

Annual Bulk Entitlement Report

**Anglesea groundwater
2023-2024**

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1. Introduction

The Anglesea Borefield is one of a number of water sources that can supplement the existing Greater Geelong water supply system. Our diverse water supply mix is part of a balanced approach to managing the region's water resources and providing greater water security. The Anglesea Borefield is used to extract groundwater from the Lower Eastern View Formation in the Jan Juc Groundwater Management Area and contains seven production bores that are licensed to extract a maximum of 40 ML in any day, 10,000 ML in any year, and 35,000 ML in any 5-year period.

When in use, groundwater from the Anglesea Borefield is pre-treated at the Anglesea Pre-Treatment Plant before it is transferred to Wurdee Boluc Reservoir, where it is stored and eventually undergoes full treatment before being supplied to customers.

The borefield was operated intermittently between 2009 and 2012 for commissioning and testing, and then again between August 2019 and end of June 2020 to supplement the existing Greater Geelong water supply system. On 27 January 2022, Barwon Water commenced a groundwater pumping test to inform a review of our bulk entitlement and environmental monitoring program for the Anglesea borefield. The pumping test ran for six months with strict environmental protection controls in place. The test was completed on 27 July 2022. We extracted 1,783 ML during the test, and this water was used to supplement drinking water supplies for Barwon Water customers.

During 2023-2024, which is the reporting period covered by this annual report, no water was extracted from the Anglesea Borefield.

Barwon Water operates the Anglesea Borefield under the Bulk Entitlement (Anglesea Groundwater) Order 2009 (the Order), which requires Barwon Water to prepare an annual report called the Annual Bulk Entitlement Report (Anglesea Groundwater). The annual report includes information on groundwater extraction rates, water quality sampling, trigger levels and any issues or difficulties in complying with the Order. This report will be available for stakeholders, agencies, our customers and community.

The Order requires Barwon Water to also establish a Monitoring and Assessment Program (MAP), which commenced in 2009. The objective of the MAP is to protect environmental values and the health of groundwater dependent ecosystems, while also continuing to collect data to build an understanding of the long-term sustainability of groundwater resources in the Anglesea area. Environmental monitoring is ongoing, even if the borefield is not in use.

Under the Order, Barwon Water is also required to undertake periodic reviews of the Bulk Entitlement (Anglesea Groundwater) Order 2009. The review conducted in 2013 identified a number of areas of the MAP that should continue to be monitored, as well as areas that are not considered to be dependent on groundwater from the Lower Eastern View Formation and, therefore, could be subject to reduced monitoring. As a result of the 2013 review, a revised MAP was established and subsequently approved by the Minister for Water in September 2014. Barwon Water has since implemented the revised MAP 2014 and has been operating in accordance with the MAP 2014.

In accordance with the Order, Barwon Water must prepare an annual report, to be called an Annual Bulk Entitlement Report (Anglesea Groundwater) which must include the following information in respect of the 12-month period, 1 July 2023 to 30 June 2024:

- a) the daily amount of groundwater taken under the Order;
- b) the monthly amount of groundwater taken under the Order;

- c) the annual amount of groundwater taken under the Order and from each bore;
- d) the results of the water quality sampling carried out under the monitoring and assessment program;
- e) any period or periods of greater than 30 days during which the average of the daily groundwater levels in an observation bore was below a trigger level as provided for in clause 9 of the Order;
- f) any issues or difficulties experienced or anticipated by Barwon Water in implementing an approved program or restoring groundwater levels as provided for in clause 9 of the Order;
- g) any arrangements entered into with an existing groundwater user under clause 7 of the Order;
- h) the results of any independent arbitration under clause 18 of the Order to which Barwon Water is a party; and
- i) any difficulties experienced or anticipated by Barwon Water in complying with the Order and any remedial action taken or proposed by it.

2. Groundwater extraction (Clauses 16.1 A, 16.2 A, 16.2 B and 16.2 C)

Under the bulk entitlement, and subject to ongoing appropriate environmental monitoring, Barwon Water is permitted to extract a maximum of 40 ML in any one day; 10,000 ML in any one year; and 35,000 ML in any five-year period. During the 2023-2024 reporting period no water was extracted from the Anglesea Borefield. Table 1 shows the daily extraction rates and Table 2 shows the total extraction per bore of the Anglesea Borefield during 2023-2024.

Community engagement

Keeping the community and key stakeholders updated on Anglesea Borefield operations and environmental monitoring is important. Barwon Water provides regular updates via the Surf Coast Shire, Anglesea River Advisory Group, Friends of Anglesea River and the wider Anglesea community.

The Anglesea Borefield operates in conjunction with an extensive environmental monitoring program, which includes community oversight of the monitoring through the Anglesea River Advisory Group.

Table 1: Total daily/monthly groundwater extraction 2023-2024

Date	Groundwater extraction rates (ML)											
	Jul 2023	Aug 2023	Sept 2023	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	April 2024	May 2024	June 2024
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
31	0.0	0.0		0.0		0.0	0.0		0.0		0.0	
Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Prog. Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Max. Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Min. Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ave. Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2: Annual groundwater extraction by bore 2023-2024

Production bores		Groundwater Extraction (ML)
MAP. ID	BE. ID	
GW1	(SPB1)	0
GW2	N/A	0
GW3	(SPB3)	0
GW4	(SPB4)	0
GW5	N/A	0
GW6	(NPB6)	0
GW7	(NPB7)	0
Annual total		0

3. Water quality sampling (Clause 16.2 D)

3.1 Groundwater quality

The 2014 MAP stipulates that groundwater salinity is to be measured twice a year at five deep observation bores (between 165 – 490m deep) as well as 11 shallow observation bores (less than 80m deep). The deep observation bores monitor the Upper Eastern View Formation (UEVF) and the Lower Eastern View Formation (LEVF), while the shallow observation bores monitor the perched water table as well as the UEVF and LEVF. The monitoring under the MAP utilises observation bores managed by Barwon Water, the State Government and Alcoa.

There are two bores identified in the MAP that monitor for saline intrusion, bore P14 in the LEVF and Coastal Bore 119349 in the UEVF. DEECA has advised that Coastal Bore 119349 is in poor condition and is scheduled for decommissioning. In 2021-22 Coastal Bore P21 in the UEVF was constructed meaning we now have data for the UEVF coastal bore.

Production bores

The MAP requires weekly monitoring of field salinity and temperature in each production bore (GW1-GW7) that is in operation when taking groundwater. The Anglesea Borefield was not operated during 2023-2024. Given this, no field salinity readings were taken from the production bores.

Deep observation bores

The 2023-2024 groundwater salinity results from the deep observation bores are provided in

Table 3, while the results over the whole monitoring period (from April 2010 onwards) have been provided graphically in Figure 1. This figure depicts the salinity measurements against the groundwater extraction and recovery periods. A linear regression line has been developed for each site in order to compare the results over the monitoring period.

Laboratory testing of major cations and anions, salinity (TDS and EC), pH, and bromide (for bores P14) was also completed at these groundwater bores and has been provided in Appendix E.

