Murrumbidgee Irrigation

2018 ANNUAL COMPLIANCE REPORT

Growing our future together

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Abbreviations

ANZECC	Australian and New Zealand Environment and Conservation Council
BBSW	Barren Box Storage and Wetland
CSIRO	Commonwealth Scientific Investigation and Research Organisation
DOI Water	Department of Industry, Water
EC	Electrical Conductivity
EPA	Environment Protection Authority
EPL	Environment Protection Licence
ETo	Reference crop evapotranspiration
GIS	Geographic Information System
ha	Hectare(s)
LTA	Long-term average
MI	Murrumbidgee Irrigation Limited
MIA	Murrumbidgee Irrigation Area
µS/cm	Micro Siemens per centimetre
µg/L	Micrograms per litre
ML	Megalitre
NRAR	Natural Resources Access Regulator
OEH	Office of Environment and Heritage
SOP	Standard Operating Procedure
t	Tonnes
LAG	EPL Point 4 - Gogeldrie Main Drain at Gooragool Lagoon
GMSRR	EPL Point 5 - Gogeldrie Main Southern Drain River Road
YMS	EPL Point 6 - Yanco Main Southern Drain
ROCUDG	EPL Point 7 - Point Cudgel Creek Roaches Escape
MIRFLD	EPL Point 15 - Mirrool Creek Floodway Wyvern Station

Preface

The Annual Compliance Report 2016/17 has been prepared to meet the reporting requirements of the licences held by Murrumbidgee Irrigation (MI) with the Department of Industry, Water (DoI Water) and the NSW Environment Protection Authority (EPA). MI operates under a Combined Water Supply Work Approval and Water Use Approval 40CA403245 (Combined Approval) issued by DoI Water, and an Environment Protection Licence (EPL) 4651 issued by the EPA in accordance with the Protection of the Environment Operations Act 1997.

MI is committed to achieving organisational excellence through operating safely, efficiently and effectively, all of which contribute towards the measure of MI's environmental and 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 for our Combined Approval in 2017/18. 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 automated monitoring stations.

There were no significant events in 2017/18 that required notification to the Minister.

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 2017/18. MI did not construct new works that would allow further discharge from the Area of Operations. In 2017/18, the boundary of MI's Area of Operations increased by 2,717 hectares, which is identified in Figure 1.

Table 1 Combined Water Supply Work Approval and Water Use Approval (40CA403245) reporting summary

Licence section	Condition	Report Section
Notification of events	10	1. Statement of Compliance
Plans of the Area of Operations, Authorised Works, Monitoring Sites and Water Management Infrastructure	12.1	2. Plan of Operations and Works
	12.2	
Statement of Compliance	12.3	1. Statement of Compliance
Presentation of Data and Analyses	12.4	Section 1 - 6
	12.5	
	12.6	
	12.7	Provided on USB
	12.8	1. Statement of Compliance
New Measures to Limit Groundwater Recharge and Discharge of Salt	12.9	8. New Measures to Limit Groundwater Recharge and Discharge of Salt
Reporting on Water Management	12.10	3.3 Diversions and Water Allocation
	12.11	3.5 Water discharged from Area of Operation
	12.12	3.9 Water Balance
	12.13 (a) (b)	3.1 Climate Conditions
	(c) – (j)	4. Water Use
Reporting on Salinity and Salt load	12.14	5. Salinity and Salt load
	12.15	
	12.16	
Reporting on Groundwater Conditions	12.17	6. Groundwater Conditions

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:

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

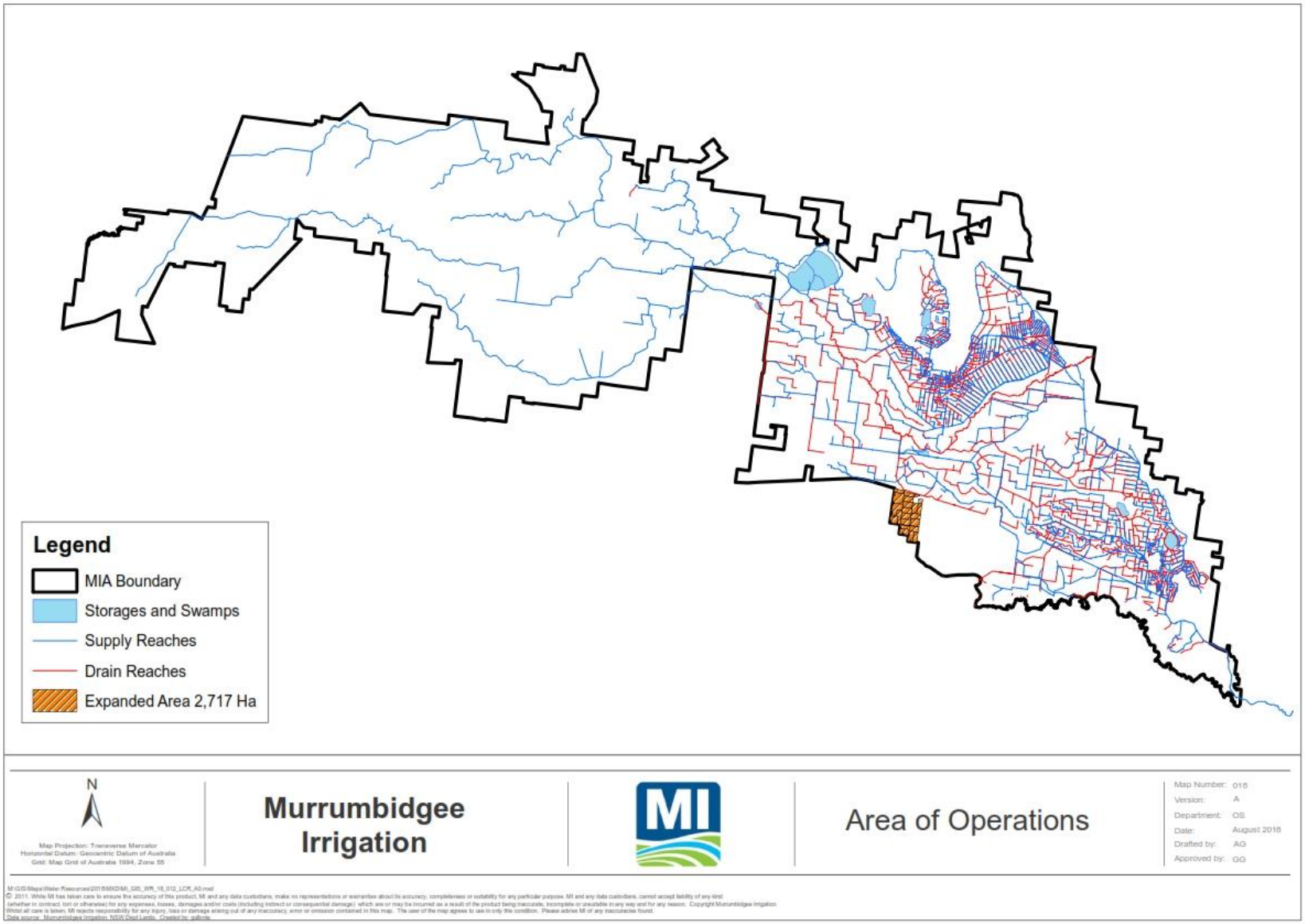

Figure 1 Murrumbidgee Irrigation's Area of Operation, identifying areas of expansion

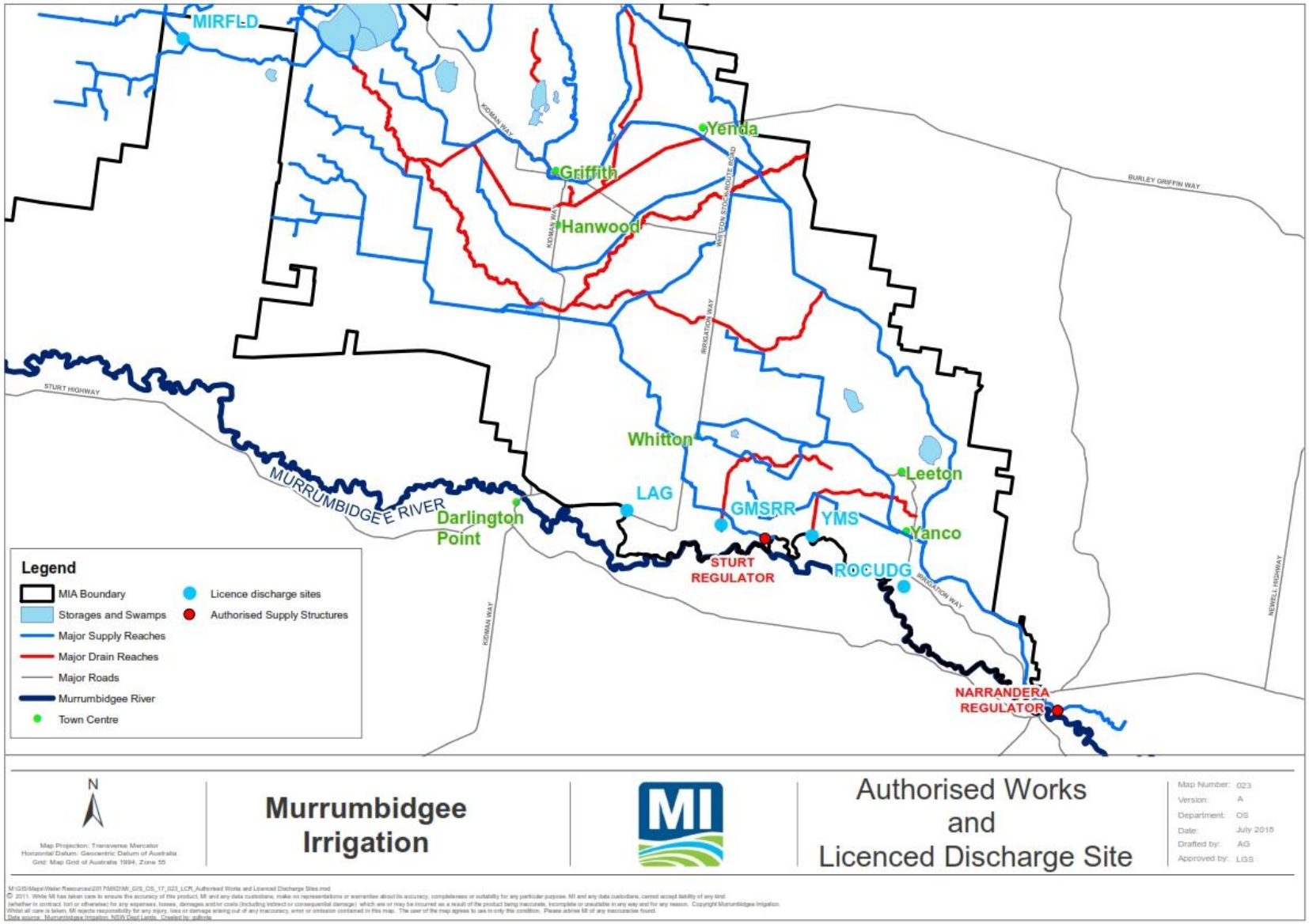

Figure 2 Location of authorised supply works and licence discharge points

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 2. Below average rainfall was recorded during the 2017/18 reporting period, in contrast to 2016/17 that included above average rainfall and a 1/150-year flood event.

Table 2 Griffith CSIRO weather station rainfall and ETo

Year	Total rainfall (mm)	Total ETo (mm)
2017/18	315	1894
2016/17	556	1593
2015/16	529	1712
2005/06	357	1935

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 the contract with MI to ensure flow measurements meet the conditions of Combined Approval 40CA403245. The calibration report summary for the NARREG AFFRA is presented in Table 3 and the STURT AFFRA presented in Table 4. The full calibration report is included with the submission of this report. The STURT AFFRA unit was repaired in September 2017.

Table 3 Main Canal at NARREG (410127) calibration report

Date	Time	Calibration Measurements:	AFFRA Sensor:	Deviation
12/09/2017	13:29	1225	1278	-4.12%
11/10/2017	12:40	1715	1680	2.07%
21/11/2017	10:03	2956	2926	1.01%
14/03/2018	12:29	2327	2340	-0.54%

Table 4 Sturt Canal at STURT (410129) calibration report

Date	Time	Calibration	AFFRA Sensor:	Deviation
25/08/2017	14:02	796	745	6.82%*
25/08/2017	14:41	722	719	0.37%
13/09/2017	12:48	766	778	-1.45%
12/10/2017	9:06	985	895	10.07%**
12/10/2017	12:28	769	741	3.75%
3/11/2017	11:28	686	671	2.26%
16/05/2018	15:34	292	295	-0.82%

* Gauging was performed during a steep fall with the old Affra unit in place. The site was re-measured later in the day after the new instrument installed. This second measurement was relied upon.

** Conditions were windy during this measurement with predominantly upstream winds. A second measurement was done later in the day when the wind had subsided, and this measurement should be relied upon.

3.3 Diversions and Water Allocation

A monthly summary of gross water diverted from the Murrumbidgee River is presented in Table 5. These volumes represent gross diversions entering the supply system via MI's two authorised water supply works at NARREG and STURT. The total diversion volume of 945,805 ML includes an environmental water diversion volume of 600 ML diverted for the Office of Environment and Heritage (OEH). Total deliveries to customers includes 1,602 ML of captured water delivered following rainfall (estimation), which is further outlined in Section 3.7 of this report.

Table 5 Monthly summaries of water diversions (ML) deliveries to customers (ML), 2017/18

Month	STURT	NARREG	Total diversion	Deliveries to customers
Jul-17	3,544	6,071	9,615	2,902
Aug-17	13,419	28,479	41,898	34,004
Sep-17	22,757	54,688	77,445	70,488
Oct-17	30,123	69,002	99,125	90,525
Nov-17	22,520	78,442	100,962	89,569
Dec-17	29,325	94,287	123,612	108,606
Jan-18	46,609	134,530	181,139	158,777
Feb-18	33,709	93,564	127,273	118,191
Mar-18	15,544	63,140	78,684	63,389
Apr-18	9,965	36,033	45,998	31,699
May-18	10,047	29,160	39,207	29,274
Jun-18	0	20,847	20,847	3,539
Total	**237,562**	**708,243**	**945,805**	**800,963**
Deliveries resulting from rainfall				1,602
Total Deliveries to customers				**802,565**

Table 6 compares water allocations, diversions, total deliveries and climate data from the 2017/18 reporting year to previous years. Although announced allocations determine much of the irrigation demand, rainfall and ETo can significantly affect the total diversions for the year. Below average rainfall was recorded throughout the catchment in 2017/18, resulting in 45% allocation for General Security and 95% allocation for High Security allocation announcement. Total diversions and deliveries to customers increased compared to the previous reporting year, due in part to customer entitlement carry over, inter valley water trades into the MIA, forward water sale initiatives and company enhancement to eligible customers.

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.

Table 6 Water allocation, total diversions and deliveries 2017/18 compared to previous years

Year	Announced Allocation (%) General / High	Diversions (ML)	Deliveries (ML)	Rainfall (mm) Griffith AWS	ETo (mm) Griffith AWS
2017/18	45/95	945,805	800,963	315	1,894
2016/17	100/100	780,083	621,094	556	1,593
2015/16	37/95	643,957	526,278	529	1,712
2005/06	54/95	1,036,519	829,990	367	1,935

3.4 Environmental diversions

At the request of OEH, 600 ML (including 20% conveyance) of environmental water was delivered in March and April 2017 to Tuckerbill Swamp as shown in Table 7. This volume is accounted for in total Diversions and Deliveries.

Table 7 Environmental water diversions for 2017/18

Month	Tuckerbill Swamp (ML)
Mar-17	186
Apr-17	414
Total	**600**

3.5 Water discharged from Area of Operations

Monthly discharge volumes for each discharge monitoring point are shown in Table 8. A total of 4,471 ML was discharged from MI's area of operations in 2017/18 with 3,405 ML of this total released to the Mirrool Creek Floodway (MIRFLD) to mitigate localised flooding.

Table 8 Monthly discharge volumes (ML) recorded at monitoring points

Month	LAG (41010940)	ROCUDG (41010005)	YMS (410083)	GMSRR (41010921)	MIRFLD (41010163)
Jul-17	0	0	0	0	0
Aug-17	1.5	33.4	0	1.3	0
Sep-17	25.0	1.1	0	2.5	0
Oct-17	27.9	8.1	0	10.7	0
Nov-17	20.6	0	0	0.1	100
Dec-17	111.6	108.8	0	56.5	3,305
Jan-18	17.7	59.0	0	0	0
Feb-18	21.4	22.5	0	0	0
Mar-18	9.0	33.9	0	0	0
Apr-18	0.9	44.0	0	0	0
May-18	0	64.8	0	28.2	0
Jun-18	6.3	107.1	195.0	47.1	0
Total	**241.9**	**482.4**	**195.0**	**146.3**	**3,405**

Table 9 shows total discharge volumes from MI's Area of Operation compared to previous years. The total volume discharged in 2017/18 included 3,405ML diverted to MIRFLD to mitigate localised flooding. However, this was significantly lower when compared to 2016/17 where 121,363 ML of floodwater was diverted to the MIRFLD after a major flood event. Except for flood mitigation releases, increased efficiency of MI's drainage reuse system is exhibited in the reduction of discharge volumes from 2005/06.

Table 9 Annual water volumes (ML) discharged from the MIA

Year	Total discharged (ML)
2017/18	4,471
2016/17	122,092
2015/16	1,079
2005/06	8,570

3.6 Supply efficiency

Table 10 illustrates the simple efficiency of MI's supply system to be at 85% for 2017/18. The simple efficiency provides insight into how the supply system is managed under the season's climatic conditions, whilst balancing irrigation demand and minimising system losses.

Table 10 Supply efficiency from 2017/18 and previous years

Year	Sturt Canal	Main Canal	Environment Diversions	NET TOTAL Irrigation Diversions	Deliveries (ML)	Conveyance (ML)	Simple Efficiency (%)
2017/18	237,56	708,243	600	945,805	800,963	144,842	85%
2016/17	196,23	583,849	986	779,097	621,094	158,003	80%
2015/16	141,08	505,845	2,977	643,957	526,278	117,679	82%
2005/06	233,38	805,277	2,146	1,036,519	829,990	206,529	80%

3.7 Water balance

The annual water balance in Table 11 has been produced to meet condition 2.12 of MI's Combined Approval. For the 2017/18 reporting year, the annual water balance has been refined to provide a clearer representation of system operations. To assist with interpretation of this water balance, each line has been referenced to the specific requirements of Condition 2.12.

Total deliveries to customers includes environmental water deliveries. Overland flood losses in 2016/17 refer to overland flows from bank cuts or breaches during peak flood periods. With reference to Condition 2.10 (c) and 2.11(b), no water was extracted or discharged for environmental or river operational purposes. The conveyance volumes represented in this water balance account for seepage, evaporated water and general conveyance required to deliver water to customers.

Total gross diversions of 945,805 ML for 2017/18 were used to generate water deliveries of 802,566 ML A large rainfall event in December 2017 created localised flooding, requiring water to be discharged to the Mirrool Creek Floodway. 3,405ML was released to the floodway to mitigate the flood impacts, with 1,602ML captured and delivered to customers. Therefore, the total volume of water delivered to customers for 2017/18 was 802,565 ML.

Table 11 Annual Water Balance (ML)

Condition	Sources	2017/18	2016/17*	2015/16*	2005/06
2.10 (a) (b)	River diversions	945,805	780,083	643,957	1,036,519
2.12 (c)	Internal storage volume (July 1, 2017)	32,318	29,042	15,621	N/A
2.12 (b)	Water captured (measured)	5,007	171,376		0
	Total	**983,131**	**980,501**	**659,578**	**1,036,519**
	Applications				
2.10 (d)	Deliveries to customers (river and storages)	800,963	621,094	526,278	829,990
2.10 (d)	Deliveries to customers (captured flood water)	1,602	49,225	0	0
2.12 (b) delivered	Environmental water diversions	600	986	2,629	N/A
2.12 (b) loss	Conveyance	151,904	127,960	101,629	206,518
2.12 (c)	Internal storage volume (June 30, 2018)	25,256	32,318	29,042	N/A
2.11 (a)	Discharges out of area of operation	4,471	121,363		11
2.12 (b) loss	Overland flood discharge	0	25,600		0
2.12 (b) loss	Customer flood discharge	0	1,955		0
	Total	**983,131**	**980,501**	**659,578**	**1,036,519**

*Presentation of data from these reporting years has changed from previous reports to better align with reporting conditions

4 Water Use

4.1 Crop statistics

For each water order customers are required to nominate their water use to a crop or use. This data is not validated at the farm level and is therefore an estimate only. Table 12 shows water deliveries and estimated crop water use for 2017/18. It is important to note the water use data presented for the total area of crop are also influenced by rainfall, ETo and irrigation practices, which are not considered in these figures.

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

Table 12 Summary of water deliveries for major crop groupings 2017/18

Crop/Purpose	Area (ha)	Volume Delivered(ML)	Crop Water Use (ML/ha)
Citrus	7,942	48,260	6.1
Cotton	21,861	174,778	8.0
Industrial	29	6,385	218.7
Other crops	327	2,733	8.4
Other fruits	1,231	5,682	4.6
Plantation	68	542	8.0
Rice	20,588	220,423	10.7
Stock & domestic	257	5,720	22.3
Summer cereals	2,736	22,462	8.2
Summer oilseeds	464	2,271	4.9
Summer pasture	2,483	15,614	6.3
Town supplies	-	12,019	-
Vegetables	1,897	10,940	5.8
Vines	18,187	80,105	4.4
Winter cereals	46,595	91,335	2.0
Winter oilseeds	3,024	7,371	2.4
Winter pasture	8,080	22,338	2.8
Not Defined*	-	73,590	-
Total	**135,770**	**802,566**	**-**

*No crop type assigned by customer at time of use

A comparison of crop water use for 2017/18 with previous years is presented in Table 13. Cotton accounted for the largest area grown (21,861 ha), marginally higher than rice (20,588 ha). However, rice accounted for the highest volume of water deliveries in the MIA. Although allocations were lower compared to the previous season, increased customer allocation carry over, inter valley water trades into the MIA, forward water sale initiatives and company enhancement to eligible customers in 2017/18 provided opportunity for customers to increase their area of non-permanent plantings.

