to validate satellite mapping and provided information that will be able to inform future management actions.
- Satellite mapping provided a reasonably accurate depiction on the extent of inundation from the peak watering event in 2015-16. This has been a valuable tool used in assessing the extent of the delivery of environmental water enabling the ecological benefits to be evaluated. Through comparison with MDBA modelling, errors can be identities between the two methods. This will be an effective tool in assisting management decisions with the delivery of environmental water in the future. The MDBA modelling provides an adaptive and accurate method which is able to be conducted at regular intervals to show changes inundation over short time periods.
- To enable more comprehensive monitoring of moira grass, additional measures should to be taken in order to collect more data e.g. set up additional monitoring sites, gather additional parameters on growth such as percentage cover, water temperature and thatch depth.

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Appendix A

Millewa Gauge Data Collected in 2015

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Deadmans Creek	313302E/6032905N	96.37	03-08-2015		0.20		Gulpa regulator
			10-08-2015		1.24		
			18-08-2015	9:40	1.35	750	
			26-08-2015	10:50	1.38	778	
			02-09-2015	8:40	1.38	777	
			10-09-2015	14:25	1.38	733	
			16-09-2015	12:10	1.41	760	
			23-09-2015	11:38	1.44	763	
			30-09-2015	14:30	1.47	802	
			06-10-2015	10:15	1.49	803	
			13-10-2015	12:26	1.52	847	
			19-10-2015	11:10	1.54	833	
			30-10-2015	11:45	1.56	855	
			06-11-2015	9:30	1.61	876	
			16-11-2015	13:50	1.58	814	
			23-11-2015	8:41	1.56	772	
			04-12-2015	11:15	1.46	598	
			11-12-2015	12:30	1.39	549	
Campbell's Crossing	312305E/6033625N	94.14	02-09-2015	8:30	1.58	777	Gulpa regulator
			10-09-2015	14:25	1.60	733	
			16-09-2015	12:00	1.59	760	
			23-09-2015	11:43	1.65	763	
			30-09-2015	10:27	1.62	802	
			06-10-2015	10:10	1.63	803	
			13-10-2015	12:20	1.65	847	
			19-10-2015	11:08	1.66	833	
			30-10-2015	8:25	1.66	855	
			06-11-2015	15:06	1.72	876	
			16-11-2015	13:40	1.68	814	
			23-11-2015	8:37	1.66	772	
			04-12-2015	11:45	1.67	598	
			11-12-2015	12:26	1.63	549	

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Lousy Crossing	314188E/6035088N	93.72	30-09-2015 06-10-2015 30-10-2015	12:00 11:45 11:39	0.00 0.00 0.00		Gulpa regulator
Blackgate Lagoon Outlet	311195E/6036882N	93.06	16-09-2015 22-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015 04-12-2015	10:10 11:21 8:40 8:36 9:55 9:43 12:20 15:13 14:30 9:19 10:00	0.41 0.44 0.44 0.48 0.52 0.52 0.56 0.64 0.56 0.52 0.45		Gulpa regulator
Porkeys	312107E/6037645N	93.3	26-08-2015 02-09-2015 10-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015 04-12-2015	 11:45 1:35 8:55 8:40 10:00 10:55 12:25 9:24 15:50 10:48 10:58	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00		McCartney's regulator

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Bowls Kiln	313316E/6039808N	92.93	10-08-2015 17-08-2015 26-08-2015 02-09-2015 10-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015 04-12-2015	 12:15 14:35 14:40 11:32 13:30 10:00 9:50 10:08 10:47 1:18 9:14 15:45 15:40 10:55	0.00 0.44 0.99 1.00 1.00 0.99 1.00 1.00 1.01 1.04 1.05 1.05 1.06 1.11 1.10 1.11		McCartney's
Horseshoe Lagoon	3111999E/6039808N	90.79	14-08-2015 26-08-2015 02-09-2015 10-09-2015 16-09-2015 22-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015 04-12-2015	 11:05 3:30 15:40 10:25 11:30 8:57 8:48 11:44 9:50 12:30 8:21 14:40 9:29 10:14	0.46 1.12 1.12 1.10 1.20 1.28 1.31 1.26 1.17 1.14 1.33 1.77 2.13 2.17 2.01		Gulpa regulator

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Gulpa Creek Rd	311123E/6041001N	92.6	14-08-2015 26-08-2015 02-09-2015 10-09-2015 16-09-2015 22-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015	 11:20 3:25 15:35 10:28 11:00 9:01 8:30 11:39 9:55 12:00 8:24 14:45 9:31	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00		McCartney's regulator
Melvilles Waterhole	313181E/6040798N	92.23	10-08-2015 17-08-2015 26-08-2015 02-09-2015 10-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 23-11-2015	 12:10 2:40 14:50 11:30 1:28 10:15 9:45 10:21 10:44 13:16 9:10 10:25	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00		McCartney's regulator

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Melvilles Road	313309E/6042411N	91.84	10-08-2015 17-08-2015 26-08-2015 02-09-2015 10-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015	 12:00 2:45 15:05 11:10 1:20 9:45 9:30 10:25 10:25 13:00 9:00 15:30 10:22	0.00 0.15 0.00 0.125 0.26 0.28 0.29 0.27 0.28 0.32 0.34 0.42 0.36 0.26 0.20		McCartney's regulator
Taylors Bridge Rd 1 (north)	312200E/6045423N	91.66	10-08-2015 17-08-2015 15-09-2015 22-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015	 10:10 10:40 9:17 9:00 11:06 10:05 12:30 8:36 15:30 9:41	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00		Edward River regulator
Teds Rd	312175E/6044111N	91.44	14-08-2015 26-08-2015 02-09-2015 16-09-2015 22-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015	 12:00 15:20 10:35 10:53 9:11 8:57 11:12 10:00 12:35	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00		McCartney's regulator