Table 3: Groundwater Quality Results – Deep Observation bores

Bore ID	Aquifer	Depth (m)	Date	Field Parameters			Lab Result	
				Temp °C	pH	EC (µS/cm)	EC (µS/cm)	TDS (mg/L)
119348	LEVF	N/A	Jul-23	23.6	7.33	1247	1300	787
			Jan-24	23.7	7.31	1303	1330	632
SB2	UEVF	229	Jul-23	16.34	5.64	3172	3170	1820
			Jan-24	19.6	5.52	2037	2100	1040
NB2	UEVF	165	Jul-23	12.63	5.83	2453	2460	1550
			Jan-24	23.3	5.68	2491	2320	1400
P14	LEVF	504	Jul-23	15.4	6.24	938	944	805
			Jan-24	20.5	5.79	779	844	405
P15	LEVF	466	Jul-23	16	4.96	892	876	579
			Jan-24	23.1	4.92	893	919	478

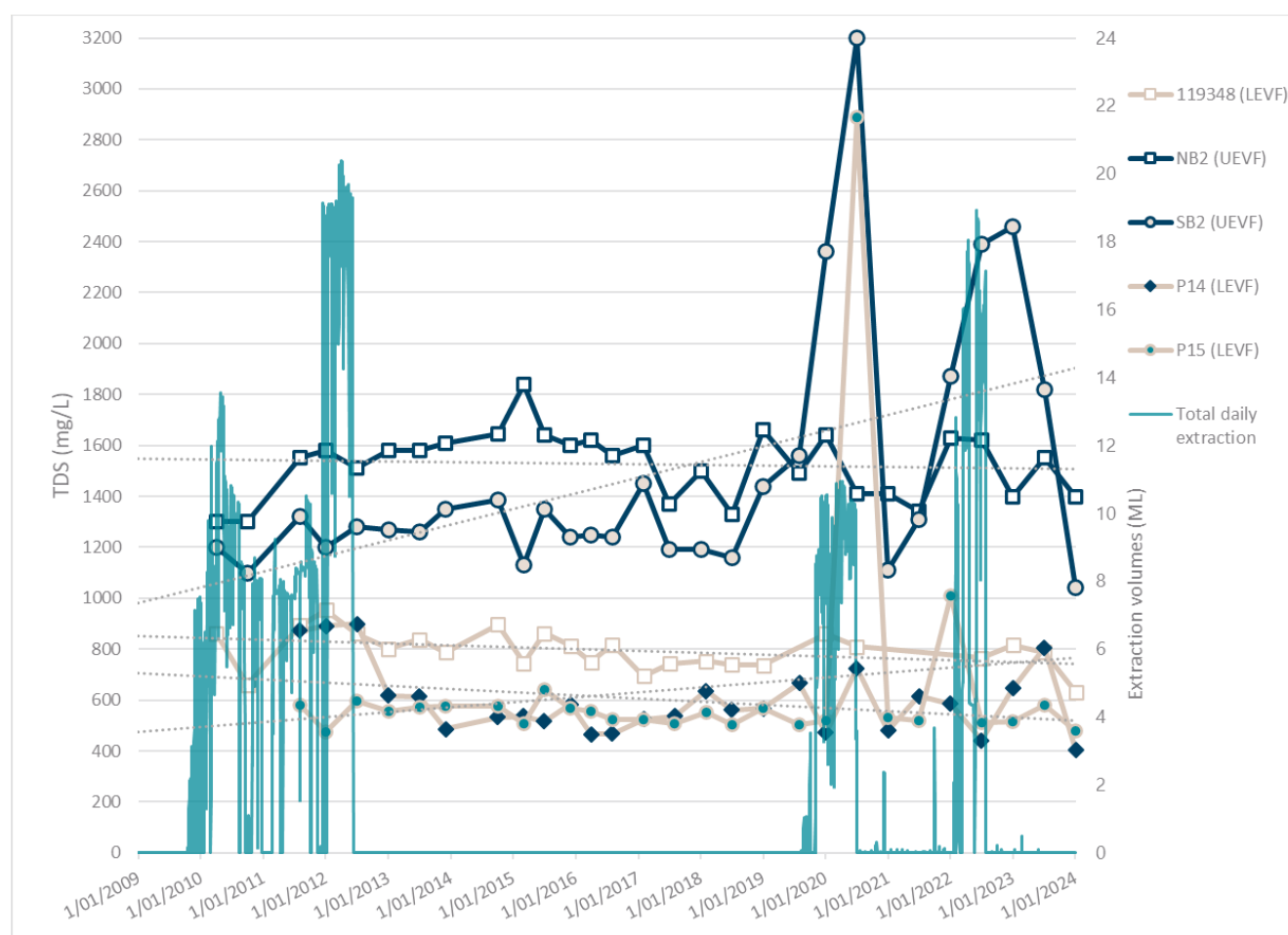


Figure 1: Groundwater quality results – deep observation bores

The field readings taken for the Electrical Conductivity (EC) are conducted during the bore purging process. Both the Total Dissolved Solids (TDS) and EC are taken to measure the salinity in groundwater samples. The TDS readings are measured in controlled laboratory conditions by weighing the residual

solids that remain after the water from the sample is evaporated. This method is proven to be much more accurate than the EC readings, where an electrical current is passed through the sample and measured. Since the TDS yields more accurate results, these results have been used to analyse the trends in the groundwater salinity.

Given its proximity to the coastline, P14 is also tested for chloride and bromide to monitor for potential seawater intrusion. Testing began in December 2013 and has continued bi-annually since then. Seawater in an open ocean has a constant chloride/bromide ratio of approximately 285g/1g (285:1). Therefore, a decreasing chloride/bromide ratio, in conjunction with rising salinity can be indicative of saline intrusion. Results in Figure 2 show that there is no indication of saline intrusion at observation bore P14.