Table 13 Total deliveries to major crop types 2017/18 compared to previous years (ML)

Year	Rice	Pasture	Cereal and Oil Seeds	Vegetables	Citrus + Vines + Other Fruits	Other Crops + Plantations	S&D + Towns + Industrial	Cotton
2017/18	220,423	37,952	123,439	10,940	134,046	76,864	24,123	174,778
2016/17	304,200	26,030	57,479	10,129	109,257	71,376	9,844	82,004
2015/16	136,805	19,449	96,851	10,011	128,789	22,729	31,832	79,812
2005/06	355,254	65,878	181,641	27,588	142,025	9,481	48,123	n/a

Note: Cotton was included in 'other crops and plantations' for 2005/06

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 and 4 ML/ha, 4 and 4.1-8 ML/ha and above 8.1 ML/ha.

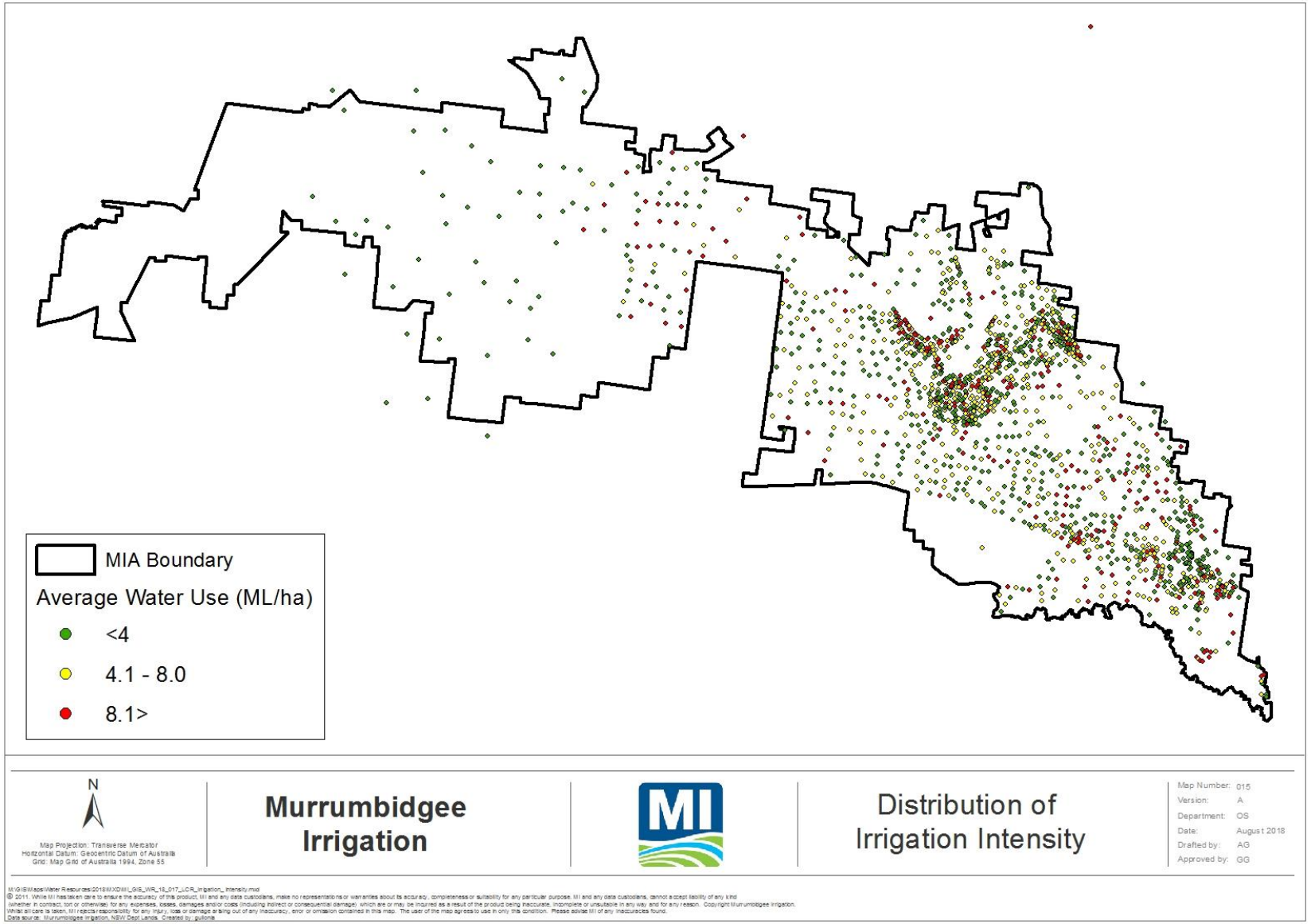

Figure 3 Distribution of irrigation intensity across the MIA

5 Salinity and Salt Load

5.1 Extracted salt load

Electrical conductivity (EC) sensors were installed at NARREG and STURT in September 2017. The salt loads for NARREG and STUR are calculated using Water NSW monitoring site 410001 on the Murrumbidgee River for July, August and September and data reported from EC sensors installed at the offtakes for the remaining months. The monthly mean EC values and extracted salt loads are presented in Table 14.

Table 14 Total extracted salt load for 2017/18

Month	STUR			NARREG		
	Flow (ML)	mean EC (µS/cm)	STUR Salt (t)	Flow (ML)	Mean EC (µS/cm)	NARREG Salt (t)
Jul-17	3,758	177	400	5,426	177	686
Aug-17	13,990	81	699	31,440	81	1,483
Sep-17	22,630	140	2,037	54,400	140	4,895
Oct-17	30,390	101	1,871	69,130	104	4,258
Nov-17	22,760	103	1,397	81,010	99	4,657
Dec-17	29,350	145	2,521	93,470	139	8,061
Jan-18	46630	78	2,168	134,800	85	6,867
Feb-18	33,790	117	1,084	93,840	120	6,799
Mar-18	15,790	144	1,329	63,530	153	5,789
Apr-18	9,903	121	660	36,090	122	2,637
May-18	10,190	115	752	29,090	133	2,263
Jun-18	17	184	2	21,110	136	1,635
Total	**239,200**	**-**	**14,920**	**713,300**	**-**	**50,030**

Table 15 presents the total extracted salt loads for 2017/18 and previous years. During 2017/18, an estimated 64,950 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 15 Extracted salt-load (t) for 2017/18 compared to previous years

Year	Diversions (ML)	Extracted salt load (t)		
		STUR	NARREG	Total
2017/18	945,805	14,920	50,030	64,950
2016/17	780,083	11,722	32,903	44,625
2015/16	643,957	10,939	39,758	50,696
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 out of 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 and totals from previous years are compared in Table 16.

An estimated 854 tonnes was discharged from MI's Area of Operation in 2017/18. The majority of salt was discharged to the MIRFLD, which corresponds with the volume of water discharged at this site.

Table 16 Discharged salt load 2017/18 compared to previous years

Year	Water discharged (ML)	Discharged Salt load (t)
2017/18	4,471	854
2016/17	122,092	34,230
2015/16	1,620	201
2005/06	8,570	1,887

Table 17 Monthly summary of flow, EC and salt loads at monitoring points for 2017/18

Month	Flow (ML)	Mean EC (µS/cm)	Min.EC (µS/cm)	Max. EC (µS/cm)	Salt load (t)	Flow (ML)	Mean EC (µS/cm)	Min.EC (µS/cm)	Max. EC (µS/cm)	Salt load (t)
	Yanco Main Southern Escape (YMS) 410083					Gooragool Lagoon Escape (LAG) 41010940				
Jul-17	0.0	-	-	-	0.0	0.0	-	-	-	0.0
Aug-17	0.0	-	-	-	0.0	1.5	363	332	392	0.0
Sep-17	0.0	-	-	-	0.0	25.0	370	118	1190	4.0
Oct-17	0.0	-	-	-	0.0	27.9	265	77.2	694	4.0
Nov-17	0.0	-	-	-	0.0	20.6	218	89.4	725	3.0
Dec-17	0.0	-	-	-	0.0	111.6	235	92	1150	17.0
Jan-18	0.0	-	-	-	0.0	17.7	356	0.4	612	4.0
Feb-18	0.0	-	-	-	0.0	21.4	234	120	355	3.0
Mar-18	0.0	-	-	-	0.0	9.0	269	199	355	1.0
Apr-18	0.0	-	-	-	0.0	0.9	303	277	327	0.0
May-18	0.0	-	-	-	0.0	0.0	-	-	-	0.0
Jun-18	195.0	1330	882	1760	166.0	6.3	564	541	588	2.0
Total	**195.0**				**166.0**	241.9				**40**
	Gogeldrie Main Southern Escape (GMSRR) 41010921					Cudgel Creek Escape (ROCUDG) 41010005				
Jul-17	0.0	-	-	-	0.0	0.0	-	-	-	0.0
Aug-17	1.3	261	162	352	0.0	33.4	149	125	177	3.0
Sep-17	2.5	306	129	417	0.0	1.1	158	132	222	0.0
Oct-17	10.7	153	99.9	235	1.0	8.1	206	179	257	1.0
Nov-17	0.1	143	121	188	0.0	0.0	-	-	-	0.0
Dec-17	56.5	248	159	340	7.0	108.8	213	182	255	13.0
Jan-18	0.0	-	-	-	0.0	59.0	221	186	247	8.0
Feb-18	0.0	-	-	-	0.0	22.5	254	203	307	3.0
Mar-18	0.0	-	-	-	0.0	33.9	276	169	328	5.0
Apr-18	0.0	-	-	-	0.0	44.0	174	154	201	5.0
May-18	28.2	176	159	193	3.0	64.8	151	117	199	6.0
Jun-18	47.1	117	30.4	195	3.0	107.1	123	100	145	8.0
Total	**146.3**				**14**	**482.4**				**52**
	Mirrool Creek Floodway (MIRFLD) 41010163									
Nov-17	100	237.3	219.3	255.3	17.1					
Dec-17	3,305	297.2	294.1	300.3	565.3					
Total	**3,405**				582					

5.3 Salt load summary

The salt loads presented in Table 18 show that of the 64,952 tonnes of salt received through diversions recorded at MI's authorised supply works (NARREG and STURT), 852 tonnes was discharged from the area of operations and an estimated 64,096 tonnes was retained within the MIA. It is important to note that this is a simple annual salt balance that considers salt loads entering and leaving via authorised works and 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 Salinity Management Strategy.

Table 18 Salt load summary for 2017/18

Extracted	**Salt load (t)**
STUR	14,920
NARREG	50,030
Total extracted	**64,950**
Discharged	**Salt load (t)**
YMS	166
GMSRR	14
LAG	40
ROCUDG	52
MIRFLD	582
Total discharged	**854**
Retained	**64,096**

6 Groundwater Conditions

6.1 Groundwater Monitoring and Reporting

A total of 641 piezometers are listed in Schedule 2 of the Combined Approval and the locations of these bores are displayed in Figure 4. In September 2017/18, 587 piezometers were monitored, which equates to 91.5% of the total piezometer network.

Table 19 Groundwater piezometer status summary (September 2017)

Total bores	Total destroyed	Dry, Flooded or Blocked	Total read
641	54	20	587

Groundwater levels and salinity (reported as EC) are measured in September to give insight into groundwater levels prior to the irrigation season and again in March to identify regional groundwater trends. The network consists of piezometers in the shallow and deep Shepparton Formation and a smaller monitoring network in the Calivil Formation.

Depth to water table data is reported for 2017/18, 2016/17, 2015/16, and 2005/2006. The 2005/06 reporting year was chosen for reference for depth to water table to coincide with the peak of the millennium drought for the MIA. Groundwater salinity is reported for 2017/18, 2016/17, 2015/16, 2002 and 1980. Due to the limited data sets from 2005/06, data from 2002 and 1980 was chosen to represent suitable comparisons for salinity changes from a historical perspective.

The number of piezometers read within depth ranges for September are shown in Table 20.

Table 20 Number and percent of total piezometers read within each depth range

Year	Number <2M of surface	Number 2-4M of surface	Number >4M of surface	% <2M of surface	% 2-4M of surface	% >4M of surface	Total
2017	65	163	339	11%	29%	60%	567
2016	78	123	363	14%	22%	64%	564
2015	76	121	368	13%	21%	65%	565
2005	55	225	342	9%	36%	55%	622

6.2 Groundwater salinity

The number of piezometers read within salinity ranges for September is shown in Table 21 and the percentage of total piezometers measured within each range is presented in Table 22. The data identifies similar groundwater salinity trends throughout years reported for the Shallow Shepparton, Deep Shepparton and Calivil formations, including benchmark year 1980. In 2015, the lower number of total piezometers monitored for EC was a result of equipment failure during the monitoring program. DPI Water was notified, and additional equipment was purchased.

Discussions between DPI Water and MI in 2017/18 identified the need for an extensive review of the groundwater monitoring and reporting requirements within the Combined Approval. It is expected that this will be finalised this year, and the changes included in MI's ACR 2018/19.

Table 21 Number of piezometers read within each salinity range

Year	0-2000 (µS/cm)	2001-5000 (µS/cm)	5001-10000 (µS/cm)	10001-20000 (µS/cm)	20001-30000 (µS/cm)	30001-40000 (µS/cm)	>40000 (µS/cm)	Total
2017	287	157	85	34	4	0	0	567
2016	247	126	86	57	19	5	1	541
2015	165	92	65	48	16	7	3	396
1980	250	211	180	152	47	2	1	843

Table 22 Percentage of total piezometers read within each salinity range

Year	0-2000 (µS/cm)	2001-5000 (µS/cm)	5001-10000 (µS/cm)	10001-20000 (µS/cm)	20001-30000 (µS/cm)	30001-40000 (µS/cm)	>40000 (µS/cm)	Total
2017	51%	28%	15%	6%	1%	0%	0%	567
2016	46%	23%	16%	11%	4%	1%	0%	541
2015	42%	23%	16%	12%	4%	2%	1%	396
1980	30%	25%	21%	18%	6%	0%	0%	843

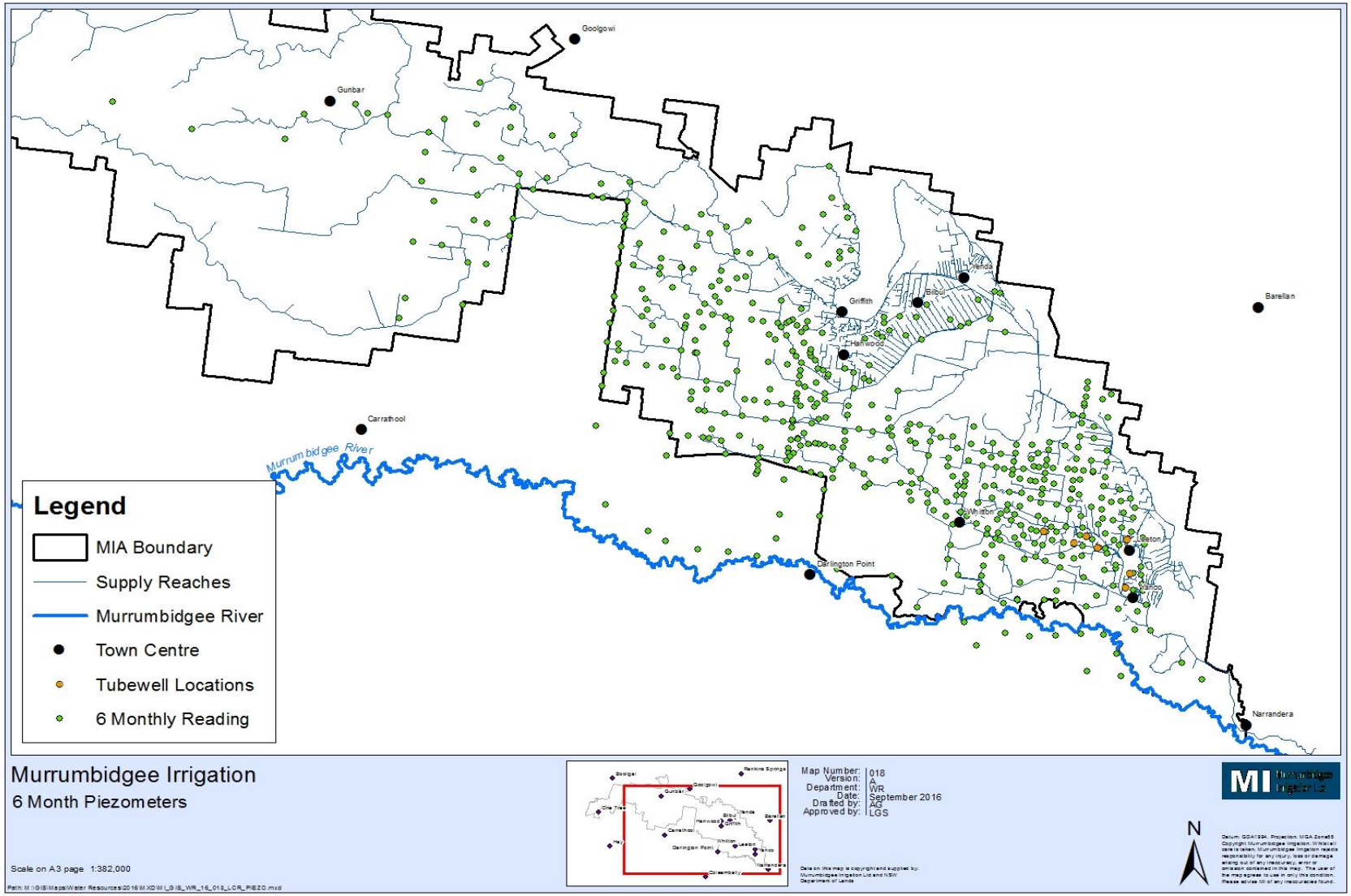

Figure 4 Location of piezometers and tubewells in the MIA 2017/18

6.3 Shallow Shepparton Formation

September and March depth to water table and salinity maps for piezometers in the shallow Shepparton Formation are presented in Figures 5 to 20. Groundwater levels in this formation are expected to be highly influenced by seasonal rainfall, geology and irrigation. This is indicated by the comparing maps from September to March for each reporting year, which identify a marginal rise in groundwater levels. This is particularly evident when comparing Figure 5 and Figure 6, with an increase in groundwater level exhibited in March 2018 (Figure 5).

General salinity changes in the Shallow Shepparton Formation from September to March for each reporting year show decreases in EC values across the MIA. These areas of reduced salinity correlate with an increase in groundwater levels, highlighting potential recharge areas.

When compared to recent years, 2005/06 groundwater levels (Figure 17 and 18) appear to be deeper across the MIA, with fewer piezometers within 2m from surface level. This is likely a result of reduced recharge from rainfall, as a result of drought conditions.