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Taylors Bridge Rd 2 (south)	313198E/6043143N	91.84	10-08-2015 17-08-2015 26-08-2015 02-09-2015 10-09-2015 16-09-2015 22-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015	 12:00 15:15 15:25 10:41 10:45 9:20 9:05 11:10 10:10 12:40 8:41 14:50 9:41	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.12 0.00 0.00		McCartney's regulator
Cross Road	312819E/6041621N		26-08-2015 02-09-2015 10-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 16-11-2015 23-11-2015	11:30 14:25 14:55 11:20 13:22 9:55 9:41 11:55 10:40 13:10 15:35 10:37	0.51 0.54 0.57 0.58 0.58 0.57 0.61 0.66 0.67 0.72 0.69 0.65		McCartney's regulator
Taylor's Bridge (Edward River)	314301E/6043331N		17-08-2015 02-09-2015 10-09-2015 22-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015	 15:00 15:10 10:50 9:23 10:40 10:12 12:42 8:44 14:55 9:46	1.94 1.73 2.02 2.04 2.04 2.08 2.10 2.15 2.07 1.80 1.70		Edward River regulator

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Cornalla Creek	319496E/6034609N	95.44	10-08-2015 17-08-2015 26-08-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015	 15:16 11:00 13:15 11:00 11:25 9:50 12:32 11:40 9:05 12:40	0.00 0.78 0.40 0.80 0.80 0.82 0.81 0.86 0.88 0.90 0.91 0.92		Forest regulators (upstream of Picnic Point)
Caldwell's Waterhole	316568E/6041684N	92.53	10-08-2015 17-08-2015 26-08-2015	 14:20	1.30 1.86 1.46		Forest regulators (upstream of Fisherman's Bend)
Tin Hut Creek	319901E/6036050N	95.32	10-08-2015 17-08-2015 26-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015	 15:11 9:00 11:05 13:22 10:55 14:20 11:00 14:00 14:29 9:09 14:41	0.66 0.70 0.29 0.00 0.74 0.76 0.77 0.80 0.84 0.86 0.88 0.86 0.87		Forest regulators (upstream of Fisherman's Bend)
Quambies Road	317342E/6034854N	93.25	10-08-2015 26-08-2015	 14:35	1.04 0.63		Forest regulators (upstream of Fisherman's Bend)

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Towrong Creek (Dudley's Rd)	324968E/6039493N	96.38	26-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	2:51 10:00 11:30 13:40 10:40 14:06 13:35 9:26 14:19 11:22 14:33	1.58 2.77 3.00 3.04 3.06 3.08 3.11 3.16 3.14 2.89 2.95		Forest Regulators (upstream of Fisherman's Bend)
Plantation Causeway	325270E/6037689N	96.51	10-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	 10:15 11:35 13:25 10:35 14:02 13:25 9:30 14:12 11:15 12:45	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00		Forest regulators (upstream of Fisherman's Bend)
Burnt Bridge	324343E/6037656N	94.64	10-08-2015 26-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	 15:02 10:00 11:15 13:30 10:45 14:10 13:40 9:15 14:23 11:26 12:30	0.85 0.45 0.00 1.50 1.51 1.52 1.55 1.59 1.63 1.63 1.53 1.59		Forest regulators (upstream of Fisherman's Bend)

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Wild Dog Creek	321705E/6041511	93.22	07-08-2015 17-08-2015 26-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015	 15:20 8:55 10:45 12:55 11:20 11:00 10:40 12:35 11:30 8:57 12:30 13:55 9:00	1.04 1.48 1.12 0.90 1.53 1.51 1.52 1.51 1.54 1.58 1.58 1.61 1.59 1.11 1.06		Forest regulators (upstream of Picnic Point)
Toupna Creek 2 (Fishermans Bend Rd)	325978E/6034210N	97.69	07-08-2015 17-08-2015 02-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015	 9:10 11:40 11:08 13:09 11:50 9:21	2.58 2.66 2.59 2.69 2.74 2.75 2.74 2.53		Forest regulators (upstream of Fisherman's Bend)
Toupna Creek 1 (Firehut Rd)	336348E/6036108N	99.86	10-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	 14:00 13:30 15:05 13:55 13:00 12:32 12:00 13:45 10:47 14:10	1.91 1.91 1.88 1.90 1.90 1.96 2.00 2.03 1.98 1.53 1.55		Forest regulators (upstream of Fisherman's Bend)

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Rabbit Proof Gate (Toupna Crossing Rd)	331529E/6038163N	97.58	10-08-2015 27-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015	 12:55 10:20 11:45 13:48 10:26 13:54 13:25 9:37 14:01 11:11 12:54	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00		Forest regulators (upstream of Fisherman's Bend)
Scott's Beach Entrance (Smithers Culvert)	343522E/6032660N	100.57	03-08-2015 17-08-2015 27-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	11:30 12:00 11:20 12:50 14:20 9:15 13:20 12:00 11:30 11:53 10:05 13:48	 0.92 1.03 0.81 0.76 0.86 0.85 0.93 0.98 0.91 0.83 0.76	12 462 14 596 12 003 15 030 13 489 11 980 11 965 12 439 12 979 13 286 12 779 12 361 11 477	Yarrawonga
Low Sandy	346219E/6031008N	101.62	03-08-2015 17-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015	11:40 11:40 13:00 14:50 9:23 13:27 12:07 11:20 11:59 10:10	< gauge 0.44 0.61 0.20 0.12 0.11 0.26 0.36 0.40 0.32 0.16	12 462 14 170 15 030 13 489 11 980 11 965 12 439 12 979 13 286 12 779 12 361	Yarrawonga
Aratula Creek 3	349049E/6031803N	101.78	03-08-2015 17-08-2015 02-09-2015	 11:50	0.00 0.00 0.00		