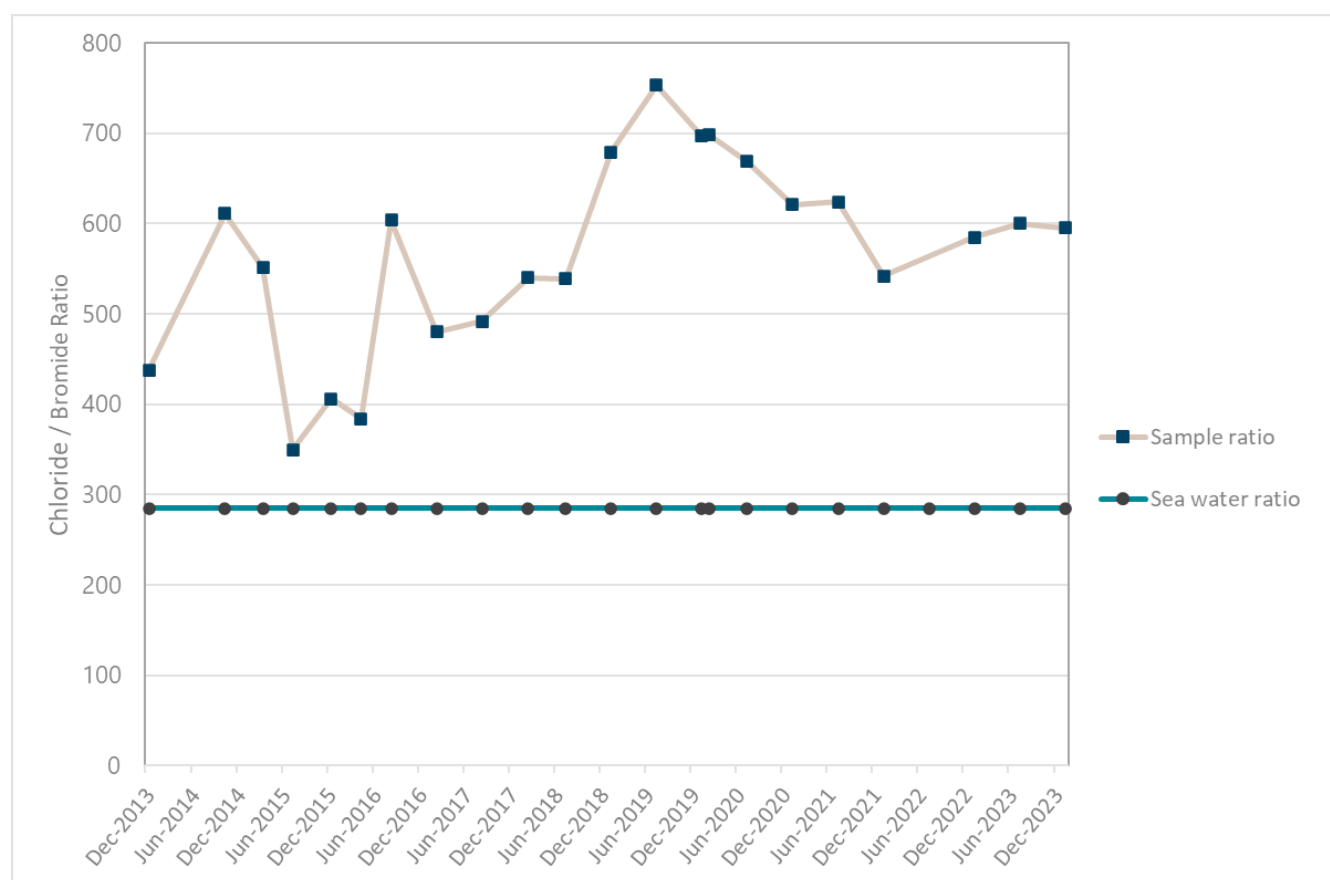


Figure 2 illustrates the chloride/bromide ratios overtime. The trend remains above the 285:1 ratio associated with seawater. Hence there continues to be no indication of saline intrusion at P14 to date.

Shallow observation bores

The 2023-2024 groundwater salinity results from the shallow observation bores are provided in Table 4. Groundwater salinity monitoring at the shallow observation bores commenced in April 2015, which provides the opportunity to look at longer-term trends. Figure 3 below shows the trend of each shallow observation bore over time using the data available.

The assessment of groundwater quality is primarily focused on salinity as the main indicator of changes in the aquifer system. Salinity levels in the perched water table generally fluctuate more than in the upper or lower eastern view formations. This is potentially due to the variable nature of the water level

in the perched water table as a result of climatic conditions. When considering the impact of the climate versus pumping it is important to consider P17, which is considered to sit outside the area of influence from pumping. Results for shallow observation bore water level versus salinity level is provided in Appendix G.

Table 4: Groundwater Quality Results – Shallow Observation bores

			Field Parameters			Lab Result	
Bore ID	Aquifer	Date	Temp °C	pH	EC (µS/cm)	EC (µS/cm)	TDS (mg/L)
Anglesea River Catchment							
WTOB3	PWT	Jul-23	14.3	5.56	1517	1640	923
		Jan-24	15.25	5.47	1558	1560	841
P7B	PWT	Jul-23	12.6	3.79	1328	1340	760
		Jan-24	16.1	4.09	1419	1480	678
P8	PWT	Jul-23	11.82	5.17	2243	2240	1210
		Jan-24	15.94	5.2	2275	2200	1570
P19	UEVF	Jul-23	14.4	5.83	1201	1240	783
		Jan-24	16.72	5.78	1277	1230	658
P12	LEVF	Jul-23	11.1	5.45	1455	1130	714
		Jan-24	15.35	6.41	1174	1140	611
WTOB2	PWT	Jul-23	12.4	3.93	3157	3330	2140
		Jan-24	15.3	4.07	3193	2970	1680
Salt Creek Catchment							
P16	LEVF	Jul-23	11.85	4.61	285	298	534
		Jan-24	15.7	4.54	346	350	898
P17	PWT	Jul-23	13.69	6.68	1421	1400	778
		Jan-24	15.0	6.46	1329	1300	1050
P1	PWT	Jul-23	11.81	6.4	505	483	372
		Jan-24	14.61	6.26	455	418	925
WTOB1	PWT	Jul-23	14.6	5.32	1269	1350	879
		Jan-24	15.8	5.09	1412	1420	829

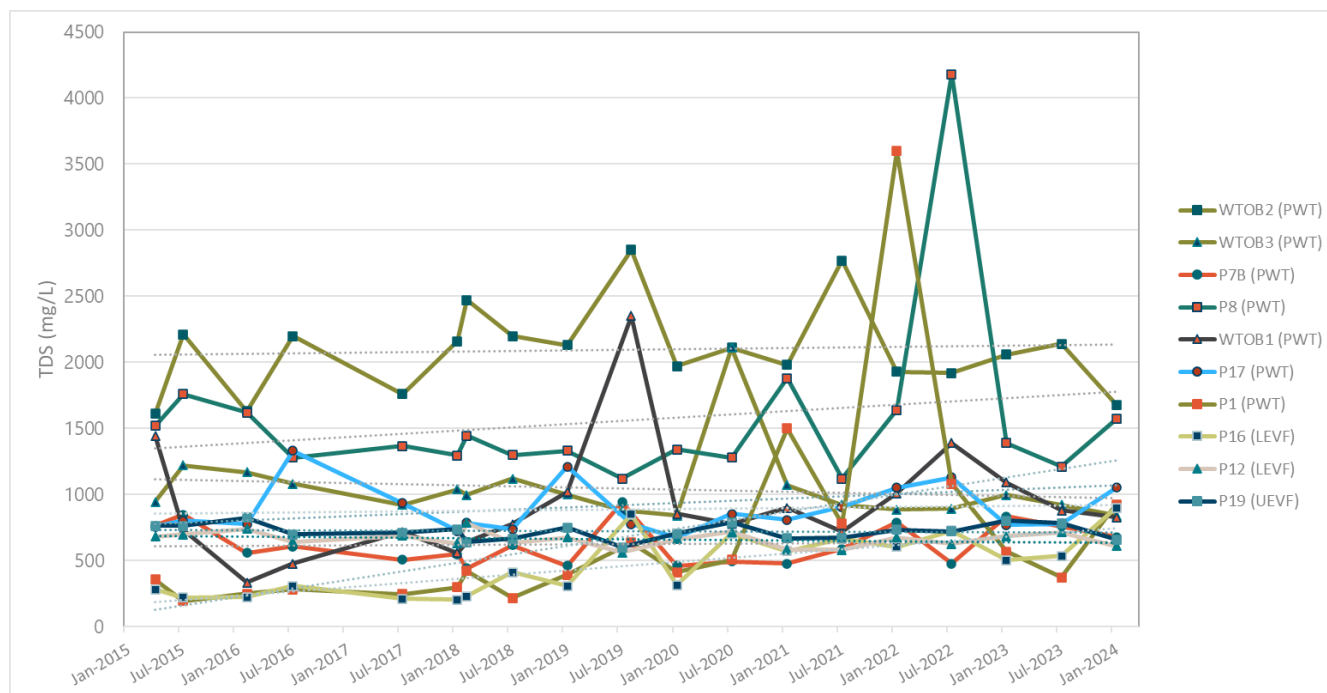


Figure 3: Groundwater quality results – shallow observation bores

3.2 Surface water quality – field testing

As outlined in the MAP 2014, Barwon Water monitors surface water quality at the sites listed in Table 5. The objective of this sampling is to;

- monitor baseline surface water quality, and monitor for any potential quality changes over time
- assist in the assessment of groundwater and surface water interactions in many areas, by reviewing the water quality data collected over time, in conjunction with groundwater and surface water level monitoring
- assist in the assessment of the process of acid generation in the catchments.

The water quality parameters tested are Electrical Conductivity (EC), Total Dissolved Solids (TDS), pH, Dissolved Oxygen (DO) and temperature. The location of the surface water sites has been provided in Appendix B and the results of the water quality testing is provided in Appendix C.

