Murrumbidgee Irrigation

2020 Annual Compliance Report

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Abbreviations

AFFRA	Acoustic Flowmeter For Remote Areas
ANZECC	Australian and New Zealand Environment and Conservation Council
BBS	Barren Box Storage
CSIRO	Commonwealth Scientific Investigation and Research Organisation
DPIE	NSW Department of Planning, Industry and Environment
EC	Electrical Conductivity
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ETo	Evapotranspiration (crop reference)
GIS	Geographic Information System
GMSRR	EPL Point 5 - Gogeldrie Main Southern Drain River Road
ha	Hectare(s)
LAG	EPL Point 4 - Gogeldrie Main Drain at Gooragool Lagoon
LTA	Long-term average
MI	Murrumbidgee Irrigation Limited
MIA	Murrumbidgee Irrigation Area
MIRFLD	EPL Point 15 - Mirrool Creek Floodway Wyvern Station
ML	Megalitre
NARREG	Narrandera Regular
NRAR	Natural Resources Access Regulator
OEH	Office of Environment and Heritage
ROCUDG	EPL Point 7 - Point Cudgel Creek Roaches Escape
SOP	Standard Operating Procedure
t	tonnes
µS/cm	micro siemens per centimetre
µg/L	micrograms per litre
WAL	Water Access Licence
YMS	EPL Point 6 - Yanco Main Southern Drain

Preface

The Annual Compliance Report 2019/20 has been prepared to meet the reporting requirements of the licences held by Murrumbidgee Irrigation (MI).

MI operates under a Combined Water Supply Work Approval and Water Use Approval 40CA403245 (Combined Approval) issued by the NSW Department of Primary Industry – Water and regulated by the Natural Resources Access Regulator (NRAR). MI also holds an Environment Protection Licence (EPL) 4651 issued by the NSW Environment Protection Authority (EPA).

MI is committed to achieving organisational excellence through operating safely, efficiently and effectively, all of which contribute towards the measure of MI's compliance performance.

COMBINED WATER SUPPLY WORK APPROVAL AND WATER USE APPROVAL

1 Statement of compliance

Murrumbidgee Irrigation (MI) has met the conditions of the Monitoring and Reporting Plan dated 16 March 2018 for our Combined Approval in 2019/20. The compliance requirements are cross referenced within this report and listed in Table 1.

MI has quality assurance and control procedures to guarantee data integrity and to ensure that all compliance obligations are met. This includes using a NATA accredited laboratory for water sample analysis and contracting an external hydrological service provider to manage and maintain our licensed supply and discharge points.

Table 1 Combined Approval (40CA403245) reporting summary

Approval section	Condition	Report section
Submission of annual compliance report	1	This report
Plans of the area of operations, authorised works, monitoring sites and water management infrastructure	2.1	2. Plan of operations and works
	2.2	
Statement of compliance	2.3	1. Statement of compliance
Presentation of data and analyses	2.4	Sections 3 - 7
	2.5	
	2.6	
	2.7	Provided via email with report
	2.8	1. Statement of Compliance
New measures to limit groundwater recharge and discharge of salt	2.9	8. New measures to limit groundwater recharge and discharge of salt
Reporting on water management	2.10	3.3 Diversions and water allocation
	2.11	3.5 Water discharged from area of operation
	2.12	3.6 Water balance
	2.13 (a) (b)	3.1 Climate conditions
	(c) – (i)	4. Water use
Reporting on salinity and salt load	2.14	5. Salinity and salt load
	2.15	
	2.16	
Reporting on groundwater conditions	2.17	6. Groundwater conditions

Approval section	Condition	Report section
Discharge of noxious aquatic weeds	5	9.1 Discharge of noxious aquatic weeds
Discharge of blue green algae	6	9.2 Discharge of blue-green algae

There was one significant event in 2019/20 that required notification to the Minister, which is detailed in Table 2.

Table 2 Significant event notifications

Date	Reference	Event	Notification Method
07/05/2020	385359	Meter algorithm improvements identified	S91i Self Reporting Form
Actions, steps or procedures taken by MI to remedy: S91i process followed and certificate of validation completed and submitted by 2 June 2020.			

MI did not change or modify the condition of the existing authorised water supply works or authorised discharge works listed in the Combined Approval during 2019/20. MI did not construct new works that would allow further discharge from the Area of Operations.

2 Plan of operations and works

MI's area of operations, storages and major supply and drainage channels are presented in Figure 1. The Murrumbidgee Irrigation Area (MIA) is supplied by water stored in Burrinjuck and Blowering dams and released to the Murrumbidgee River. Water is diverted from the Murrumbidgee River in accordance with the conditions of the Combined Approval, via two authorised supply works (Figure 2):

- NARREG - Narrandera Regulator (after diversion from Berembed Weir via Bundidgerry Creek and regulator)
- STURT - Sturt Regulator (after diversion from Gogeldrie Weir)

There are five (5) sites which have the potential to discharge water outside MI's area of operations, which are presented in Figure 2. These sites are monitored in accordance with MI's Combined Approval and Environmental Protection Licence (EPL) 4651.

MI's five discharge monitoring points are:

- EPL Point 4 - LAG – Gogeldrie Main Drain at Gooragool Lagoon
- EPL Point 7 - ROCUDG – Cudgel Creek Roaches Escape
- EPL Point 6- YMS – Yanco Main Southern Drain
- EPL Point 5 - GMSRR – Gogeldrie Main Southern Drain River Road
- EPL Point 15 - MIRFLD – Mirrool Creek Floodway Wyvern Station

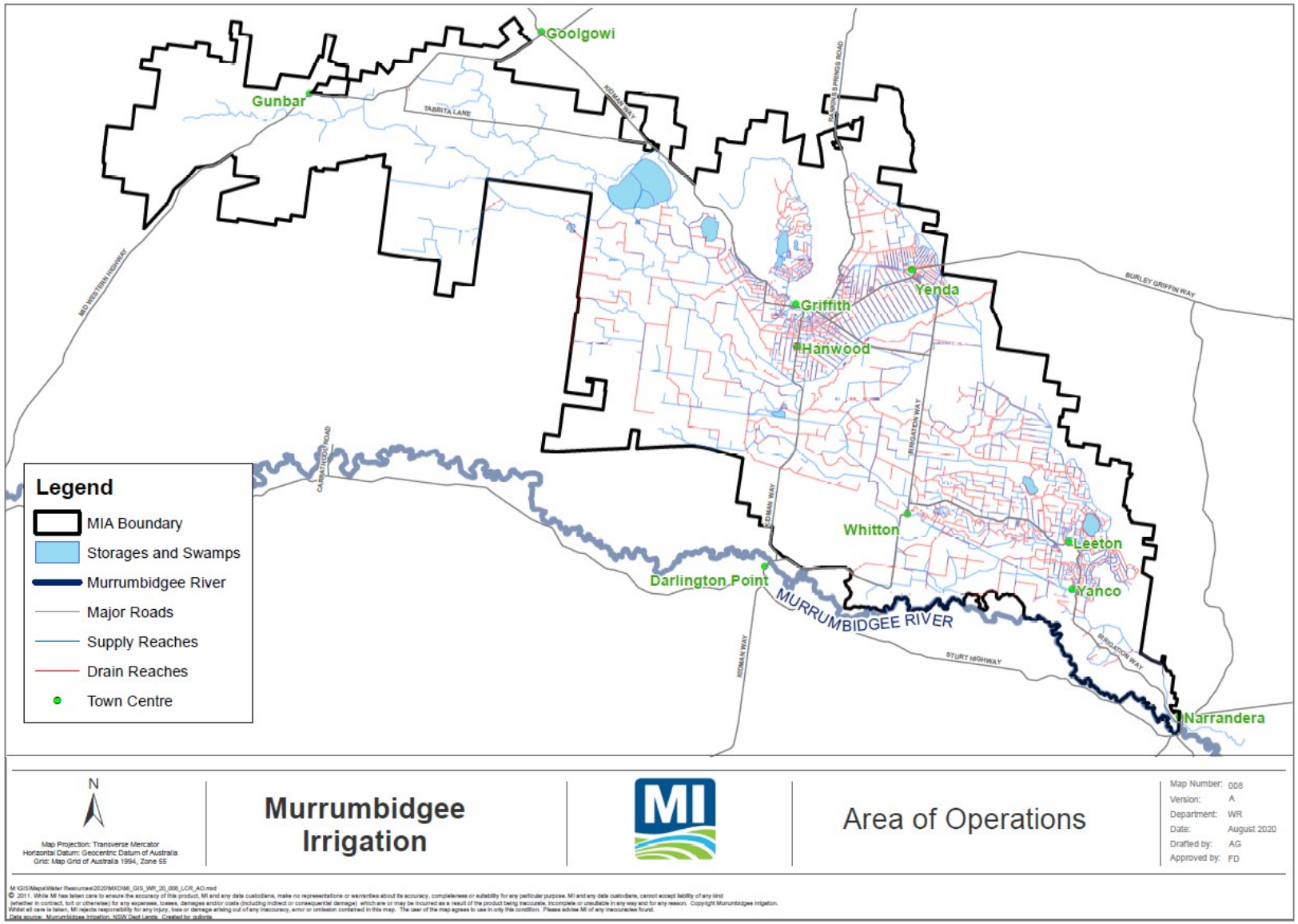

Figure 1 Murrumbidgee Irrigation's Area of Operation

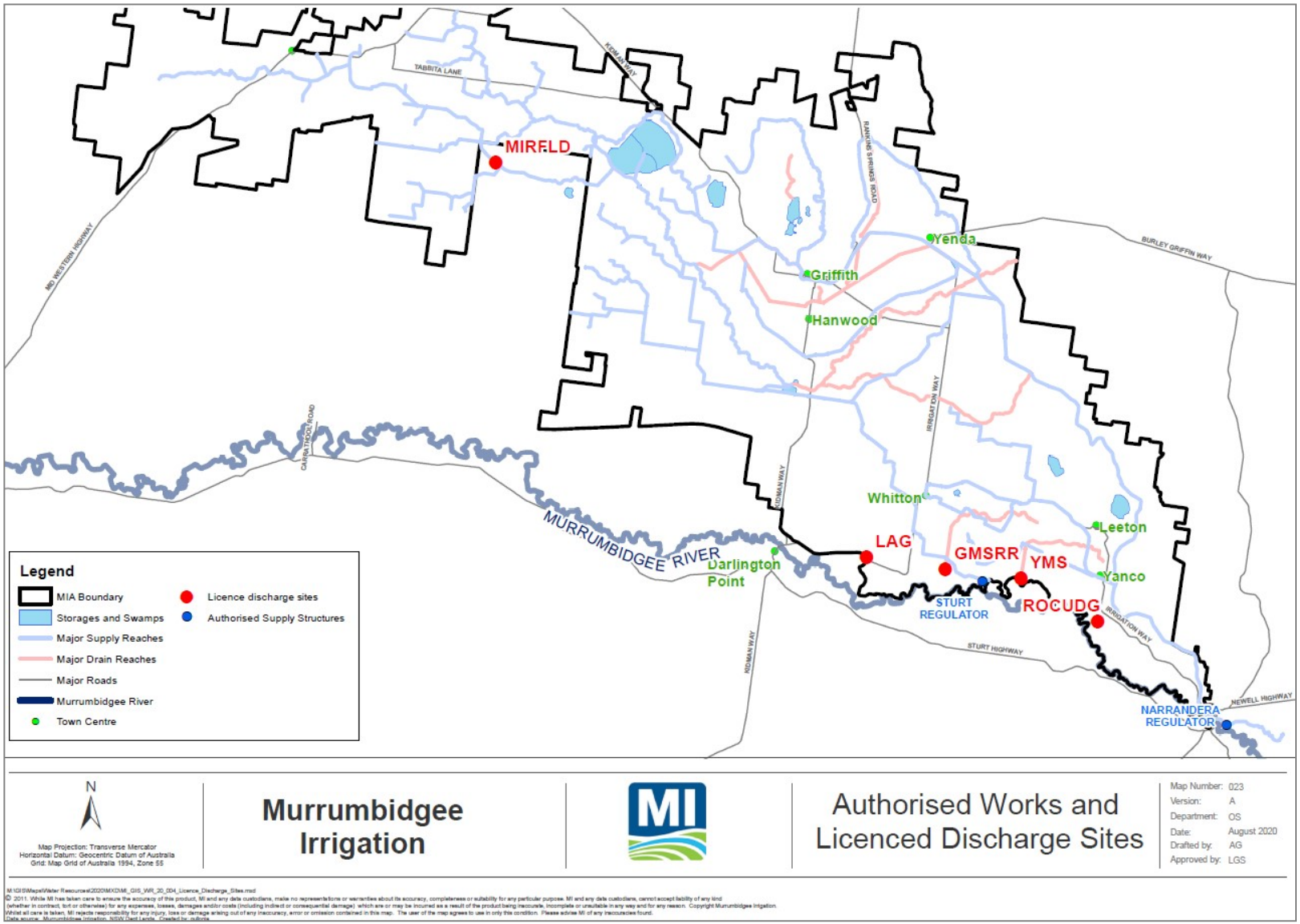

Figure 2 Location of authorised supply works and licence discharge points

3 Reporting on water management

MI's water management information is presented below. There are no internal benchmarks or targets that are relevant to this report.

3.1 Climate conditions

Rainfall and evapotranspiration (ETo) data recorded at the Griffith CSIRO weather station is presented in Table 3. Below average rainfall was recorded in 2019/20 reporting period, with an increase of 27mm from the prior reporting period. The rainfall recorded in 2019/20 is very similar to the rainfall recorded during 2005/06 which fell during the millennium drought.

Table 3 Griffith CSIRO weather station rainfall and ETo

Year	Total rainfall (mm)	Total ETo (mm)
2019/20	364	1,784
2018/19	337	1,914
2017/18	315	1,894
2016/17 (includes flood Sept 2016)	556	1,593
2005/06	357	1,935

*Note: *1 and 2 February 2020 data were not recorded in Griffith due to Telstra communications issues as a result of high temperatures during this period. The data for the two days has been patched with data from the Griffith airport site by CSIRO.*

3.2 Calibration report for Main Canal and Sturt Canal AFFRA units

The calibration reports for Narrandera Regulator (NARREG) and Sturt Canal offtake (STURT) AFFRA units have been provided by Ventia as part of a contract with MI to ensure flow measurements meet the conditions of Combined Approval 40CA403245. The calibration report summary for the NARREG AFFRA unit is presented in Table 4 and the STURT AFFRA unit presented in Table 5. The VENTIA flow, EC, and salt load monitoring financial year report is included as Attachment A.

Table 4 Main Canal at NARREG (410127) calibration report

Date	Time (24hr)	Calibration measurements: Q measured discharge ML/day	AFFRA sensor: Q recorded mean ML/day	Deviation (%)
25/09/2019	1404	838	850	-1.30%
30/10/2019	1542	1132	1140	-0.72%
27/11/2019	1141	1351	1400	-3.47%
30/01/2020	0728	1911	1911	-0.03%
26/02/2020	0755	1182	1170	1.07%
27/05/2020	1141	138	138	0.55%

Table 5 Sturt Canal at STURT (410129) calibration report

Date	Time (24hr)	Calibration measurements: Q measured discharge ML/day	AFFRA sensor: Q recorded mean ML/day	Deviation (%)
25/09/2019	1639	101.375	101	0.37%
30/10/2019	0933	444.273	446	-0.33%
30/10/2019	1018	425.894	426	-0.02%
27/11/2019	0826	76.034	75	1.46%

Date	Time (24hr)	Calibration measurements: Q measured discharge ML/day	AFFRA sensor: Q recorded mean ML/day	Deviation (%)
17/12/2019	1144	126.642	95	33.94%*
17/12/2019	1236	128.518	101	27.90%*
17/12/2019	1405	129.598	148	-12.33%*
29/01/2020	1121	122.302	147	-16.80%**

* Gaugings conducted when gates were being tested. As such, the measurement may be in error.
** The measurement was conducted with a moderate wind blowing directly upstream and has been discounted for use with the index table.

3.3 Diversions and water allocation

A monthly summary of gross water diverted from the Murrumbidgee River is presented in Table 6. These volumes represent diversions entering the supply system via MI's two authorised water supply works at NARREG and STURT. The total diversion volume of 349,523 ML includes an environmental water diversion volume of 3,612 ML diverted on behalf of the Office of Environment and Heritage (OEH).

Table 6 Monthly summaries of water diversions delivered to customers, 2019/20

Month	STURT	NARREG	Total diversion	Delivered to customers
Jul-19	92	2,469	2,561	1,514
Aug-19	1,590	10,819	12,409	7,620
Sep-19	3,284	26,244	29,528	23,095
Oct-19	6,030	39,777	45,807	35,571
Nov-19	4,901	35,662	40,563	33,031
Dec-19	9,140	64,600	73,740	59,649
Jan-20	6,664	59,533	66,197	55,102
Feb-20	2,710	31,586	34,296	31,594
Mar-20	331	17,179	17,510	15,915
Apr-20	218	7,165	7,383	6,553
May-20	1,491	10,243	11,734	9,649
Jun-20	0	7,795	7,795	5,978
Total	**36,451**	**313,072**	**349,523**	**285,270**

Note: All figures in ML

Table 7 compares water allocations, diversions, total deliveries and climate data from the 2019/20 reporting year to prior years. Although announced allocations determine much of the irrigation demand, rainfall and ETo can significantly affect the total diversions for the year.

Table 7 Water allocation, total diversions and deliveries 2018/19 compared to previous years

Year	Announced allocation (%) general / high	Diversions (ML)	Deliveries (ML)	Rainfall (mm) Griffith AWS	ETo (mm) Griffith AWS
2019/20	11/95	349,523	285,270	364	1,784
2018/19	7/95	586,752	487,204	337	1,914
2017/18	45/95	945,805	800,963	315	1,894
2016/17	100/100	780,083	621,094	556	1,593
2005/06	54/95	1,036,519	829,990	367	1,935

Note: All figures in ML

Below average rainfall was recorded throughout the catchment in 2019/20, resulting in 11% allocation for General Security and 95% allocation for High Security allocation.

When low rainfall years are coupled with high ETo rates, as seen in 2005/06, water supply demand increases dramatically. However, it must be noted flows for that year were supplemented by the Snowy Hydro borrows, which added just over 100,000ML of water to the available water pool.

The volume of water diversions debited to each grouping of MI's Water Access Licences are shown in Table 8.

Table 8 Diversions debited to Water Access Licences groups

Year	WAL 1 High Security	WAL 2 General Security	WAL 3 Towns	WAL 4 Stock & Domestic	WAL 5 Other
2019/20	212,062	50,985	19,699	7,263	59,514
2018/19	269,817	161,433	19,699	7,345	128,458
2017/18	265,936	495,573	19,699	7,345	157,252

Note: All figures in ML

3.4 Environmental diversions

At the request of OEH, 3,612 ML of environmental water was delivered in 2019/20 as shown in Table 9. This volume is accounted for in total diversions and deliveries shown in Table 8.