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Winter Creek	321140E/6037442N	94.66	10-08-2015 26-08-2015 02-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015	 15:05 9:45 13:25 10:50 14:16 13:45 14:00 14:27 11:30 12:40	0.00 0.36 0.00 1.02 1.02 1.04 1.12 1.17 1.19 1.07 1.21		Forest regulators (upstream of Fisherman's Bend)
Towrong Outlet 1 (Northern Millewa -Pig Sty)	314251E/6043970N	91.69	10-08-2015 17-08-2015 26-08-2015 02-09-2015 10-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 23-11-2015	 13:20 15:00 15:15 11:10 10:55 12:55 9:30 9:04 10:45 10:20 12:50 8:55 15:00 9:45	0.55 0.95 0.62 0.51 1.08 1.04 1.09 1.11 1.11 1.13 1.16 1.18 1.22 1.15 0.78 0.61		Forest regulators (upstream of Fisherman's Bend) & Edward River regulators (east)
Towrong Outlet 3 (Great Wall of China)	314911E/6046997N	89.65	10-08-2015 17-08-2015 26-08-2015 23-11-2015	 13:45 9:55	0.00 1.12 0.86 0.80		Forest regulators (upstream of Fisherman's Bend) & Edward River regulators (east)

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Tootalong Creek	332409E/6037395N	98.73	10-08-2015 17-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	 10:30 11:50 13:45 10:22 13:52 13:21 9:41 14:00 11:09	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00		
Towrong Outlet 2 (Northern Millewa)	314113E/6045553N	90.96	10-08-2015 17-08-2015 26-08-2015	 13:40	0.00 0.28 0.15		Forest regulators (upstream of Fisherman's Bend) & Edward River regulators (east)
Coolamon Crossing	313056E/6027807N	94.05	15-08-2015 18-08-2015 26-08-2015 04-09-2015 10-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 29-10-2015 09-11-2015 16-11-2015 23-11-2015 04-12-2015 11-12-2015	 9:45 9:40 13:45 12:20 15:55 13:45 14:47 14:48 14:30 14:56 11:20 9:45 13:15 8:00 12:10 13:00	0.00 0.00 0.00 0.00 0.55 0.59 0.60 0.60 0.63 0.66 0.63 0.67 0.71 0.69 0.65 0.60 0.54		Gulpa regulator

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Warwick Creek Crossing	314053E/6029614N	95.71	04-09-2015 17-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 29-10-2015 09-11-2015 16-11-2015 23-11-2015 04-12-2015 11-12-2015	14:00 10:00 14:05 14:55 14:54 14:26 14:51 11:30 14:30 13:25 8:18 12:14 13:05	0.00 1.05 1.04 1.05 1.07 1.10 1.11 1.13 1.17 1.16 1.13 1.05 1.00		Gulpa regulator
O'Shannassy's Creek (Porter's Plain)	313062E/6024985N	93.46	15-08-2015 18-08-2015 26-08-2015 04-09-2015 10-09-2015 17-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 20-10-2015 29-10-2015 09-11-2015 16-11-2015 23-11-2015 04-12-2015 11-12-2015	 10:50 9:15 12:10 11:55 9:00 14:30 15:35 14:30 14:20 13:50 10:45 9:40 13:00 8:00 12:30 13:30	0.16 0.40 0.57 0.61 0.64 0.60 0.50 0.46 0.47 0.50 0.52 0.54 0.62 0.53 0.44 0.47 0.32		Gulpa-Porters-O'shannassy's regulators
Porters Creek	315384E/6024985N	94.62	04-09-2015 10-09-2015 17-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 29-10-2015	14:00 13:00 10:00 14:05 15:10 15:00 14:20 12:00	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00		

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Moira Lake West	311942E/6021658N	92.84	15-08-2015 18-08-2015 26-08-2015 04-09-2015 10-09-2015 17-09-2015 24-09-2015 30-09-2015 14-10-2015 20-10-2015 29-10-2015 09-11-2015 16-11-2015 23-11-2015 11-12-2015	 10:10 8:40 10:00 11:00 13:40 9:40 9:35 14:35 10:55 9:50 9:00 19:13 7:30 13:37	0.00 1.06 1.14 1.16 1.19 1.08 0.95 0.91 0.94 0.96 0.97 1.01 0.97 0.80 0.61		Forest regulators downstream of Picnic Point
Algeboia Plain	313609E/6017797N	93.14	10-09-2015 16-09-2015 01-10-2015 29-10-2015 10-11-2015	10:20 12:10 10:50 9:05 12:30	0.50 0.42 0.30 0.11 0.19		Yarrawonga & Forest regulators downstream of Picnic Point
Algeboia Rd	311476E/6018028N	93.27	15-08-2015 18-08-2015 25-08-2015 04-09-2015 11-09-2015 17-09-2015 23-09-2015 30-09-2015 14-10-2015 19-10-2015 29-10-2015	 10:25 12:15 9:00 8:45 8:30 15:10 15:47 16:00 16:00 12:45	0.00 0.00 0.79 0.81 0.84 0.77 0.61 0.48 0.34 0.30 0.19		Forest regulators downstream of Picnic Point