Table 5: Surface water quality sites – field testing

Catchment	BW ID	Site ID	SINo.	Site description	Monitoring frequency
Salt Creek	SV3	GS7	235274A	Breakfast Creek Tributary @ V notch	Monthly
	SV1	GS1	235273A	Breakfast Creek @ Road Bridge	Monthly
	SV4	GS2	235276A	Salt Creek @ Denhams Track	Monthly
	SV2	GS3	235222A	Salt Creek (Encoder) @ Alcoa	Monthly
	SGP2-B (pool)	N/A	235275A	Salt Creek (Pool) above swamp @ Denham Track	Monthly
Anglesea River	AGP1-B (pool)	N/A	235271A	Upper Anglesea River @ AARC	Monthly
	AV1	GS4	235270A	Upper Anglesea River @ AARC (V Notch)	Monthly
	AV3	GS6	235277A	Anglesea River @ Gumflats Road	Monthly
	ASP7 (pool)	N/A	235280A	Anglesea Swamp @ Vegetation Site P7	Monthly
	AGP2 (pool)	N/A	235272A	Anglesea Wetlands @ Allardyne Track	Monthly
	AV2	GS5	235260A	Anglesea River (Marshy Creek) @ Alcoa	Monthly

3.3 Surface water quality – laboratory testing

Barwon Water conducts laboratory sampling at all sites listed in Table 6 as outlined in the MAP 2014. This sampling is conducted biannually and the tested parameters include major cations and anions, salinity and pH. Water samples are taken by Australian Laboratory Services (ALS) to be independently tested. The full results from the laboratory testing of surface water sites are provided in Appendix D, with result for pH and EC provided below in table 7 and 8.

Table 6: Surface water quality sites – laboratory testing

Catchment	BW ID	Site ID	SINo.	Site description
Salt Creek	SV3	GS7	235274A	Breakfast Creek Tributary @ V notch
	SV1	GS1	235273A	Breakfast Creek @ Road Bridge
	SV4	GS2	235276A	Salt Creek @ Denhams Track
	SV2	GS3	235222A	Salt Creek (Encoder) @ Alcoa
Anglesea River	AV1	GS4	235270A	Upper Anglesea River @ AARC (V Notch)
	AV3	GS6	235277A	Anglesea River @ Gumflats Road
	AV2	GS5	235260A	Anglesea River (Marshy Creek) @ Alcoa

Observations

The following trends have been identified from the surface water quality results taken from the field and laboratory testing:

- As the water flows downstream through the swamp the salinity levels generally increase, although this can vary depending on catchment and climate conditions. The higher surface water salinities recorded at the downstream ends of both catchments reflects the storage and concentration of salts in the main swamps through evapotranspiration, which can remain stored in the swamps until sufficient rainfall is generated to flush the salts downstream into the Anglesea Estuary. This is supported by the results in Table 7 that shows field reading results from upstream to downstream in both the Salt Creek and Anglesea River catchment.

Table 7: Surface water results (2023-24), indicating increasing salinity (EC) from upstream to downstream through the Salt Creek and Anglesea River catchments

Date	Salt Creek				Anglesea River		
	235274A	235273A	235276A	235222A	235270A	235277A	235260A
	SV3	SV1	SV4	SV2	AV1	AV3	AV2
Jul-23	292	498	301	365	785	Dry	2780
Aug-23	457	323	309	396	867	Dry	2810
Sep-23	117	293	289	443	883	Dry	2870
Oct-23	255	265	412	741	959	Dry	2890
Nov-23	274	306	293	Dry	Dry	Dry	3300
Dec-23	306	323	282	605	1027	Dry	3220
Jan-24	374	361	308	1125	1063	Dry	3700
Feb-24	304	318	301	Dry	Dry	Dry	3073
Mar-24	347	Dry	257	Dry	Dry	Dry	Dry
Apr-24	319	Dry	No Access due to DEECA planned burn program	Dry	Dry	Dry	Dry
May-24	487	539	266	Dry	Dry	Dry	Dry
Jun-24	310	390	276	Dry	Dry	Dry	Dry

- Table 8 shows field readings with a continuing trend of lower pH values generally being recorded at the downstream end of the Salt Creek and Anglesea catchments below the swamps. These results are consistent with the current understanding that the source of acidity in the catchments is the presence of naturally occurring sulphides (pyrites). When the catchments are subjected to wetting and drying cycles these pyritic sediments are oxidised, which causes acid generation in the swamps. The acid is released from the swamps as rainfall flushes the stored acid from the downstream end of the swamps to the estuary. The water quality results show no correlation between the values observed and groundwater extraction periods.

Table 8: Surface water results (2022-23 & 2023-24), indicating decreasing pH from upstream to downstream in the Anglesea catchment

Date	Salt Creek				Anglesea River		
	235274A	235273A	235276A	235222A	235270A	235277A	235260A
	SV3	SV1	SV4	SV2	AV1	AV3	AV2
Jul-22	5.7	5.8	6.2	4.2	6.6	Dry	2.9
Aug-22	6.6	6.3	6.3	4.2	7.4	4.3	3.2
Sep-22	6.1	7.2	6.8	3.8	7	4.5	3.2
Oct-22	5.9	7	6.4	3.9	6.7	4.3	3.1
Nov-22	5.8	6.5	6.1	4	5.7	5.6	3.2
Dec-22	5.6	6.4	6.4	4.1	6.5	4.6	3.4
Jan-23	6.6	6.1	6.5	3.8	6.4	Dry	3.3
Feb-23	6	6.1	6.3	4	Dry	Dry	3.3
Mar-23	5.5	6.8	6.9	3.1	Dry	Dry	Dry
Apr-23	6.7	6	6.8	Dry	Dry	Dry	Dry
May-23	6	5.6	6.1	4.6	Dry	Dry	Dry
Jun-23	5.5	6	6.6	4.6	5.2	Dry	Dry
Jul-23	6	6.6	6.6	4.6	6.1	Dry	3.16
Aug-23	6.8	6.2	6.7	4.8	5.6	Dry	3.06
Sep-23	5.1	5	6.3	4.3	5.3	Dry	3.25
Oct-23	5.4	5.4	6.1	4.4	5.8	Dry	3.29
Nov-23	5.2	6.3	6.1	Dry	Dry	Dry	2.97
Dec-23	6.9	6.2	6.7	3.8	5.5	Dry	2.97
Jan-24	5.1	5.7	6	4	5.2	Dry	2.95
Feb-24	4.9	5.9	5.9	Dry	Dry	Dry	2.6
Mar-24	4.8	Dry	6	Dry	Dry	Dry	Dry
Apr-24	5.3	Dry	No Access due to DEECA planned burn program	Dry	Dry	Dry	Dry
May-24	5.7	5.8	6.3	Dry	Dry	Dry	Dry
Jun-24	4.9	4.7	5.8	Dry	Dry	Dry	Dry

- To further understand the distribution of acid sulfate soils across the Salt Creek and Anglesea River catchment, Monash University were contracted by Barwon Water to undertake soil sampling for potential acid sulfate soils. This report was completed in December 2020. A copy of the full report and summary report can be found on the [Barwon Water website](#).
- All the data collected through the monitoring and assessment program will be pivotal in informing the current bulk entitlement review. It is through this process that more detailed analysis of the longer-term data sets will be undertaken.

4. Groundwater trigger levels (Clause 16.2 E)

The groundwater trigger levels were revised in 2014 following the Bulk Entitlement review. The revised Bulk Entitlement's groundwater trigger levels were established with the objective of maintaining groundwater levels in the perched water table to within the likely range of natural variation, and ensure that there is no significant drawdown recorded in the perched water table as a result of pumping from the Anglesea Borefield. If the perched water table is maintained within these natural variations, then impacts to surface water flow, acid generation processes and, therefore, ecology should not occur as a result of groundwater extraction from the Lower Eastern View Formation. The groundwater trigger levels are set for two bores in the Anglesea Swampland:

- Bore P19: Monitoring the Upper Eastern View Formation
- Bore P8: Monitoring the Perched Water Table

The trigger mechanism accounts for the seasonal variation in the groundwater levels using groundwater levels measured at bore P17, which sits outside the area of influence for the Anglesea Borefield. These trigger levels use daily recorded values, which are converted to a monthly average and are calculated based on the following formulae:

$$P8 = 0.3131 * P17 + 9.4666 - 2 \text{ Standard Deviations of Error}$$

$$P19 = 0.2391 * P1 + 16.82 - 2 \text{ Standard Deviations of Error}$$

It should be noted that these formulae are the amended calculation as discussed in section 5.2. The trigger levels are shown in Figure 4 and Figure 5. At all times during 2023-2024 the groundwater trigger was not exceeded.