Table 9 Environmental water diversions for 2019/20

Month	Tuckerbill Swamp	Turkey Flats	Yanco Ag	Campbell's Swamp	Total
Jul-19	0	0	0	0	0
Aug-19	0	0	0	0	0
Sep-19	0	0	0	0	0
Oct-19	99	173	982	345	1598
Nov-19	36	165	0	0	201
Dec-19	98	236	240	0	574
Jan-20	0	189	0	128	316
Feb-20	66	36	484	96	682
Mar-20	0	0	0	0	0
Apr-20	240	0	0	0	240
May-20	0	0	0	0	0
Jun-20	0	0	0	0	0
Total (ML)	**539**	**798**	**1,706**	**569**	**3612**

3.5 Water discharged from area of operations

Monthly discharge volumes for each discharge monitoring point are shown in Table 10.

A total of 127 ML was discharged from MI's Area of Operations during 2019/20.

Table 10 Monthly discharge volumes (ML) recorded at monitoring points

Month	LAG (41010940)	ROCUDG (41010005)	YMS (410083)	GMSRR (41010921)	MIRFLD (41010163)
Jul-19	0	0	0	0	0
Aug-19	0	0	0	0	0
Sep-19	22	0	0	3.2	0
Oct-19	0	0.3	0	0	0
Nov-19	0	3.4	0	0	0
Dec-19	0	0.1	0	0	0

Month	LAG (41010940)	ROCUDG (41010005)	YMS (410083)	GMSRR (41010921)	MIRFLD (41010163)
Jan-20	0	0	0	0	0
Feb-20	0.7	0	0	0	0
Mar-20	16.1	0	41.5	0	0
Apr-20	2.3	0	0	0	0
May-20	26.3	8.8	0	0	0
Jun-20	2.1	0	0	0	0
Total	**69.5**	**12.6**	**41.5**	**3.2**	**0**

Note: All figures in ML

Table 11 shows total discharge volumes from MI's Area of Operation compared to prior years.

The total volume discharged in 2019/20 was significantly lower compared to prior years. This was a result of several factors including:

- Customer on-farm efficiencies and recycling reducing drainage discharge volumes
- Recycling of drainage waters within the MIA
- Improved water ordering efficiencies

We note in 2016/17 121,363 ML was diverted to the MIRFLD as a means of flood risk mitigation as a result of the September 2016 flood event.

Table 11 Total volumes discharged from the MIA

Year	Total discharged (ML)
2019/20	127
2018/19	642
2017/18	4,471
2016/17	122,092
2005/06	8,570

3.6 Water balance

The annual water balance in Table 12 has been produced to meet condition 2.12 of the Combined Approval Monitoring and Reporting Plan. To assist with interpretation of this water balance, each line has been referenced to the specific requirements of Condition 2.12.

The conveyance volumes represented in this water balance account for seepage, evaporated water from in channel and storage, and general conveyance required to deliver water to customers. Overland flood losses in 2016/17 refers to overland flows from bank cuts or breaches during peak flood periods.

Total gross diversions of 349,523 ML for 2019/20 were used to generate water deliveries of 281,658 ML to customers and 3,612 ML for environmental water diversions.

There were no flood events resulting in captured flood water deliveries during 2019/20, therefore the total volume of water delivered to customers for 2019/20 was sourced from river diversions and internal storage.

Table 12 Annual water balance as at 1 July 2020 and prior years

Condition	Sources	2019/20	2018/19	2017/18	2016/17	2005/06
2.10 (a) (b)	River diversions	349,523	586,752	945,805	780,083	1,036,519
2.12 (c)	Internal storage (July 1)	2,434	25,256	32,318	29,042	N/A
2.12 (b)	Water captured (measured)	0	0	5,007	171,376	0
	Total	**351,957**	**612,008**	**983,131**	**980,501**	**1,036,519**
	Applications					
2.10 (d)	Deliveries to customers (river and storages)	281,658	484,208	800,963	621,094	829,990
2.10 (d)	Deliveries to customers (captured flood water)	0	0	1,602	49,225	0
2.12 (b) delivered	Environmental water diversions	3,612	2,996	600	986	N/A
2.12 (b) loss	Conveyance	61,836	121,728	151,904	127,960	206,518
2.12 (c)	Internal storage (June 30)	4,724	2,434	25,256	32,318	N/A
2.11 (a)	Discharges out of area of operation	127	642	4,471	121,363	11
2.12 (b) loss	Overland flood discharge	0	0	0	25,600	0
2.12 (b) loss	Customer flood discharge	0	0	0	1,955	0
	Total	**351,957**	**612,008**	**983,131**	**980,501**	**1,036,519**

Note: All figures in ML

4 Water use

4.1 Crop statistics

Customers are required to nominate the intended water use to a crop or purpose when placing water orders. This data is not validated at the farm level and is therefore an estimate only. Table 13 shows water deliveries and estimated crop water use for 2019/20. It is important to note the water use data presented for the total area of crop is influenced by seasonal rainfall, ETo and irrigation practices.

The 'Not Defined' category refers to water taken by MI customers without placing an order. This information is obtained after the meter is read and does not provide opportunity to allocate the water to a use.

Table 13 Summary of water deliveries for major crop groupings 2019/20

Crop/ purpose	Area (ha)	Volume delivered (ML)	Crop water use (ML/ha)
Citrus	7,995	34,995	4.4
Cotton	392	1,170	3
Nuts	5,687	47,258	8.3
Other crops	228	1,588	7
Other fruits	1,097	4,352	4
Plantation	195	380	1.9
Rice	2,213	27,302	12.3
Stock & domestic	341	3,854	11.3
Summer cereals	1,314	9,996	7.6
Summer oilseeds	40	403	10.1
Summer pasture	347	1,626	4.7
Vegetables	2,009	10,655	5.3
Vines	17,808	74,881	4.2
Winter cereals	6,943	18,650	2.7
Winter oilseeds	167	1,057	6.3

Crop/ purpose	Area (ha)	Volume delivered (ML)	Crop water use (ML/ha)
Winter pasture	397	2,721	6.9
Not defined*	-	22,002	-
Total	**47,173**	**262,890**	

*No crop type assigned by customer at time of use

A comparison of crop water use for 2019/20 with prior years is presented in Table 14. Reduced general security allocation dramatically reduced seasonal summer cropping deliveries in 2019/20. As a result, the combined permanent plantings of citrus, vines and other fruits accounted for the highest volume of water deliveries in the MIA.

Table 14 Total deliveries to major crop types 2019/20 compared to previous years

Year	Rice	Pasture	Cereal and oil seeds	Vegetables	Citrus, vines, other fruits	S&D, towns, industrial	Other crops, plantations	Cotton
2019/20	27,302	4,346	30,105	10,655	114,229	22,216	23,969	1,170
2018/19	37,171	12,753	88,968	10,518	130,716	22,174	71,460	113,443
2017/18	220,423	37,952	123,439	10,940	134,046	24,123	76,864	174,778
2016/17	304,200	26,030	57,479	10,129	109,257	9,844	71,376	82,004
2005/06	355,254	65,878	181,641	27,588	142,025	48,123	9,481	

Note: Cotton was included in 'other crops and plantations' for 2005/06. All figures in ML

4.2 Irrigation intensity

Irrigation intensity is displayed in Figure 3 by water use (ML/ha) at a property level.

This map identifies locations of landholdings using between >0 to 4; >4 to 8; and above 8 ML/ha.

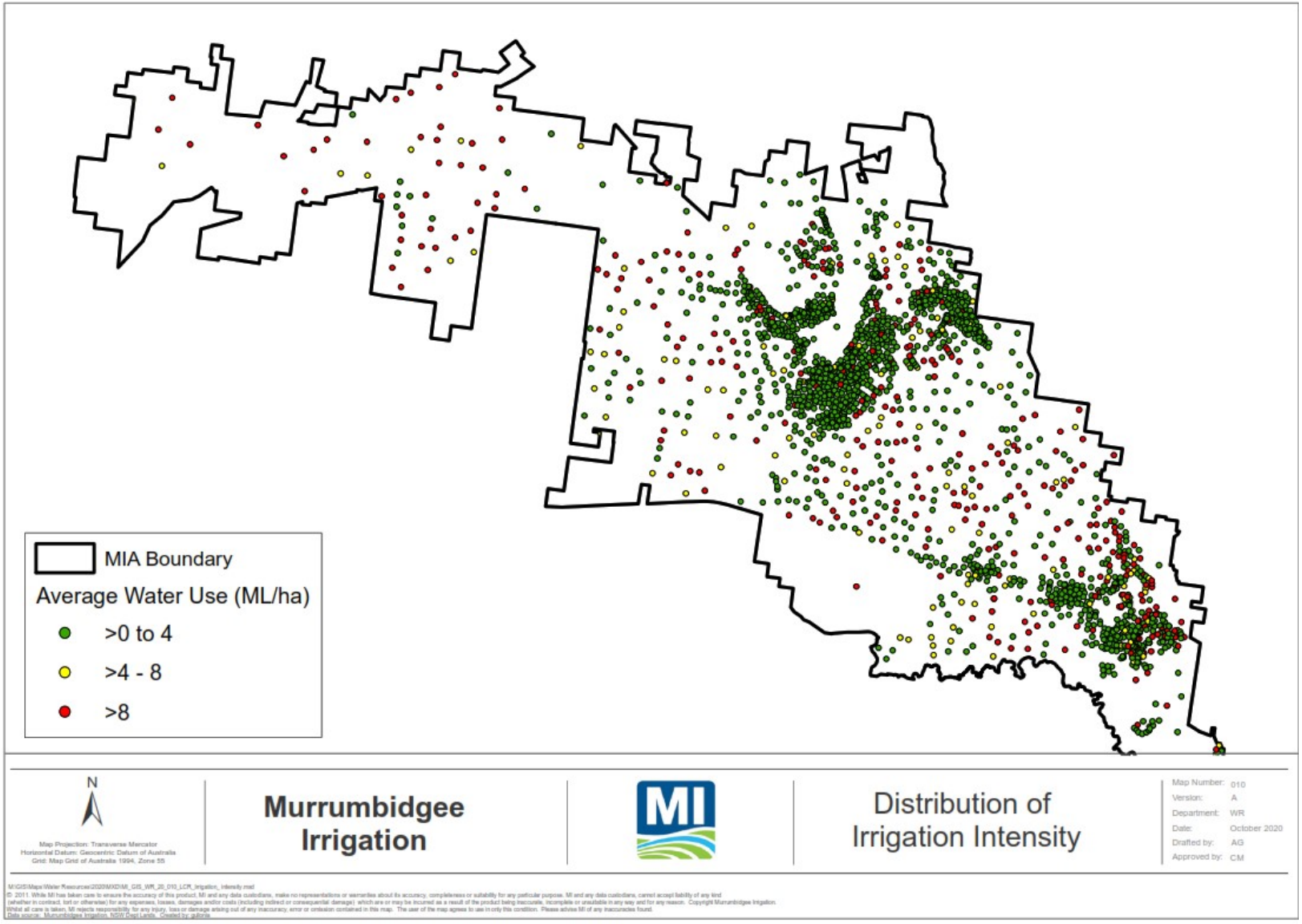

Figure 3 Distribution of irrigation intensity across the MIA

5 Salinity and salt load

5.1 Extracted salt load

The monthly mean electrical conductivity (EC) values and extracted salt loads are calculated using EC sensors at MI's two river offtake sites NARREG and Sturt and presented in Table 15.

Table 15 Total extracted salt load for 2019/20

Month	STURT			NARREG		
	Flow (ML)	Mean EC (µS/cm)	Salt (t)	Flow (ML)	Mean EC (µS/cm)	Salt (t)
Jul-19	92	208	15	2,469	195	235
Aug-19	1,590	170	171	10,819	187	1,165
Sep-19	3,284	129	256	26,244	121	1,917
Oct-19	6,030	80.1	268	39,777	72.9	1,728
Nov-19	4,901	70.0	213	35,662	81.5	1,775
Dec-19	9,140	52.1	272	64,600	55.9	2,110
Jan-20	6,664	55.2	205	59,533	55.7	1,942
Feb-20	2,710	70.4	109	31,586	78.3	1,563
Mar-20	331	111	39	17,179	122	1,328
Apr-20	218	158	27	7,165	185	811
May-20	1,491	156	211	10,243	184	1,284
Jun-20	0	0	0	7,795	198	1,170
Total	**36,451**		**1,787**	**313,072**		**17,030**

Table 16 presents the total extracted salt loads for 2019/20 and prior years.

During 2019/20, an estimated 18,817 tonnes of salt was imported into MI's area of operation from the Murrumbidgee River. Generally, the amount of salt is relative to the volume of water diverted from the river, which is evident for all reporting years.

Table 16 Extracted salt-load (t) for 2019/20 compared to prior years

Year	Diversions (ML)	Extracted salt load (t)		
		STURT	NARREG	Total
2019/20	349,523	1,787	17,030	18,817
2018/19	586,752	6,952	27,570	34,522
2017/18	945,805	14,920	50,030	64,950
2016/17	780,083	11,722	32,903	44,625
2007/08	393,973	1,778	26,816	28,594

5.2 Discharged salt load

There are five discharge monitoring points that can discharge water from MI's area of operation. The locations of these sites are shown in Figure 2 of this report.

Flow, EC and salt load data for these sites is presented in Table 17. When standing water is held at a discharge location, while EC measurements are taken, no flow occurs. Alternatively, minor flows do not trigger accurate measurements to enable salt load calculations.

An estimated 25 tonnes were discharged from MI's Area of Operation through the five discharge monitoring points in 2019/20.

Table 17 Monthly summary of flow, EC and salt loads at monitoring points for 2019/20

Month	Flow (ML)	Mean EC (µS/cm)	Min EC (µS/cm)	Max EC (µS/cm)	Salt load (t)
Yanco Main Southern Escape (YMS) 410083					
Jul-19	-	-	-	-	-
Aug-19	-	-	-	-	-
Sep-19	-	-	-	-	-
Oct-19	-	-	-	-	-
Nov-19	-	-	-	-	-
Dec-19	-	-	-	-	-
Jan-20	-	-	-	-	-
Feb-20	-	-	-	-	-
Mar-20	41.5	121	74.8	192	3.2
Apr-20	-	-	-	-	-
May-20	-	605	427	650	-
Jun-20	-	-	-	-	-
Total	**41.5**				**3.2**
Gooragool Lagoon Escape (LAG) 41010940					
Jul-19	-				-
Aug-19	-				-
Sep-19	22	671.0	41.8	814.0	9.0
Oct-19	-				-
Nov-19	-				-
Dec-19	-				-
Jan-20	-				-
Feb-20	0.7	60.0	1.1	158.0	-
Mar-20	16.1	636.0	198.0	798.0	5.0
Apr-20	2.3	240.0	11.9	691.0	-
May-20	26.3	424.0	157.0	758.0	6.0
Jun-20	2.1	551.0	472.0	749.0	1.0
Total	**69.5**				**21**
Gogeldrie Main Southern Escape (GMSRR) 41010921					
Jul-19	-	-	-	-	-
Aug-19	-	-	-	-	-
Sep-19	3.2	245	227	259	-
Oct-19	-	-	-	-	-
Nov-19	-	-	-	-	-
Dec-19	-	-	-	-	-
Jan-20	-	-	-	-	-
Feb-20	-	-	-	-	-
Mar-20	-	-	-	-	-
Apr-20	-	-	-	-	-
May-20	-	-	-	-	-
Jun-20	-	-	-	-	-

Month	Flow (ML)	Mean EC (µS/cm)	Min EC (µS/cm)	Max EC (µS/cm)	Salt load (t)
Total	**3.2**				
Cudgel Creek Escape (ROCUDG) 41010005					
Jul-19	-	-	-	-	-
Aug-19	-	-	-	-	-
Sep-19	-	-	-	-	-
Oct-19	0.3	75.4	55.7	104.0	-
Nov-19	3.4	87.6	52.5	124.0	-
Dec-19	0.1	88.3	75.2	109.0	-
Jan-20	-	108.0	97.0	130.0	-
Feb-20	-	85.1	64.6	109.0	-
Mar-20	-	66.7	59.9	75.5	-
Apr-20	-	-	-	-	-
May-20	8.8	134.0	114.0	177.0	1.0
Jun-20	-	124.0	41.4	146.0	-
Total	**12.6**				**1.0**
Mirrool Creek Floodway (MIRFLD) 41010163					
	-	-	-	-	-
Total	**-**				**-**

Table 18 details the discharged salt load for the current reporting year and prior years, including the benchmark year.

The salt load is fully dependent on the volume discharged, however the reduction in salt can also be attributed to MI's efforts to recycle irrigation discharge water within the MIA and our customers' efforts to improve water efficiency and recycle irrigation waters on-farm.

Table 18 Discharged salt load 2019/20 compared to prior years

Year	Water discharged (ML)	Discharged Salt load (t)
2019/20	127	25
2018/19	642	98
2017/18	4,471	854
2016/17	122,092	34,230
2005/06	8,570	1,887

5.3 Salt load summary

The salt loads presented in Table 19 show 18,817 tonnes of salt was received through diversions recorded at MI's authorised supply works (NARREG and STURT). A total of 25 tonnes was discharged from the Area of Operations and an estimated 18,792 tonnes was retained within the MIA.

Table 19 Salt load summary for 2019/20

Extracted	Salt load (t)
STUR	1,787
NARREG	17,030
Total extracted	**18,817**

Discharged	Salt load (t)
YMS	3
GMSRR	0
LAG	21
ROCUDG	1
MIRFLD	0
Total discharged	**25**
Retained	**18,792**

It is important to note that this is a simple annual salt balance that considers salt loads entering via authorised works and leaving via approved discharge locations. The balance does not consider other factors that impact total salt loads in the MIA.

No additional data is held by MI that is relevant to the assessment of salinity impacts under the Murray Darling Basin – Basin Salinity Management 2030.

6 Groundwater conditions

The following information is provided from MI's groundwater network monitoring only. MI cannot comment on influences on groundwater from other sources, including groundwater extraction by private owners or other entities and any recharge or disturbance from other developments or activities.

6.1 Groundwater monitoring and reporting

Groundwater monitoring was completed in the last quarter of 2019. The network consists of piezometers in the Shallow and Deep Shepparton Formation and a smaller monitoring network in the Calivil Formation.

A total of 641 piezometers are required to be monitored and reported on as per Attachment 2 of the Monitoring and Reporting Plan. The locations of these bores are displayed in Figure 4.

Table 20 provides a status summary of the groundwater piezometers monitored in 2019.

A total of 534 piezometers were read during the monitoring, which equates to 83% of the network and 89% of the network which has not been destroyed. A total of 94% of the MI piezometer network was still in place, with only 39 piezometers noted as destroyed.

During the monitoring, 68 piezometers could not be found in the field. It is believed this was due to a combination of factors, including altered site access, site redevelopment, removal of marker stakes, ground conditions and staff unfamiliar with the area. A concerted effort is being made in 2020 to ensure all locations are inspected and site identification is improved.

Table 20 Groundwater piezometer status summary 2019

Total bores	Total destroyed+	Dry, flooded or blocked	Not found	Total read
641	39	47	68	534

Note: + piezometers damaged or destroyed in the field due to land development or other uses or actions.

Depth to water table data is reported for 2019/20, 2018/19, 2017/18 and 2005/2006. The 2005/06 reporting year was chosen for reference as it represents a time period that includes the millennium drought in the MIA.