2017/18

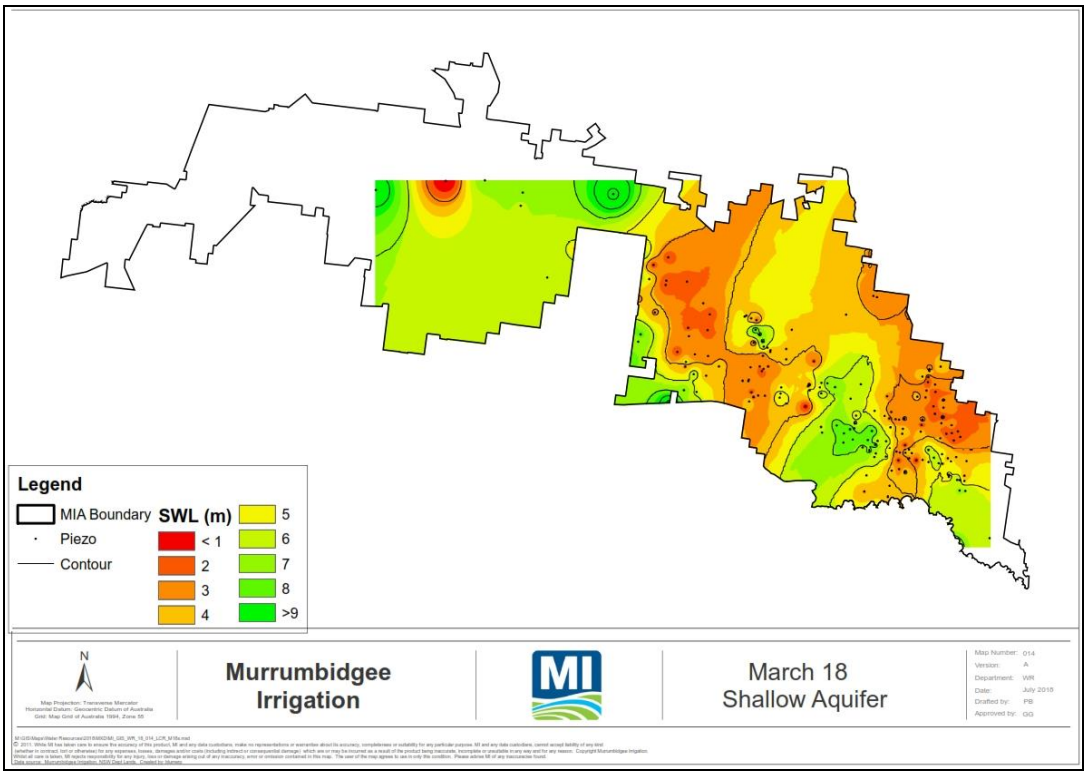

Figure 5 Shallow Shepparton Formation- depth to water table, March 2018

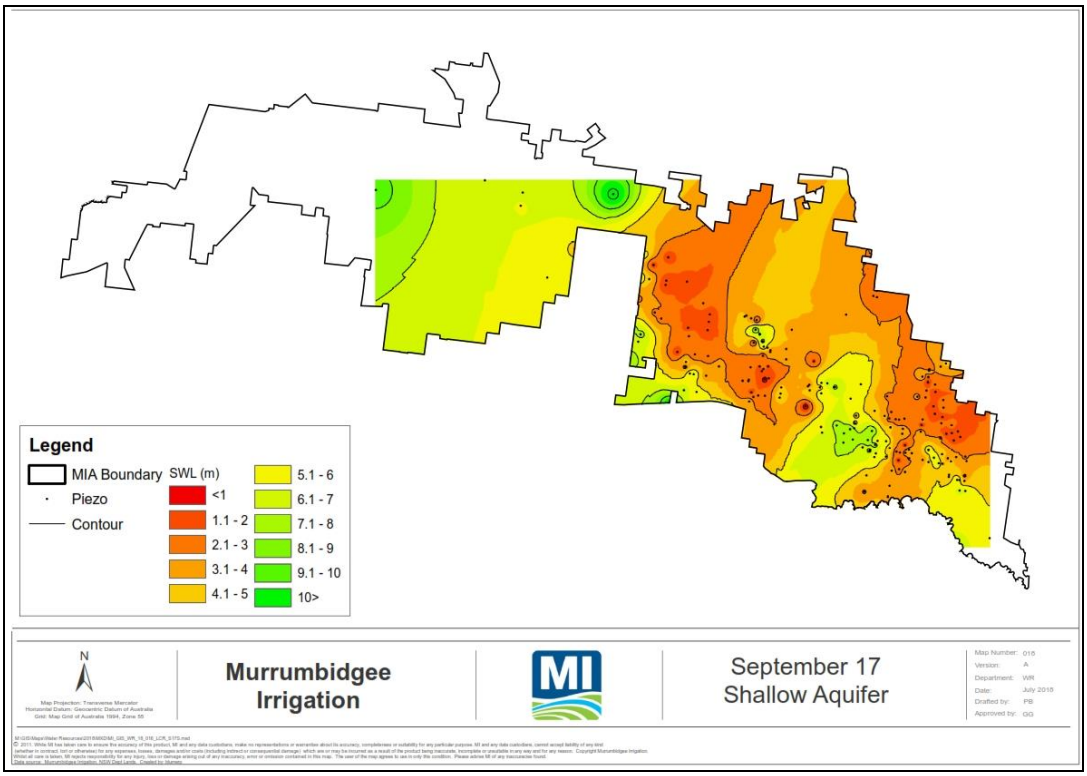

Figure 6 Shallow Shepparton Formation- depth to water table, Sep 2017

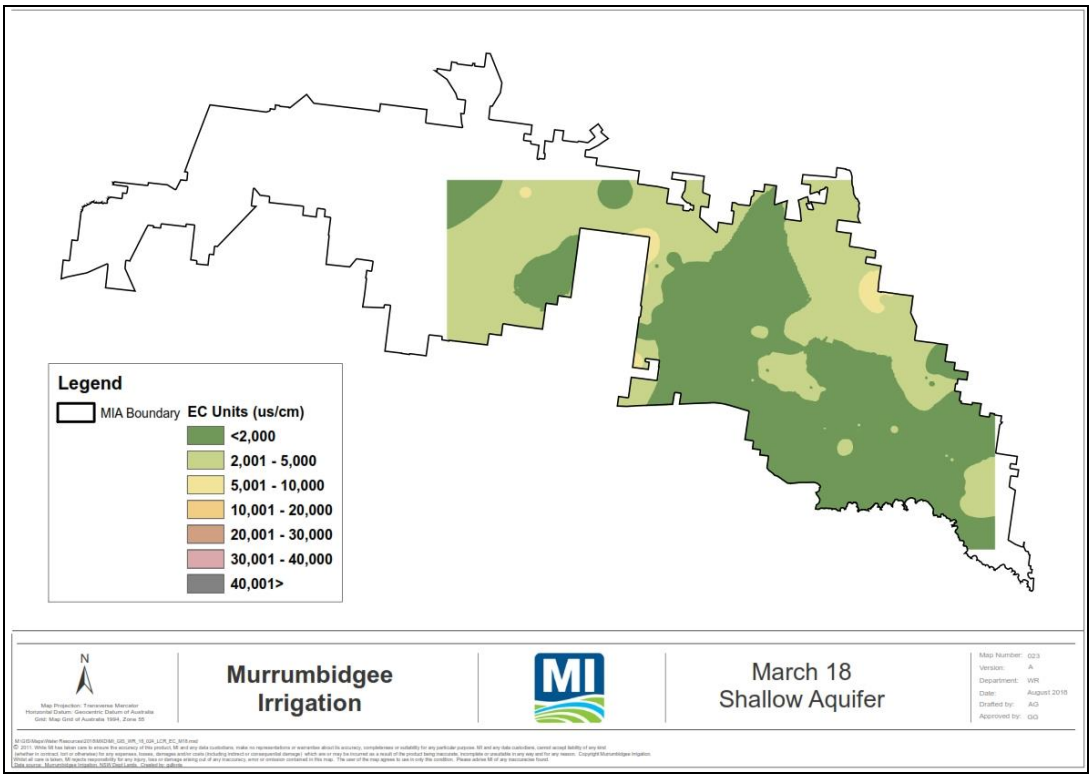

Figure 7 Shallow Shepparton Formation- Groundwater Salinity, March 2018

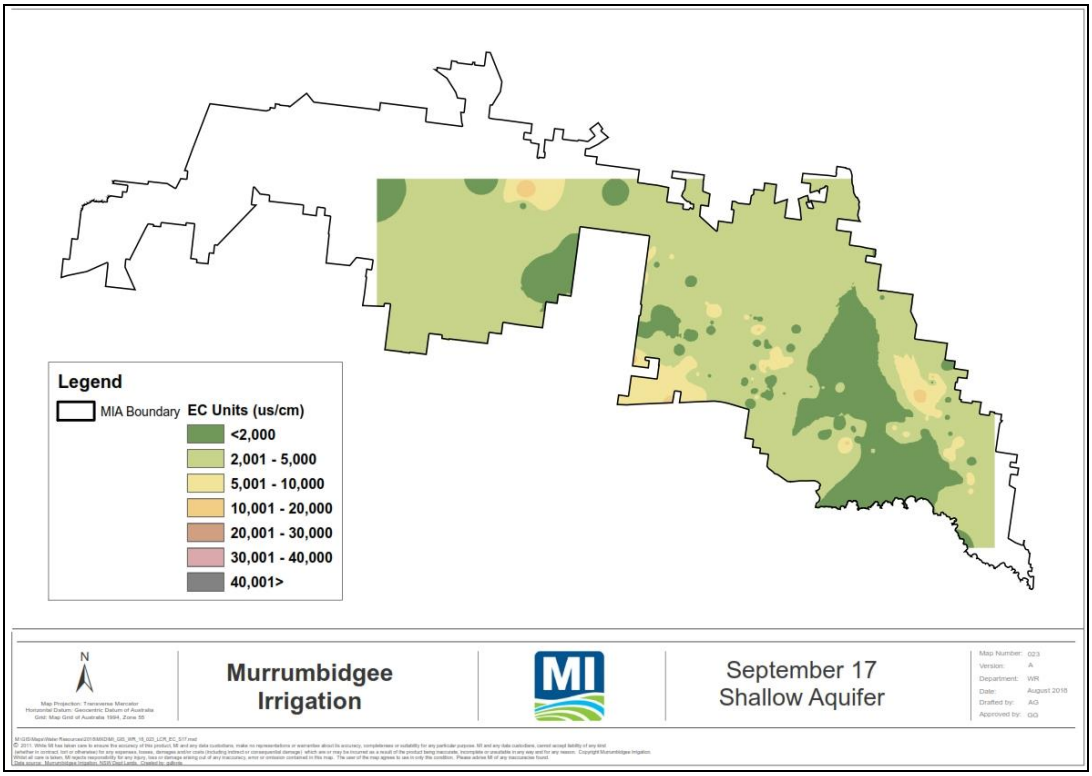

Figure 8 Shallow Shepparton Formation- Groundwater Salinity, Sep 2017

2016/17

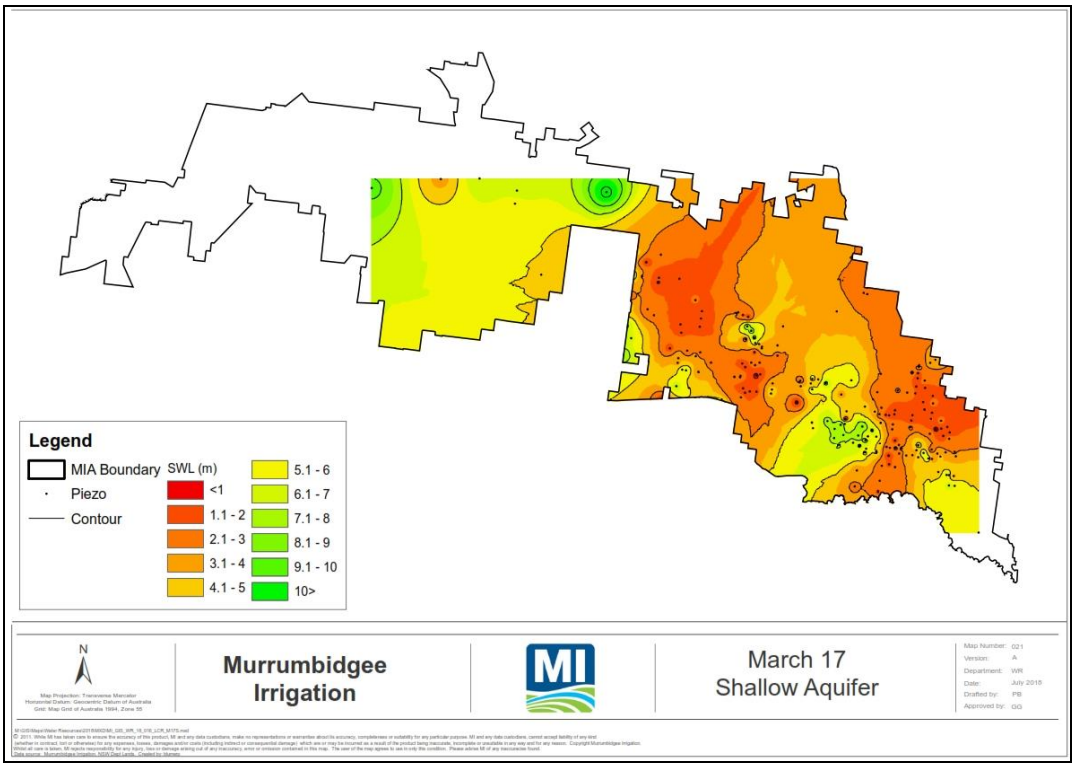

Figure 9 Shallow Shepparton Formation- depth to water table, March 2017

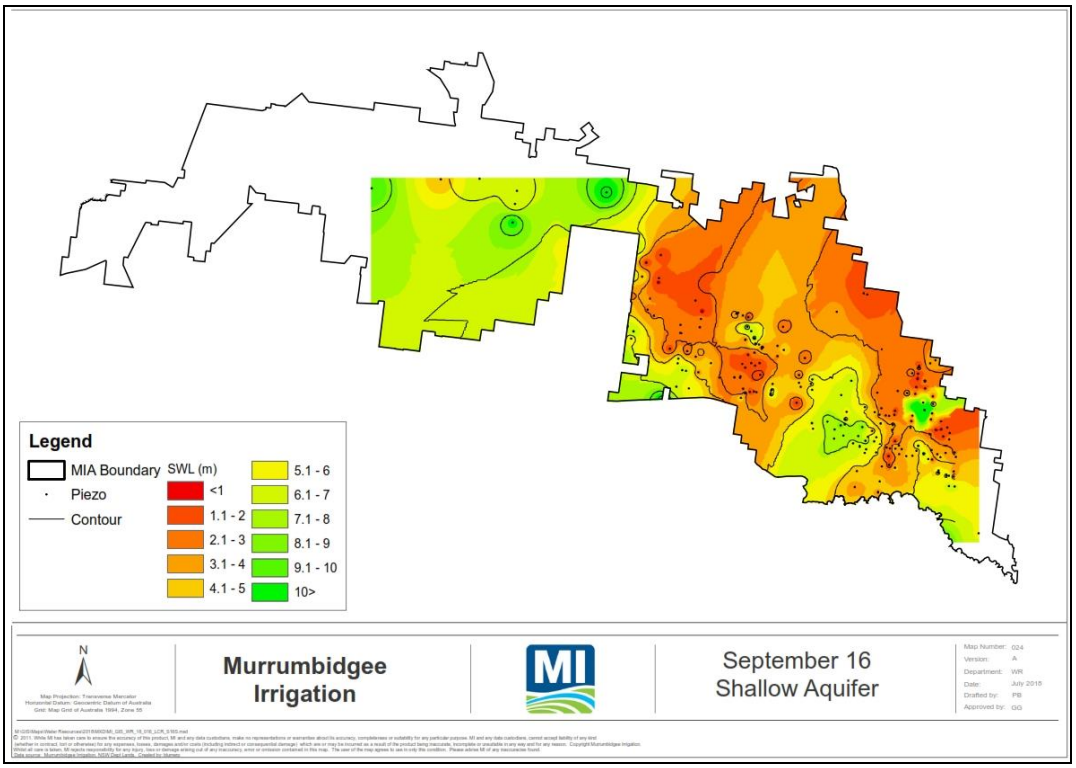

Figure 10 Shallow Shepparton Formation- depth to water table, Sep 2016

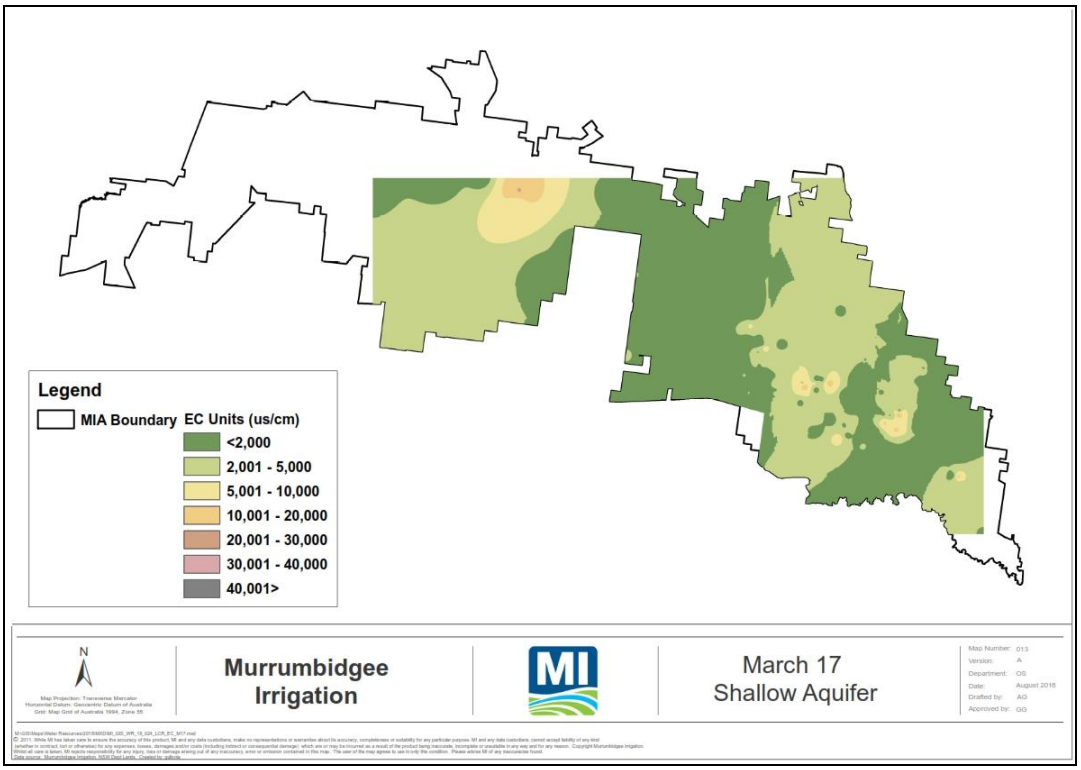

Figure 11 Shallow Shepparton Formation- Groundwater Salinity, March 2017

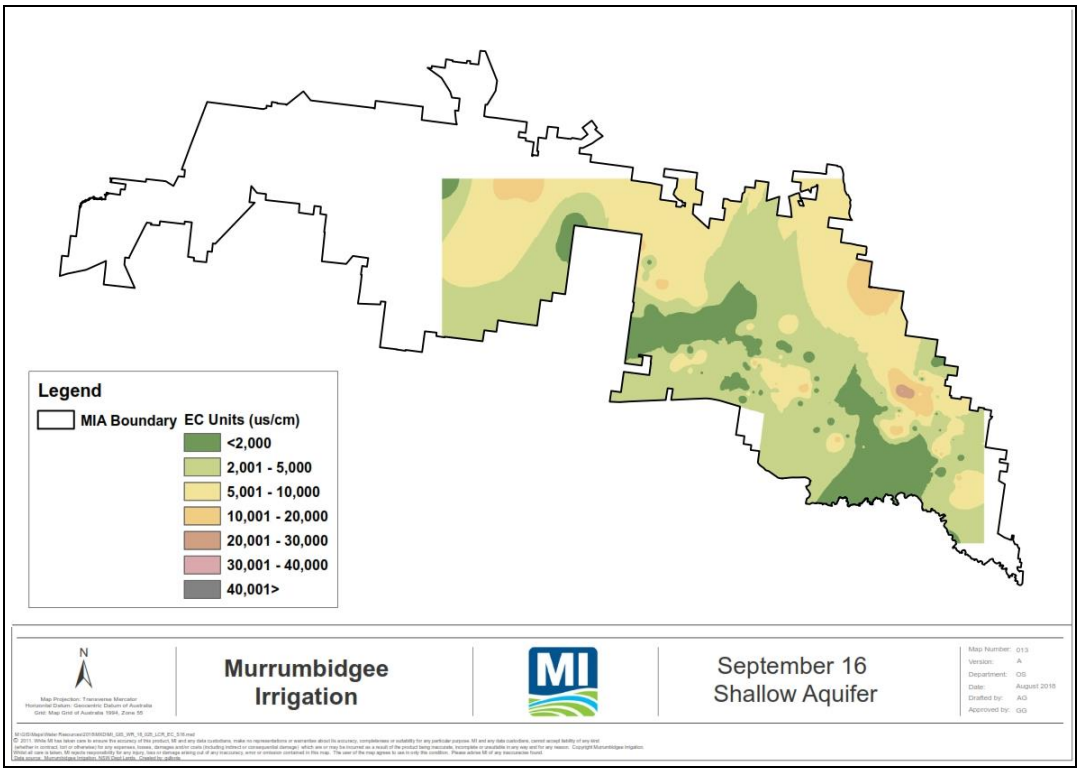

Figure 12 Shallow Shepparton Formation- Groundwater Salinity, Sep 2016

2015/16

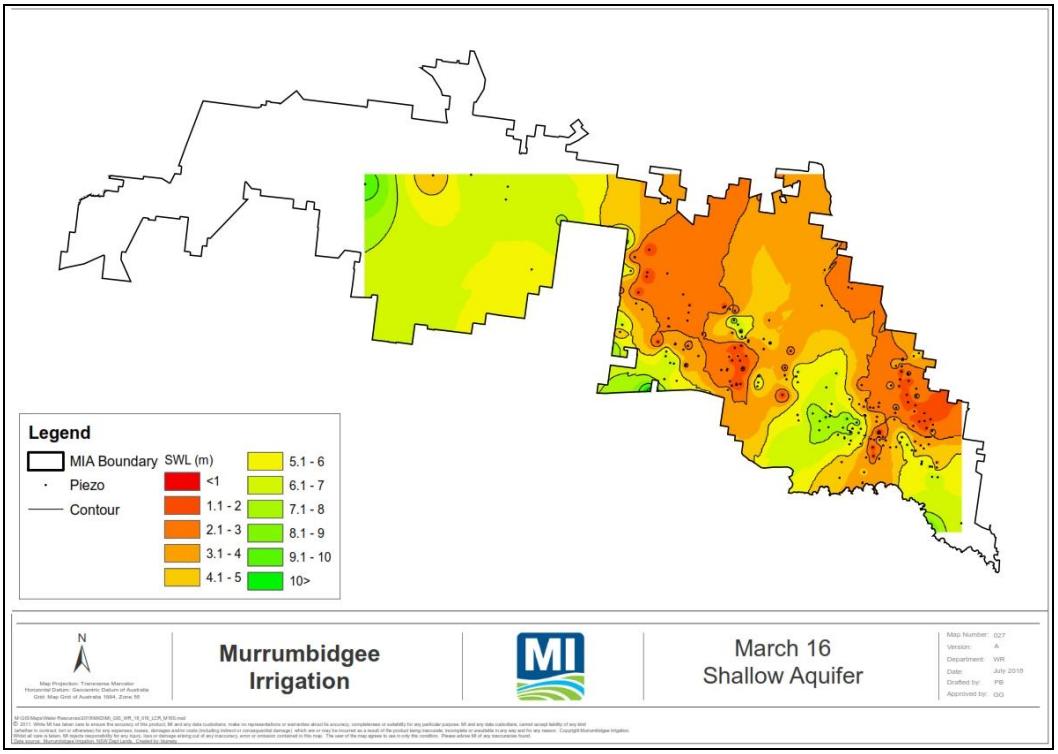

Figure 13 Shallow Shepparton Formation- depth to water table, March 2016

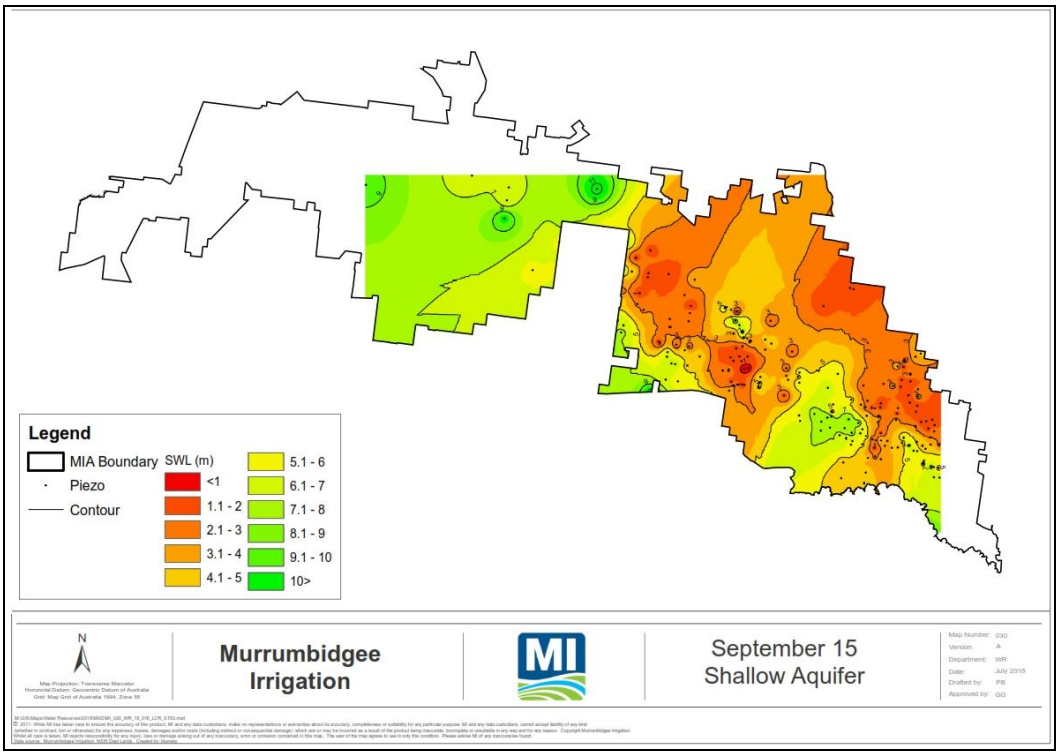

Figure 14 Shallow Shepparton Formation- depth to water table, March 2016

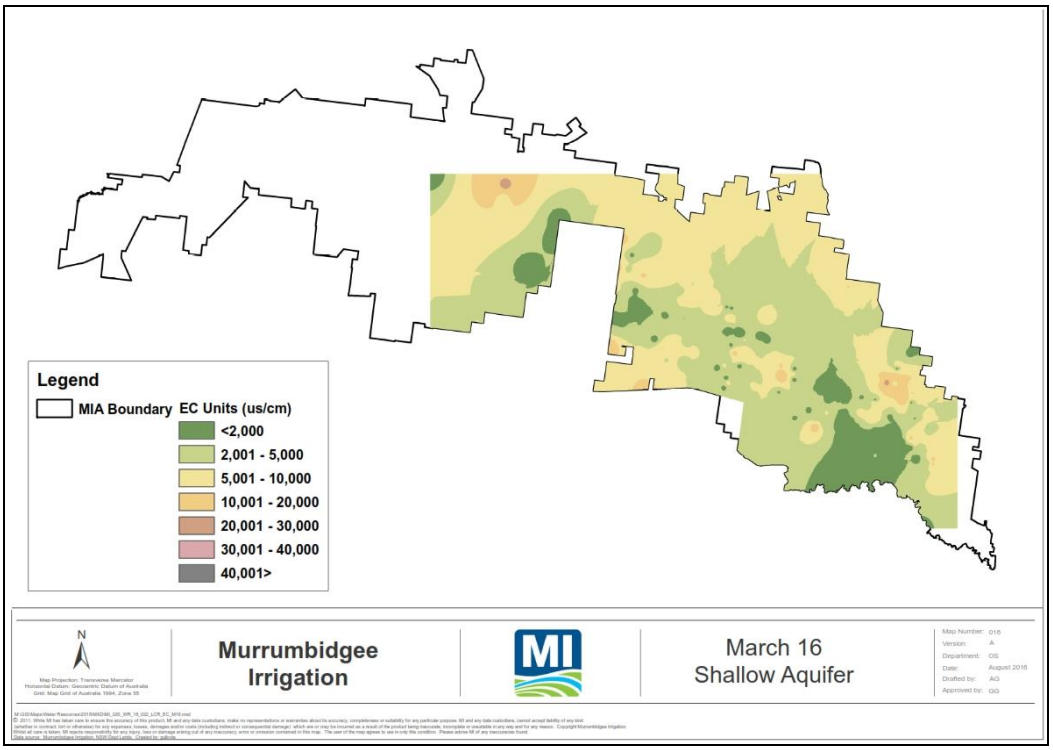