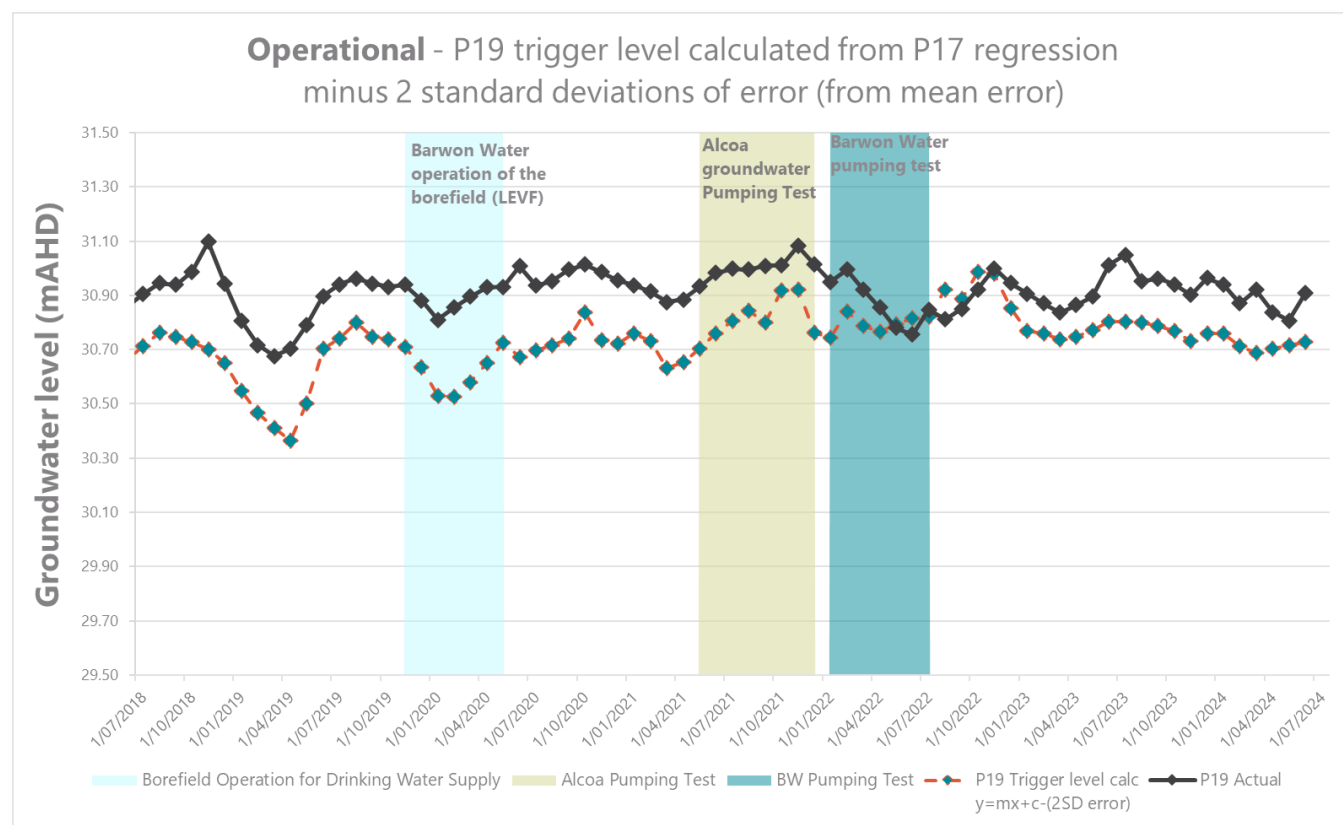


Figure 4: Groundwater level and the trigger level for P19 in the upper eastern view formation.

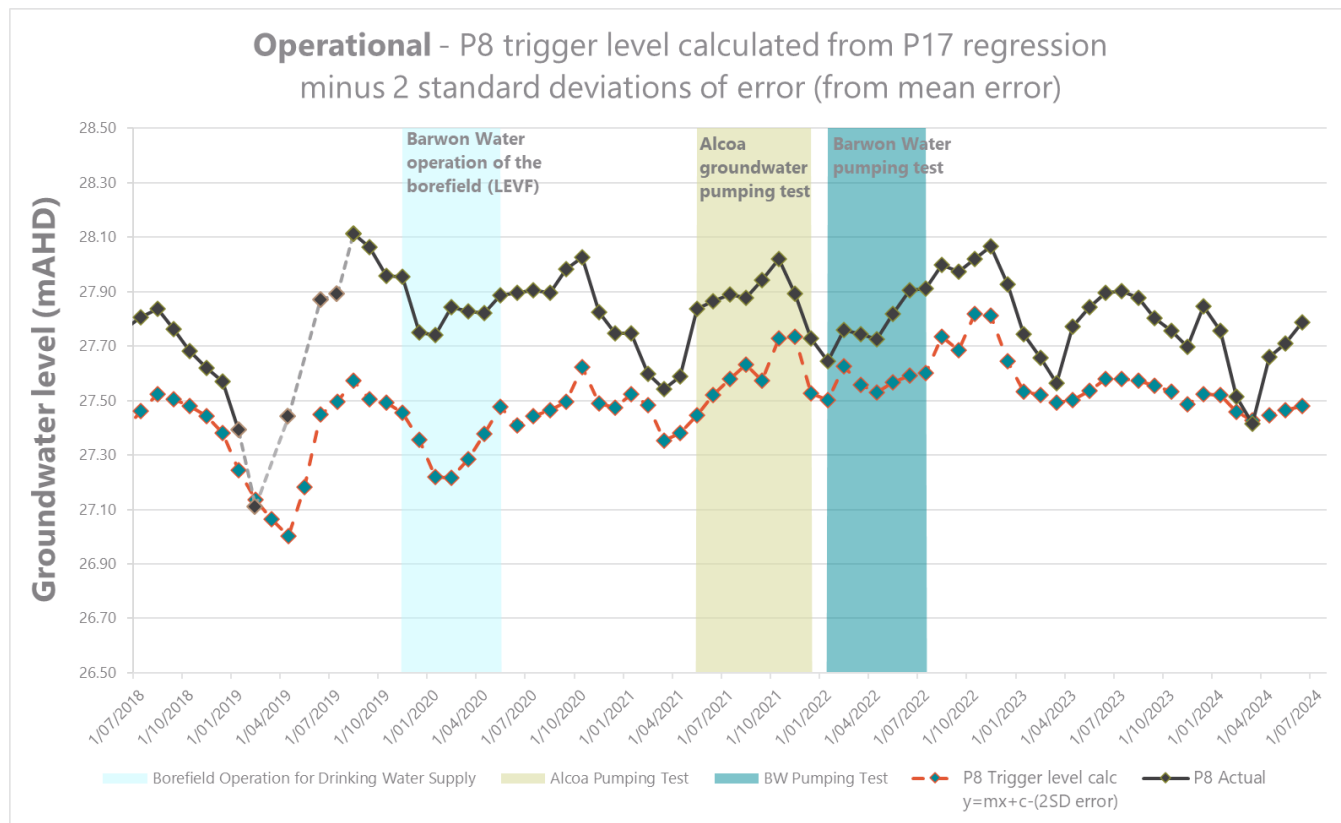


Figure 5: Groundwater level and the trigger level for P8 in the perched water table.

For the trigger to be exceeded, groundwater levels at both bores need to fall below a certain threshold level (also known as a 'trigger') for the month.