The number of piezometers read within depth ranges for 2019 are shown in Table 21.

Table 21 Number and percent of total piezometers readings within each depth range

Year	<2M of surface	2-4M of surface	>4M of surface	% <2M of surface	% 2-4M of surface	% >4M of surface	Total
2019	5	96	386	1%	20%	79%	487
2018	23	151	367	4%	28%	68%	541
2017	65	163	339	11%	29%	60%	567
2005	55	225	342	9%	36%	55%	622

Table 21 shows that the trend in groundwater depth at each piezometer is trending downward, with 79% of piezometers reading at a depth greater than four metres below the ground surface.

Table 22 provides a comparison of the three depth class areas relative to the previous two years and historical reference year. The area for each class is estimated using the depth measurement from each piezometer and its known location. The value for an area is interpolated from the point measurement using Nearest Neighbour Resampling method. This information can change if certain piezometers are not read due to being blocked, flooded, destroyed or lack of access.

In 2019 when compared to 2017 there has been an overall reduction of hectares in the shallow depth range, including when compared to the 2005 figures. The small rise in hectares from 2018 to 2019 for shallow groundwater levels may not be significant, given the inherent uncertainties in the area calculations.

The overall trend in groundwater levels using both point data from Table 21 and area data from Table 22 shows groundwater levels are at a deeper level when compared to both recent years and the benchmark year of 2005.

The area of operations has decreased between 2005 and 2019 and approval granted in 2015 to reduce the groundwater piezometer network.

Table 22 Change in groundwater depth

Groundwater depth range (m)	Depth to water table area (ha)				Change in depth [+ = rising] [- = falling]		
	2019	2018	2017	2005	2019 vs 2018	2019 vs 2017	2019 vs 2005
<2M	161	0	1,829	996	+161	-1,668	-835
2-4M	32,310	76,393	120,189	109,772	-44,083	-87,879	-77,462
>4M	892,237	848,315	658,149	815,545	+43,922	+234,088	+76,692
Total	924,708	924,708	780,168	926,313			

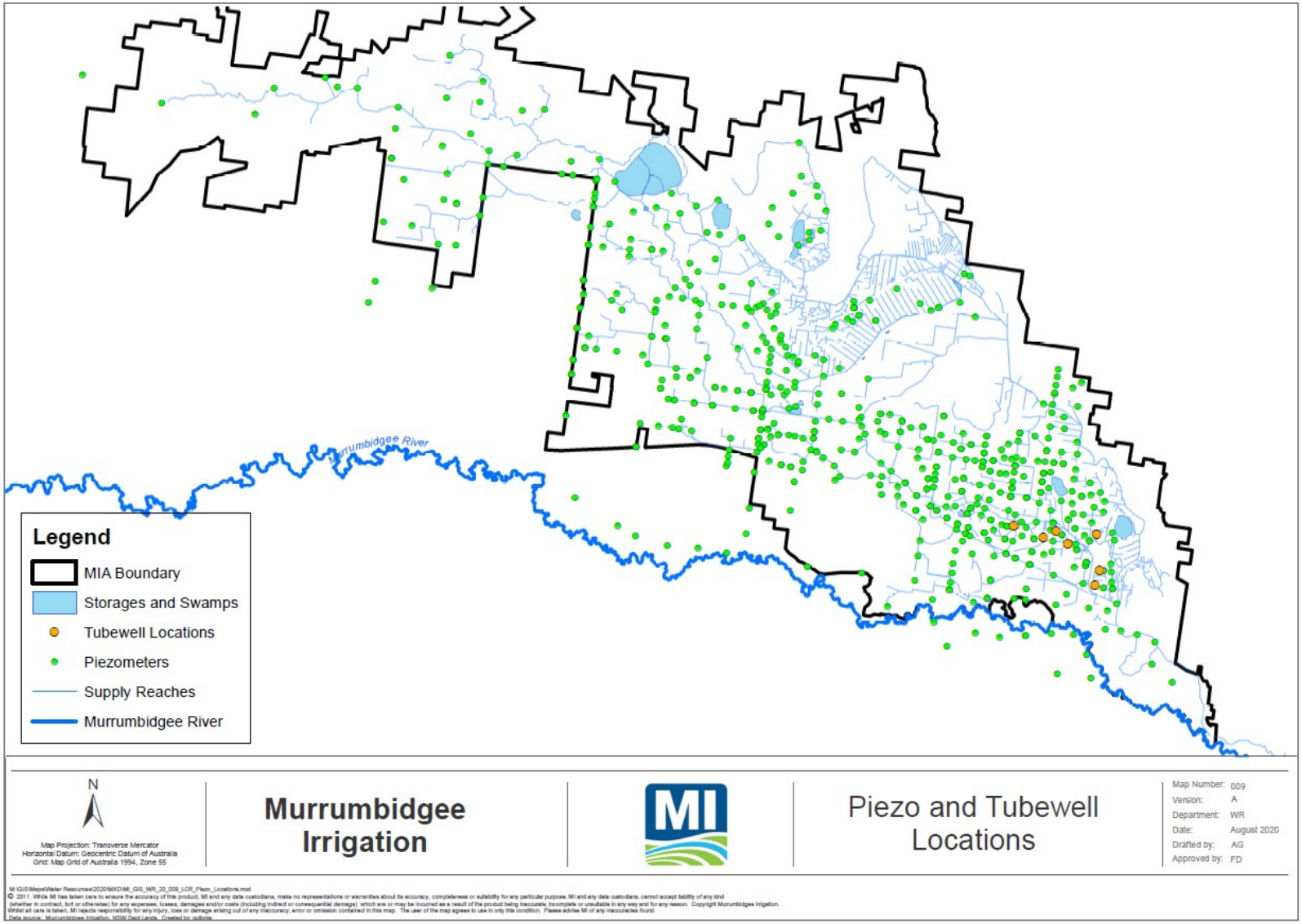

Figure 4 Location of piezometers and tubewells in the MIA 2019/20

6.2 Groundwater salinity

Groundwater salinity was not requested by the Minister for 2019/2020 reporting year.

6.3 Shallow Shepparton Formation

The depth to water table in 2019 for piezometers in the shallow Shepparton Formation are presented in Figure 5 to Figure 9.

Groundwater levels in this formation are expected to be highly influenced by seasonal rainfall, geology and irrigation. A comparison between Figure 5 and Figure 6 demonstrates that the majority of groundwater levels have lowered in comparison with prior years. Below average rainfall combined with less diversions and deliveries to customers would have impacted the aquifers ability to recharge.

When compared to 2005/06 (Figure 9), recent groundwater levels appear to have mainly lowered across the MIA, with fewer piezometers reading standing water levels within 2 m from surface level. While groundwater levels can be influenced by ongoing drought conditions and below average rainfall, it is likely that groundwater levels have lowered due to the following:

- Reduction in flood irrigation practices
- Improved water efficiency on farm, including water retention and recycling
- Seepage reduction works across the MIA network