Figure 15 Shallow Shepparton Formation- Groundwater Salinity, March 2016

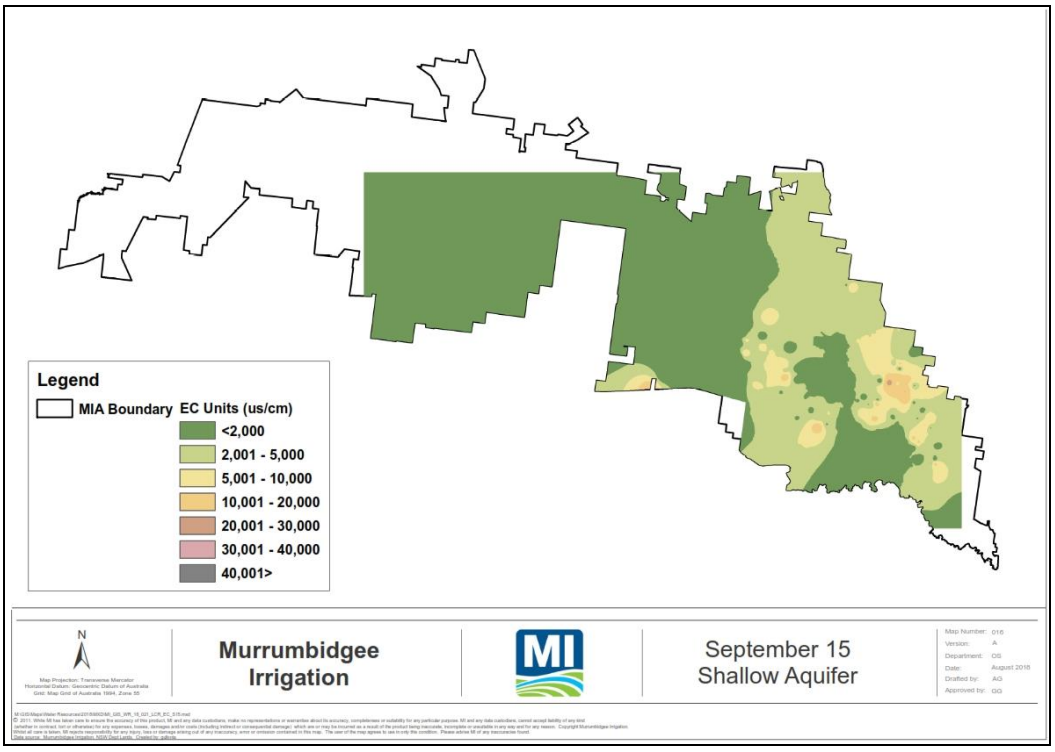

Figure 16 Shallow Shepparton Formation- Groundwater Salinity, Sep 2015

2005/06

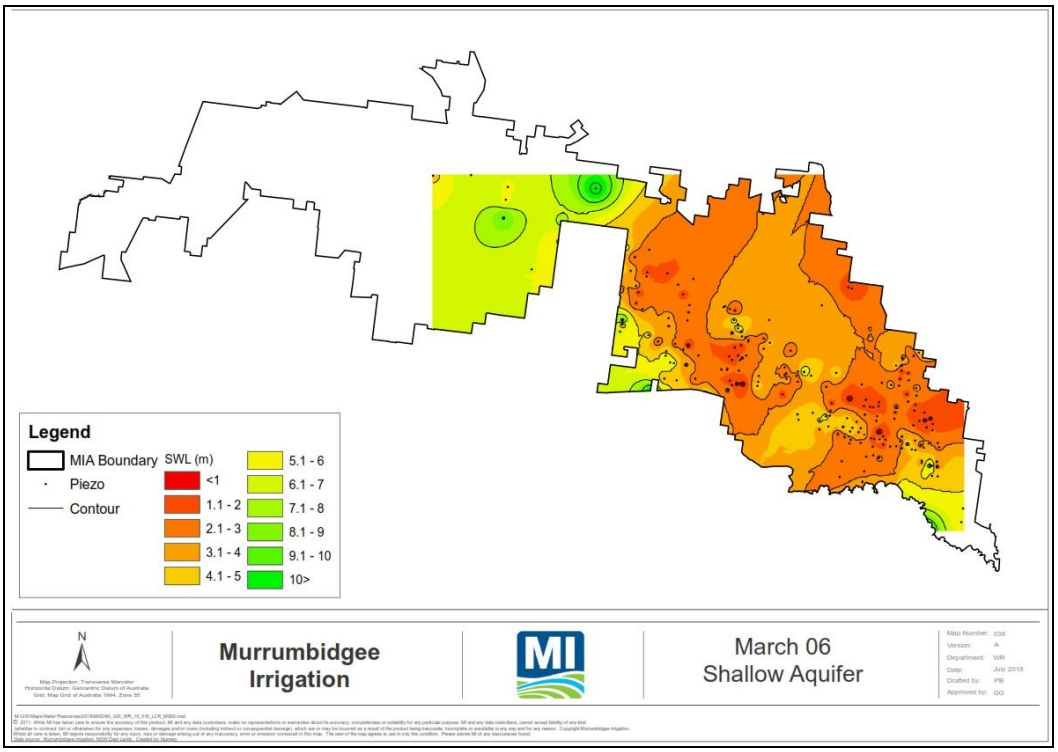

Figure 17 Shallow Shepparton Formation - depth to water table, March 2006

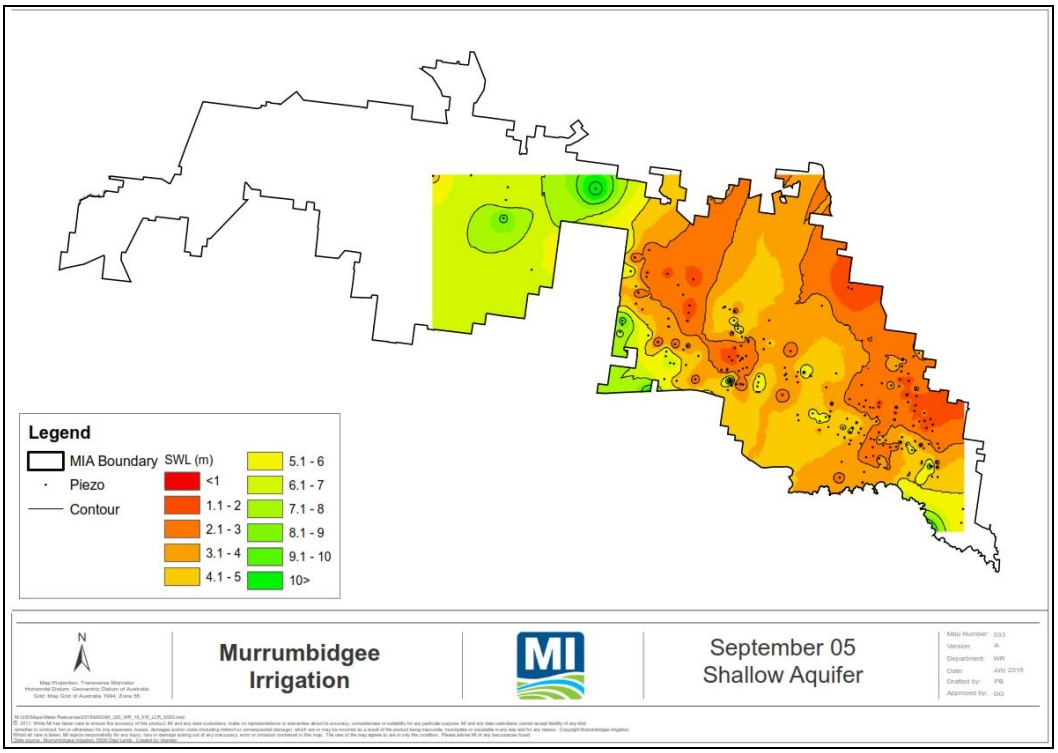

Figure 18 Shallow Shepparton Formation - depth to water table, Sep 2005

1980/2002

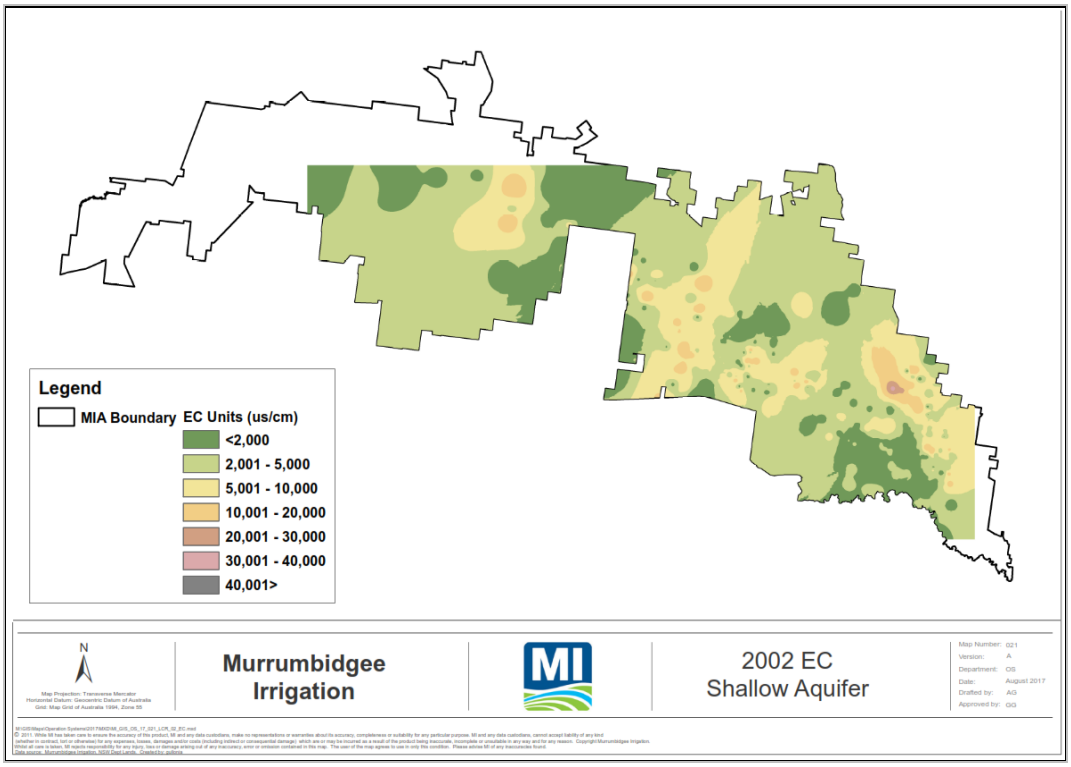

Figure 19 Shallow Shepparton Formation, groundwater salinity, Sep 2002

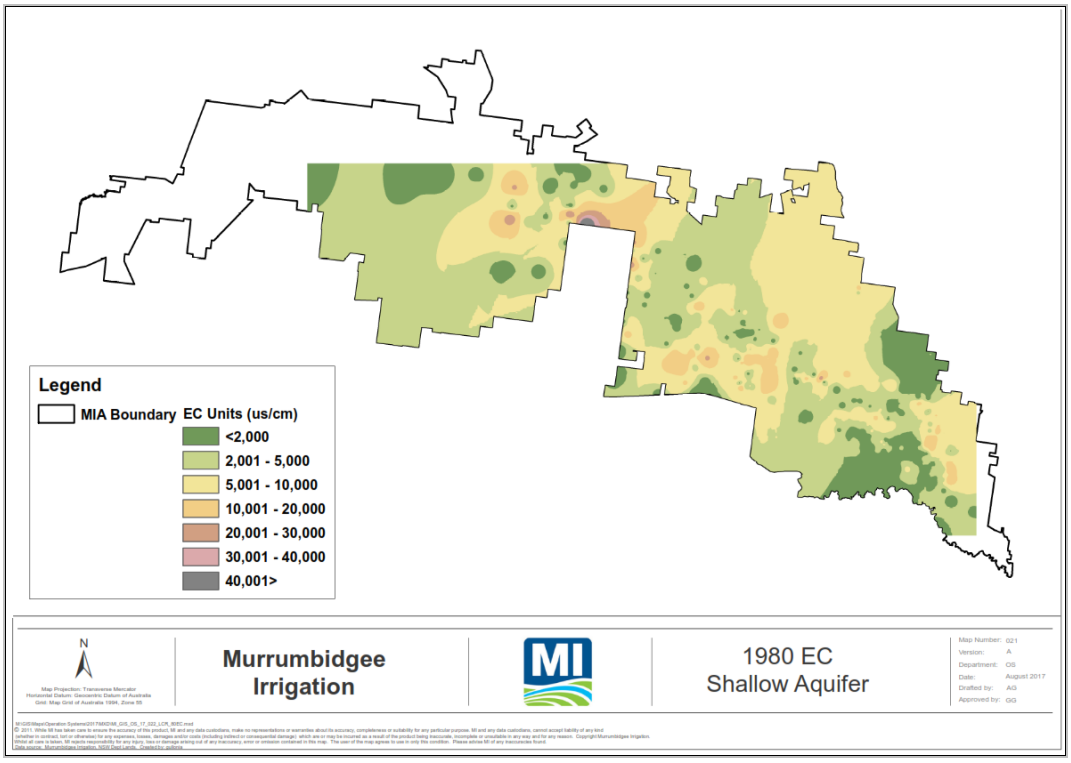

Figure 20 Shallow Shepparton Formation – groundwater salinity, Sep 1980

6.4 Deep Shepparton Formation

Depth to water table and salinity maps for piezometers in the deep Shepparton Formation are presented in Figures 21 to 36. Groundwater levels and salinity trends in the deep Shepparton Formation can be influenced by connectivity with the shallow Shepparton Formation, therefore the trends observed in the shallow Shepparton Formation also evident in the deep Formation.

Groundwater levels and salinity appear to have remained relatively constant from September 2017 to March 2018, with irrigation applied during the season potentially offsetting the below average rainfall experienced.