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Bullatale Offtake (Upstream)	339310E/6033316N		03-08-2015 10-08-2015 17-08-2015 27-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	11:20 11:30 11:05 12:45 14:30 9:40 13:40 10:52 10:55 12:34 9:54 13:36	0.80 1.15 1.02 0.81 1.16 0.84 0.83 0.83 0.94 1.02 1.07 0.99 0.90 0.84	12 462 15 996 14 465 12 067 15 030 13 116 12 007 11 965 12 439 12 979 13 286 12 779 12 300	Yarrawonga
Bullatale Offtake (Downstream)	339310E/6033316N		03-08-2015 10-08-2015 17-08-2015 27-08-2015 02-09-2015 11-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	11:25 11:30 11:05 12:45 14:30 9:40 13:40 10:52 11:00 12:35 9:54 13:36	0.8.. 0.6? 0.66 0.75 0.68 0.64 0.64 0.67 0.69 0.53 0.51 0.51 0.51	12 462 15 996 14 465 12 067 15 030 13 116 12 007 11 965 12 439 12 979 13 286 12 779 12 300	Yarrawonga
(Plantation) Glowrey's Regulator (Upstream)	337436E/6032947		02-09-2015 11-09-2015 16-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	11:00 12:20 14:05 12:55 11:45 10:45 12:37 9:48 13:10	0.69 0.41 0.46 0.55 0.62 0.67 0.60 0.55 0.48		Yarrawonga

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
(Plantation) Glowrey's Regulator (Downstream)	337436E/6032947		10-08-2015 17-08-2015 02-09-2015 11-09-2015 16-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	 11:00 12:20 14:05 12:55 11:45 10:45 12:27 9:48 13:10	0.00 0.89 0.94 0.84 0.84 0.93 0.97 1.00 0.91 0.93 0.88		Yarrawonga
Mary Ada Regulator (Downstream)	330850E/6034477N		17-08-2015 02-09-2015 24-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-1015 30-10-2015	 9:20 10:55 11:52 11:30 10:15 12:04 9:32	3.18 3.22 3.23 3.29 3.33 3.37 3.33 7.85	14 465 15 030 11 920 12 439 12 979 13 286 12 779 12 300	Yarrawonga
Mary Ada (Upstream)	330850E/6034477N		17-08-2015 02-09-2015 24-09-2015 30-09-2015 03-10-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015	 9:20 10:55 12:55 11:30 10:15 12:03 9:32	8.93 9.08 8.99 9.08 9.10 9.14 9.20 9.13 9.19	14 465 15 030 11 920 12 439 13 035 12 979 13 286 12 779 12 300	Yarrawonga

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
McCartneys Bridge Regulator (Downstream)	3113376E/6037387N		10-08-2015		94.03	742	Gulpa Regulator
			14-08-2015		94.08	733	
			26-08-2015	11:00	94.13	778	
			02-09-2015	15:35	94.12	777	
			16-09-2015	10:15	94.12	760	
			22-09-2015	11:20	94.13	773	
			30-09-2015	8:50	94.12	802	
			06-10-2015	8:40	94.18	803	
			14-10-2015	13:05	94.20	847	
			19-10-2015	9:48	94.22	833	
			30-10-2015	12:25	94.28	855	
			06-11-2015	8:15	94.34	857	
			16-11-2015	14:36	94.27	814	
			23-11-2015	9:22	94.24	772	
			04-12-2015	10:05	94.16	598	
McCartneys Bridge Regulator (Upstream)	3113376E/6037387N		10-08-2015		94.03	742	Gulpa Regulator
			26-08-2015	11:00	94.13	778	
			02-09-2015	15:35	94.12	777	
			10-09-2015	15:40	94.12	733	
			16-09-2015	10:15	94.12	760	
			22-09-2015	11:20	94.13	773	
			30-09-2015	8:50	94.12	802	
			06-10-2015	8:40	94.18	803	
			14-10-2015	13:05	94.18	847	
			19-10-2015	9:48	94.23	833	
			30-10-2015	12:25	94.28	855	
			06-11-2015	8:15	94.34	876	
			16-11-2015	14:36	94.27	814	
			23-11-2015	9:22	94.24	772	
			04-12-2015	10:05	94.05	598	

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Moira Creek (upstream of reg.)	315103E/6019175N		10-09-2015 17-09-2015 24-09-2015 01-10-2015 09-10-2015 15-10-2015 20-10-2015 29-10-2015 10-11-2015 16-11-2015 04-12-2015	8:55 14:15 9:10 9:00 12:00 10:35 10:20 8:25 13:05 19:30 11:30	94.06 93.98 93.80 93.78 93.78 93.81 93.82 93.84 93.88 93.70 93.46		Forest regulators downstream of Picnic Point
Pinchgut Regulator (Downstream)	331412E/6033683N		17-08-2015 24-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015	 10:50 11:30 10:23 12:13 9:30	1.45 1.49 1.63 1.67 1.60 8.64	14 465 11 920 12 979 13 286 12 779 12 300	Yarrawonga
Pinchgut Regulator (Upstream)	331412E/6033683N		17-08-2015 24-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015	 10:50 12:30 11:30 10:26 12:13 9:37	9.12 9.20 9.28 9.33 9.38 9.31 9.35	14 465 11 920 12 439 12 979 13 286 12 779 12 300	Yarrawonga
Potts Regulator (Upstream)	329777E/6034341N		17-08-2015 14-10-2015 19-10-2015 30-10-2015	 10:10 12:00 9:30	8.41 8.66 8.60 8.64	14 465 13 286 12 779 12 300	Yarrawonga