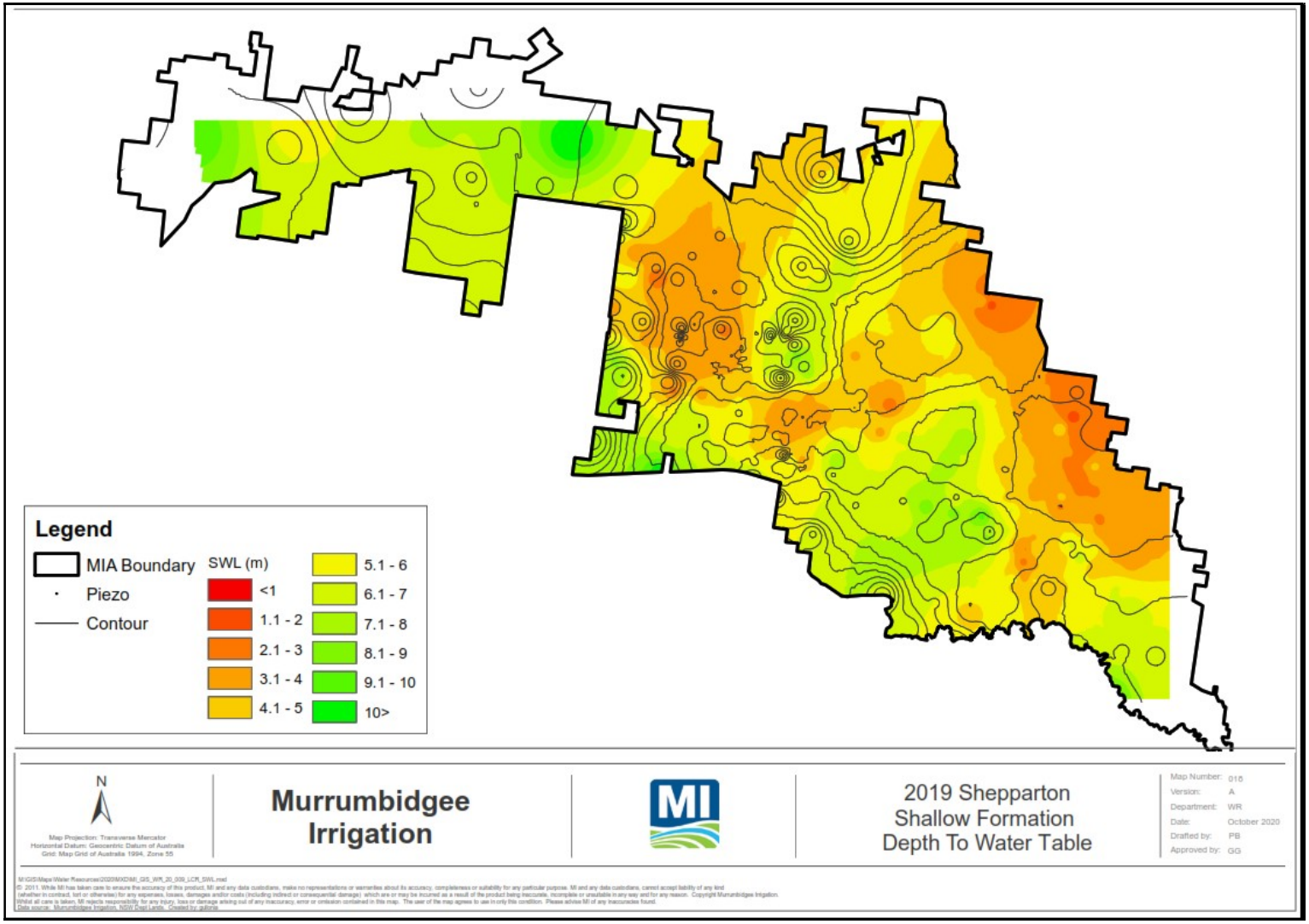

Figure 5 Shallow Shepparton Formation – depth to water table 2019

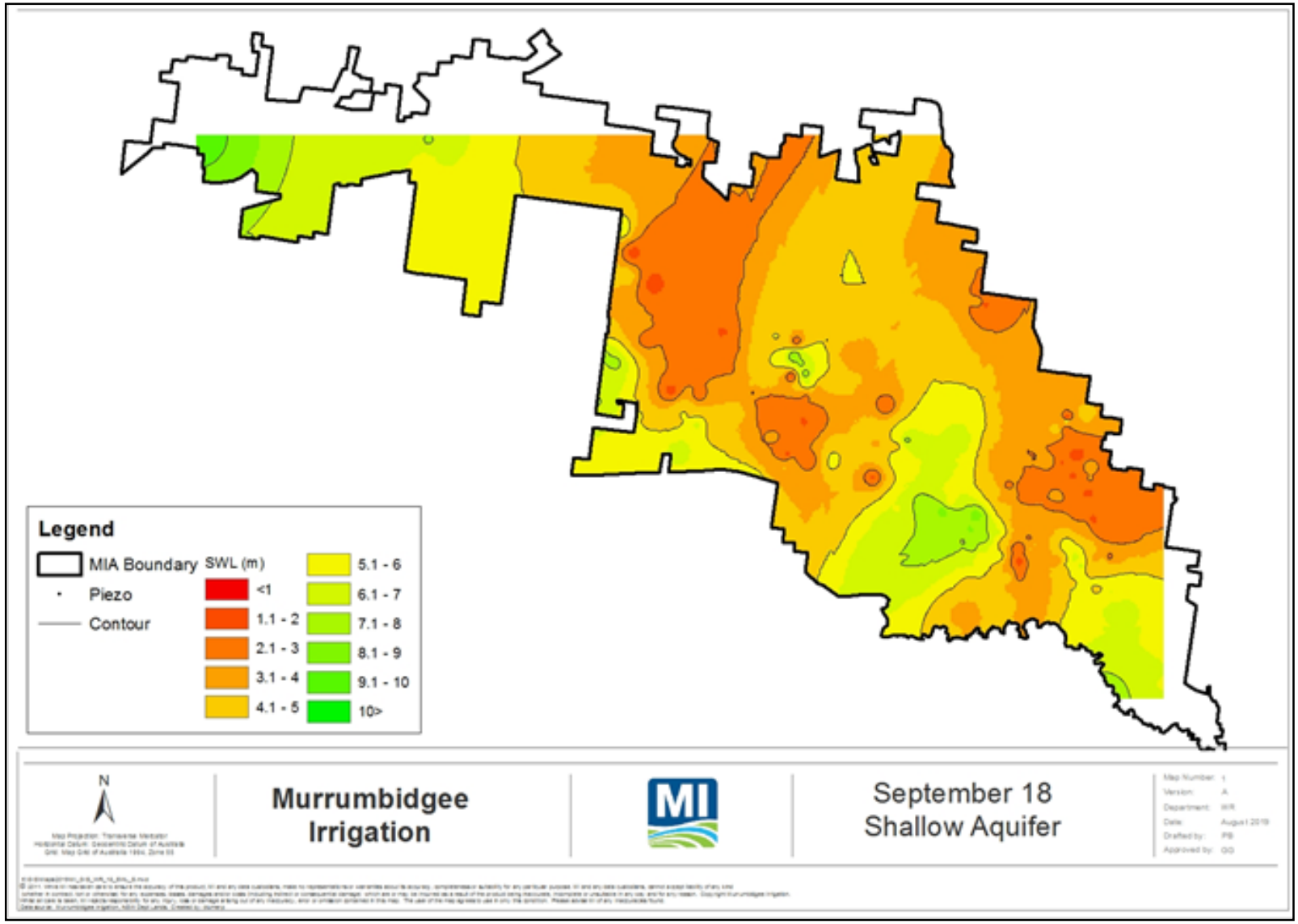

Figure 6 Shallow Shepparton Formation – depth to water table September 2018

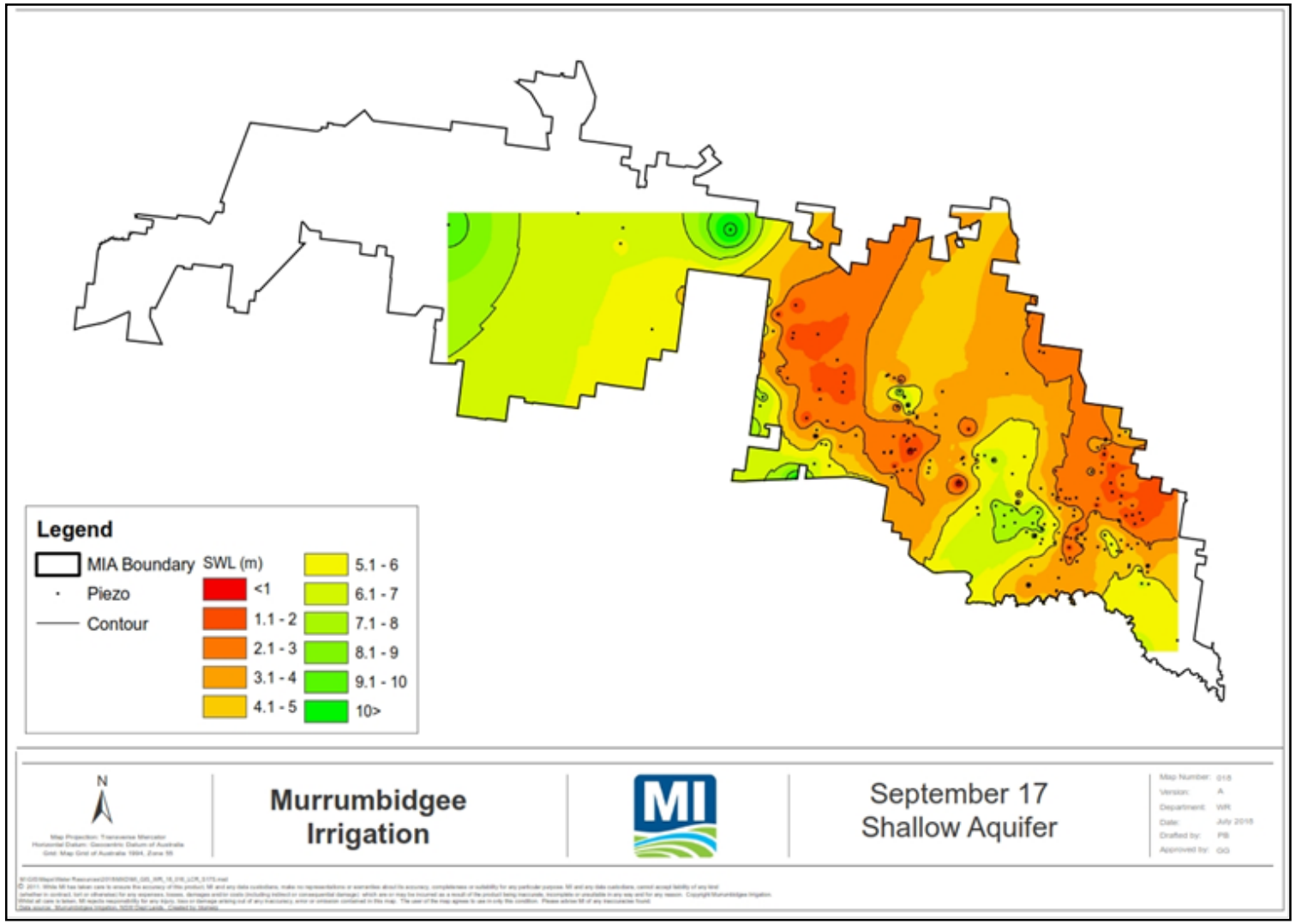

Figure 7 Shallow Shepparton Formation - depth to water table, September 2017

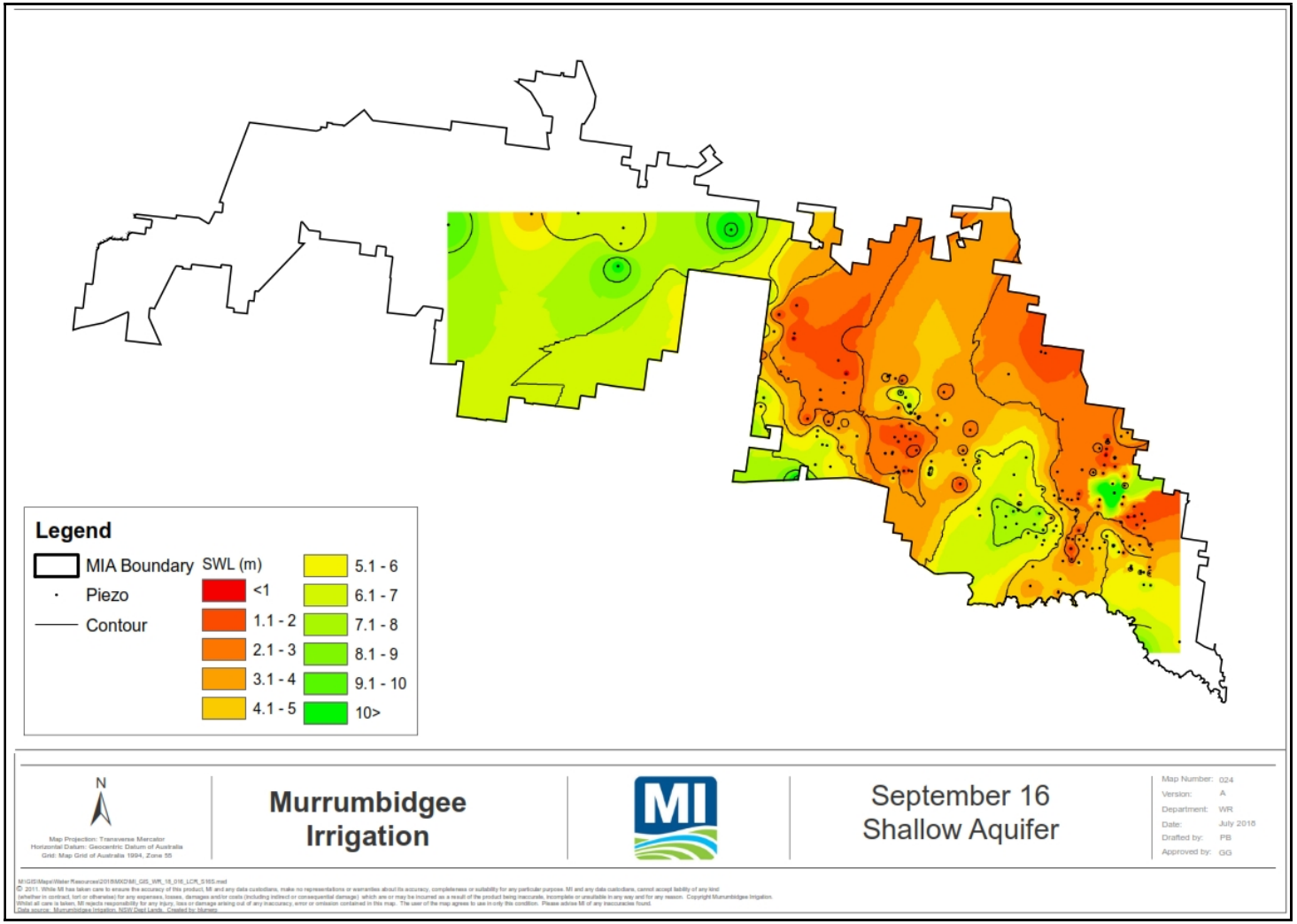

Figure 8 Shallow Shepparton Formation - depth to water table, September 2016

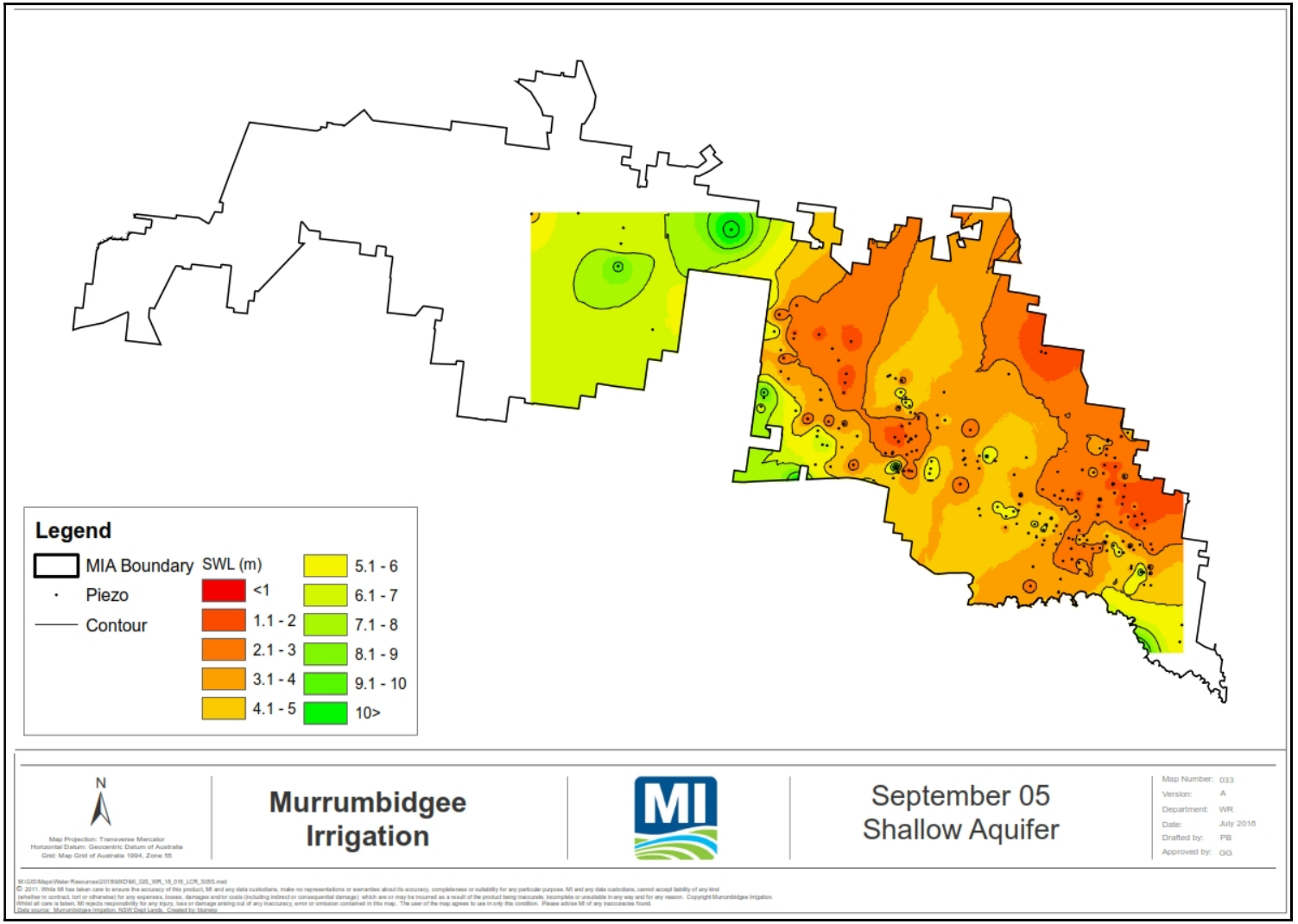

Figure 9 Shallow Shepparton Formation - depth to water table, September 2005

6.4 Deep Shepparton Formation

Depth to water table for piezometers in the deep Shepparton Formation are presented in Figure 10 to Figure 14.

Groundwater levels in the deep Shepparton Formation can be influenced by connectivity with the shallow Shepparton Formation. Therefore, a comparison between Figure 10 and Figure 11 also demonstrates that the groundwater levels have lowered in comparison with prior years.

Groundwater levels appear to have lowered in the deep Shepparton formation. This deep formation is potentially influenced by the reduced number of flood irrigated fields and below average rainfall.