For the month of March 2024, the P19 component of the trigger was not exceeded (groundwater levels remained above the threshold set for the month) whereas P8 was exceeded (groundwater levels fell below the threshold).

While the groundwater levels in the PWT (P8) declined, our investigations showed there was no correlation to the groundwater levels in the UEVF (P19) and it is also important to note that there was no groundwater extraction during this time.

This means the reduced water level in the PWT is most likely due to the extremely dry conditions experienced in the previous months

5. Issues in implementing the program or restoring groundwater levels (Clause 16.2 D, 16.2 F)

5.1 Water quality sampling

Monthly water quality sampling is conducted at eleven surface water sites to observe pH, temperature, DO and EC. Some of the sampling sites were dry for a period of time during the past year. Water quality sampling could not be completed when a sampling site was dry.

5.2 Bulk Entitlement Minor Amendment

There is an error in the formula described in the Order that is used to calculate the trigger level in observation bore P19. This typographical error does not impact on the trigger levels; however, Barwon Water is working with DEECA on an amendment notice to reflect the original intent. Barwon Water plans to submit an application in accordance with section 45 of the *Water Act 1989*, to apply to amend

the Bulk Entitlement (Anglesea Groundwater) Order 2009 to correct this error as part of the bulk entitlement review process.

5.3 Amendment to the Monitoring and Assessment Program (MAP)

There have been no amendments to the MAP in 2023-2024 however, future amendments will be required as a result of the mine rehabilitation works being undertaken by Alcoa.

There are currently a number of observation bores that Alcoa own that are included in Barwon Water's monitoring and assessment program.

Bores that are no longer required for a specific purpose for Alcoa, are being decommissioned by Alcoa as a result. Decommissioned bores listed below are not all listed in the MAP but are provided for context in what has changed over the reporting period in the Anglesea catchment.

Decommissioned:

- WB9 Sept 2020
- WB10 Aug 2020
- WB13 Jun 2021
- WB17 May 2021
- Old MB1 June 2021

The current review of our bulk entitlement and environmental monitoring program will make an assessment of the most appropriate observation bores to be monitored through the monitoring program. Although a number of bores have been decommissioned there has also been a number of new bores constructed by Alcoa that are also currently being monitored by Barwon Water and could be incorporated into an updated MAP.

6. Arrangements with existing groundwater users (Clause 16.2 G)

There have been no arrangements entered into that would trigger this clause.

7. Independent Arbitration (Clause 16.2 H)

Independent arbitration has not been necessary.

8. Difficulties in compliance with the order (Clause 16.2 I)

8.1 Bore 115868 (UEVF) and 119349 (UEVF) replacements

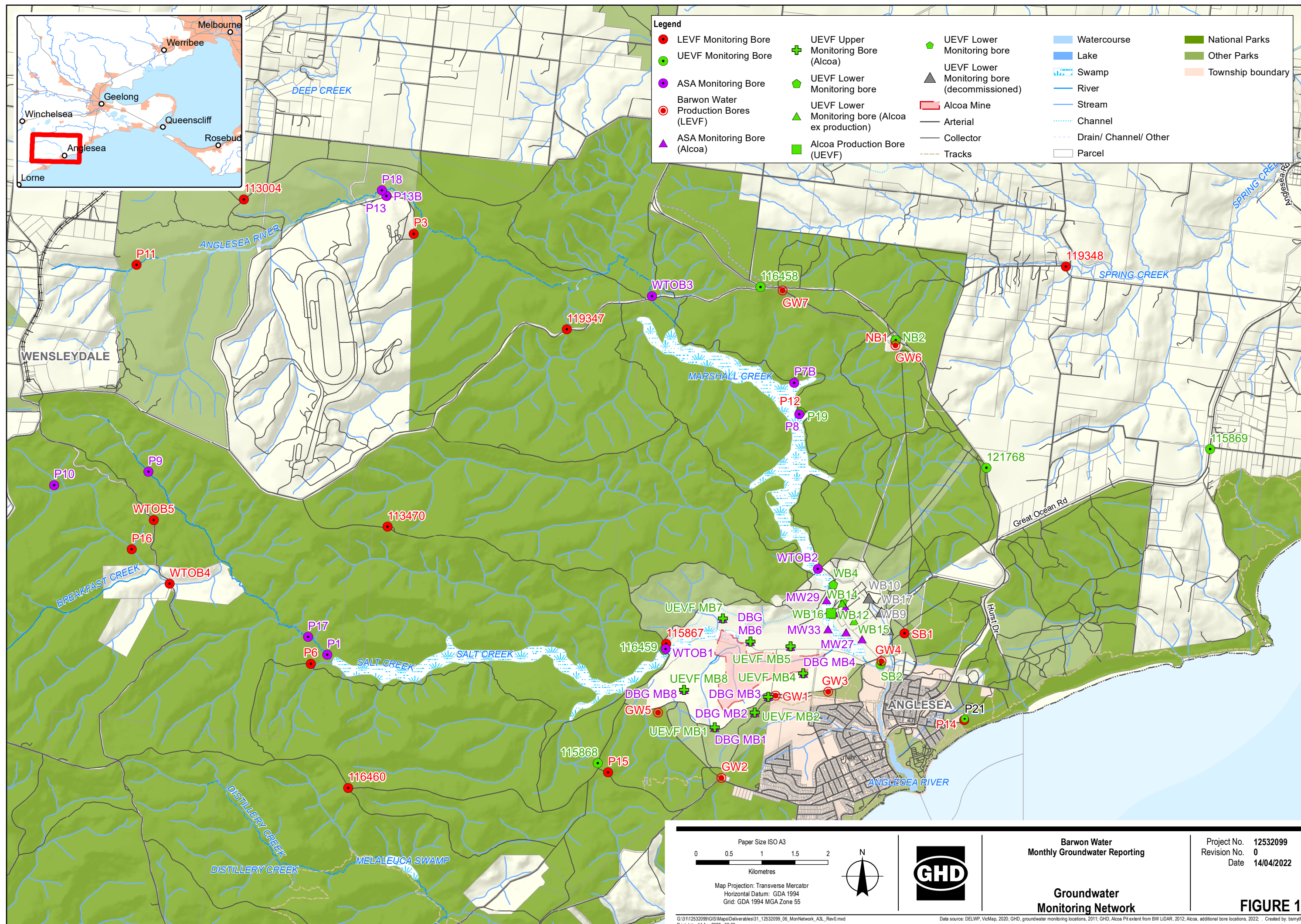
DEECA has advised that bores 115868 and coastal bore 119349 are in poor condition and are scheduled for decommissioning and replacement. Following notification of the planned decommissioning, a condition assessment was undertaken on each bore in July 2019 and independently reviewed by Barwon Water's consultants. The recommendation was that both bores are beyond refurbishment and should be decommissioned and replaced to improve our understanding of the Anglesea borefield.

Bore 119349 was decommissioned in 2019, and a replacement (P21) was constructed in 2021.

Bore 115868 is currently under request for a section 27 consent with Parks Victoria for a replacement bore to be constructed at the same site. If approved by Parks Victoria, Barwon Water will proceed with construction of the replacement bore.