Location	AMG	Altitude (AHD LIDAR Map)	Date	Time	Gauge Height (m)	River Flow (ML/day)	Water Source
Reed Beds (Bird Hide)	343499E/6032601N		18-08-2015 26-08-2015 02-09-2015 10-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 13-10-2015 19-10-2015 30-10-2015 06-11-2015 16-11-2015 18-11-2015 23-11-2015 04-12-2015 08-12-2015 11-12-2015	9:45 10:20 8:45 14:00 12:30 11:25 11:00 10:20 12:30 11:15 8:41 14:30 14:15 17:00 9:05 11:30 12:00 12:35	94.44 94.58 94.51 94.52 94.53 94.65 94.56 94.58 94.61 94.61 94.63 94.68 94.66 94.44 94.62 94.54 94.50 94.47	750 778 777 733 760 763 802 803 847 833 855 876 814 777 772 598 569 549	Gulpa regulator
Toupna Creek (Toupna Crossing Rd)	334167E/6035042N		10-08-2015 02-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	 10:30 12:00 10:18 12:45 13:17 12:07 13:50 11:06 13:03	2.02 1.99 2.00 2.03 2.07 2.10 2.14 2.10 1.65 1.66		Forest regulators (upstream of Fisherman's Bend)
Towrong Creek (Tocumwal-Mathoura Rd)			10-08-2015 02-09-2015 16-09-2015 23-09-2015 30-09-2015 06-10-2015 14-10-2015 19-10-2015 30-10-2015 06-11-2015	 10:20 15:29 10:30 14:00 13:29 9:30 14:12 11:15 12:50	5.16 4.90 5.19 5.19 5.22 5.28 5.32 5.30 4.99 5.04		Forest regulators (upstream of Fisherman's Bend)
Warrick Ck Reg.(upstream)	316802E/6029642N		10-09-2015 06-10-2015	13:50 15:48	95.61 95.71		Yarrawonga

Appendix B

Millewa Water Quality Readings 2015

	Date	Time	Height	DO	EC	Temp	pH
Bowls Kiln (a)	17-08-2015		0.44	6.63			
	26-08-2015	12:15	0.99	6.25			
	02-09-2015	14:35	1.00	6.10			
	10-09-2015	14:40	1.00	6.02	0.05	12.96	6.30
	16-09-2015	11:32	0.99	5.34	0.06	13.60	6.71
	23-09-2015	13:30	1.00	5.17	0.06	14.45	7.24
	30-09-2015	10:00	1.00	4.13	0.06	13.91	7.18
	06-10-2015	9:50	1.01	2.76	0.06	18.05	7.05
	13-10-2015	10:08	1.04	1.48	0.06	16.56	6.83
	19-10-2015	10:47	1.05	1.08	0.06	18.30	7.05
	30-10-2015	1:18	1.05	1.35	0.06	20.69	7.15
	06-11-2015	9:14	1.06	0.62	0.06	20.40	6.96
	16-11-2015	15:45	1.11	3.25	0.06	24.42	7.53
	23-11-2015	15:40	1.10	3.58	0.05	24.97	7.91
Melvilles Road (b)	02-09-2015	2:45	0.125	5.91			
	10-09-2015	15:05	0.26	6.10	0.051	13.53	7.60
	16-09-2015	11:10	0.28	5.26	0.055	13.60	6.71
	23-09-2015	1:20	0.29	6.32	0.062	14.06	7.04
	30-09-2015	9:45	0.27	4.72	0.063	13.72	7.12
	06-10-2015	9:30	0.28	2.98	0.064	18.67	7.07
	13-10-2015	10:25	0.32	2.61	0.063	16.31	7.00
	19-10-2015	10:25	0.34	2.53	0.063	18.37	7.00
	30-10-2015	13:00	0.42	2.46	0.060	22.43	7.25
	06-11-2015	9:00	0.36	1.22	0.061	20.47	7.05
	16-11-2015	15:30	0.26	3.55	0.060	25.80	7.39
	23-11-2015					19.92	7.51
Wild Dog Creek (c)	17-08-2015		1.48	5.20			
	26-08-2015	15:20	1.12	4.82			
	11-09-2015	10:45	1.53	4.99	0.051	11.24	6.82
	16-09-2015	12:55	1.51	3.99	0.061	14.00	6.85
	23-09-2015	11:20	1.52	4.35	0.062	11.95	6.73
	30-09-2015	11:00	1.51	4.07	0.059	14.85	7.27
	06-10-2015	10:40	1.54	3.02	0.063	20.48	7.17
	14-10-2015	12:35	1.58	2.74	0.060	18.60	7.04
	19-10-2015	11:30	1.58	2.31	0.068	19.13	7.25
	30-10-2015	8:57	1.61	1.93	0.065	20.37	7.07
	06-11-2015	12:30	1.59	1.72	0.064	20.59	7.05
	16-11-2015	13:55	1.11	2.21	0.072	25.38	6.94
	23-11-2015	9:00	1.06	3.19	0.082	22.23	7.10
Towrong Outlet 1 (Northern Millewa -Pig Sty (d)	17-08-2015		0.95	5.91			
	26-08-2015	13:20	0.62	5.46			
	02-09-2015	15:00	0.51	5.78			
	10-09-2015	15:15	1.08	5.06	0.49	12.75	7.40
	16-09-2015	10:55	1.09	4.12	0.058	15.01	6.48
	23-09-2015	12:55	1.11	4.54	0.062	13.57	6.89
	30-09-2015	9:30	1.11	3.97	0.061	15.69	6.98
	06-10-2015	9:04	1.13	2.56	0.064	20.43	6.88
	13-10-2015	10:45	1.16	1.34	0.074	18.43	7.00
	19-10-2015	10:20	1.18	1.30	0.073	19.72	6.92
	30-10-2015	12:50	1.22	0.75	0.069	21.42	7.66
	06-11-2015	8:55	1.15	0.40	0.071	21.08	6.59
	16-11-2015	15:00	0.78	2.11	0.071	23.70	7.13
	23-11-2015	9:45	0.61	1.92	0.072	21.03	7.29