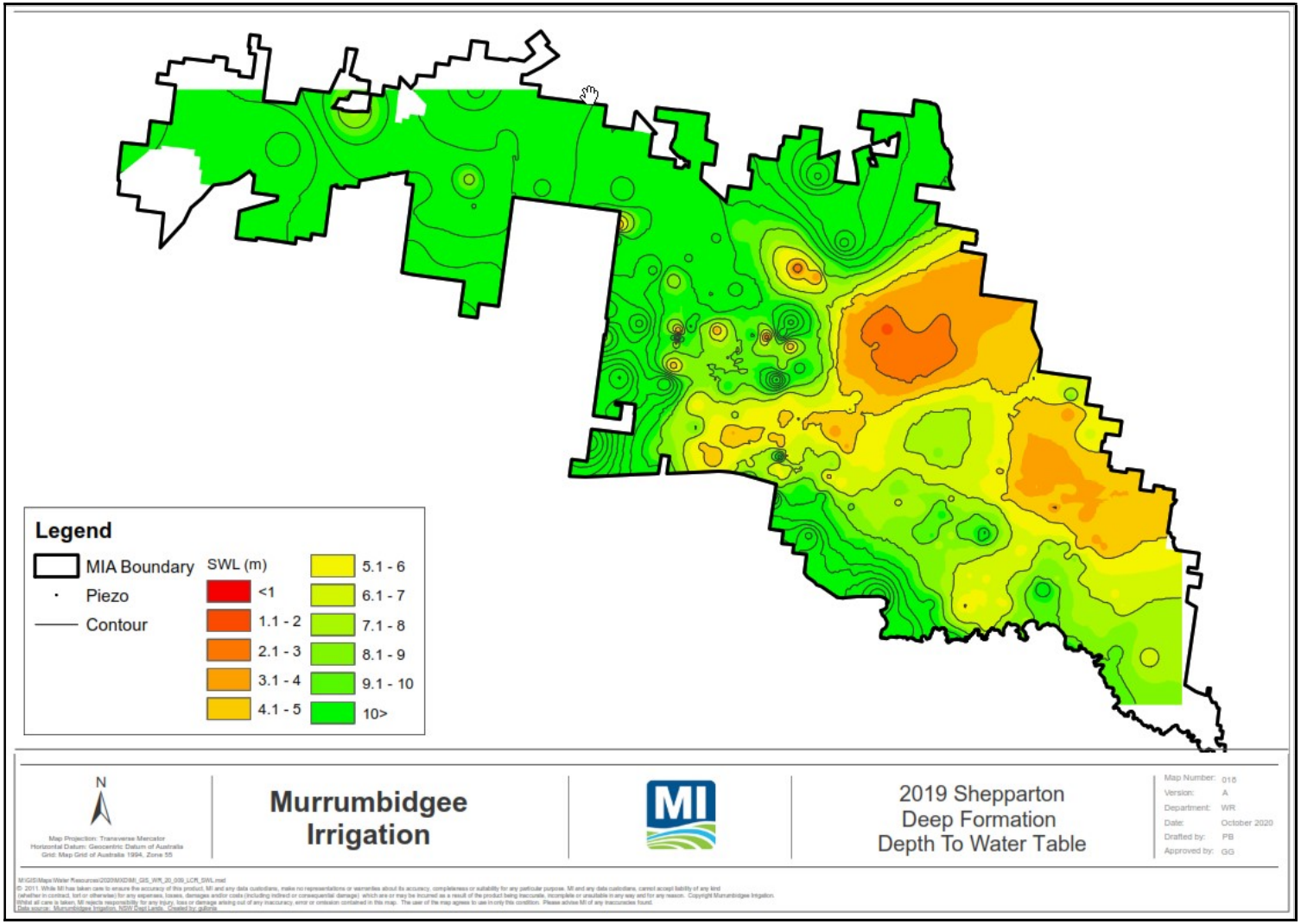

Figure 10 Deep Shepparton Formation - depth to water table, 2019

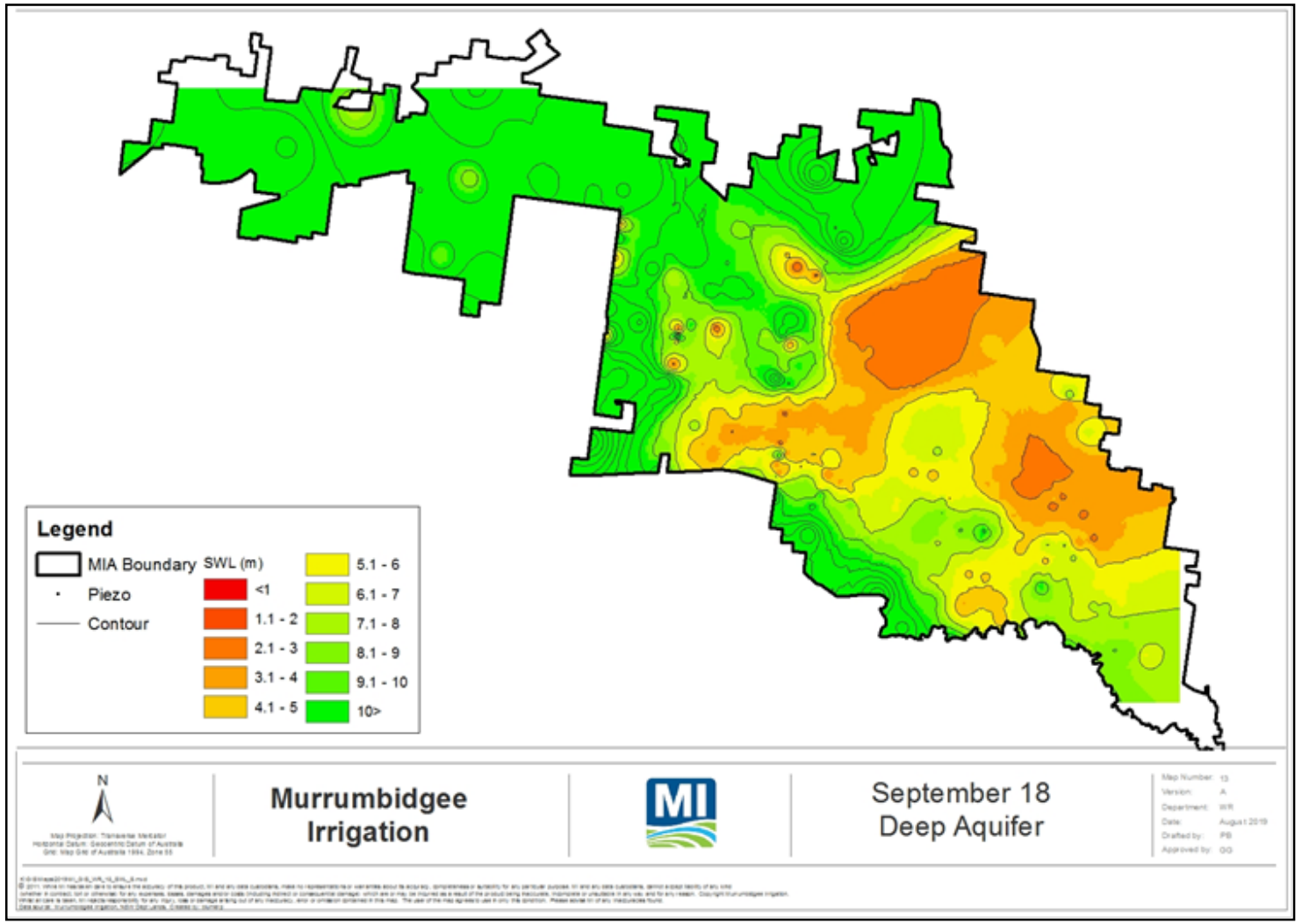

Figure 11 Deep Shepparton Formation - depth to water table, September 2018

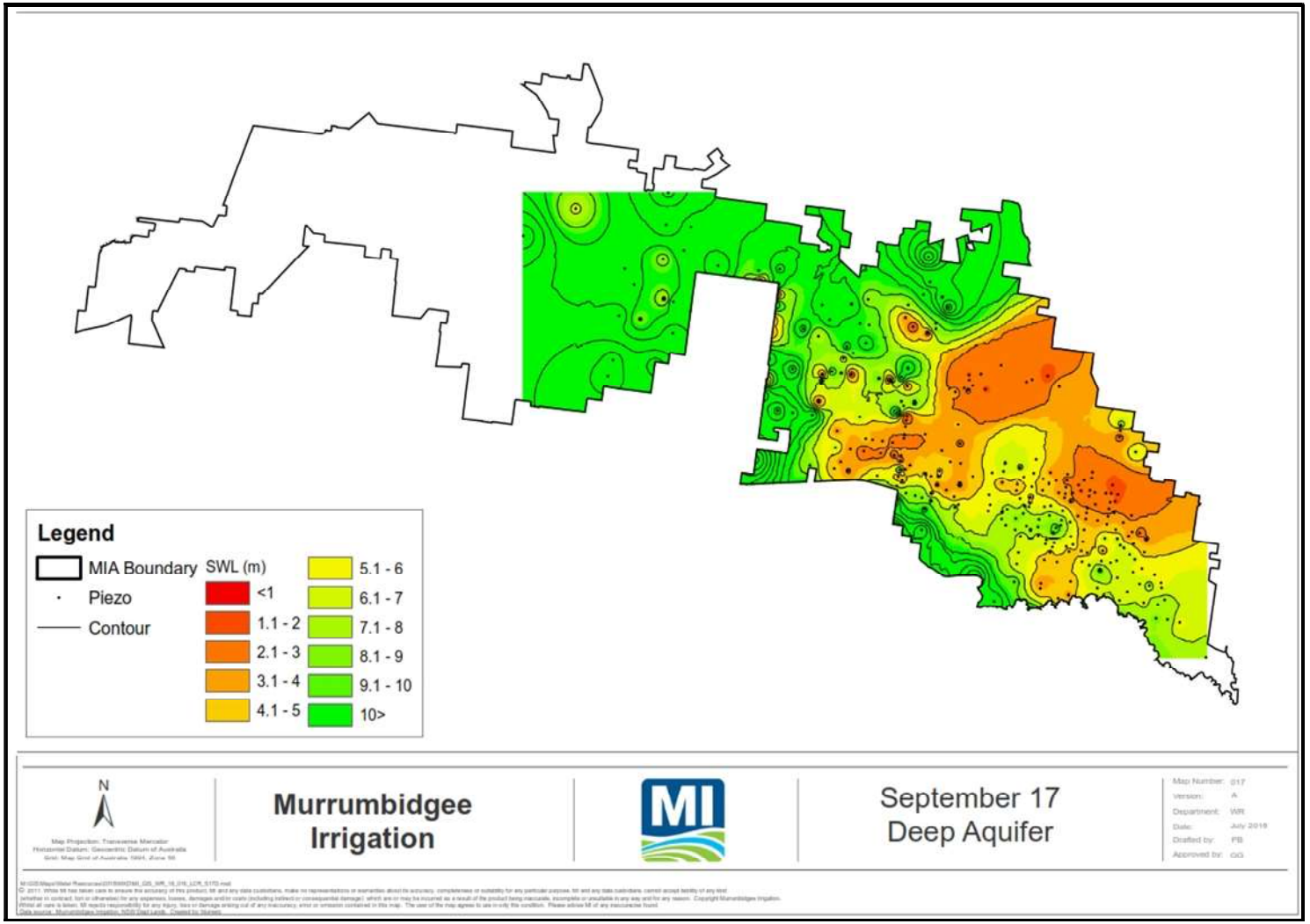

Figure 12 Deep Shepparton Formation - depth to water table, September 2017

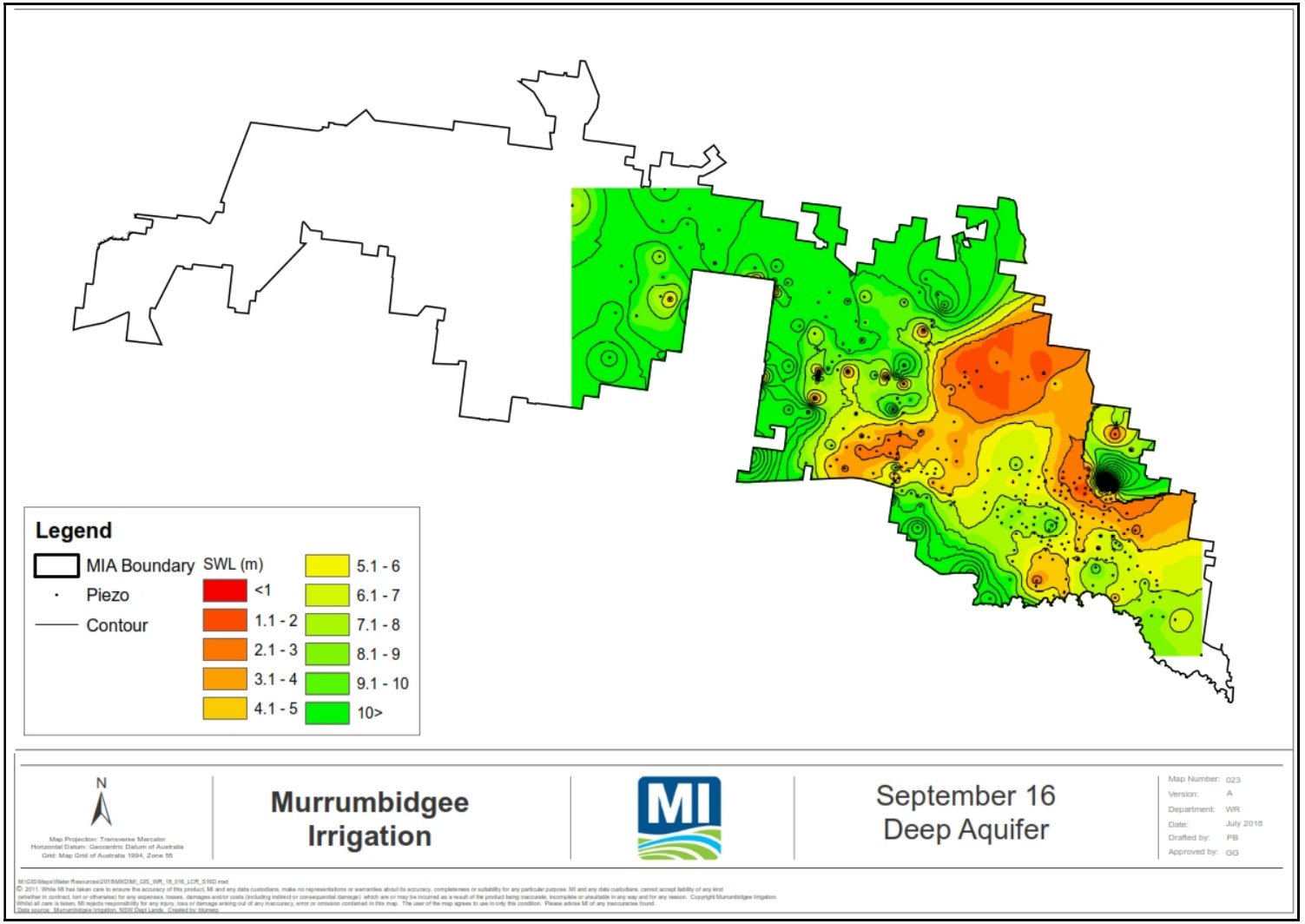

Figure 13 Deep Shepparton Formation - depth to water table, September 2016

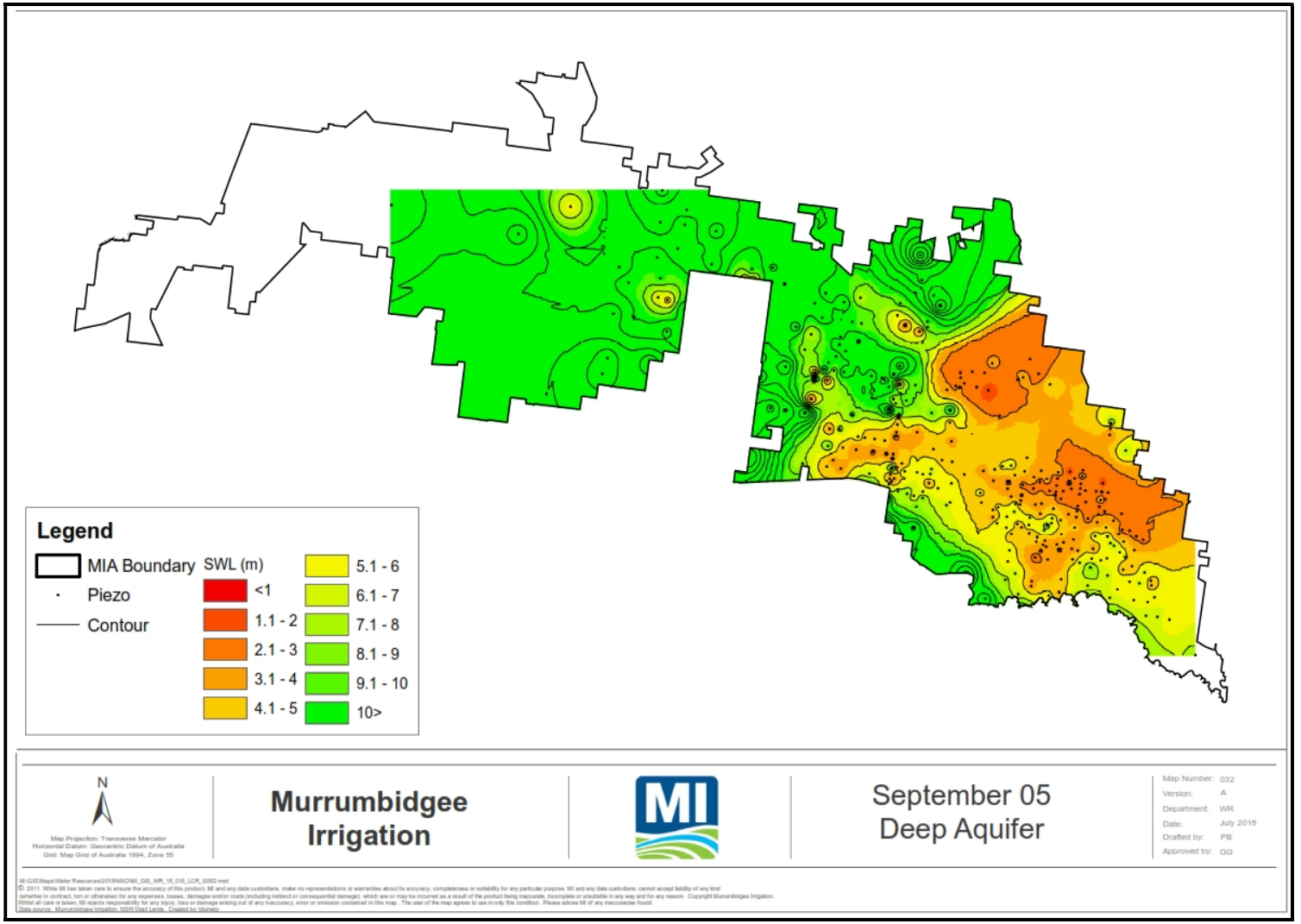

Figure 14 Deep Shepparton Formation – Depth to water table, September 2005

6.5 Calivil Formation

Depth to water table for piezometers in the Calivil Formation are presented in Figure 15 to Figure 19.

Level trends in this formation generally represent drawdown from the shallow and deep Shepparton aquifers. When comparing Figure 15 and Figure 16 the depth to water table has lowered. Overall, the levels in this aquifer remain consistent for all reporting years, with most piezometers reading a depth to water table of more than 10 metres.