2017/18

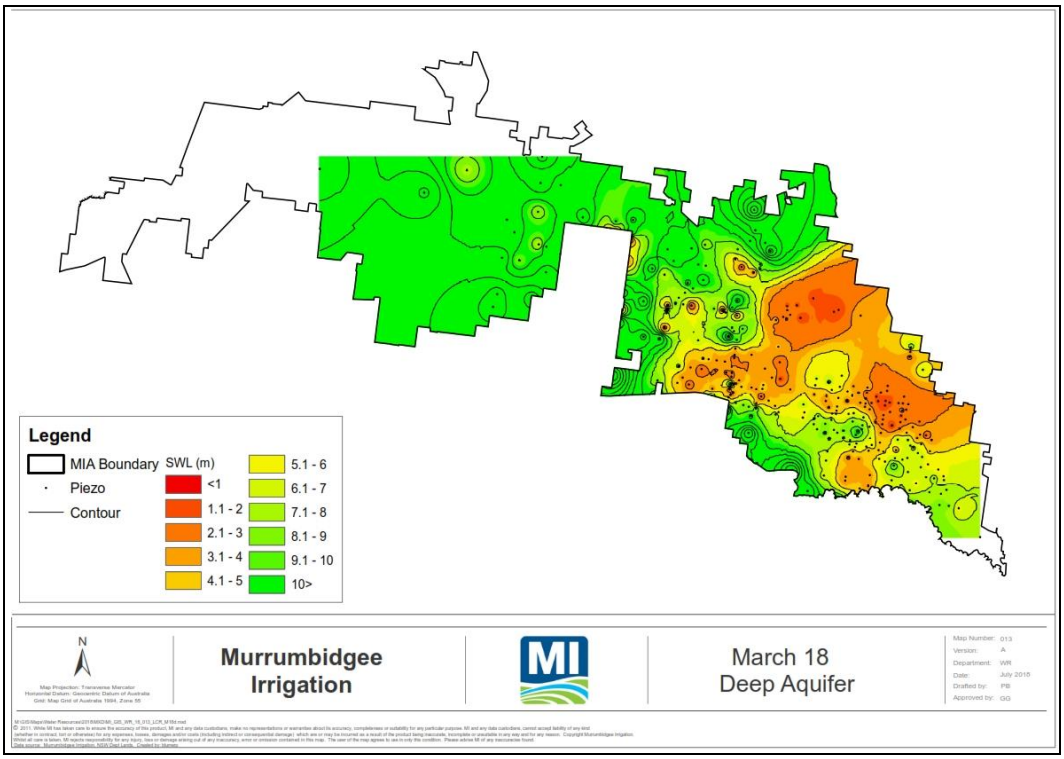

Figure 21 Deep Shepparton Formation- depth to water table, March 2018

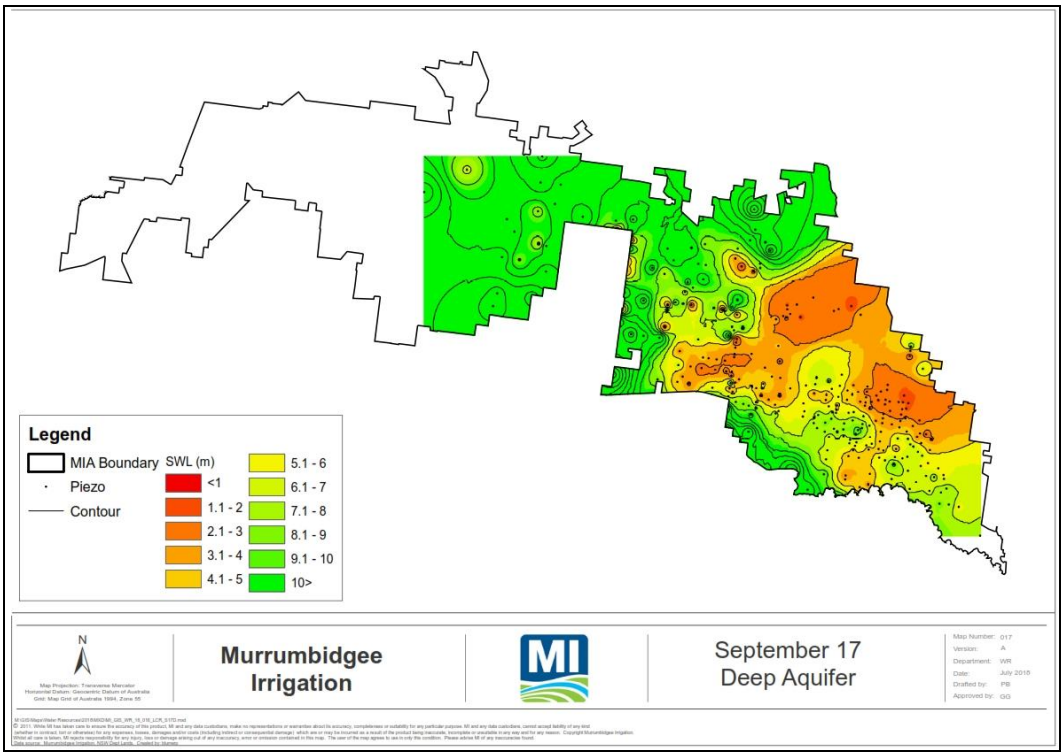

Figure 22 Deep Shepparton Formation- depth to water table, Sep 2017

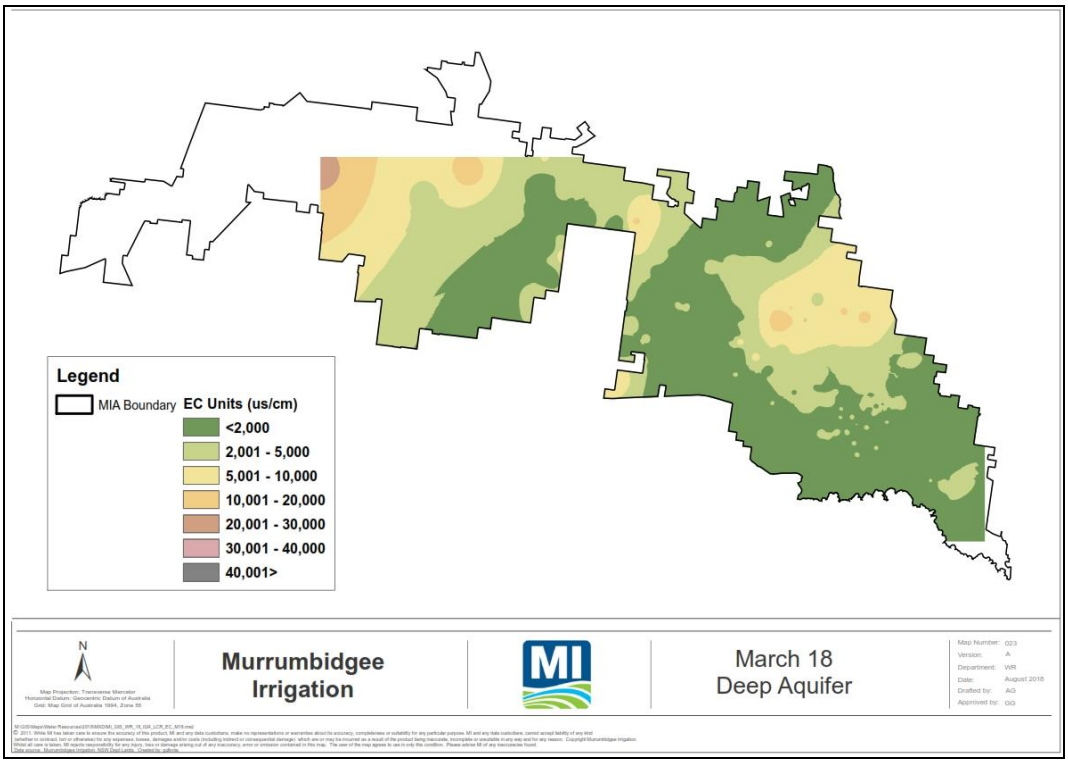

Figure 23 Deep Shepparton Formation- depth to water table, Sep 2017

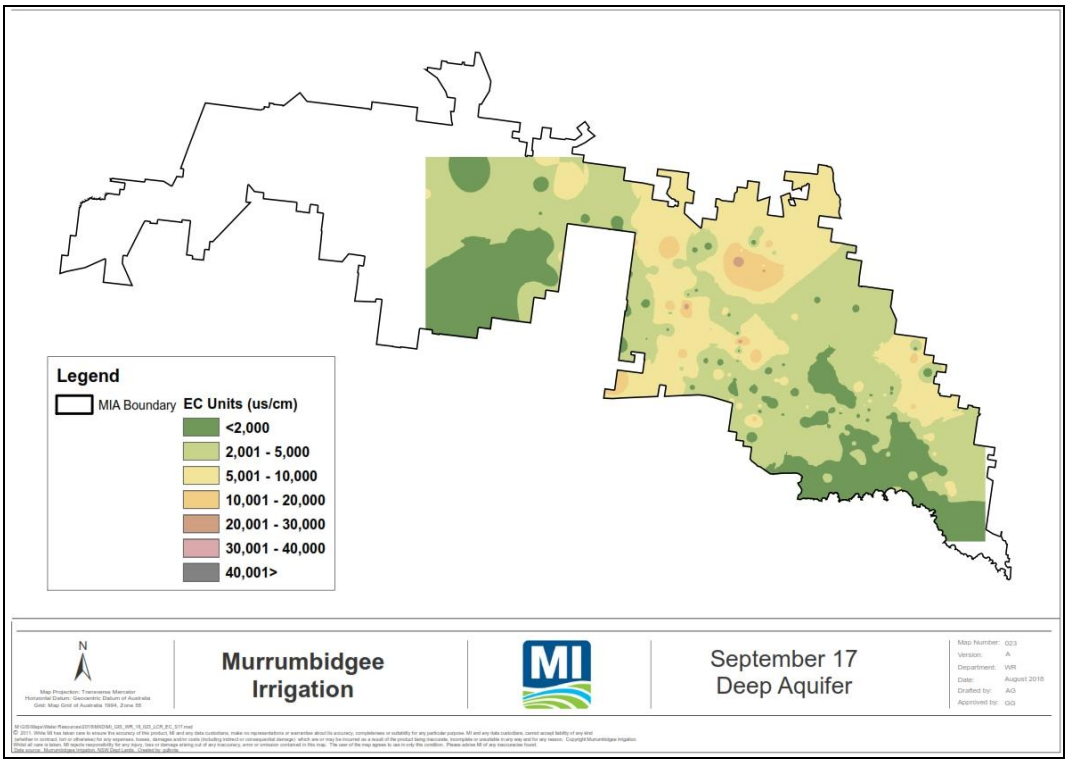

Figure 24 Deep Shepparton Formation- Groundwater Salinity, Sep 2017

2016/17

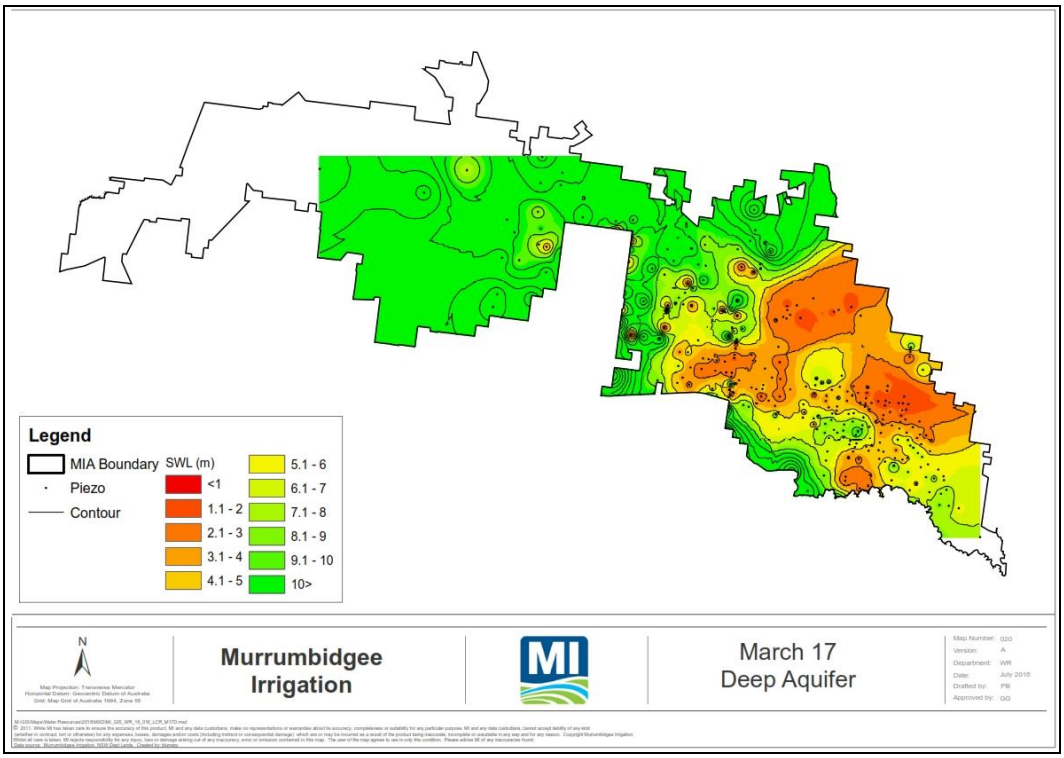

Figure 25 Deep Shepparton Formation- depth to water table, March 2017

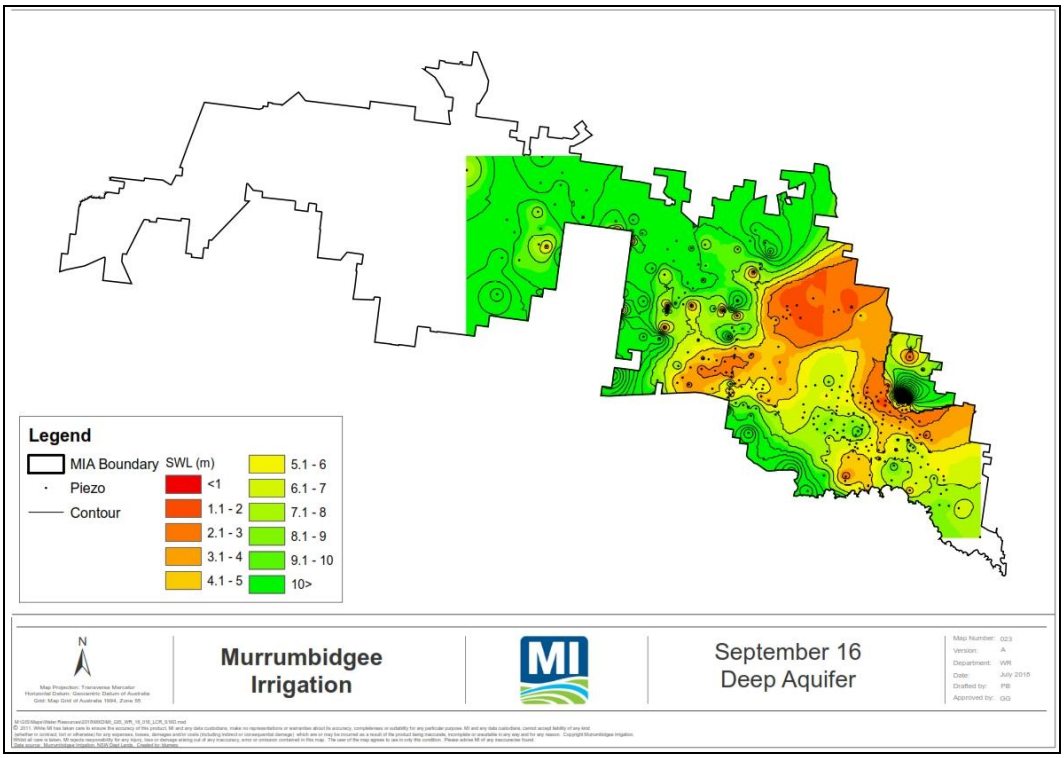

Figure 26 Deep Shepparton Formation- depth to water table, Sep 2016

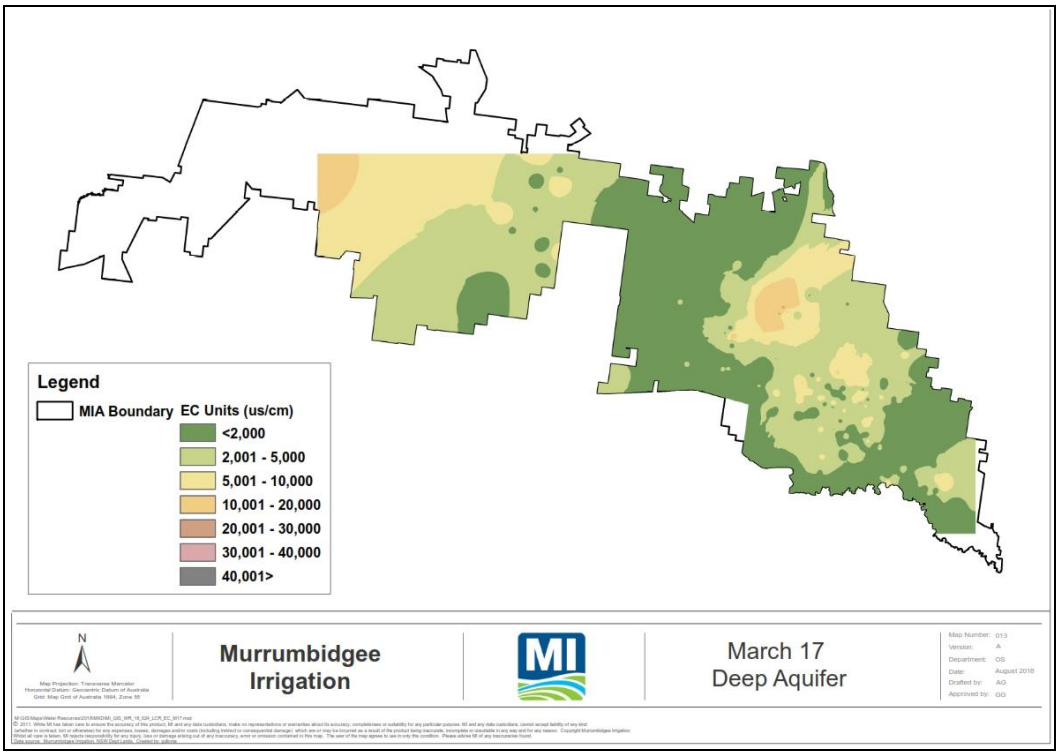

Figure 27 Deep Shepparton Formation- Groundwater Salinity, March 2017

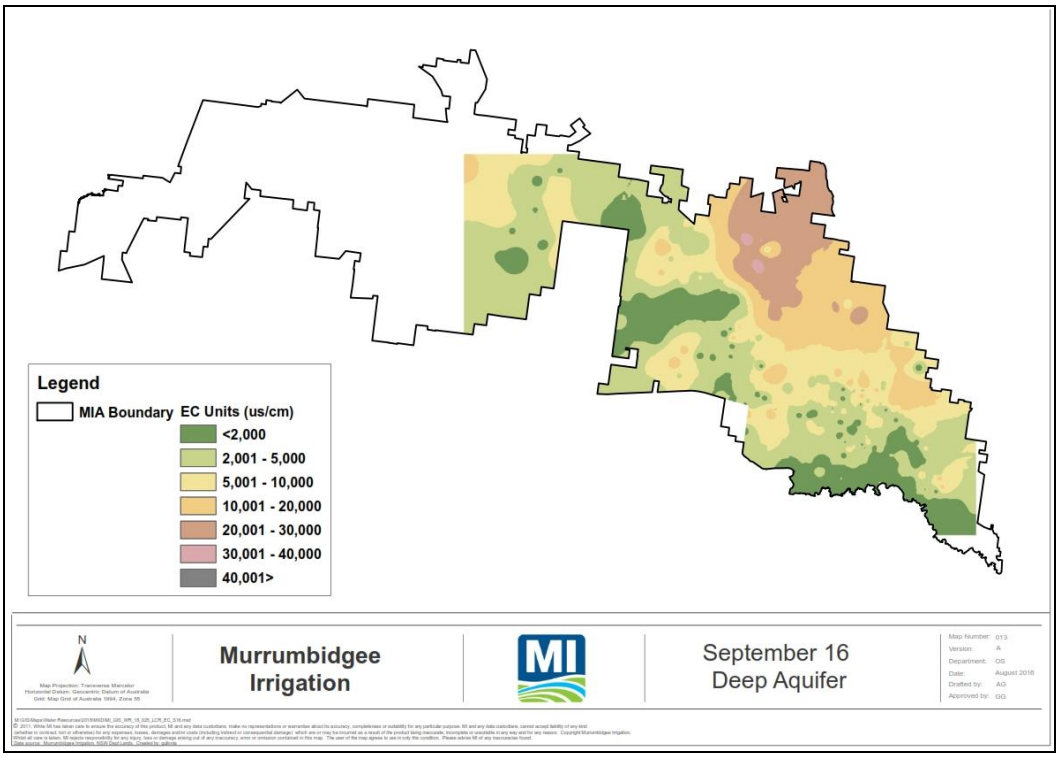

Figure 28 Deep Shepparton Formation- Groundwater Salinity, Sep 2016

2015/16

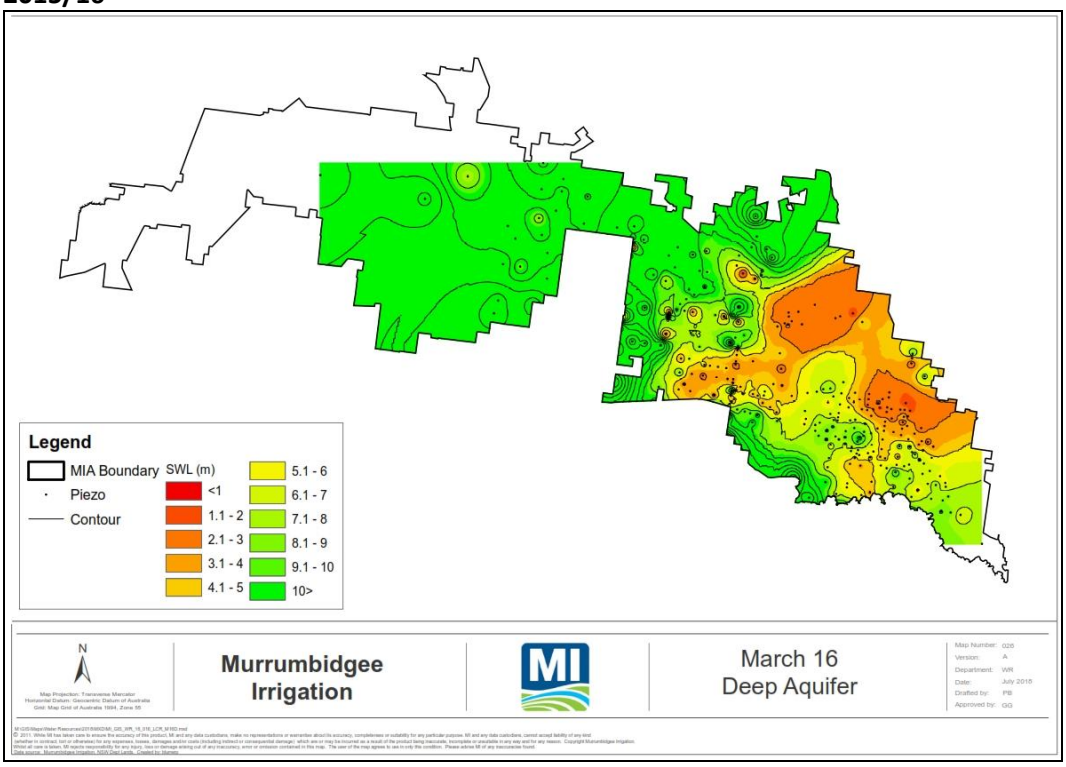

Figure 29 Deep Shepparton Formation- depth to water table, March 2016

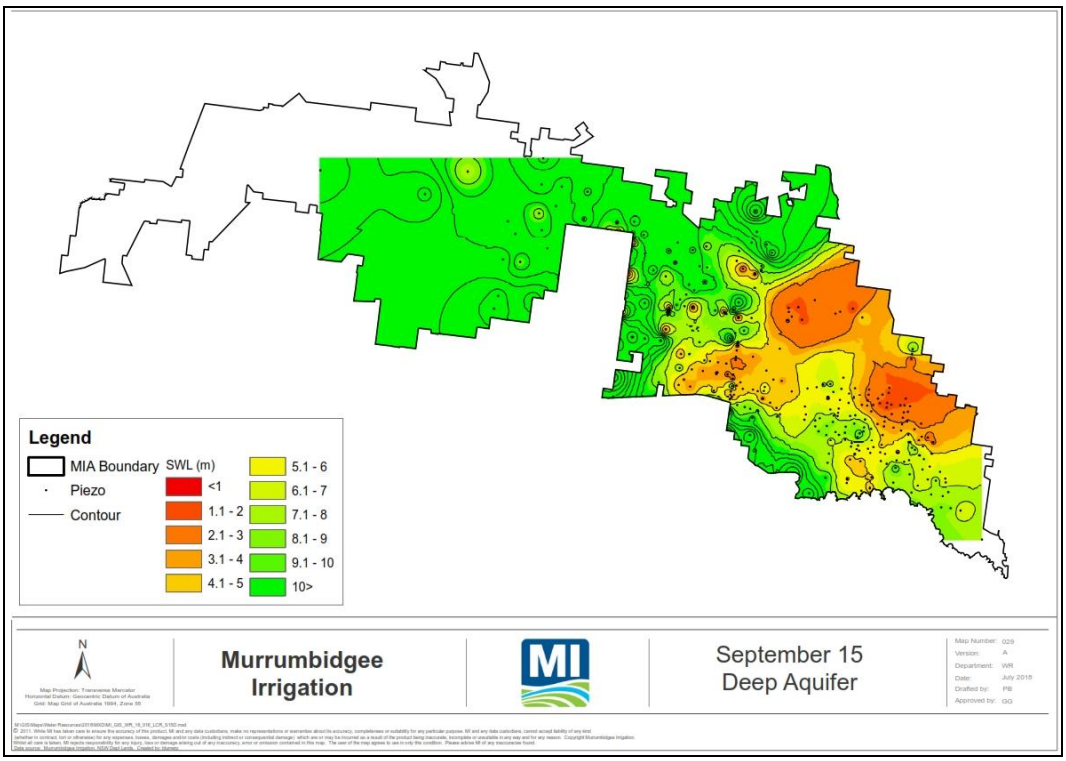

Figure 30 Deep Shepparton Formation- depth to water table, September 2015

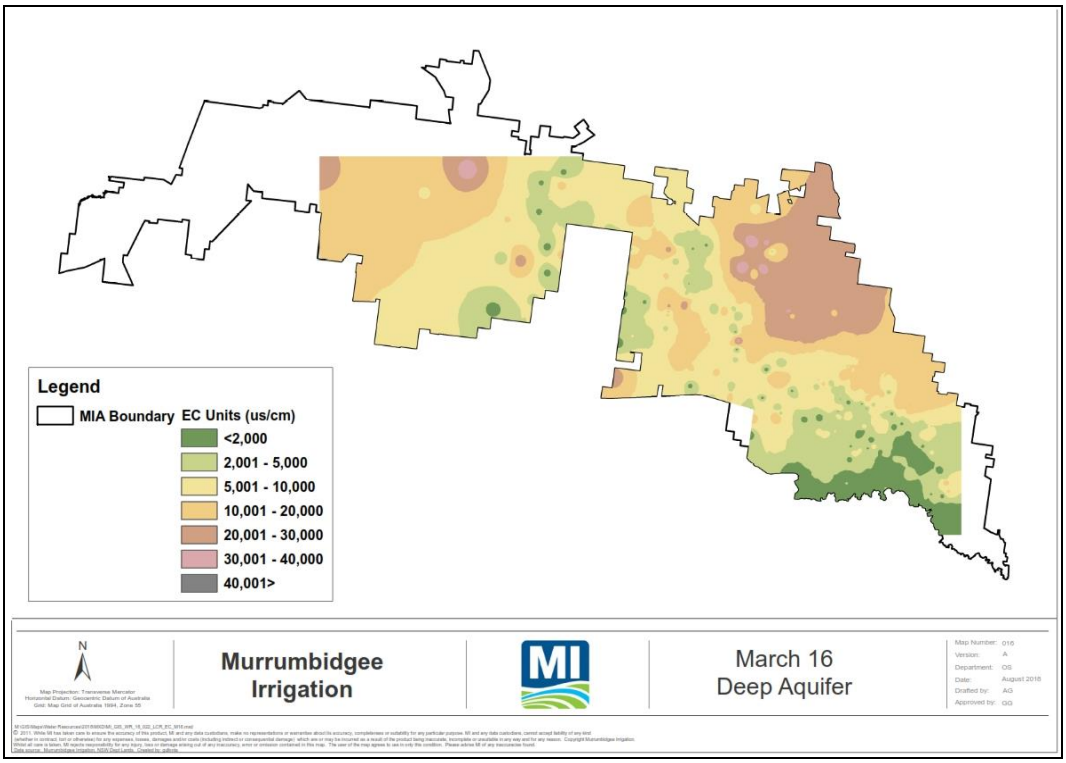

Figure 31 Deep Shepparton Formation- Groundwater Salinity, March 2016

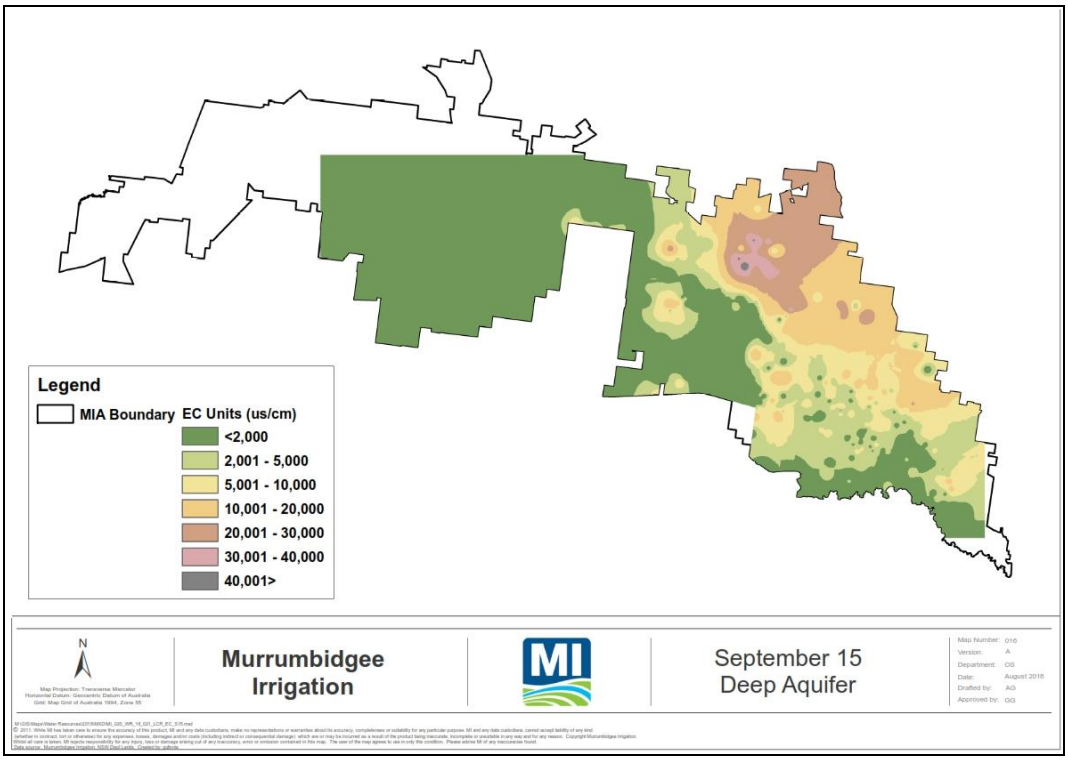

Figure 32 Deep Shepparton Formation- groundwater Salinity, Sep 2015