	Date	Time	Height	DO	EC	Temp	pH
Towrong Outlet 3 (Great Wall of China) (e)	17-08-2015		1.12	6.20			
	26-08-2015	13:45	0.86	5.79			
	23-11-2015	9:55	0.80	3.07	0.09	20.21	7.39
Moira Creek (upstream of reg.) (f)	10-09-2015	8:55	94.06	5.78	0.051	12.18	6.72
	17-09-2015	14:15	93.98	5.44	0.062	15.50	6.62
	24-09-2015	9:10	93.80	6.29	0.065	11.44	7.27
	01-10-2015	9:00	93.78	5.89	0.064	16.14	7.09
	09-10-2015	12:00	93.78	5.09	0.057	18.55	7.04
	15-10-2015	10:35	93.81	4.55	0.059	20.24	7.18
	20-10-2015	10:20	93.82	4.41	0.061	20.18	7.24
	29-10-2015	8:25	93.84	4.68	0.058	18.31	7.05
	10-11-2015	13:05	93.88	5.05	0.061	21.84	7.36
	16-11-2015	19:30	93.70	5.59	0.065	23.69	7.65
	04-12-2015	11:30	93.46	3.68	0.069	21.13	7.22
Barker's Bridge (Gulpa) (g)	09-11-2015	10:30		3.65	0.057	20.54	7.16
	16-11-2015	16:10		4.24	0.055	22.56	7.54
	23-11-2015	14:38		4.19	0.059	23.00	7.90
	04-12-2015	8:55		4.21	0.056	21.54	7.32
Gulpa Mouth (h)	09-11-2015	11:35		4.02	0.058	21.70	7.48
	16-11-2015	16:25		4.64	0.057	23.84	7.42
	23-11-2015	14:55		4.75	0.054	24.66	8.11
	04-12-2015	9:15		4.43	0.057	21.60	7.70
Edward (U/S of Gulpa outlet) (i)	09-11-2015	11:40		4.22	0.058	21.45	7.42
	16-11-2015	16:30		5.00	0.057	23.87	7.63
	23-11-2015	14:50		5.14	0.058	24.65	8.02
	04-12-2015	9:20		4.95	0.053	21.00	7.68