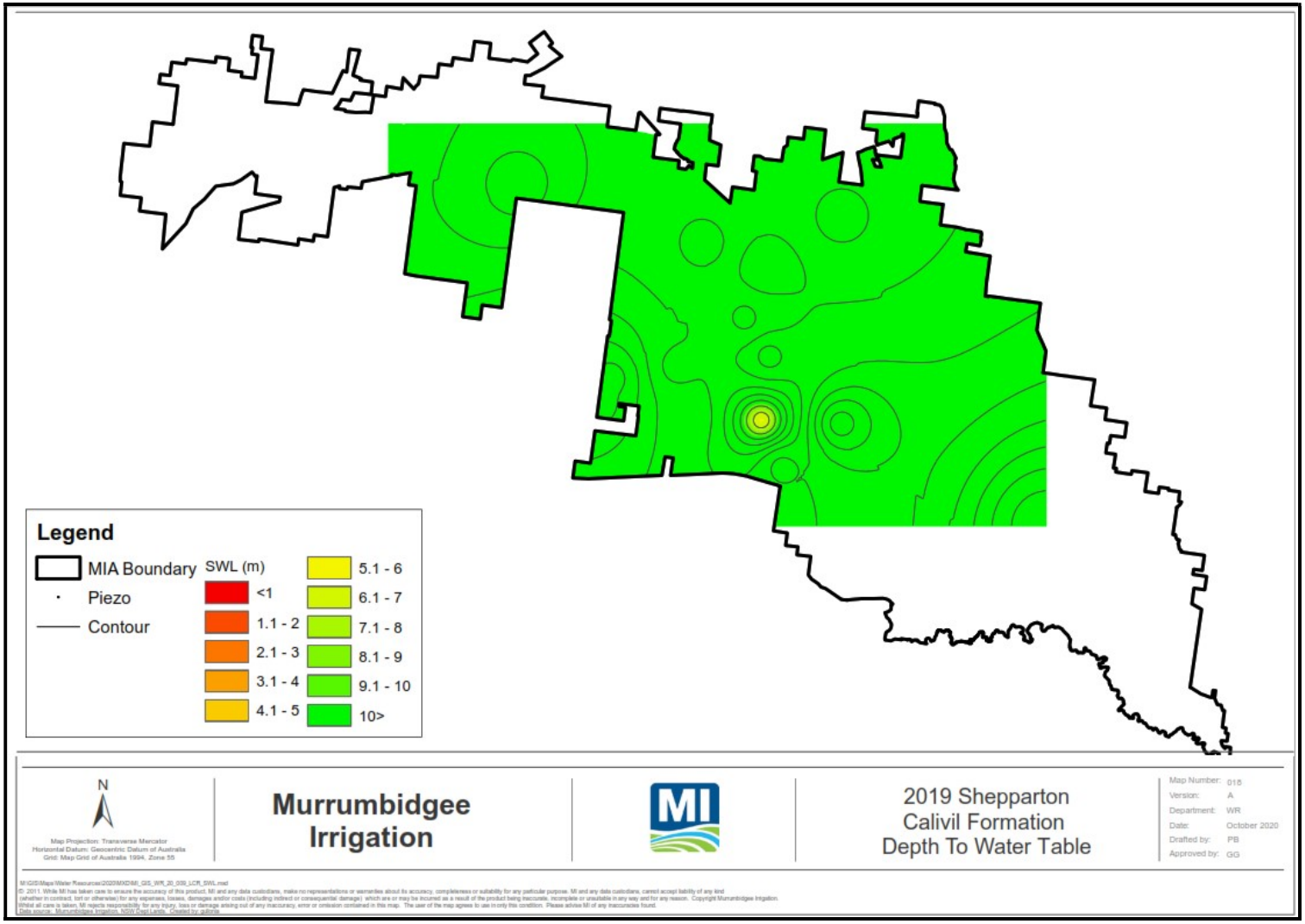

Figure 15 Calivil Formation – depth to water table, 2019

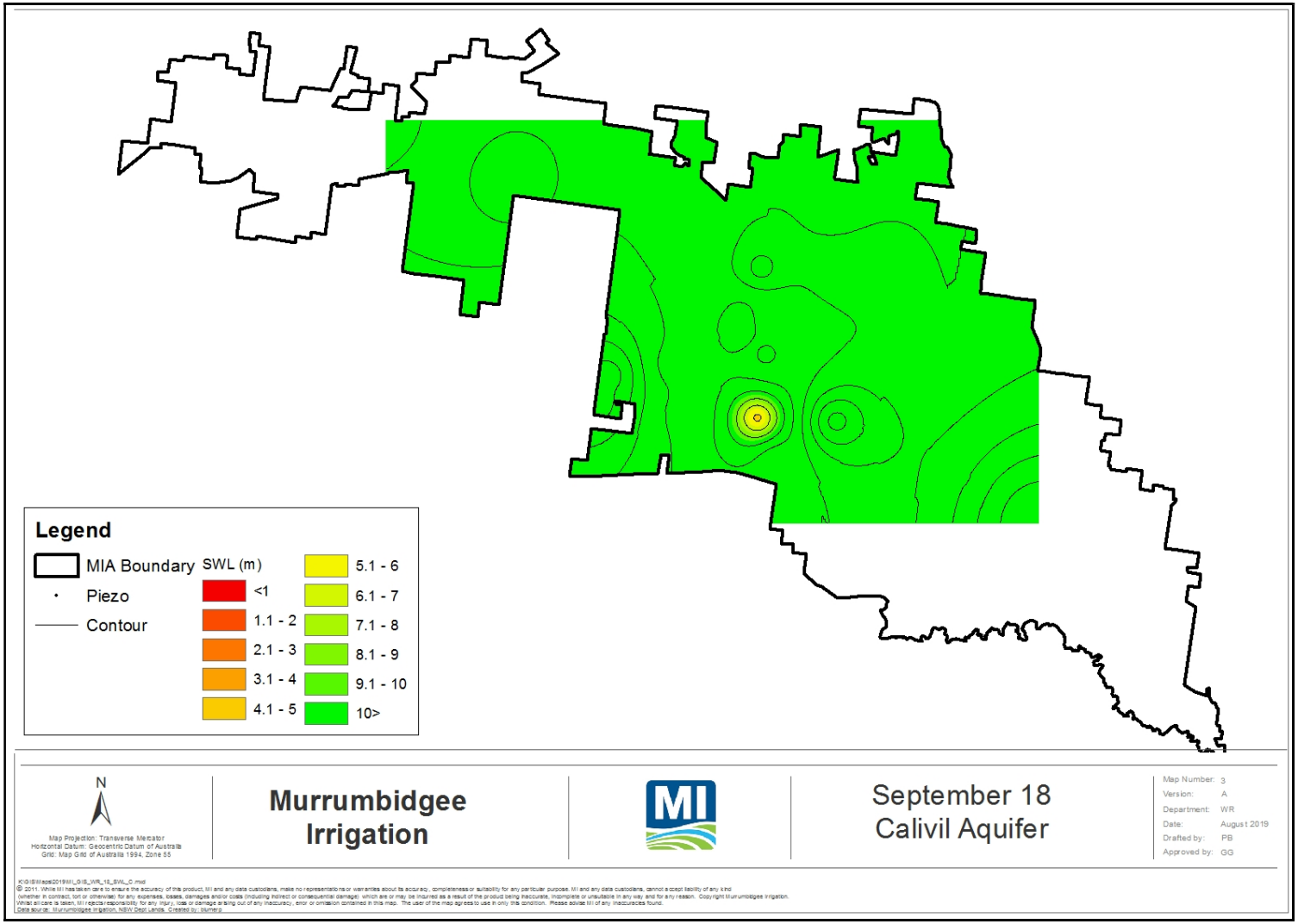

Figure 16 Calivil Formation - depth to water table, September 2018

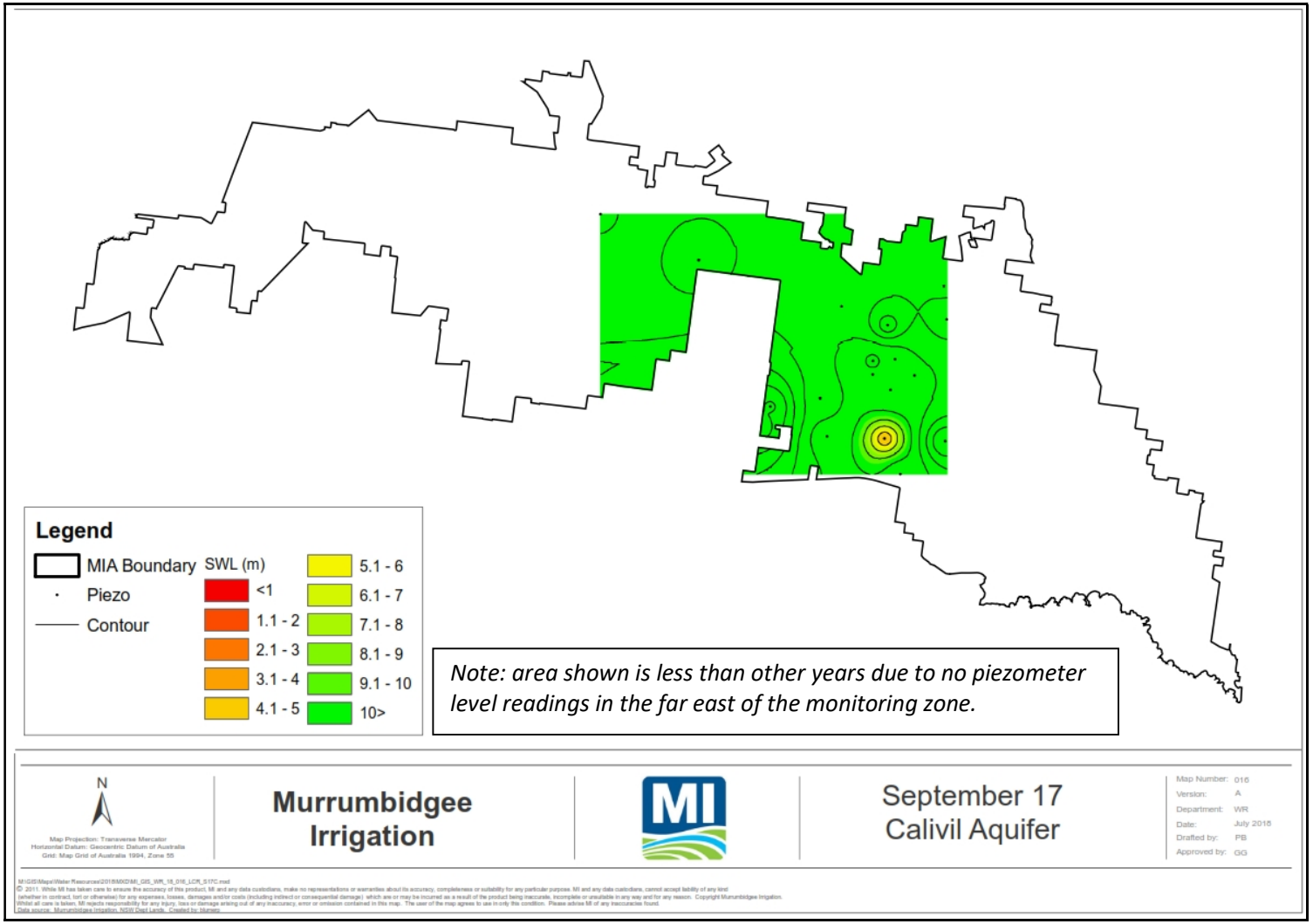

Figure 17 Calivil Formation - depth to water table, September 2017

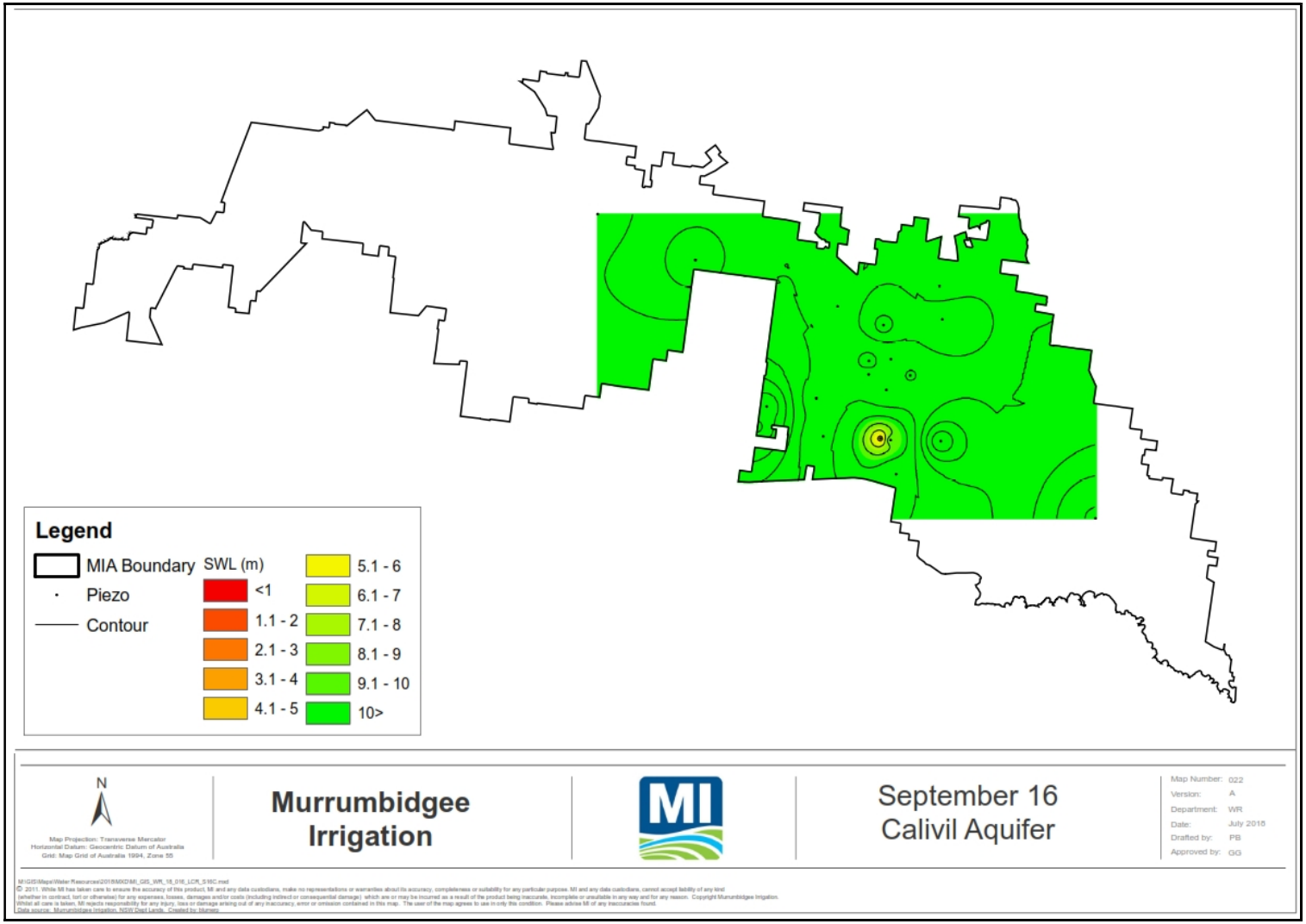

Figure 18 Calivil Formation - depth to water table, September 2016

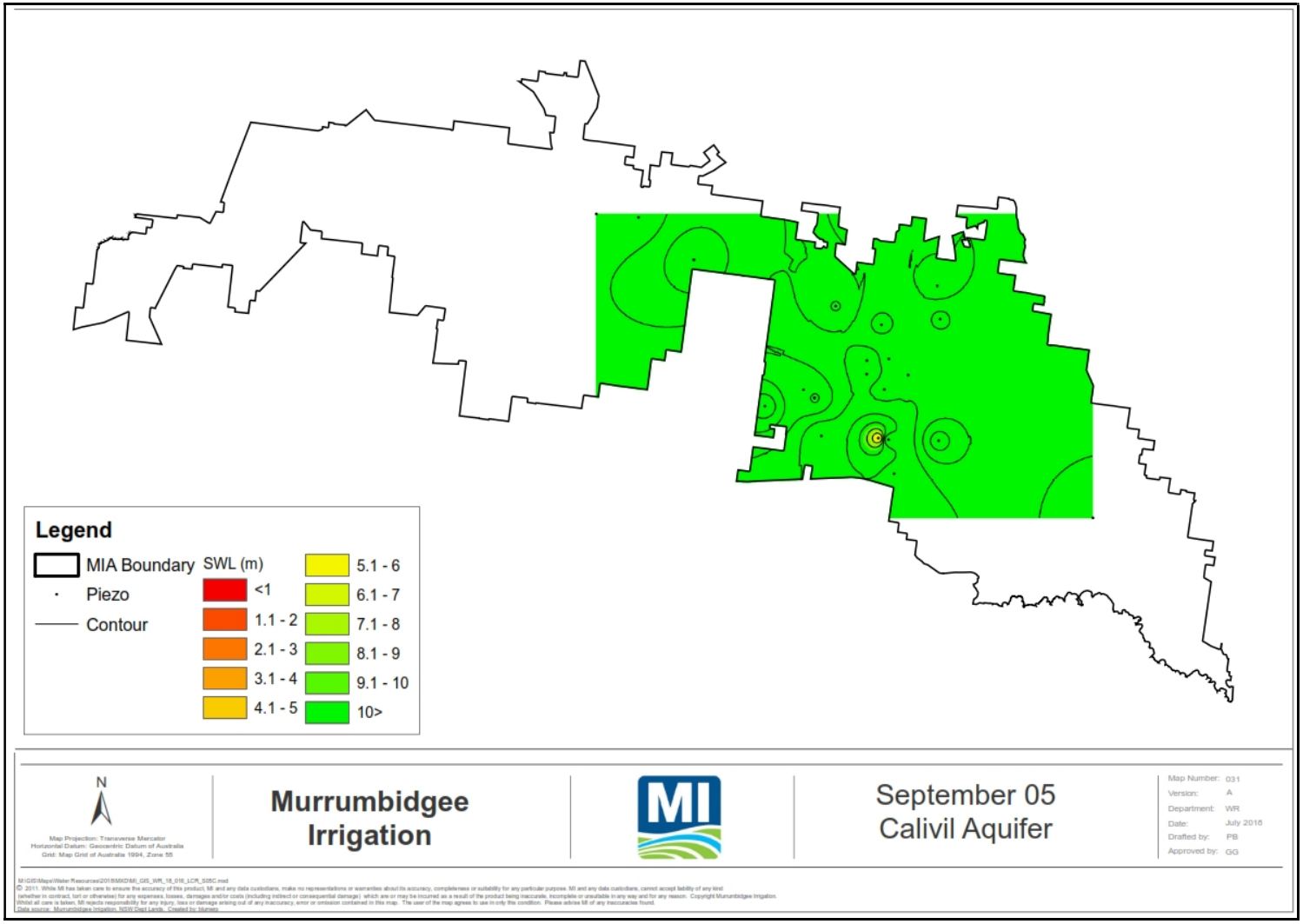

Figure 19 Calivil Formation - depth to water table, September 2005

7 Tubewells

MI monitors the volume of water and salt load pumped from seven tubewells within the MIA. The locations of the tubewells are shown in Figure 4.

No tubewells were operated during the 2019/20 reporting period. MI are in consultation with the relevant authority as to their future operation.

8 New measures to limit groundwater recharge and discharge of salt

No new measures were implemented for 2019/20.

9 Environmental protection and management

9.1 Discharge of noxious aquatic weeds

During 2019/20 irrigation year, there was no known actual or potential discharge of Class 1, 2 or 3 declared aquatic weeds from MI's Area of Operation.

9.2 Discharge of blue-green algae

No Red alert levels of blue-green algae were detected from any water sampled during discharge from MI's area of operation.

ENVIRONMENTAL PROTECTION LICENCE 4651

10 Statement of compliance

MI has fulfilled the compliance requirements as set out in EPL 4651 for 2019/20. A summary of the compliance requirements is cross referenced to this report and listed in Table 23.

One non-compliance was recorded and reported on during 2019/20 and was detailed in MI's Annual Return.

Quality assurance and control procedures are in place to ensure data integrity and to ensure that all compliance obligations are fulfilled. This includes using a NATA accredited laboratory for water sample analysis and contracting an external hydrological service provider to manage and maintain automated monitoring stations at discharge points. Internal Standard Operating Procedures (SOPs) for monitoring and reporting are reviewed and updated regularly.

MI has in place a process to receive complaints from members of the public in relation to MI's activities via the business telephone number. Contact information for complaints can be found on MI's website (https://www.mirrigation.com.au/company/contact).

Table 23 EPL 4651 monitoring and reporting requirements

Licence section	Requirement	Compliant	Included in this report
Administrative Conditions	1	Yes	No, not applicable
Discharges to Air and Water and Applications to Land	2	Yes	N/A
Limit Conditions	3	Yes	N/A
Operating Conditions	4	Yes	N/A
Maintain a Chemical Contingency Plan	O3.1	Yes	No, see: https://www.mirrigation.com.au/water/water-quality
Maintain a Chemical Control Plan	O3.5	Yes	
Maintain Pollution Incident Response Management Plan	Required for all EPL holders under the *Protection of Environment Operations Act 1997*	Yes	
Monitoring and Recording Conditions	5	Yes	10. Statement of Compliance
Monitoring Records	M1	Yes	No - available upon request from EPA
Requirement to monitor concentration of pollutants discharged	M2	Yes	11. EPL Monitoring and Reporting
Testing Methods	M3	Yes	No - Internal documents
Recording of pollution complaints	M4	Yes	No - available upon request from EPA
Telephone complaints line	M5	Yes	10. Statement of Compliance
Requirement to monitor volume or	M6	Yes	11. EPL Monitoring and

Licence section	Requirement	Compliant	Included in this report
mass			Reporting
Other Monitoring and recording conditions	M7	Yes	9.1. Noxious Weed Management
Annual return documents	R1	Yes	Submitted 25 August 2020
Annual system performance report	R4 Summary R2, R3 & R5	Yes	a) 3. Reporting on water management b) 11. EPL monitoring and reporting & 11.2 Water quality monitoring c) 11.3. Summary of events d) 12. Proposed changes

11 EPL monitoring and reporting

Under MI's EPL 4651, five locations (Figure 2) are licensed to allow water to be discharged outside MI's Area of Operation, with the condition that all flows are recorded, and specified water quality parameters are monitored. These discharge points are listed below:

- POINT 4 LAG - Gogeldrie Main Drain at Gooragool Lagoon
- POINT 5 GMSRR – Gogeldrie Main Southern Drain River Road
- POINT 6 YMS – Yanco Main Southern Drain
- POINT 7 ROCUDG – Cudgel Creek Roaches Escape
- POINT 15 MIRFLD – Mirrool Creek Floodway Wyvern Station

11.1 System performance

Table 24 presents total diversions into the MIA and total water discharged from the MIA for 2019/20 compared to previous years. In 2019/20, 127 ML was discharged. The large volume discharged in the 2016/17 season included 121,363 ML that was diverted to Mirrool Creek Floodway as a means of flood risk mitigation during a 1/150-year flood event.

In 2005/06 MI's drainage reuse system was not complete, which explains the high discharge volumes recorded in that year. MI does not discharge irrigation wastewater directly to groundwaters inside or outside the area of operations.

Table 24 Total water volumes

Year	Diversions (ML)	Discharged (ML)
2019/20	349,523	127
2018/19	586,752	642
2017/18	945,805	4,471
2016/17	780,083	122,092
2005/06	1,036,519	8,570

11.2 Water quality monitoring

Monthly summaries for each monitoring point are presented in Table 25 to Table 29. Monitoring consisted of five sampling events, with five Notification level detections. No Action levels were detected during the reporting period, compared to the prior reporting year where two Action levels were detected.

Diuron, metolachlor and chlorpyrifos were the three chemicals detected in 2019/20. Chemical detections were found at two of the five licenced sites, Point 4 - LAG and, Point 6 - YMS.

Table 25 Monitoring results for Point 4 - LAG

Month	Discharged (ML)	Sampling events	Detections	Chemical detection details
Jul-19	0	0	0	-
Aug-19	0	0	0	-
Sep-19	22	1	2	04/09/19 Notification level Chlorpyrifos (0.104µg/L) 04/09/19 Notification level Metolachlor (0.025µg/L)
Oct-19	0	0	0	-
Nov-19	0	0	0	-
Dec-19	0	0	0	-
Jan-20	0	0	0	-
Feb-20	0.7	1	1	12/02/20 Notification level Chlorpyrifos (0.043µg/L)
Mar-20	16.1	1	1	06/03/20 Notification level Metolachlor (0.063µg/L)
Apr-20	2.3	0	0	-
May-20	26.3	0	0	Supply water release via escape. No sample taken. See Annual Return
Jun-20	2.1	0	0	-
Total	**69.5**	**3**	**4**	

Table 26 Monitoring results for Point 5 - GMSRR

Month	Discharged (ML)	Sampling events	Detections	Chemical detection details
Jul-19	0	0	0	-
Aug-19	0	0	0	-
Sep-19	3.2	0	0	Supply water release (via breach of regulator). No sample taken
Oct-19	0	0	0	-
Nov-19	0	0	0	-
Dec-19	0	0	0	-
Jan-20	0	0	0	-
Feb-20	0	0	0	-
Mar-20	0	0	0	-
Apr-20	0	0	0	-
May-20	0	0	0	-
Jun-20	0	0	0	-
Total	**3.2**	**0**	**0**	-

Table 27 Monitoring results for Point 6 - YMS

Month	Discharged (ML)	Sampling events	Detections	Chemical detection details
Jul-19	0	0	0	-
Aug-19	0	0	0	-
Sep-19	0	0	0	-
Oct-19	0	0	0	-
Nov-19	0	0	0	-
Dec-19	0	0	0	-
Jan-20	0	0	0	-
Feb-20	0	0	0	-
Mar-20	41.5	1	1	06/03/20 Notification level Diuron (0.313µg/L)
Apr-20	0	0	0	-
May-20	0	0	0	-
Jun-20	0	0	0	-
Total	**41.5**	**1**	**1**	

Table 28 Monitoring results for Point 7 - ROCUDG

Month	Discharged (ML)	Sampling events	Detections	Chemical detection details
Jul-19	0	0	0	-
Aug-19	0	0	0	-
Sep-19	0	0	0	-
Oct-19	0.3	0	0	-
Nov-19	3.4	1	0	No sample taken. Low flows didn't trigger alarm
Dec-19	0.1	0	0	-
Jan-20	0	0	0	-
Feb-20	0	0	0	-
Mar-20	0	0	0	-
Apr-20	0	0	0	-
May-20	8.8	0	0	No sample taken. Low flows over 19 days did not trigger alarm
Jun-20	0	0	0	-
Total	**12.6**	**1**	**0**	-

Table 29 Monitoring results for Point 15 - MIRFLD

Month	Discharged (ML)	Sampling events	Detections	Chemical detection details
Jul-19	0	0	0	-
Aug-19	0	0	0	-
Sep-19	0	0	0	-
Oct-19	0	0	0	-

Month	Discharged (ML)	Sampling events	Detections	Chemical detection details
Nov-19	0	0	0	-
Dec-19	0	0	0	-
Jan-20	0	0	0	-
Feb-20	0	0	0	-
Mar-20	0	0	0	-
Apr-20	0	0	0	-
May-20	0	0	0	-
Jun-20	0	0	0	-
Total	**0**	**0**	**0**	**-**

Figure 20 provides a comparison of annual rainfall received, compared to the number of chemical detections for the last four years.

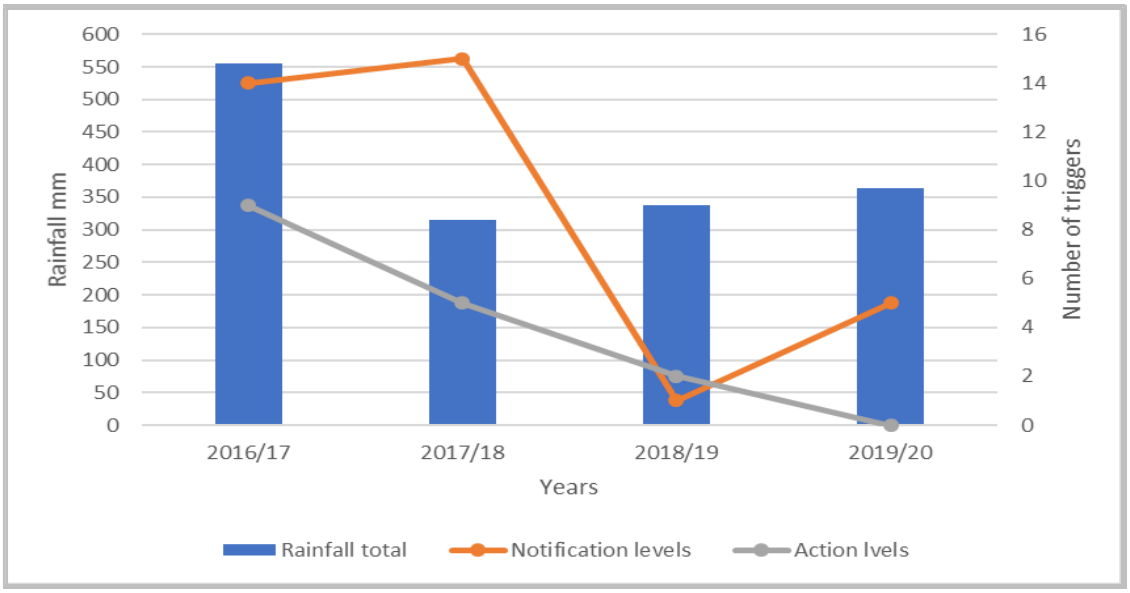

Figure 20: Comparison of irrigation drainage water notification trends

Drought conditions have occurred throughout the last three years which has led to water being retained and recycled on farms and within the MIA wherever possible. The year following the 2016 floods, saw the MIA catchment saturated and most storages full.