2005/06

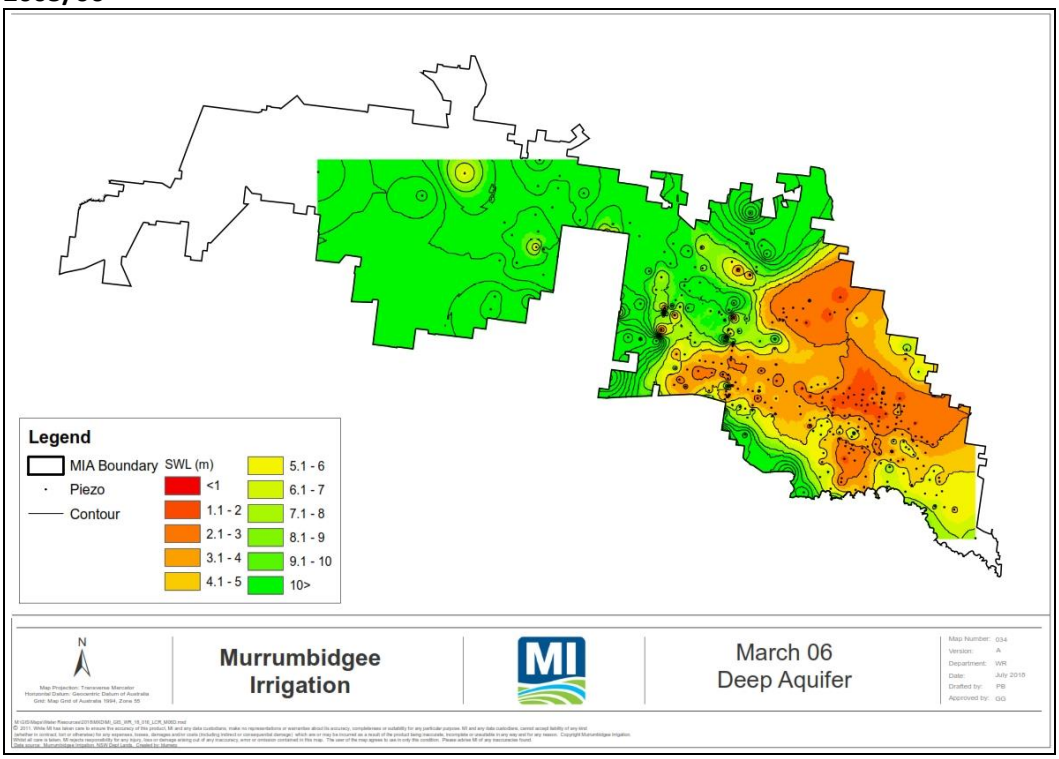

Figure 33 Deep Shepparton Formation – Depth to water table, March 2006

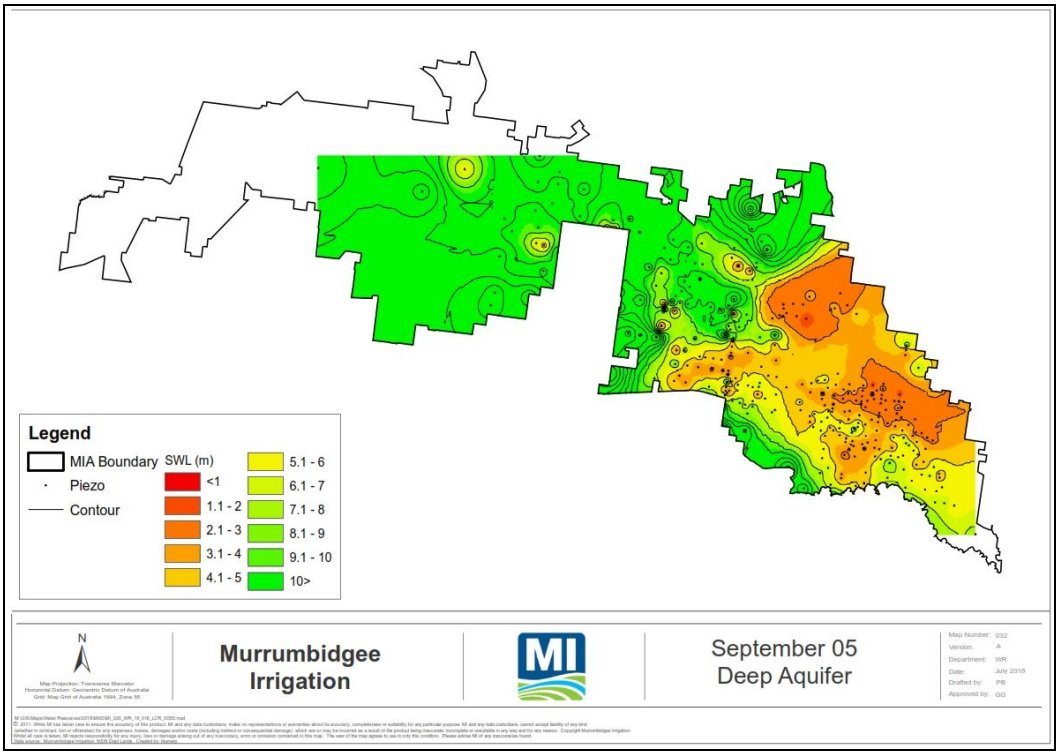

Figure 34 Deep Shepparton Formation – Depth to water table, September 2005

1980/2002

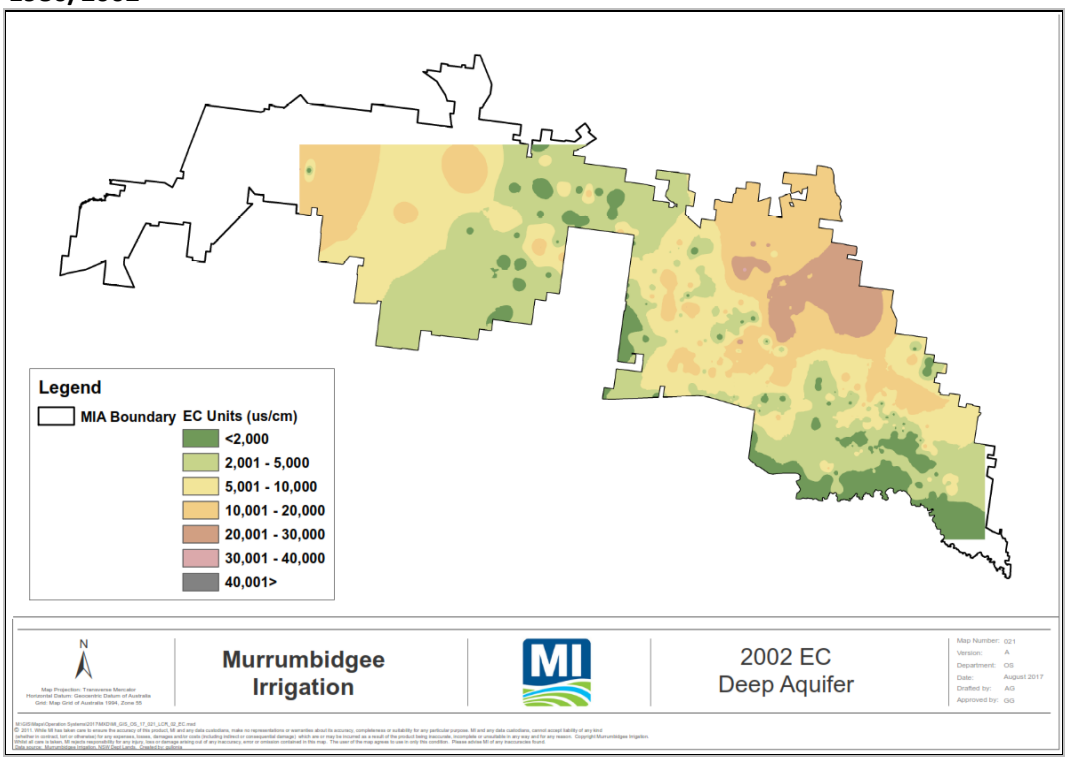

Figure 35 Deep Shepparton Formation - groundwater salinity, 2002

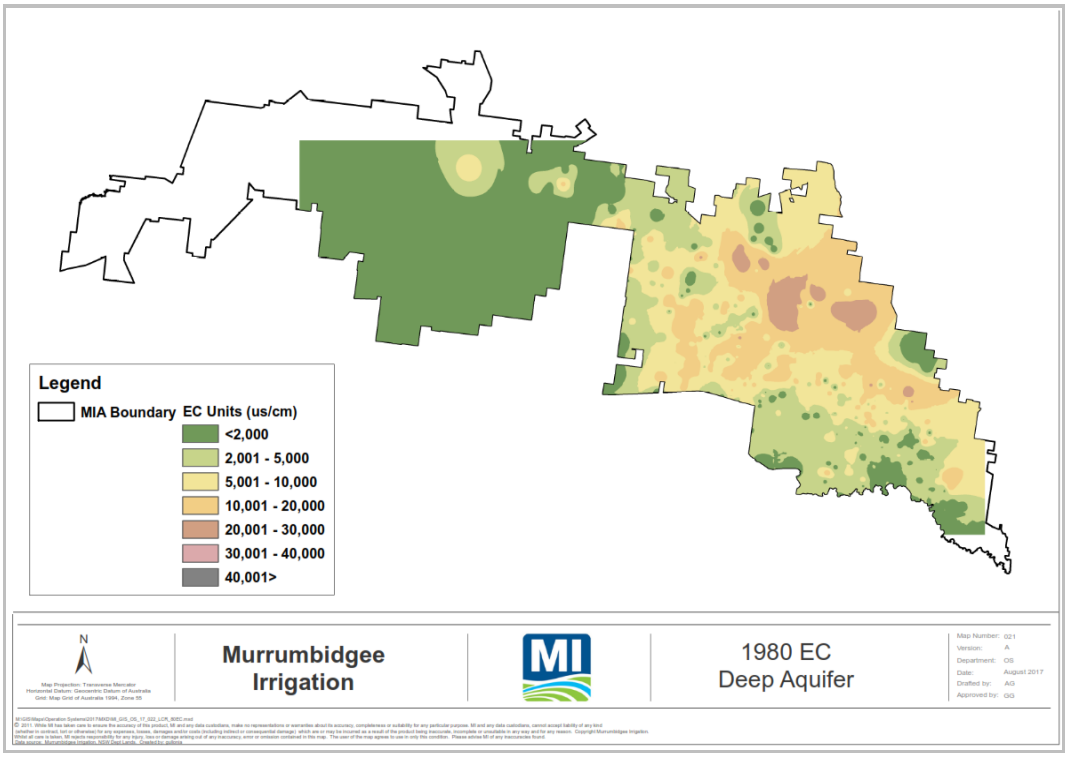

Figure 36 Deep Shepparton Formation - groundwater salinity, September 1980

6.5 Calivil Formation

Depth to water table and salinity maps for piezometers in the Calivil Formation are presented in Figures 37 to 52. Level trends in this formation generally represent drawdown from shallow aquifers. As seen in the upper formations, piezometers measured in the deep formation March 2018 (Figure 39) exhibit low salinity. This suggests that the Calivil Formation may be influenced by large flooding events, either through direct recharge, aquifer exchange or, to a lesser degree, vertical seepage from the above Shepparton Formation. However, due to the dynamic nature of groundwater aquifers, it is difficult to ascertain the true origin and significance of level changes with any confidence. Levels in this aquifer remain consistent for all reporting years, with the majority with a depth of more than 10m.