Appendix C

Site Photos

Porter's plain

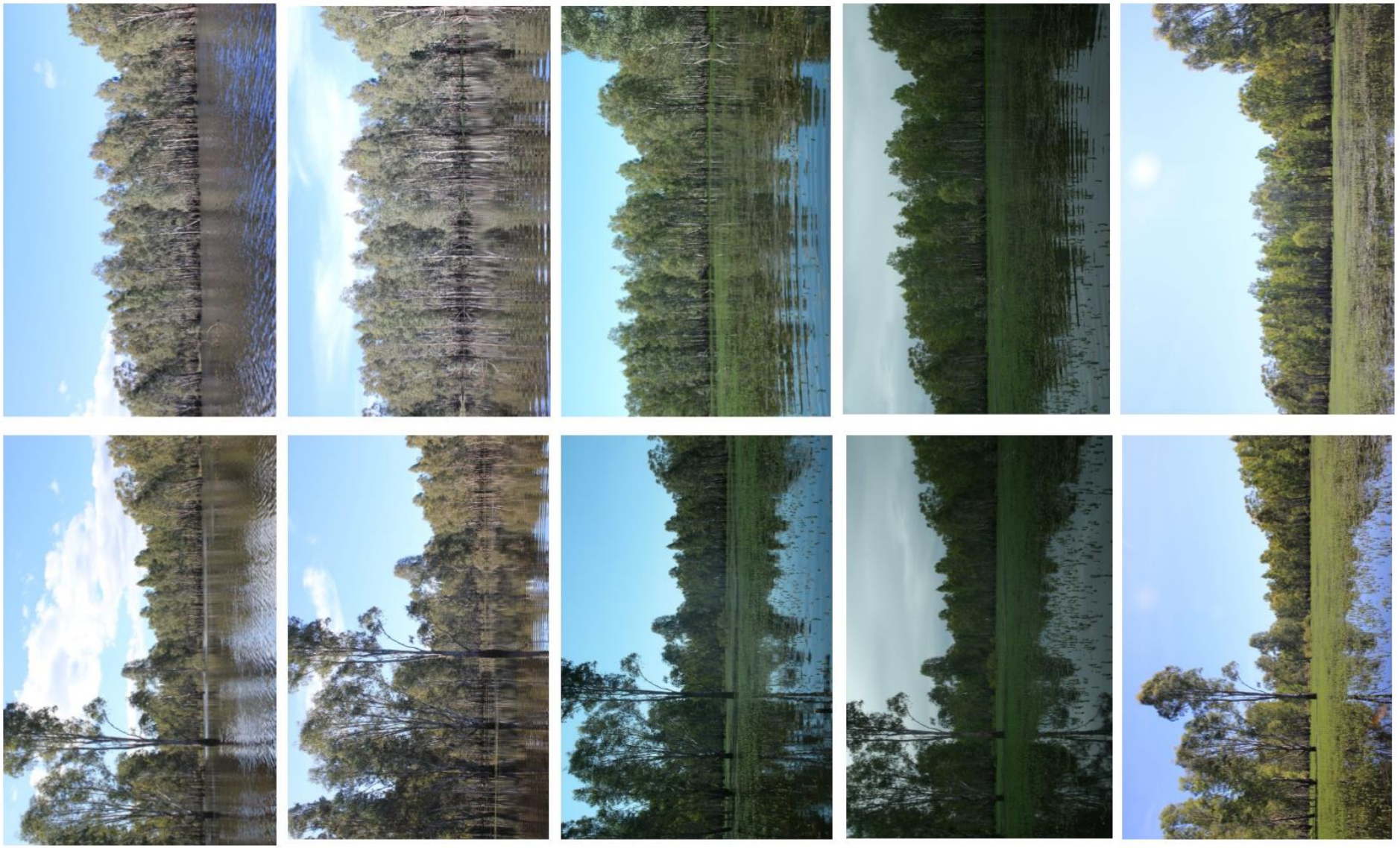
18/08/15

27/08/15

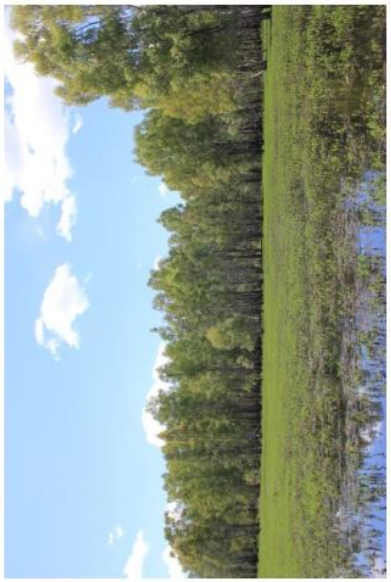
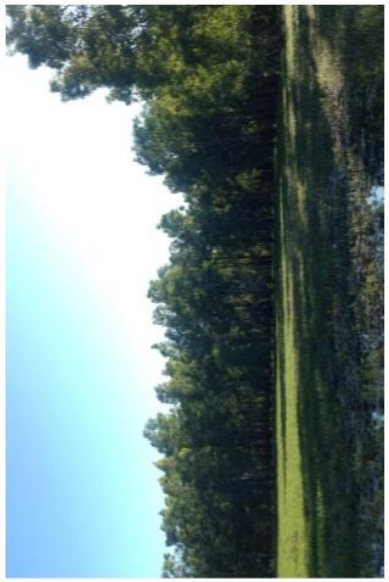
04/09/15

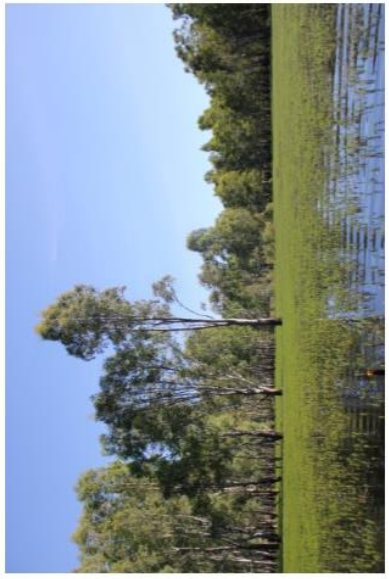
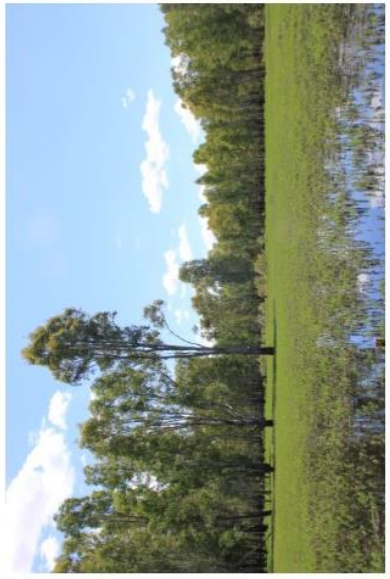
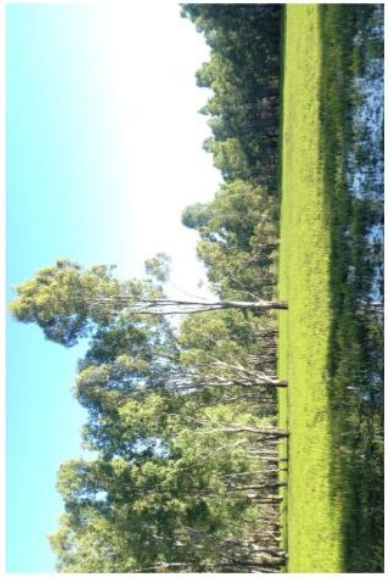
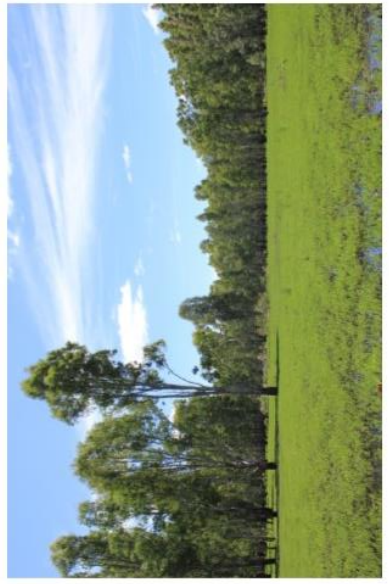
10/09/15