While the development of drought conditions following the floods, is likely to have influenced the decrease in chemical detections from 2018/19 onwards. The notification levels triggered in 2017/18, was due to the Mirrool Creek Floodway being operated on a number of occasions to reduce local flood risks, therefore the additional sampling effort resulted in chemical detections above notification levels.

Overall EPL-listed chemical levels within irrigation drainage water leaving the MIA has decreased throughout the last four years, with no above Action level detections in 2019/20.

MI is continuing to work with our customers to advise when exceedances have been recorded and encourage them to seek advice on appropriate chemical use for their businesses.

11.3 Summary of events

Table 30 contains a summary of all events that have been reported on during 2019/20. No events occurred that triggered notification of environmental harm or a written report to the EPA. A total of five exceedances were recorded throughout 2019/20 reporting period.

Table 30 Summary of events 2019/20

Year	Notification of environmental harm	Written report (of an event)	Exceedances
2019/20	0	1 (non-conformance, no env harm)	5

12 Proposed changes

MI propose no changes to the EPL conditions at this time.

Attachment A: VENTIA flow, EC, and salt load monitoring financial year report

MURRUMBIDGEE IRRIGATION LIMITED

FLOW, EC & SALT LOAD MONITORING FINANCIAL YEAR REPORT, AUGUST 2020

Issue To Lindsay Golsby-Smith

Issued Date 31/07/2020

Prepared: Ventia Utility Services
Envirnmental Monitoring
Hussain Morssi – Data Analyst

Reviewed: Ventia Utility Services
Seamus Ferry – Area Manager
Rebekah Webb– Hydrology Manager

DOCUMENT CONTROL & DISTRIBUTION LIST

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Document Control

Amendment	Date	Page	Description	Authorised
	31/07/2020			Hussain Morssi

Notification / Distribution List

Section/Group	Name
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Murrumbidgee Irrigation Limited	Paul Hutchinson
Murrumbidgee Irrigation Limited	Fern Dorricott
Murrumbidgee Irrigation Limited	Cindy McGrath
Ventia Utility Services	Seamus Ferry
Ventia Utility Services	Rebekah Webb

The above notification list is a minimum controlled distribution and it is the responsibility of the persons receiving the notification to further notify other Ventia personnel within their area if required.

TABLE OF CONTENTS

1.0 Introduction

Ventia Utility Services is contracted by Murrumbidgee Irrigation Limited (MIA) to conduct continuous level/flow and salinity monitoring at a range of locations distributed across their area of operations.

This report presents monthly statistics and annual summaries of total flow and salt loads derived from the monitoring at Drain sites for the 2019 - 2020 financial year. Site 410083 contains no flow or salt load data as the rating table was suspended as of the 01/06/2010 to present due to the installation of new gates.

This report contains information relating to Murrumbidgee Irrigation Limited Compliance sites, 410083, 41010005, 41010921 and 41010940. Also reported on are the two offtake sites being 410127 and 410129. An annual site summary can be found in this report on all sites maintained by Ventia field staff.

All data reported is extracted from the Ventia Hydstra software archive to an accuracy of three (3) significant figures.

A data extraction process called HYTAB is used when extracting the data. HYTAB utilises a configuration file provided by MIA to format the data. This file stipulates reporting to four (4) significant figures. Using four significant figures implies an unrealistic level of accuracy for the data collection processes undertaken. Ventia data reporting standards recommend a maximum of three (3) significant figures.

2.0 Annual Flow Summaries

2.1 Compliance Sites

Please note that [#] implies that although a mean monthly flow figure has been given, this flow figure is only the mean based off data capture and does not include data on days in the monthly period where a flow could not be determined. [V] denotes that the data is operational only data, the data was unable to be validated during the field visit.

```
Site      410083        YANKO MAIN SOUTHERN DRAIN AT OUTFALL (YMS)                Site         410083
Variable  141.00        Stream Discharge (Ml/d) in megalitres/day, Available for release      Year        2019/20
Year      2019/20
Day       Jul      Aug      Sep      Oct      Nov      Dec      Jan      Feb      Mar      Apr      May      Jun      Day

 Mean    [   ]U   [   ]M   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]
Median   [   ]U   [   ]M   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]
Inst.Max [   ]U   [   ]M   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]
Inst.Min [   ]U   [   ]M   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]
 Total   [   ]U   [   ]M   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]S   [   ]

Annual  Mean    [   ]                  M ...  Equipment malfunction
Ann.  Median    [   ]                  S ...  Rating table suspended
Annual Total    [   ]                  U ...  Lost data (NRE approved)
```

The rating table for this site was suspended by Ventia on the 01/06/2010 as new gates were installed by Murrumbidgee Irrigation. Ventia does not currently supply flow data for this site.

Site	41010005	CUDGEL CREEK AT ROACHES OUTFALL (ROCUDG)										Site	41010005
Variable	141.00	Stream Discharge (Ml/d) in megalitres/day, Available for release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	0.0R	0.0R	0.0R	0.0R	0.1R	0.0R	0.0R	0.0R	0.0R	0.0R	0.3R	[0.0]	
Median	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.2R	[0.0]	
Inst.Max	0.0R	0.0R	0.0R	0.6R	3.1R	0.1R	0.0R	0.0R	0.0R	0.0R	1.8R	[0.0]	
Inst.Min	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Total	0.000R	0.000R	0.000R	0.299R	3.385R	0.034R	0.000R	0.000R	0.000R	0.000R	8.832R	[0.000]	

Annual Mean [0.0]
Ann. Median [0.0]
Annual Total [12.55]

? ... Irregular data use with caution
R ... Rating table extrapolated
All Totals are in megalitres

41010005 experienced its highest flows in May 2020.

Site	41010921	GOGELDRIE MAIN SOUTHERN DRAIN AT RIVER ROAD (GMSRR)										Site	41010921
Variable	141.00	Stream Discharge (Ml/d) in megalitres/day, Available for release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	0.0R	0.0R	0.1R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Median	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Inst.Max	0.0R	0.0R	11.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Inst.Min	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Total	0.000R	0.000R	3.199R	0.000R	0.000R	0.000R	0.000R	0.000R	0.000R	0.000R	0.000R	[0.000]	

Annual Mean [0.0]
Ann. Median [0.0]
Annual Total [3.199]

R ... Rating table extrapolated
All Totals are in megalitres
Figures refer to period ending 2400 hours.

41010921 experienced its highest flows in September 2019.

Site	41010940	LAGOON DRAIN @ GOORAGOOL LAGOON (LAG)										Site	41010940
Variable	141.00	Stream Discharge (Ml/d) in megalitres/day, Available for release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	0.0R	0.0R	0.7R	0.0R	0.0R	0.0R	0.0R	0.0R	0.5R	0.1R	0.8R	[0.1]	
Median	0.0R	0.0R	0.3R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.3R	[0.0]	
Inst.Max	0.0R	0.0R	10.3R	0.0R	0.0R	0.0R	0.0R	3.8R	4.9R	0.9R	14.2R	[0.9]	
Inst.Min	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Total	0.000R	0.000R	21.98 R	0.000R	0.000R	0.000R	0.000R	0.690R	16.11 R	2.286R	26.32 R	[2.139]	

Annual Mean	[0.2]	R ...	Rating table extrapolated
Ann. Median	[0.0]	V ...	Operational Data
Annual Total	[69.52]	All Totals are in megalitres	

41010940 experienced its highest flows in September 2019.

2.2 Offtake Sites

Site	410127	MAIN CANAL AT NARRANDERA REGULATOR										Site	410127
Variable	141.00	Stream Discharge (Ml/d) in megalitres/day, Available for release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	70.6K	342 V	877	1290	1190	2080	1930	1100	559	243	330 V	[350]	
Median	16.1K	270 V	830	1270	1350	2170	2070	1150	618	233	162 V	[207]	
Inst.Max	975 K	1540 V	2090	2750	2460	4430	3670	3250	1430	665	3540 V	[4880]	
Inst.Min	0.0K	0.0V	420	598	-36.5	545	-21.6	48.2	0.0	0.0	0.0V	[43.5]	
Total	2188K	10610V	26310	39850	35620	64510	59690	31780	17340	7287	10240V	[10160]	

Annual Mean [865]
Ann. Median [694]
Annual Total [315600]

K ... Minor editing
V ... Operational Data
All Totals are in megalitres

410127 experienced minor periods of negative flow due to seiching at the site

Site	410129	STURT CANAL AT OFFTAKE										Site	410129
Variable	141.00	Stream Discharge (Ml/d) in megalitres/day, Available for release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	4.5V	55.7V	105 V	190 K	169 V	281 V	205 V	88.6K	20.1V	8.9K	82.4V	0.0	
Median	0.0V	60.9V	108 V	175 K	166 V	297 V	224 V	81.2K	0.0V	0.0K	0.0V	0.0	
Inst.Max	147 V	152 V	258 V	641 K	671 V	431 V	392 V	333 K	275 V	819 K	2460 V	0.0	
Inst.Min	0.0V	1.0V	0.0V	10.0K	1.0V	54.0V	40.0V	0.0K	0.0V	0.0K	0.0V	0.0	
Total	138V	1727V	3158V	5899K	5071V	8721V	6355V	2570K	622V	268K	2553V	0	

Annual Mean 101 K
Ann. Median 69.8K
Annual Total 37080K

K ... Minor editing
V ... Operational Data
All Totals are in megalitres

410129 experienced its highest flows in December 2019.

3.0 Annual Salt Load Summaries

3.1 Compliance Sites

Please note that [#] implies that although a mean monthly flow figure has been given, this flow figure is only the mean based off data capture and does not include data on days in the monthly period where a flow could not be determined. [V] denotes that the data is operational only data, the data was unable to be validated during the field visit.

Site	410083	YANKO MAIN SOUTHERN DRAIN AT OUTFALL (YMS)											Site	410083
Variable	804.00	Salt Transport (t/d) in tonnes/day, 6th sensor avail release											Year	2019/20
Year	2019/20													
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day	
Mean	[ ]U	[ ]M	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]		
Median	[ ]U	[ ]M	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]		
Inst.Max	[ ]U	[ ]M	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]		
Inst.Min	[ ]U	[ ]M	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]		
Total	[ ]U	[ ]M	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]S	[ ]		

Annual Mean	[ ]	M ...	Equipment malfunction
Ann. Median	[ ]	S ...	Rating table suspended
Annual Total	[ ]	U ...	Lost data (NRE approved)

No salt loads can be produced for site 410083 as no flows are calculated by Ventia.

Site	41010005	CUDGEL CREEK AT ROACHES OUTFALL (ROCUDG)										Site	41010005
Variable	804.00	Salt Transport (t/d) in tonnes/day, 6th sensor avail release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Median	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Inst.Max	0.0R	0.0R	0.0R	0.0R	0.2R	0.0R	0.0R	0.0R	0.0R	0.0R	0.1R	[0.0]	
Inst.Min	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Total	0R	0R	0R	0R	0R	0R	0R	0R	0R	0R	1R	[0]	

Annual Mean [0.0]
Ann. Median [0.0]
Annual Total [1]

? ... Irregular data use with caution
R ... Rating table extrapolated
V ... Operational Data

Site	41010921	GOGELDRIE MAIN SOUTHERN DRAIN AT RIVER ROAD (GMSRR)										Site	41010921
Variable	804.00	Salt Transport (t/d) in tonnes/day, 6th sensor avail release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Median	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Inst.Max	0.0R	0.0R	1.4R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Inst.Min	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Total	0R	0R	0R	0R	0R	0R	0R	0R	0R	0R	0R	[0]	

Annual Mean [0.0]
Ann. Median [0.0]
Annual Total [0]

R ... Rating table extrapolated
All Totals are in tonnes
Figures refer to period ending 2400 hours.

Site	41010940	LAGOON DRAIN @ GOORAGOOL LAGOON (LAG)										Site	41010940
Variable	804.00	Salt Transport (t/d) in tonnes/day, 6th sensor avail release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	0.0R	0.0R	0.3R	0.0R	0.0R	0.0R	0.0R	0.0R	0.2R	0.0R	0.2R	[0.0]	
Median	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.1R	[0.0]	
Inst.Max	0.0R	0.0R	4.4R	0.0R	0.0R	0.0R	0.0R	0.3R	1.1R	0.2R	4.7R	[0.3]	
Inst.Min	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	0.0R	[0.0]	
Total	0R	0R	9R	0R	0R	0R	0R	0R	5R	0R	6R	[1]	

Annual Mean	[0.1]	R ...	Rating table extrapolated
Ann. Median	[0.0]	V ...	Operational Data
Annual Total	[21]	All Totals are in tonnes	

3.2 Offtake Sites

Site	410127	MAIN CANAL AT NARRANDERA REGULATOR										Site	410127
Variable	803.00	Salt Transport (calc from MDFs) (t/d) in tonnes/day, 6th sensor avail release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	7.6K	37.6V	63.9	55.7	59.2	68.1	62.6	53.9	42.8	27.1	41.4V	[40.3]	
Median	2.0K	30.5V	58.6	54.3	62.8	67.5	63.0	51.5	45.5	25.1	18.1V	[24.8]	
Inst.Max	102 K	170 V	158	132	190	122	141	134	120	71.7	482 V	[537]	
Inst.Min	0.0K	0.0V	23.7	23.9	-1.5	20.5	-0.9	1.9	0.0	0.0	0.0V	[5.4]	
Total	235K	1165V	1917	1728	1775	2110	1942	1563	1328	811	1284V	[1170]	

Annual Mean	[46.7]	K ...	Minor editing
Ann. Median	[45.2]	V ...	Operational Data
Annual Total	[17030]	All Totals are in tonnes	

410127 has periods of negative salt loads due to negative flow caused by seiching at the site

Site	410129	STURT CANAL AT OFFTAKE										Site	410129
Variable	803.00	Salt Transport (calc from MDFs) (t/d) in tonnes/day, 6th sensor avail release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	0.5V	5.5V	8.5V	8.7K	7.1V	8.8V	6.6V	3.7K	1.3V	0.9K	6.8V	0.0	
Median	0.0V	5.5V	6.1V	8.4K	7.0V	9.0V	6.4V	3.6K	0.0V	0.0K	0.0V	0.0	
Inst.Max	15.1V	15.7V	22.5V	24.9K	24.3V	14.8V	13.9V	16.5K	17.3V	90.4K	214 V	0.0	
Inst.Min	0.0V	0.1V	0.0V	0.5K	0.0V	1.6V	1.6V	0.0K	0.0V	0.0K	0.0V	0.0	
Total	15V	171V	256V	268K	213V	272V	205V	109K	39V	27K	211V	0	

Annual Mean	4.9K	K ...	Minor editing
Ann. Median	4.0K	V ...	Operational Data
Annual Total	1787K	All Totals are in tonnes	

4.0 Annual EC Summaries

4.1 Compliance Sites

Site	410083	YANKO MAIN SOUTHERN DRAIN AT OUTFALL (YMS)										Site	410083
Variable	820.00	Conductivity (µS/cm) in µS/cm@25°C, Available for release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	[ ]T	[ ]U	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[121]	[ ]T	[605]	[ ]	
Median	[ ]T	[ ]U	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[121]	[ ]T	[614]	[ ]	
Max.Daily	[ ]T	[ ]U	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[146]	[ ]T	[616]	[ ]	
Min.Daily	[ ]T	[ ]U	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[95.6]	[ ]T	[568]	[ ]	
Inst.Max	[ ]T	[ ]U	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[192]	[ ]T	[650]	[ ]	
Inst.Min	[ ]T	[ ]U	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[74.8]	[ ]T	[427]	[ ]	

Annual Mean [467]
Ann. Median [614]

T ... Probe out of water/below instrument threshold
U ... Lost data (NRE approved)

Site	41010005	CUDGEL CREEK AT ROACHES OUTFALL (ROCUDG)										Site	41010005
Variable	820.00	Conductivity (µS/cm) in µS/cm@25°C, Available for release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	[ ]T	[ ]T	[ ]T	[75.4]	[87.6]	[88.3]	[108]	[85.1]	[66.7]	[ ]T	[134]	[124]	
Median	[ ]T	[ ]T	[ ]T	[73.8]	[86.6]	[87.2]	[107]	[85.5]	[66.7]	[ ]T	[135]	[126]	
Max.Daily	[ ]T	[ ]T	[ ]T	[88.7]	[111]	[98.8]	[113]	[99.5]	[66.7]	[ ]T	[158]	[141]	
Min.Daily	[ ]T	[ ]T	[ ]T	[65.2]	[64.4]	[80.2]	[105]	[70.1]	[66.7]	[ ]T	[121]	[92.7]	
Inst.Max	[ ]T	[ ]T	[ ]T	[104]	[124]	[109]	[130]	[109]	[75.5]	[ ]T	[177]	[146]	
Inst.Min	[ ]T	[ ]T	[ ]T	[55.7]	[52.5]	[75.2]	[97.0]	[64.6]	[59.9]	[ ]T	[114]	[41.4]	

Annual Mean [108]
Ann. Median [110]

? ... Irregular data use with caution
T ... Probe out of water/below instrument threshold

Site	41010921	GOGELDRIE MAIN SOUTHERN DRAIN AT RIVER ROAD (GMSRR)										Site	41010921	
Variable	820.00	Conductivity (µS/cm) in µS/cm@25°C, Available for release										Year	2019/20	
Year	2019/20													
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day	
Mean	[ ]T	[ ]T	[245]	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]		
Median	[ ]T	[ ]T	[245]	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]		
Max.Daily	[ ]T	[ ]T	[245]	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]		
Min.Daily	[ ]T	[ ]T	[245]	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]		
Inst.Max	[ ]T	[ ]T	[259]	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]		
Inst.Min	[ ]T	[ ]T	[227]	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]T	[ ]		

Annual Mean [245]
Ann. Median [245]

T ... Probe out of water/below instrument threshold
V ... Operational Data

Site	41010940	LAGOON DRAIN @ GOORAGOOL LAGOON (LAG)										Site	41010940	
Variable	820.00	Conductivity (µS/cm) in µS/cm@25°C, Available for release										Year	2019/20	
Year	2019/20													
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day	
Mean	[ ]T	[ ]T	[671]	[ ]T	[ ]T	[ ]T	[ ]T	[60.0]	[636]	[240]	[424]	[551]		
Median	[ ]T	[ ]T	[742]	[ ]T	[ ]T	[ ]T	[ ]T	[60.0]	[687]	[190]	[443]	[540]		
Max.Daily	[ ]T	[ ]T	[792]	[ ]T	[ ]T	[ ]T	[ ]T	[60.0]	[766]	[519]	[570]	[680]		
Min.Daily	[ ]T	[ ]T	[109]	[ ]T	[ ]T	[ ]T	[ ]T	[60.0]	[365]	[16.9]	[164]	[484]		
Inst.Max	[ ]T	[ ]T	[814]	[ ]T	[ ]T	[ ]T	[ ]T	[158]	[798]	[691]	[758]	[749]		
Inst.Min	[ ]T	[ ]T	[41.8]	[ ]T	[ ]T	[ ]T	[ ]T	[1.1]	[198]	[11.9]	[157]	[472]		

Annual Mean [499]
Ann. Median [520]

T ... Probe out of water/below instrument threshold
V ... Operational Data

4.2 Offtake Sites

Site	410127	MAIN CANAL AT NARRANDERA REGULATOR										Site	410127
Variable	820.00	Conductivity (µS/cm) in µS/cm@25°C, Available for release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	195	187	121	72.9	81.5	55.9	55.7	78.3	122	185	184	[198]	
Median	201	189	97.2	68.5	74.7	55.3	48.3	66.8	110	185	192	[201]	
Max.Daily	209	219	194	94.1	137	72.0	82.0	140	166	197	249	[212]	
Min.Daily	173	155	75.4	62.5	64.9	45.8	44.8	52.3	92.7	174	146	[171]	
Inst.Max	219	224	198	97.4	142	73.7	87.5	144	173	202	265	[216]	
Inst.Min	172	152	72.6	58.4	61.5	43.4	42.6	50.1	91.6	163	145	[170]	

Annual Mean [128]
Ann. Median [118]

Figures refer to period ending 2400 hours.