2017/18

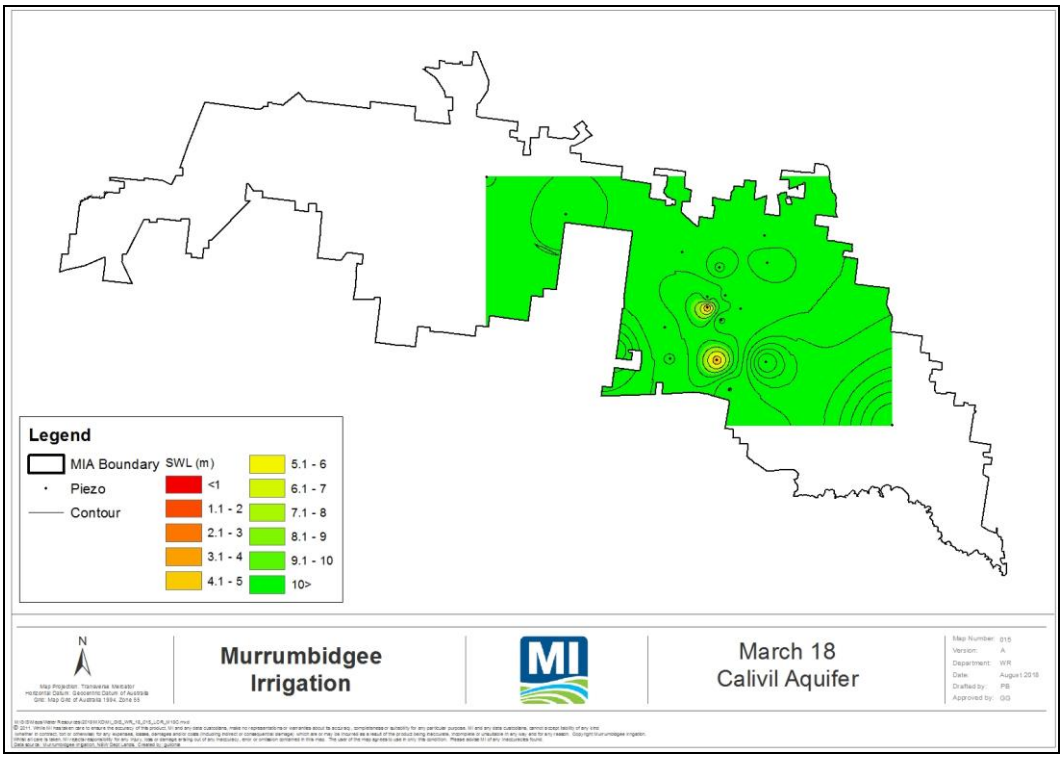

Figure 37 Calivil Formation - depth to water table, March 2018

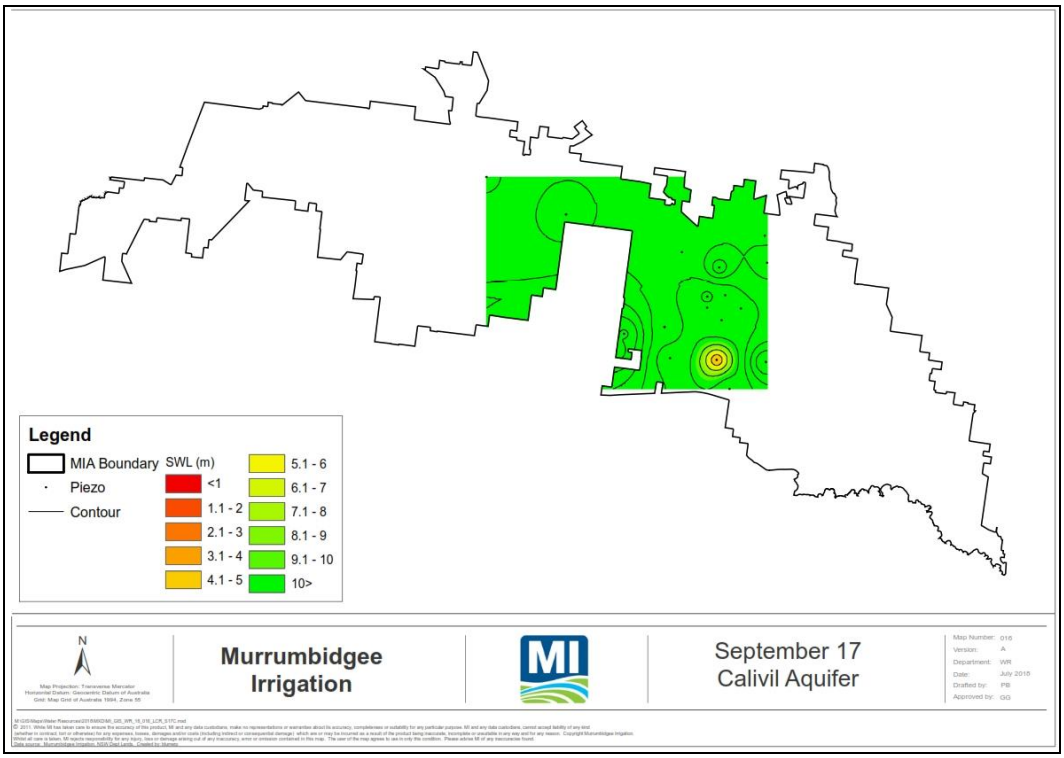

Figure 38 Calivil Formation - depth to water table, Sep 2017

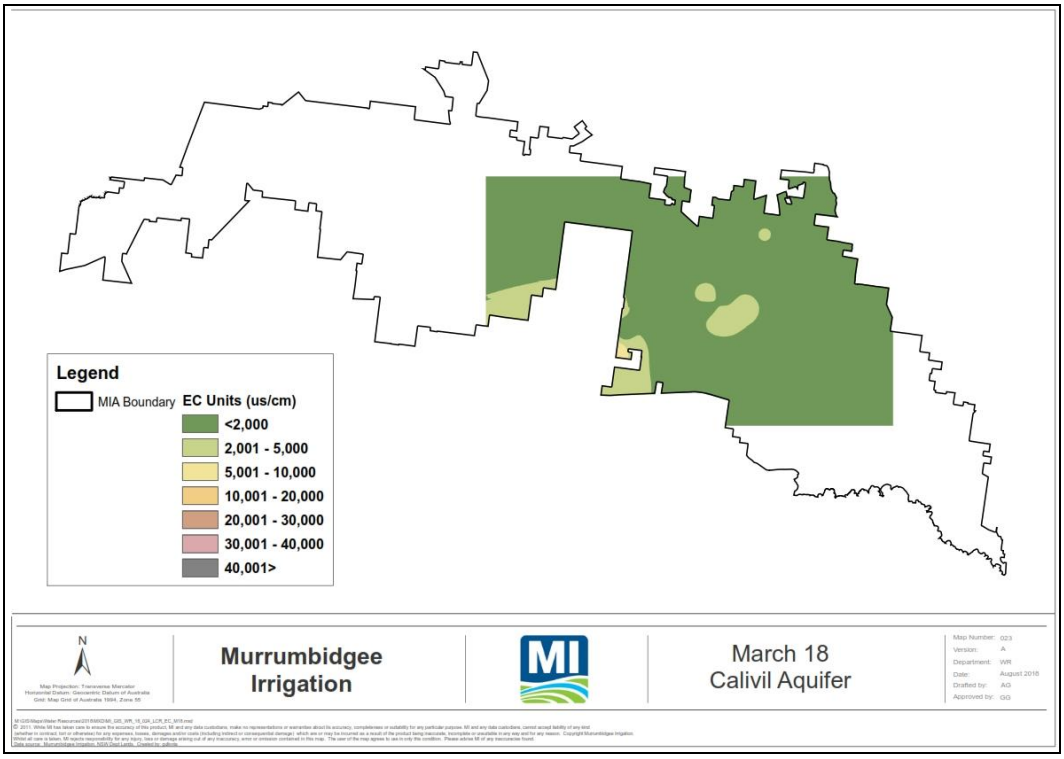

Figure 39 Calivil Formation- groundwater salinity, March 2018

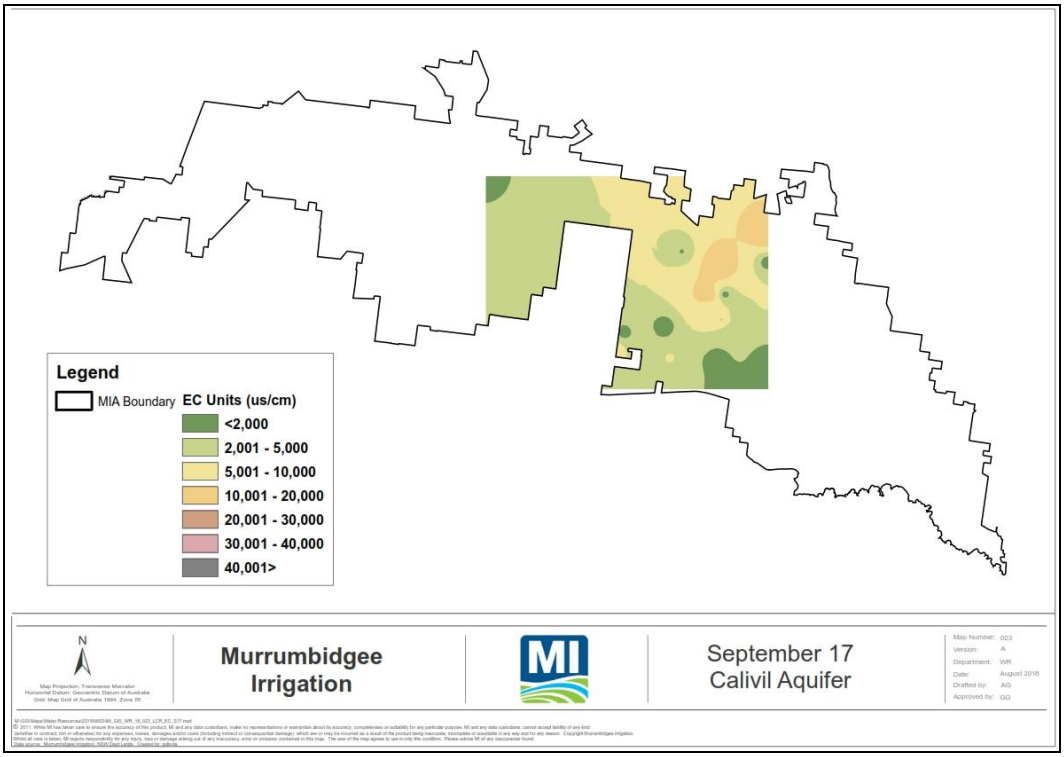

Figure 40 Calivil Shepparton Formation- groundwater salinity, Sep 2017

2016/17

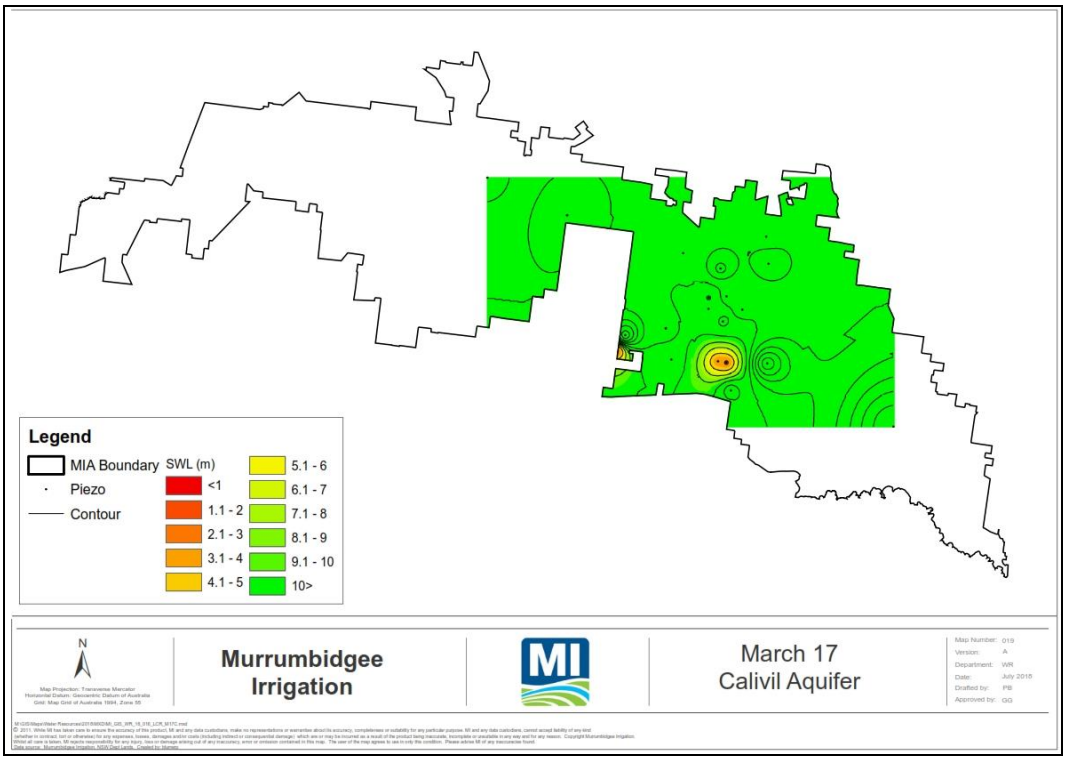

Figure 41 Calivil Formation - depth to water table, March 2017

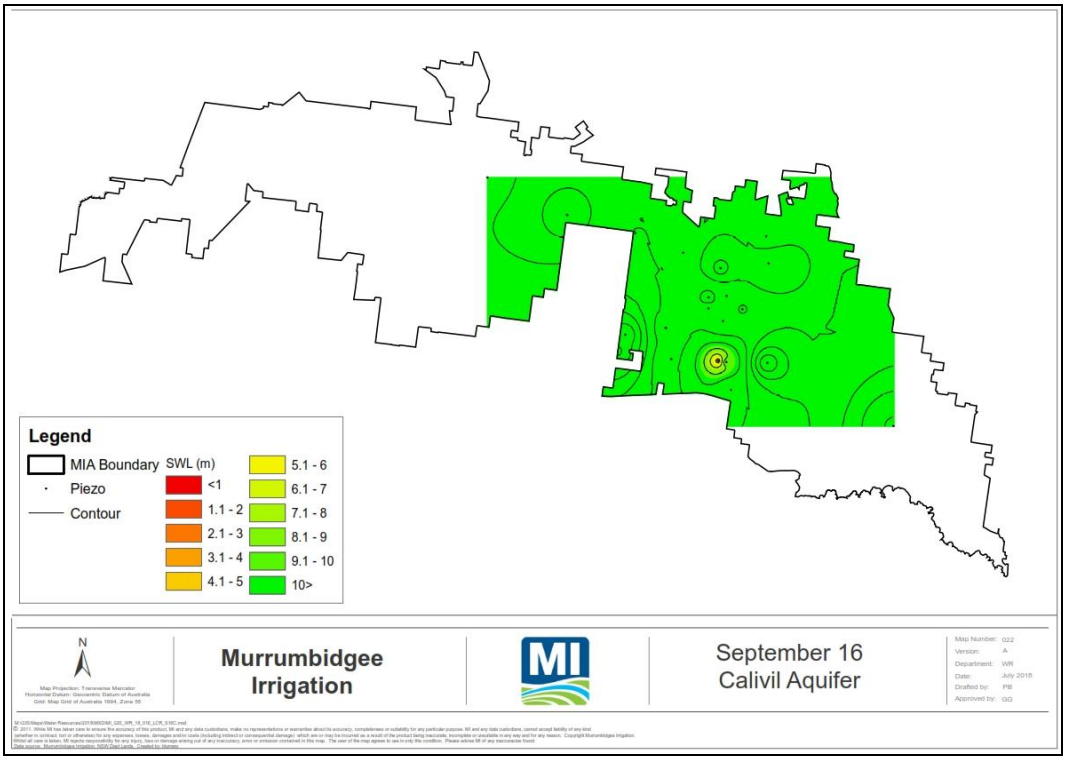

Figure 42 Calivil Formation - depth to water table, September 2016

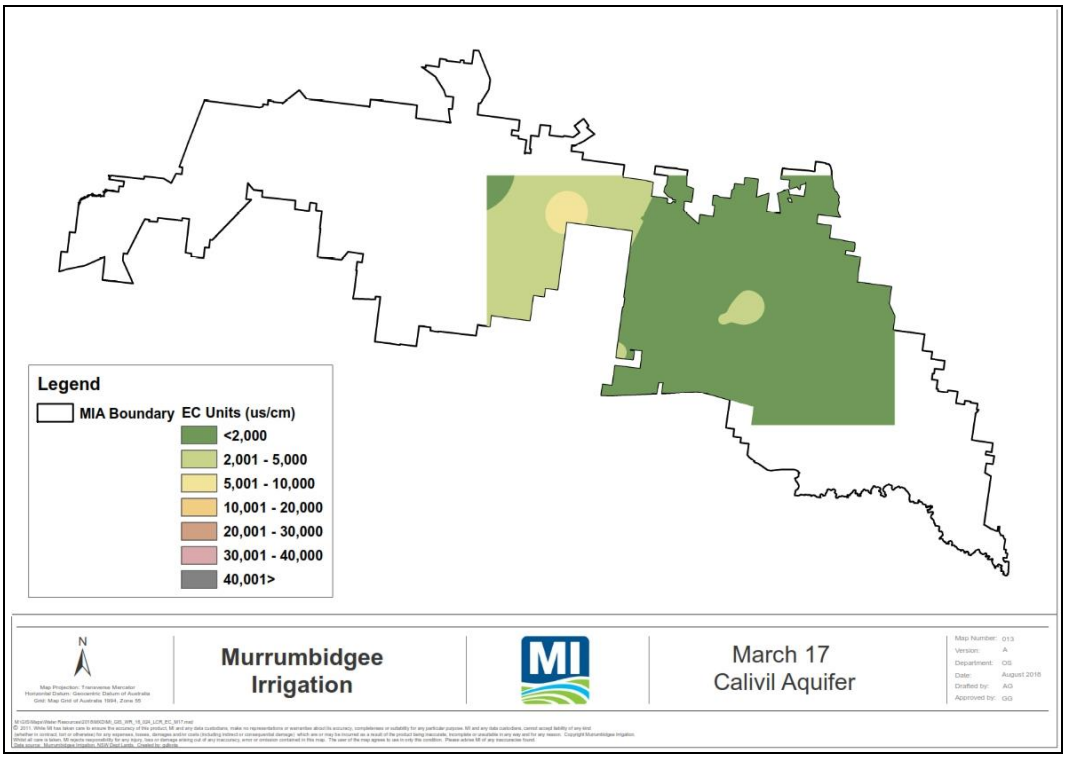

Figure 43 Calivil Formation- groundwater salinity, March 2017

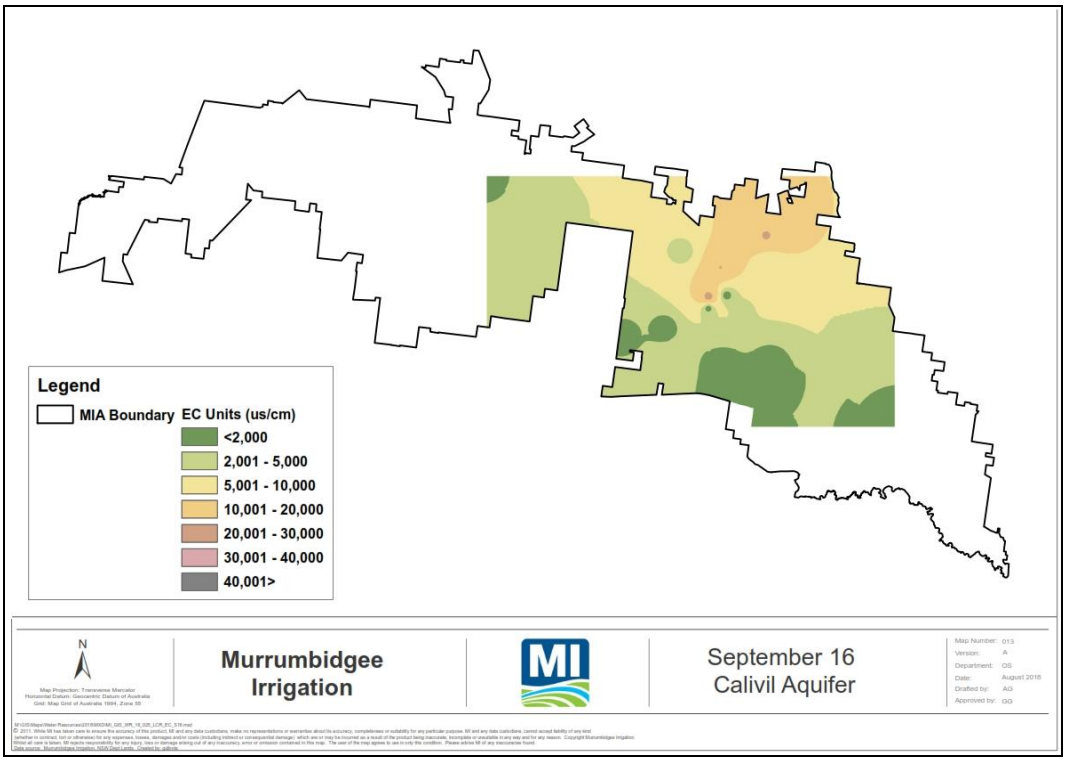

Figure 44 Calivil Formation- groundwater salinity, Sep 2016

2015/16

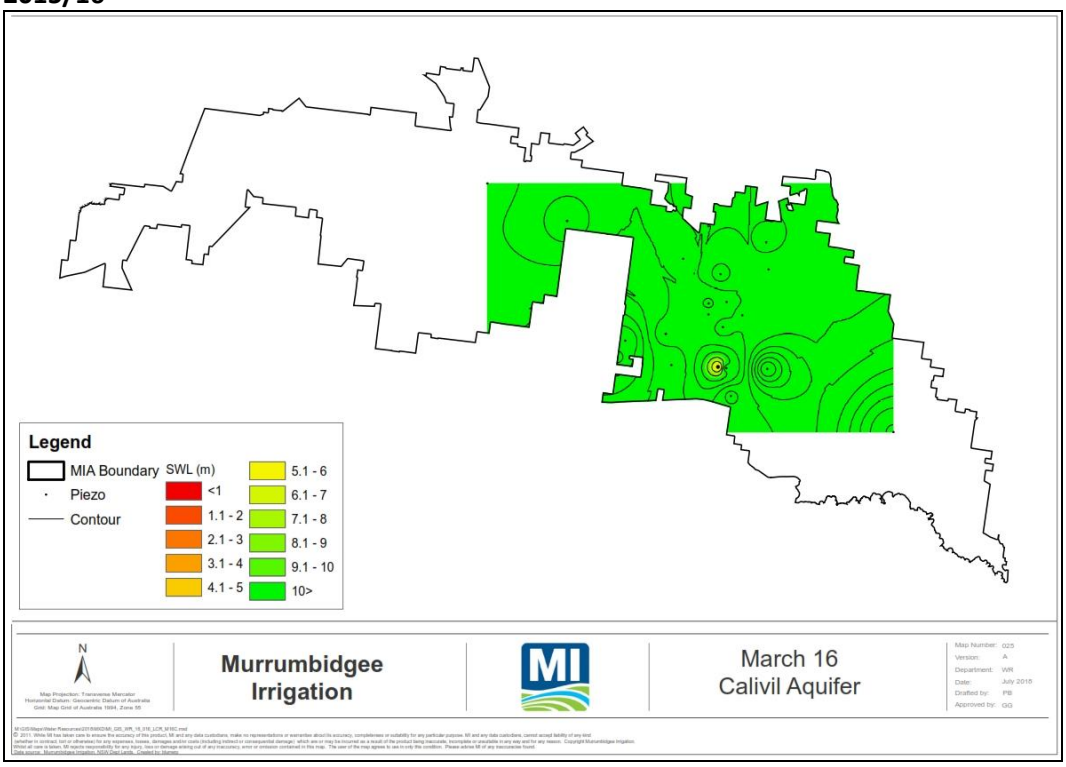

Figure 45 Calivil Formation - depth to water table, March 2016

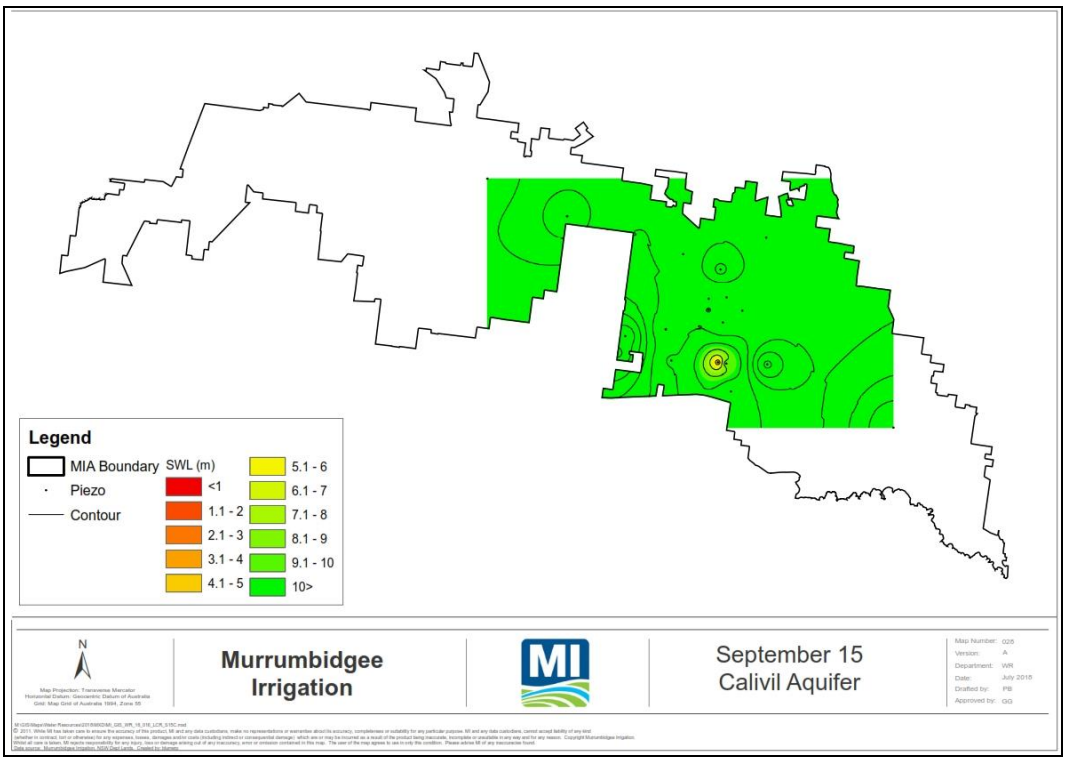

Figure 46 Calivil Formation - depth to water table, September 2015

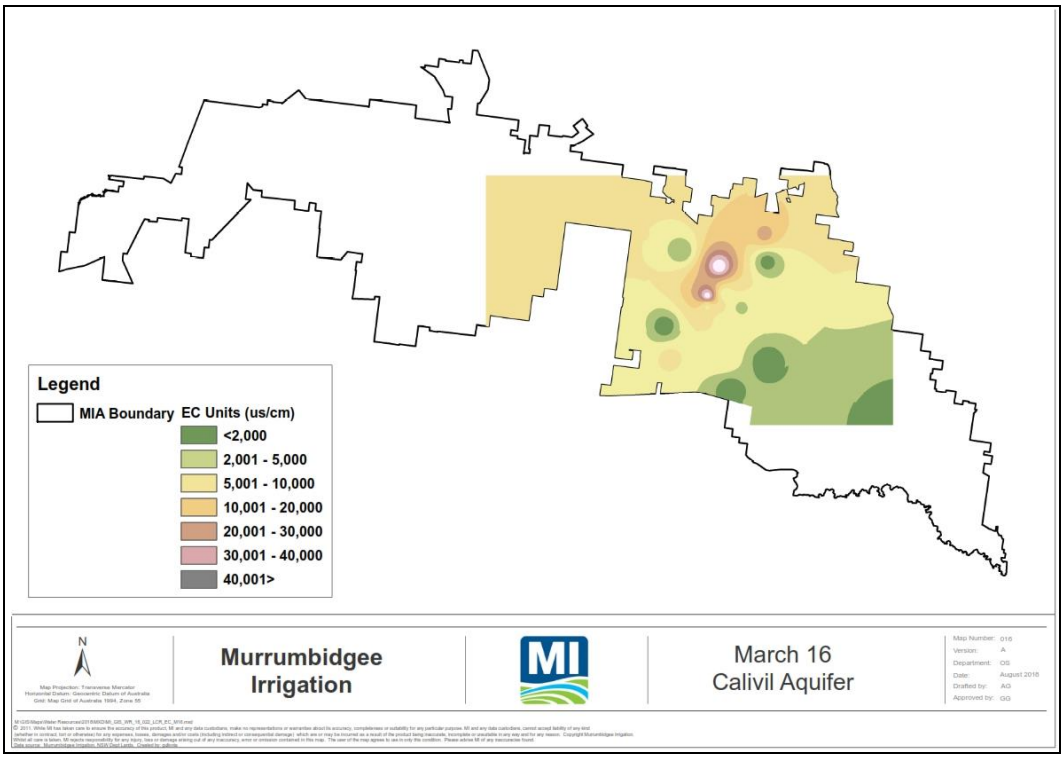

Figure 47 Calivil Formation- groundwater salinity, March 2016

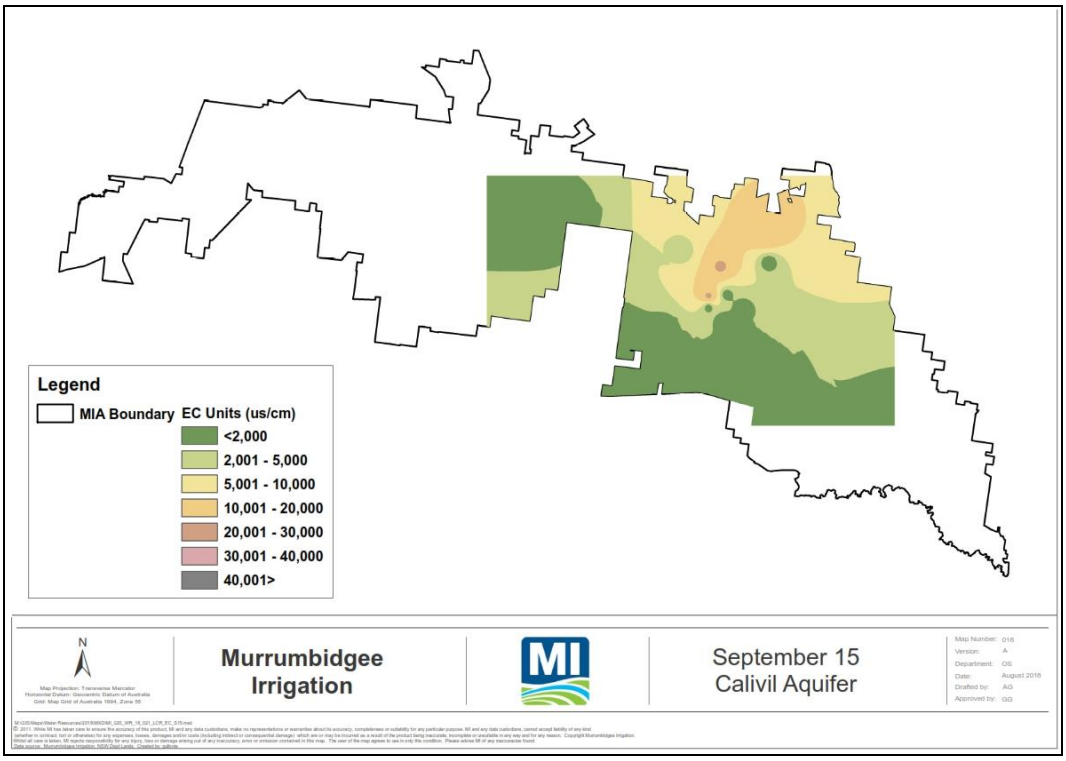

Figure 48 Calivil Formation- groundwater salinity, Sep 2015

2005/06

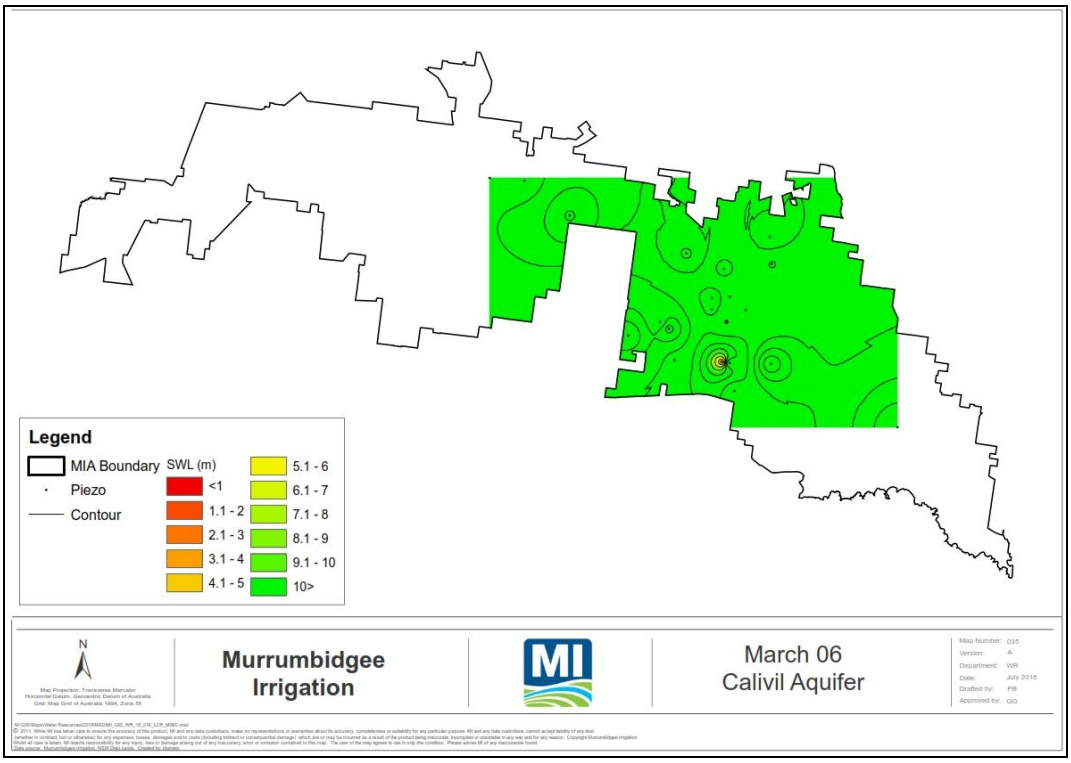

Figure 49 Calivil Formation - depth to water table, March 2006

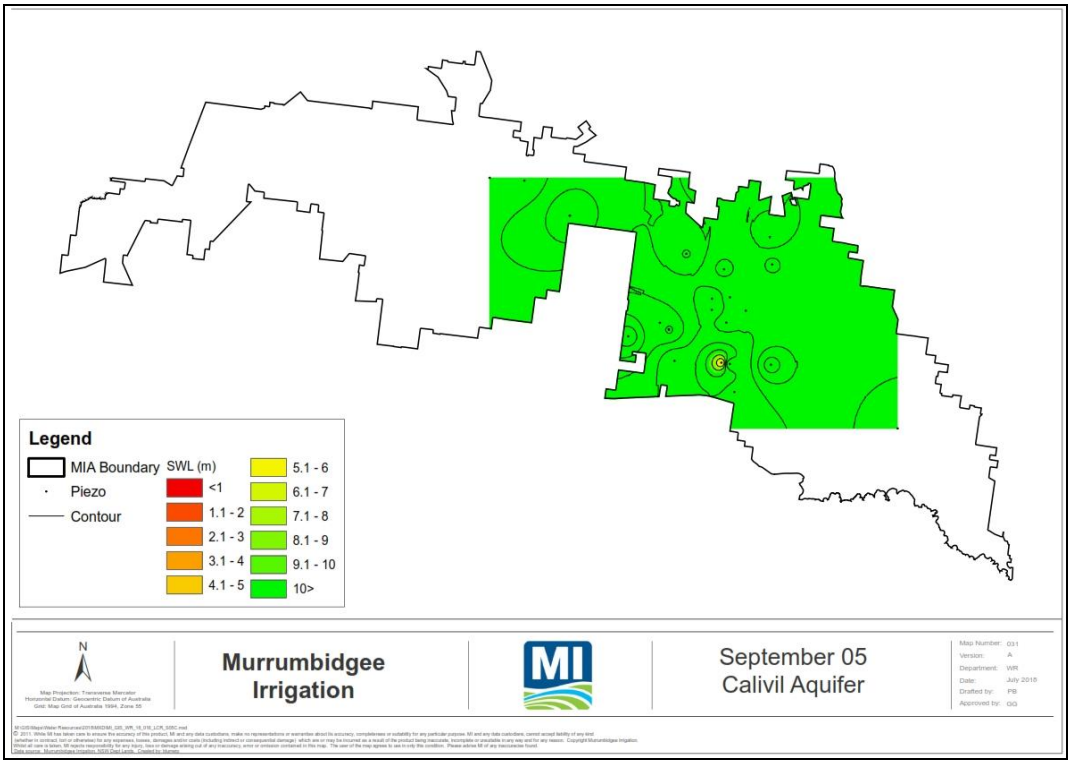

Figure 50 Calivil Formation - depth to water table, Sep 2005

1980/2002

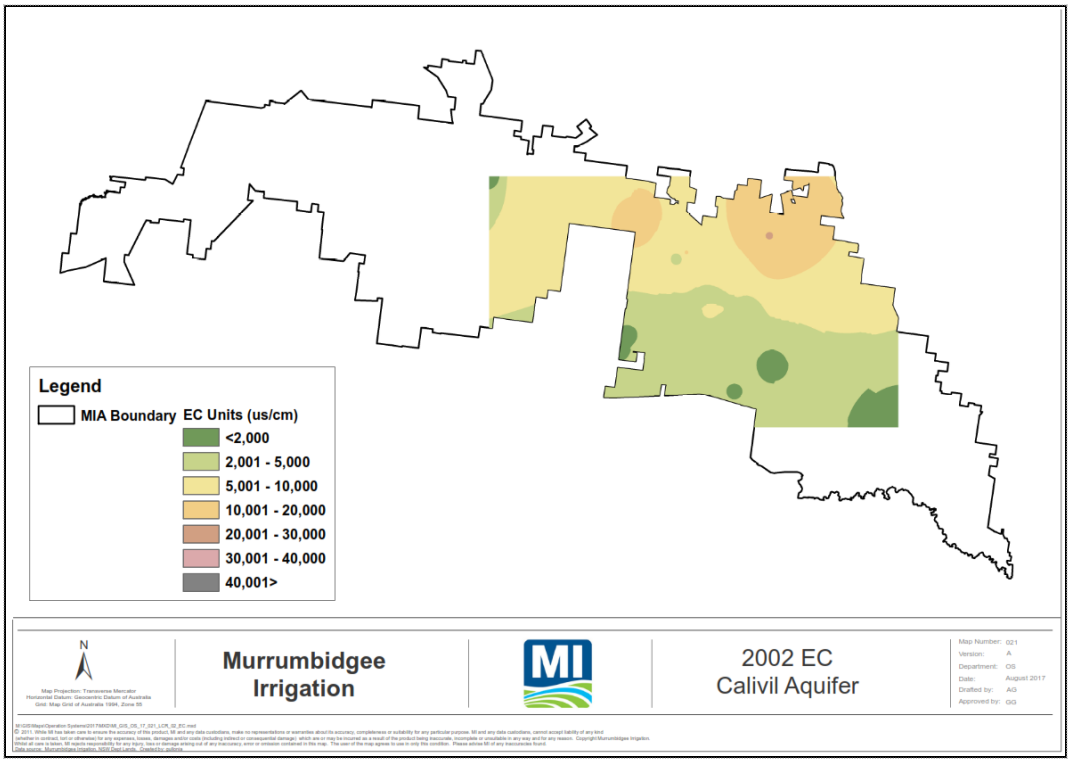

Figure 51 Calivil Formation - groundwater salinity, September 2002

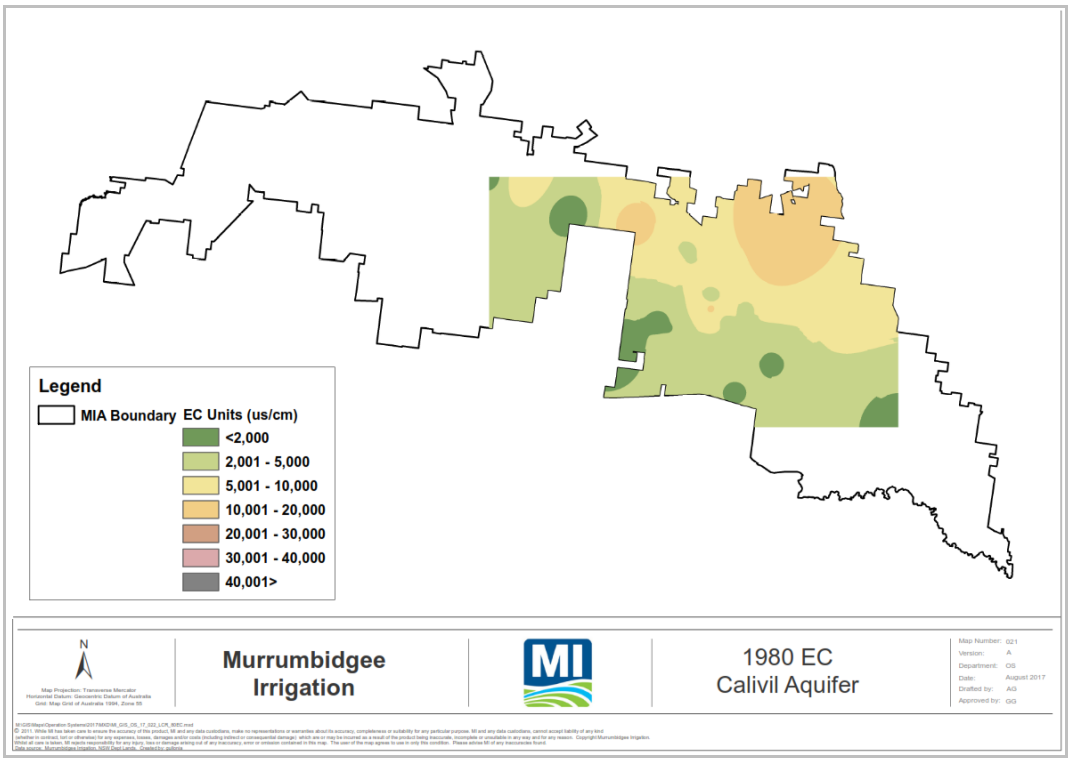

Figure 52 Calivil Formation - groundwater salinity, September 1980

7 Tubewells

MI monitors the volume of water and salt load pumped from seven tubewells within the MIA. The location of the tubewells is shown in Figure 4. Table 23 shows the total volumes and salt discharged from tubewells for 2017/18 and previous years. EC was measured in July 2018 and used to calculate salt loads. A total volume of 906 ML and 1313 tonnes of salt was discharged from tubewells for 2017/18.

Table 23 Tubewell monitoring data 2017/18 compared to previous years

2017/18			2016/17		
Location	**Volume (ML)**	**Salt load (t)**	**Location**	**Volume (ML)**	**Salt load (t)**
Five Bridges	0	0	Five Bridges	324	180*
Gil Gil	378	696	Gil Gil	518	1,061
Yanco West	321	528	Yanco West	284	513
South Leeton	0	0	South Leeton	191	816*
Baulch's	0	0	Baulch's	0	0
Wamoon	111	50	Wamoon	238	128
East Wamoon	96	39	East Wamoon	261	129
Total	**906**	**1313**	**Total**	**1816**	**2829**
2015/16			**2006/07**		
Location	**Volume (ML)**	**Salt load (t)**	**Location**	**Volume (ML)**	**Salt load (t)**
Five Bridges	658	357	Five Bridges	707	489
Gil Gil	412	755	Gil Gil	266	353
Yanco West	274	680	Yanco West	305	404
South Leeton	261	1,090	South Leeton	76	118
Baulch's	0	0	Baulch's	137	52
Wamoon	175	88	Wamoon	384	200
East Wamoon	93	40	East Wamoon	778	454
Total	**1,873**	**3,012**	**Total**	**2,653**	**2,070**

*no EC data available. Three year average used to calculate salt load

8 New Measures to Limit Groundwater Recharge and Discharge of Salt

No new measures were implemented for 2017/18.

9 Environmental Protection and Management

9.1 Discharge of noxious aquatic weeds

During 2017/18 irrigation year, there was no known potential or actual discharge of Class 1, 2 or 3 declared noxious aquatic weeds from MI's Area of Operation.

9.2 Discharge of Blue-Green Algae

No Red alert level Blue Green Algae was detected from 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 2017/18, aside from one occasion where reporting of monitoring results did not take place within required timeframes, due to an internal process failure that has since been addressed and detailed in MI's Annual Return. A summary of the compliance requirements is cross referenced to this report and listed in Table 24.

Quality assurance and control procedures are in place to guarantee 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) 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. Direction on how to make a complaint can be found on MI's website (www.mirrigation.com.au/Contact-Us).

Table 24 Environmental Protection Licence (EPL 4651) Monitoring and Reporting Requirements

Licence section	Requirement	Compliant	Report Section
Administrative Conditions	1	Yes	N/A
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	www.mirrigation.com.au/Environment/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	No	1. Statement of Compliance
Monitoring Records	M1	Yes	Available upon request from EPA
Requirement to monitor concentration of pollutants discharged	M2	Yes	11. EPL Monitoring and Reporting
Testing Methods	M3	Yes	Internal documents
Recording of pollution complaints	M4	Yes	Available upon request from EPA