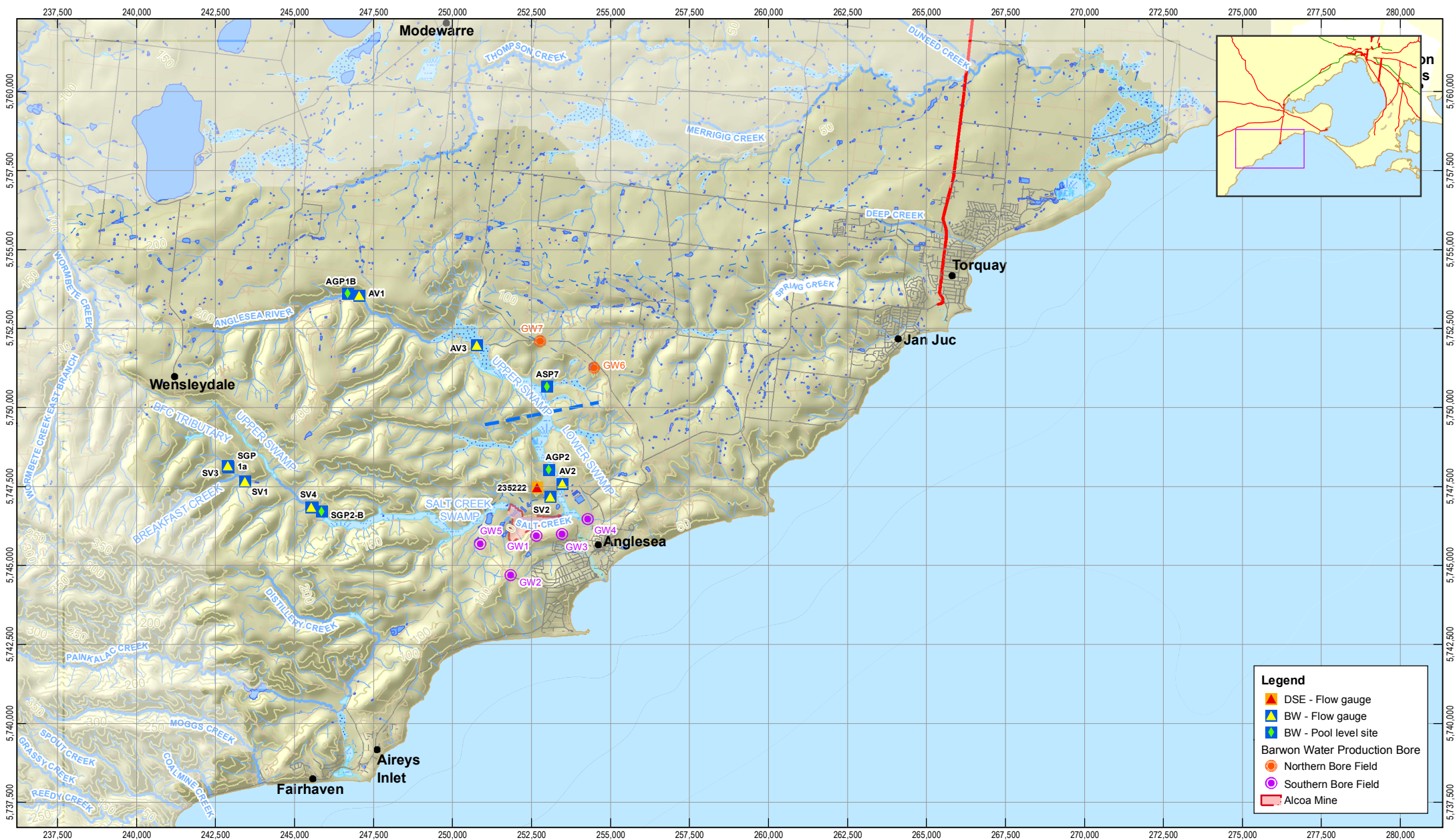
Appendix A

Observation bore locations



Appendix B

Surface water monitoring locations



1:160,000 Paper Size A4

0 0.5 1 2 3 4 5
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55



LEGEND

- Towns
- Highway
- Sealed Road (Arterial & Local)
- Unsealed Road
- Unsealed Track
- Estuary
- Lake
- Flat
- Swamp
- pondage
- River
- Stream
- Channel / Drain
- Connector
- Contours (50m)



Barwon Water
Anglesea Borefield
Numerical Modelling and Recalibration
Surface Water
Monitoring Locations

Job Number 31-32669
Revision A
Date 12 Jun 2015

Figure 2

G:\31\32669\GIS\Maps\Deliverables\0002_Anglesea_Monitoring_2014_SW_Locations.mxd

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Data source: VicMap, DSE, ABARES, Corangamite CMA, DPI, Barwon Water, BOM and SILO Created by:jeamonth

Appendix C

Surface water quality results - field testing

Name Breakfast Creek Tributary @ V notch
GHD/BW ID SV3
SINo. 235274A
BE Map ID GS7

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow at V notch	Weather conditions	Comments
10/07/2023	9:45	0.264	292	181	8.11	8.11	6	10		4.3	Cloudy	Air Temp 10.8, Water clear.
11/08/2023	7:55	0.193	457	283.3	8.61	8.61	6.8	8.2		0.6	Cloudy	Air Temp 7.2, Water clear.
6/09/2023	11:00	0.168	117	72.5	8.82	8.82	5.1	8.5		0.68	Cloudy	Air Temp 10.5, Water clear.
12/10/2023	9:50	0.162	255	158.1	9.11	9.11	5.4	10.9		0.66	Cloudy	Air Temp 12.2, Water clear.
15/11/2023	11:20	0.126	274	169.9	8.97	8.97	5.2	12		0.38	Cloudy	Air Temp 16.0, Water clear.
6/12/2023	13:00	0.166	306	189.7	8.73	8.73	6.9	13.1		0.67	Sunny	Air Temp 20.7, Water clear.
16/01/2024	9:05	0.12	374	231.9	8.25	8.25	5.1	15		0.34	Sunny	Air Temp 21.0, Water clear.
13/02/2024	8:40	0.108	304	188.5	5.37	5.37	4.9	17.3		0.29	Sunny	Air Temp 23.1, Water clear.
12/03/2024	9:00	0.1	347	215.1	5.59	5.59	4.8	15		0.06	Cloudy	Air Temp 19.5, Water clear.
15/04/2024	10:10	0.107	319	197.8	9.64	9.64	5.3	11.7		0.27	Cloudy	Air Temp 11.8, Water clear.
13/05/2024	10:50	0.126	487	301.9	10.19	10.19	5.7	12.6		0.38	Cloudy	Air Temp 11.9, Water clear.
11/06/2024	11:00	0.13	310	192.2	9.92	9.92	4.9	10.9		0.4	Cloudy	Air Temp 11.5, Water clear.

Name Breakfast Creek @ Road bridge
GHD/BW ID SV1 - Bridge
SINo. 235273A
BE Map ID GS1

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow State	Weather conditions	Comments
10/07/2023	10:00	0.258	498	308.8	8.82	8.82	6.6	10.1	10.6	Flowing	Cloudy	Water clear
11/08/2023	8:15	0.224	323	200.3	8.92	8.92	6.2	8.1	7	Flowing	Cloudy	Water clear
6/09/2023	10:30	0.217	293	181.7	8.72	7.72	5	8.2	10.1	Flowing	Cloudy	Water clear
12/10/2023	10:15	0.204	265	164.3	9.74	9.74	5.4	11.8	12.5	Flowing	Cloudy	Water clear
15/11/2023	11:00	0.178	306	189.7	8.04	8.04	6.3	12.5	15.2	Stagnant	Cloudy	Water clear, Backed up DS after road bridge no flow @ site
6/12/2023	12:45	0.208	323	200.3	8.97	8.97	6.2	15.6	20.2	Flowing	Cloudy	Water clear, Backed up DS after road bridge low flow @ site
16/01/2024	9:35	0.198	361	223.8	5.3	5.3	5.7	17.8	20.8	Flowing	Sunny	Water clear, Backed up DS after road bridge low flow @ site
13/02/2024	9:05	0.078	318	197.2	1.76	1.76	5.9	17.5	21.9	Stagnant	Sunny	Water clear, Backed up DS after road bridge low flow @ site
12/03/2024	9:15	DRY	X	X	X	X	X	X	20	DRY	Cloudy	DRY CREEK
15/04/2024	10:40	DRY	X	X	X	X	X	X	12	DRY	Cloudy	DRY CREEK
13/05/2024	11:15	0.157	539	334.2	9.1	9.1	5.8	12.4	12.1	Flowing	Cloudy	Water clear, Backed up DS after road bridge low flow @ site
11/06/2024	11:00	0.135	390	241.8	9.44	9.44	4.7	10.4	11.4	Flowing	Cloudy	Water clear, Backed up DS after road bridge low flow @ site