17/09/15



23/09/15 31/09/15 14/10/15 20/10/15 29/10/15

09/11/15 16/11/15 23/11/15 11/12/15

27/08/15

10/09/15

24/09/15

09/10/15

9/11/15

08/08/15

04/09/15

17/09/15

01/10/15

29/10/15

Moira Lake (West)

16/11/15

23/11/15

11/12/15

Moira Grass Monitoring Site (South-Western edge of Moira Lake)

10/09/15

17/09/15

24/09/15

01/10/15

09/10/15

29/10/15

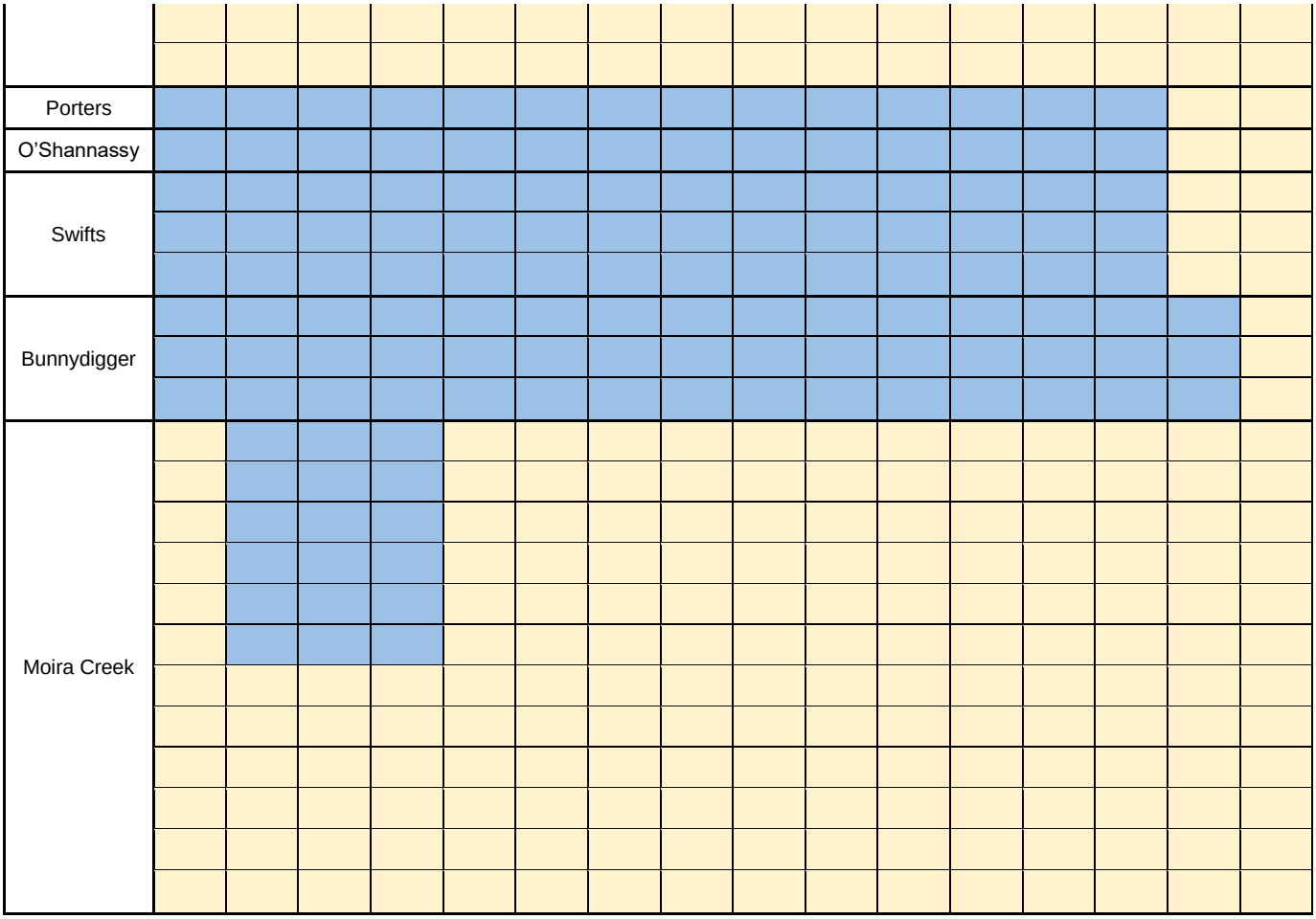
16/11/16

23/05/16

Appendix D

Regulator settings

Regulator Name	2/08/2015	5/08/2015	17/08/2015	21/08/2015	25/08/2015	31/08/2016	1/09/2015	11/09/2015	3/10/2015	20/10/2015	28/10/2015	3/11/2015	5/11/2015	9/11/2015	11/11/2015	12/11/2015
Plantation																
House																
Pinch Gut																
Mary Ada																
Potts																
Fishermans																
Nine Panel																
Nestrons																
Walthours																
Warwick																



Edward Regulators	3/08/2016	4/12/2015
Collins		
McLarens		
Opitz		
Crumps		
V Block		
Edwards		
Mains		
Keech		
Black Swamp		
Wragges		

Taylors		
Atkinsons		
Buchanans		
Dwyers		
Husseys		
Bonners		
Correys		
Little Edward		
McCartneys		
Horseshoe Lagoon 1		
Horseshoe Lagoon 2		
Horseshoe Lagoon 3		
Horseshoe Lagoon 4		
Tumudgery		
Niemur		
Reed Bed Creek		