Site	410129	STURT CANAL AT OFFTAKE										Site	410129
Variable	820.00	Conductivity (µS/cm) in µS/cm@25°C, Available for release										Year	2019/20
Year	2019/20												
Day	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Day
Mean	[208]	170	129	80.1	70.0	52.1	55.2	70.4	111	158 V	[156]	[ ]T	
Median	[207]	175	102	74.6	63.4	51.2	51.5	64.4	111	158 V	[141]	[ ]T	
Max.Daily	[232]	188	188	107	128	59.3	72.8	95.6	119	182 V	[216]	[ ]T	
Min.Daily	[170]	141	84.3	62.8	55.5	47.3	47.1	54.4	101	131 V	[130]	[ ]T	
Inst.Max	[246]	193	192	113	131	73.2	85.0	98.5	123	185 V	[224]	[ ]T	
Inst.Min	[157]	140	81.0	59.7	52.6	45.8	44.2	53.8	96.4	117 V	[126]	[ ]T	

Annual Mean [106]
Ann. Median [95.6]

T ... Probe out of water/below instrument threshold
V ... Operational Data

5.0 Annual Site Summaries for sites affected by back-up

There were no compliance or offtake sites affected by backup during the 2019/2020 reporting time.

6.0 Annual Site Visit Summary

SI No.	Site Acronym	No. of Visits	No. of Data Downloads	Discharge Measurements		Sensor Changes	General Comments
				No. of Meas.	Comments		
410083	YMS	12	10	0	No flow conditions.		Block bank remains in position following a leakage at the gate structure in November 2018. Battery stolen at site; no data collected from July 2019 download until replacement battery was re-installed in September 2019.
410085	LMC	12	12	4			Stock access to drain has caused some damage to banks of control.
410164	BOD1	0	0	-	No data		Site discontinued 2017-18.
410167	BBOW	0	0	-	No data		Site decommissioned at end of 2018-19 season.
410174	MDJWE	12	12	4			Water pumped from drain into Warburton escape at times as part of MI initiative.
41010005	ROCUDG	12	12	0			Limited flow conditions throughout season.
41010921	GMSRR	12	12	0			Limited flow conditions throughout season.
41010940	LAG	12	12	0			Limited flow conditions throughout season.
41010955	MIRMCN	12	12	4			Debris on bridge pylon has been affecting operational data following high flows.
410127	Main Canal	12	12	6			
410129	Sturt Canal	12	12	8			New programs loaded and indexing equation adjusted during season. Cross path velocity sensors being installed.
CD-2-1922	CD-2-1922	12	12	0			Monthly site visits added to contract extension. Limited flow conditions throughout season.
MS-2MDJY-01	MDJY	12	12	5			
Yoogali	MDJ_Yoogali	0	0	-	No data.		Site decommissioned in November 2018.
			TOTALS	**31**			
General Comments							

7.0 EWAs 2020

W	= EWA submitted, waiting on approval
A	= EWA approved, works right to proceed
C	= EWA completed, ready to be invoiced
I	= EWA invoiced, closed out
N	= EWA cancelled, will not be approved

EWA REF		Site ID	Name	EXTRA WORKS DESCRIPTION	Issued by	Total Value (ex GST)	Status
MI	54	410129	Sturt Offtake	Supply of posts and instrumentation to upgrade deltaflex sensors and posts at Sturt offtake.	SF	$ 50,150	A
MI	55	Various	Offtake sites	Repair and installation of multiprobes at offtake sites for turbidity and pH monitoring.	SF	$ 12,469	A

8.0 410127 MAIN CANAL @ NARRANDERA REGULATOR

8.1 Measurement Summary

Date	Time	Q Measured	Q Recorded	Deviation
25/09/2019	1404	838	850	-1.30%
30/10/2019	1542	1132	1140	-0.72%
27/11/2019	1141	1351	1400	-3.47%
30/01/2020	728	1911	1911	-0.03%
26/02/2020	755	1182	1170	1.07%
27/05/2020	1141	138	138	-0.55%

Discharge Measurement Summary

Date Measured: Wednesday, September 25, 2019

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information

Site Name	Narrandera OT
Station Number	410127
Location	50m US of gates.

Measurement Information

Party	SF
Boat/Motor	SU
Meas. Number	99

System Information

System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup

Tagline Azimuth (deg)	354.7
Salinity (ppt)	0.0
Rated Discharge (m3/s)	9.77
Discharge Method	Mid-Section
Measurement Quality	--

Units

Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings

Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty

Category	ISO	Stats
Depth	0.11%	0.46%
Velocity	0.08%	1.15%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.88%	--
Instrument	0.25%	0.25%
Overall	1.91%	1.27%

Discharge Results

Total Area	75.560
Mean Velocity	0.128
Total Width	29.500
Total Q	9.703
Maximum Measured Depth(m)	3.419
Maximum Measured Velocity(m/s)	0.202
Mean Flow Angle	-2.788
Rated Discharge	9.766
% difference Q	-0.639
Water Temperature (Independent)	17.000
Mean Water Temperature	17.223
Mean Weighted Gauge Height	5.230

Discharge Measurement Summary

Date Measured: Wednesday, October 30, 2019

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Narrandera OT
Station Number	410127
Location	70m Upstream of gates.

Measurement Information	
Party	SF/GR
Boat/Motor	SU
Meas. Number	100

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	350.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	13.18
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.11%	0.45%
Velocity	0.08%	0.74%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.76%	--
Instrument	0.25%	0.25%
Overall	1.79%	0.90%

Discharge Results	
Total Area	76.350
Mean Velocity	0.172
Total Width	29.500
Total Q	13.101
Maximum Measured Depth(m)	3.462
Maximum Measured Velocity(m/s)	0.234
Mean Flow Angle	-3.395
Rated Discharge	13.180
% difference Q	-0.602
Water Temperature (Independent)	21.000
Mean Water Temperature	22.938
Mean Weighted Gauge Height	5.250

Discharge Measurement Summary

Date Measured: Wednesday, November 27, 2019

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information

Site Name	Narrandera O/T
Station Number	410127
Location	70m US of gates.

Measurement Information

Party	SF
Boat/Motor	SU
Meas. Number	101

System Information

System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup

Tagline Azimuth (deg)	349.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	16.21
Discharge Method	Mid-Section
Measurement Quality	--

Units

Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings

Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty

Category	ISO	Stats
Depth	0.11%	0.63%
Velocity	0.09%	0.67%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.88%	--
Instrument	0.25%	0.25%
Overall	1.91%	0.96%

Discharge Results

Total Area	75.397
Mean Velocity	0.208
Total Width	29.200
Total Q	15.650
Maximum Measured Depth(m)	3.423
Maximum Measured Velocity(m/s)	0.309
Mean Flow Angle	0.537
Rated Discharge	16.210
% difference Q	-3.456
Water Temperature (Independent)	23.500
Mean Water Temperature	22.302
Mean Weighted Gauge Height	5.249

Discharge Measurement Summary

Date Measured: Thursday, January 30, 2020

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Narrandera OT
Station Number	410127
Location	Between Affra posts

Measurement Information	
Party	SF
Boat/Motor	SU
Meas. Number	102

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	349.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	22.07
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.11%	0.38%
Velocity	0.09%	1.28%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.76%	--
Instrument	0.25%	0.25%
Overall	1.79%	1.36%

Discharge Results	
Total Area	73.729
Mean Velocity	0.300
Total Width	28.700
Total Q	22.104
Maximum Measured Depth(m)	3.417
Maximum Measured Velocity(m/s)	0.400
Mean Flow Angle	0.672
Rated Discharge	22.070
% difference Q	0.153
Water Temperature (Independent)	26.000
Mean Water Temperature	25.484
Mean Weighted Gauge Height	5.220

Discharge Measurement Summary

Date Measured: Wednesday, February 26, 2020

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Narrandera O/T
Station Number	410127
Location	Gauging completed between affra posts.

Measurement Information	
Party	SF
Boat/Motor	SU
Meas. Number	103

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	349.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	13.54
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.11%	0.43%
Velocity	0.08%	1.51%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.76%	--
Instrument	0.25%	0.25%
Overall	1.79%	1.60%

Discharge Results	
Total Area	74.726
Mean Velocity	0.183
Total Width	29.400
Total Q	13.689
Maximum Measured Depth(m)	3.388
Maximum Measured Velocity(m/s)	0.249
Mean Flow Angle	4.004
Rated Discharge	13.539
% difference Q	1.103
Water Temperature (Independent)	25.000
Mean Water Temperature	25.026
Mean Weighted Gauge Height	5.218

Discharge Measurement Summary

Date Measured: Wednesday, May 27, 2020

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Narrandera OT
Station Number	410127
Location	

Measurement Information	
Party	SF
Boat/Motor	SU
Meas. Number	104

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	349.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	1.51
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.11%	0.60%
Velocity	0.39%	1.72%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.88%	--
Instrument	0.25%	0.25%
Overall	1.95%	1.85%

Discharge Results	
Total Area	71.826
Mean Velocity	0.022
Total Width	28.400
Total Q	1.594
Maximum Measured Depth(m)	3.318
Maximum Measured Velocity(m/s)	0.047
Mean Flow Angle	2.453
Rated Discharge	1.510
% difference Q	5.594
Water Temperature (Independent)	12.300
Mean Water Temperature	12.758
Mean Weighted Gauge Height	5.216

9.0 410129 STURT CANAL @ OFFTAKE

9.1 Measurement Summary

Date	Time	Q Measured	Q Recorded	Deviation
25/09/2019	1639	101.375	101	0.37%
30/10/2019	933	444.273	446	-0.33%
30/10/2019	1018	425.894	426	-0.02%
27/11/2019	826	76.034	75	1.46%
17/12/2019	1144	126.642	95	33.94%*
17/12/2019	1236	128.518	101	27.9%*
17/12/2019	1405	129.598	148	-12.33%*
29/01/2020	1121	122.302	147	-16.80%**

The measurement results have been compiled using the new index table.
* Gaugings were conducted alongside Murrumbidgee Irrigation, during a time when the gates were being tested. As such, the measurement results may be in error. Additionally, during this time period, the level was only high enough for the to utilise the velocity table using Path 1, Path 2, and Path 3 and the deviation from this table is higher than the velocity table using all Affra paths.
** The measurement was conducted with a moderate wind blowing directly upstream and has been discounted for use with the index table.

In the 2018/2019 irrigation season, the measurements displayed a persistent negative trend. With the 2019/2020 season, while some gaugings have been discounted, the measurements early in the season display a more balance trend. The new index table has been successful there but will need to be checked when the flows resume at higher levels.

Discharge Measurement Summary

Date Measured: Wednesday, September 25, 2019

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Sturt OT
Station Number	410129
Location	10m US of affra posts

Measurement Information	
Party	SF
Boat/Motor	SU
Meas. Number	111

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	331.4
Salinity (ppt)	0.0
Rated Discharge (m3/s)	1.14
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Results	
Total Area	56.162
Mean Velocity	0.021
Total Width	27.500
Total Q	1.172
Maximum Measured Depth(m)	2.819
Maximum Measured Velocity(m/s)	0.043
Mean Flow Angle	-1.492
Rated Discharge	1.140
% difference Q	2.818
Water Temperature (Independent)	17.000
Mean Water Temperature	17.595
Mean Weighted Gauge Height	2.522

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.11%	1.02%
Velocity	0.35%	3.27%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.95%	--
Instrument	0.25%	0.25%
Overall	2.01%	3.44%

Discharge Measurement Summary

Date Measured: Wednesday, October 30, 2019

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Sturt O/T
Station Number	410129
Location	10m US of Affra post.

Measurement Information	
Party	SF/GR
Boat/Motor	SU
Meas. Number	112

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	324.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	5.44
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.11%	0.78%
Velocity	0.11%	1.50%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.95%	--
Instrument	0.25%	0.25%
Overall	1.98%	1.71%

Discharge Results	
Total Area	51.246
Mean Velocity	0.100
Total Width	27.500
Total Q	5.140
Maximum Measured Depth(m)	2.620
Maximum Measured Velocity(m/s)	0.147
Mean Flow Angle	0.667
Rated Discharge	5.440
% difference Q	-5.521
Water Temperature (Independent)	21.400
Mean Water Temperature	20.868
Mean Weighted Gauge Height	2.339

Discharge Measurement Summary

Date Measured: Wednesday, October 30, 2019

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Sturt OT
Station Number	410129
Location	

Measurement Information	
Party	SF/GR
Boat/Motor	SU
Meas. Number	113

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	324.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	5.16
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.11%	0.60%
Velocity	0.18%	1.17%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.82%	--
Instrument	0.25%	0.25%
Overall	1.85%	1.34%

Discharge Results	
Total Area	51.288
Mean Velocity	0.096
Total Width	27.500
Total Q	4.930
Maximum Measured Depth(m)	2.616
Maximum Measured Velocity(m/s)	0.153
Mean Flow Angle	0.081
Rated Discharge	5.160
% difference Q	-4.453
Water Temperature (Independent)	21.400
Mean Water Temperature	20.635
Mean Weighted Gauge Height	2.332

Discharge Measurement Summary

Date Measured: Monday, January 1, 2018

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information

Site Name	Sturt O/T
Station Number	410129
Location	30m upstream of Affra posts

Measurement Information

Party	SF
Boat/Motor	SU
Meas. Number	114

System Information

System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup

Tagline Azimuth (deg)	329.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	0.91
Discharge Method	Mid-Section
Measurement Quality	--

Units

Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings

Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty

Category	ISO	Stats
Depth	0.11%	0.91%
Velocity	0.60%	2.76%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.88%	--
Instrument	0.25%	0.25%
Overall	2.00%	2.92%

Discharge Results

Total Area	65.504
Mean Velocity	0.014
Total Width	28.000
Total Q	0.884
Maximum Measured Depth(m)	3.173
Maximum Measured Velocity(m/s)	0.034
Mean Flow Angle	2.765
Rated Discharge	0.910
% difference Q	-2.815
Water Temperature (Independent)	23.800
Mean Water Temperature	21.244
Mean Weighted Gauge Height	2.900

Discharge Measurement Summary

Date Measured: Tuesday, December 17, 2019

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Sturt O/T
Station Number	410129
Location	

Measurement Information	
Party	SF
Boat/Motor	SU
Meas. Number	115

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	329.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	1.61
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.11%	0.39%
Velocity	0.31%	4.06%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.70%	--
Instrument	0.25%	0.25%
Overall	1.76%	4.09%

Discharge Results	
Total Area	48.426
Mean Velocity	0.030
Total Width	25.500
Total Q	1.465
Maximum Measured Depth(m)	2.558
Maximum Measured Velocity(m/s)	0.076
Mean Flow Angle	-5.212
Rated Discharge	1.612
% difference Q	-9.091
Water Temperature (Independent)	24.200
Mean Water Temperature	27.000
Mean Weighted Gauge Height	2.254

Discharge Measurement Summary

Date Measured: Tuesday, December 17, 2019

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Sturt OT
Station Number	410129
Location	

Measurement Information	
Party	SF
Boat/Motor	SU
Meas. Number	116

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	329.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	1.40
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.10%	0.43%
Velocity	0.21%	2.71%
Width	0.10%	0.10%
# Cells	0.10%	--
# Stations	1.70%	--
Instrument	0.25%	0.25%
Overall	1.75%	2.76%

Discharge Results	
Total Area	48.831
Mean Velocity	0.030
Total Width	25.500
Total Q	1.483
Maximum Measured Depth(m)	2.577
Maximum Measured Velocity(m/s)	0.076
Mean Flow Angle	-4.308
Rated Discharge	1.401
% difference Q	5.866
Water Temperature (Independent)	24.200
Mean Water Temperature	27.480
Mean Weighted Gauge Height	2.262

Discharge Measurement Summary

Date Measured: Tuesday, December 17, 2019

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information	
Site Name	Sturt OT
Station Number	410129
Location	

Measurement Information	
Party	SF
Boat/Motor	SU
Meas. Number	117

System Information	
System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup	
Tagline Azimuth (deg)	329.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	1.59
Discharge Method	Mid-Section
Measurement Quality	--

Units	
Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings	
Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty		
Category	ISO	Stats
Depth	0.11%	0.61%
Velocity	0.24%	2.70%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.70%	--
Instrument	0.25%	0.25%
Overall	1.75%	2.78%

Discharge Results	
Total Area	49.228
Mean Velocity	0.030
Total Width	25.500
Total Q	1.500
Maximum Measured Depth(m)	2.605
Maximum Measured Velocity(m/s)	0.070
Mean Flow Angle	-1.976
Rated Discharge	1.588
% difference Q	-5.515
Water Temperature (Independent)	24.200
Mean Water Temperature	28.650
Mean Weighted Gauge Height	2.280

Discharge Measurement Summary

Date Measured: Wednesday, January 29, 2020

Recorded file is located under My Documents|SonTek Data|YYYY_MM_DD|StationaryDataFiles

Site Information

Site Name	Sturt O/T
Station Number	410129
Location	Endless Wire

Measurement Information

Party	SF/MS
Boat/Motor	SU
Meas. Number	118

System Information

System Type	RS-M9
Serial Number	2169
Firmware Version	4.10

System Setup

Tagline Azimuth (deg)	326.0
Salinity (ppt)	0.0
Rated Discharge (m3/s)	1.81
Discharge Method	Mid-Section
Measurement Quality	--

Units

Distance	m
Velocity	m/s
Area	m2
Discharge	m3/s
Temperature	degC

Discharge Calculation Settings

Track Reference	System (default)
Depth Reference	Vertical Beam

Discharge Uncertainty

Category	ISO	Stats
Depth	0.11%	0.39%
Velocity	0.40%	2.28%
Width	0.11%	0.11%
# Cells	0.11%	--
# Stations	1.56%	--
Instrument	0.25%	0.25%
Overall	1.64%	2.33%

Discharge Results

Total Area	64.903
Mean Velocity	0.022
Total Width	27.500
Total Q	1.418
Maximum Measured Depth(m)	3.142
Maximum Measured Velocity(m/s)	0.054
Mean Flow Angle	-3.092
Rated Discharge	1.810
% difference Q	-21.655
Water Temperature (Independent)	27.600
Mean Water Temperature	27.268
Mean Weighted Gauge Height	2.870