Telephone complaints line	M5	Yes	1. Statement of Compliance
Requirement to monitor volume or mass	M6	Yes	11. EPL Monitoring and Reporting
Other Monitoring and recording conditions	M7	Yes	8.1. Noxious Weed Management
Annual return documents	R1		Submitted August 2017
Notification of environmental harm	R2	Yes	N/A
Written Report (of an event)	R3	Yes	N/A
Annual system performance report	R4	Yes	Full Report
Other reporting conditions	R5	Yes	Section 10

11 EPL Monitoring and Reporting

Under MI's EPL 4651, five points (Figure 2) are licenced 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 measured during flow or rainfall events. These monitoring points are referred to throughout this section.

11.1 System performance

Table 25 presents total diversions into the MIA and total water discharged from the MIA for 2017/18 compared to previous years. In 2017/18, 4,471 ML was discharged and included 3,405ML discharged to Mirrool Creek Floodway to mitigate localised flooding. The large volume discharged in the 2016/17 season included 121,363 ML that was diverted to Mirrool Creek Floodway in response to well above average rainfall and subsequent floodwater entering MI drainage networks from catchments in and outside of the MIA.

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 waste water directly to groundwaters inside or outside the area of operations.

Table 25 Total water volumes (ML)

Year	Diversions	Discharged
2017/18	945,805	4,471
2016/17	780,083	122,092
2015/16	643,957	1,079
2005/06	1,036,519	8,570

11.2 Water Quality Monitoring

Monthly summaries for each monitoring point are presented in Table 26 - 30. Monitoring consisted of 44 sampling events, with 5 action level and 15 notification level detections. Action level detections. consisted of 3 Metolachlor, 1 Chlorpyrifos and 1 Thiobencarb. The number of Action level detections was lower compared to last reporting year where 9 Action levels were detected.

Diuron, Metolachlor, Chlorpyrifos and Thiobencarb were the four chemicals detected in 2017/18. Chemical detections were found at 3 of the 5 Licenced sites, Point 4 – LAG, Point 5 – GMSRR and Point 15 – MIRFLD.

Table 26 Monitoring results for Point 4 - LAG

Point 4 – LAG				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-17	0.0	0	0	-
Aug-17	1.5	0	0	-
Sep-17	25.0	2	0	-
Oct-17	27.9	4	3	3/10/2017 Notification level Diuron (1.17µg/L) 10/10/2017 Notification level Diuron (4.81 µg/L) Notification level Simazine (4.82 µg/L)
Nov-17	20.6	3	1	3/11/2017 Notification level Diuron (1.39 µg/L)
Dec-17	111.6	3	1	3/12/2017 Action level Metolachlor (1.33 µg/L)
Jan-18	17.7	4	1	8/1/2018 Notification level Metolachlor (0.059 µg/L)
Feb-18	21.4	1	0	-
Mar-18	9.0	2	1	27/3/2018 Action level Chlorpyrifos (0.266 µg/L)
Apr-18	0.9	0	0	--
May-18	0.0	0	0	-
Jun-18	6.3	0	0	-
Total	241.9	19	7	-

Table 27 Monitoring results for Point 5 - GMSRR

Point 5 – GMSRR				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-17	0.0	0	0	-
Aug-17	1.3	0	0	-
Sep-17	2.5	1	0	-
Oct-17	10.7	2	0	-
Nov-17	0.1	0	0	-
Dec-17	56.5	3	2	4/12/2017 Notification level Diuron (1.2 µg/L) Notification level Metolachlor (0.025 µg/L)
Jan-18	0.0	0	0	-
Feb-18	0.0	0	0	-
Mar-18	0.0	0	0	
Apr-18	0.0	0	0	
May-18	28.2	1	0	
Jun-18	47.1	2	1	19/6/2018 Notification level Chlorpyrifos (0.087 µg/L)
Total	146.3	9	3	

Table 28 Monitoring results for Point 6 - YMS

Point 6 – YMS				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-17	0.0	0	0	-
Aug-17	0.0	0	0	-
Sep-17	0.0	0	0	-
Oct-17	0.0	0	0	-
Nov-17	0.0	0	0	-
Dec-17	0.0	0	0	-
Jan-18	0.0	0	0	-
Feb-18	0.0	0	0	-
Mar-18	0.0	0	0	-
Apr-18	0.0	0	0	-
May-18	0.0	1	0	-
Jun-18	195	1	0	-
Total	195	2	0	-

Table 29 Monitoring results for Point 7 - ROCUDG

Point 7 – ROCUDG				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-17	0.0	0	0	-
Aug-17	33.4	1	0	-
Sep-17	1.1	0	0	-
Oct-17	8.1	1	0	-
Nov-17	0.0	0	0	-
Dec-17	108.8	2	0	-
Jan-18	59.0	2	0	-
Feb-18	22.5	0	0	-
Mar-18	33.9	1	0	-
Apr-18	44.0	1	0	-
May-17	64.8	2	0	-
Jun-17	107.1	0	0	-
Total	482.4	10	0	-

Table 30 Monitoring results for Point 15 - MIRFLD

Point 15 – MIRFLD				
Month	**Discharge Volumes (ML)**	**No. of sampling events**	**No. of detections**	**Chemical detection details**
Jul-17	0.0	0	0	-
Aug-17	0.0	0	0	-
Sep-17	0.0	0	0	-
Oct-17	0.0	0	0	-
Nov-17	100	2	6	20/11/2017 Notification level Chlorpyrifos (0.064 µg/L) Action level Metolachlor (0.216 µg/L). 22/11/2017 Notification level Chlorpyrifos (0.083 µg/L) Notification level Diuron (2.5 µg/L) Action level Metolachlor 0.434 µg/L) Action level Thiobencarb (4.79 µg/L)
Dec-17	3305	2	4	1/12/2017 Notification level Chlorpyrifos (0.015 µg/L) Notification level Metolachlor (0.045 µg/L) 10/12/2017 Notification level Chlorpyrifos (0.029 µg/L) Notification level Metolachlor (0.039 µg/L)
Jan-18	0.0	0	0	-
Feb-18	0.0	0	0	-
Mar-18	0.0	0	0	-
Apr-18	0.0	0	0	-
May-18	0.0	0	0	-
Jun-18	0.0	0	0	-
Total	3405	4	10	-

END