Name Salt Creek @ Denham's Track
GHD/BW ID SV4
SINo. 235276A
BE Map ID GS2

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow State	Weather conditions	Comments
10/07/2023	11:15	0.277	301	187	8.91	8.91	6.6	9.5	10.4	Flowing	Cloudy	Flowing
11/08/2023	9:45	0.23	309	192	8.72	8.72	6.7	7.8	7.5	Flowing	Cloudy	Flowing
6/09/2023	9:30	0.213	289	179	8.92	8.92	6.3	7	6.9	Flowing	Cloudy	Flowing
12/10/2023	11:55	0.216	412	255	8.72	8.72	6.1	10.8	12.7	Flowing	Cloudy	Flowing
15/11/2023	9:55	0.177	293	182	8.11	8.11	6.1	11.4	15.1	Flowing	Cloudy	Flowing
6/12/2023	11:45	0.21	282	175	8.91	8.91	6.7	13.5	18.5	Flowing	Sunny	Flowing
16/01/2024	11:45	0.188	308	191	7.8	7.8	6	16.3	25.1	Flowing	Sunny	Flowing
13/02/2024	10:30	0.157	301	187	6.72	6.72	5.9	15.3	20.1	Flowing	Sunny	Flowing
12/03/2024	10:35	0.06	257	159	5.77	5.77	6	17	19.5	Stagnant	Cloudy	Pool only
15/04/2024	11:30											No Access due to DEECA Planned burning program
13/05/2024	12:15	0.195	266	165	10.09	10.09	6.3	11.3	14.9	Flowing	Cloudy	Flowing
11/06/2024	13:00	0.192	276	171	10	10	5.8	9.8	12.1	Flowing	Cloudy	Flowing

Name

GHD/BW ID

SINo.

BE Map ID

Salt Creek (Encoder) @ Alcoa

SV2

235222A

GS3

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow State	Weather conditions	Comments
10/07/2023	13:45	0.057	365	226.3	9.12	9.12	4.6	9.4	14.3	Stagnant	Cloudy	Water clear
7/08/2023	14:00	BELOW	396	245.5	11.1	11.1	4.8	8.4	15.1	Stagnant	Cloudy	Water clear
7/09/2023	9:45	BELOW	443	274.7	10.22	10.22	4.3	8.8	13.5	Stagnant	Cloudy	Water clear
12/10/2023	6:55	BELOW	741	459.4	10.62	10.62	4.4	14.9	14.1	Stagnant	Cloudy	Water clear
16/11/2023	10:20	DRY	X	X	X	X	X	X	18	DRY	Cloudy	DRY
7/12/2023	9:15	BELOW	605	375.1	9.27	9.27	3.8	20.8	21	Stagnant	Sunny	Water clear
29/01/2024	7:50	BELOW	1125	697.5	9.13	9.13	4	19.3	16.8	Stagnant	Sunny	Water clear
14/02/2024	7:20	DRY	X	X	X	X	X	X	17	DRY	Cloudy	DRY
13/03/2024	8:15	DRY	X	X	X	X	X	X	17.2	DRY	Cloudy	DRY
16/04/2024	9:00	DRY	X	X	X	X	X	X	8.2	DRY	Cloudy	DRY
15/05/2024	11:20	DRY	X	X	X	X	X	X	11	DRY	Cloudy	DRY
12/06/2024	11:45	DRY	X	X	X	X	X	X	11.4	DRY	Cloudy	DRY

Name Salt Creek (Pool)above swamp @ Denham Track (new downstream site)
GHD/BW ID SGP2-B
SINo. 235275A
BE Map ID

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (C)	Flow State	Weather conditions	Comments
10/07/2023	11:00	2.095	375	232.5	7.92	3.11	6.5	9.4	10.5	Flowing	Cloudy	Dark tannin stain.
11/08/2023	9:25	2.042	368	228.2	7.76	3.41	6.8	7.9	7.5	Flowing	Cloudy	Dark tannin stain.
6/09/2023	9:00	2.02	432	267.8	7.67	3.11	6.9	6.8	6.9	Flowing	Cloudy	Dark tannin stain.
12/10/2023	11:40	2.003	498	308.8	7.75	3.81	6.8	11.2	12.6	Flowing	Cloudy	Dark tannin stain.
15/11/2023	9:30	2.2	303	187.9	8.71	3.21	6.4	12.1	15	Flowing	Cloudy	Dark tannin stain.
6/12/2023	9:35	1.98	323	200.3	8.11	4.23	6.8	13.8	18.2	Flowing	Cloudy	Dark tannin stain.
16/01/2023	10:30	1.954	298	184.8	7.25	7.25	6.1	16.7	24.5	Flowing	Sunny	Dark tannin stain.
13/02/2024	10:20	1.9	352	218.2	3.88	3.88	5.6	15.9	22	Flowing	Sunny	Dark tannin stain.
12/03/2024	10:20	1.814	364	225.7	5.97	2.97	5.9	16.2	18.3	Flowing	Cloudy	Dark tannin stain.
15/04/2024	11:30											No Access due to DEECA Planned burning program
13/05/2024	12:05	1.953	354	219.5	9.83	4.11	6.5	11.8	14.7	Flowing	Cloudy	Dark tannin stain.
11/06/2024	12:40	1.955	401	248.6	6.15	3.11	6.3	10	12	Flowing	Cloudy	Dark tannin stain.

Name Upper Anglesea River (Pool) @ Australian Automotive Research Centre - (New downstream pool site)
GHD/BW ID AGP1-B
SINo. 235271A
BE Map ID

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow State	Weather conditions	Comments
10/07/2023	9:00	2.180	680	421.6	7.94	3.21	6.8	9.9	10.5	Stagnant	CLOUDY	Water tannin stained.
7/08/2023	10:35	2.380	798	494.8	8.62	2.11	6.4	9.2	8.5	Stagnant	CLOUDY	Water tannin stained.
6/09/2023	12:05	2.375	895	554.9	8.96	2.71	5.8	8.9	11.8	Stagnant	CLOUDY	Water tannin stained.
12/10/2023	8:40	2.300	967	599.5	8.91	8.91	6.4	10.7	13.3	Stagnant	CLOUDY	Water tannin stained.
15/11/2023	8:20	2.207	1067	661.5	8.5	8.5	6.3	14.6	14.6	Stagnant	CLOUDY	Water tannin stained.
6/12/2023	10:35	2.303	1047	649.1	8.21	8.21	6.4	11.8	17.8	Stagnant	Sunny	Water tannin stained.
16/01/2024	8:20	2.324	1152	714.2	6.71	6.71	6.4	12.8	20.5	Stagnant	Sunny	Water tannin stained.
13/02/2024	7:45	2.220	1052	652.2	6.43	6.43	5.9	13.5	22.9	Stagnant	Sunny	Water tannin stained.
12/03/2024	8:05	1.986	1227	760.7	5.97	5.97	6	18.9	19.1	Stagnant	CLOUDY	Water tannin stained.
15/04/2024	9:20	1.750	1164	721.7	7.65	7.65	6.2	11.9	11.5	Stagnant	CLOUDY	Water tannin stained.
13/05/2024	10:05	1.631	1362	844.4	8.48	3.24	6.7	12.1	10.1	Stagnant	CLOUDY	Water tannin stained.
11/06/2024	10:20	1.520	1152	714.2	8.57	8.57	5.8	10.7	11.8	Stagnant	CLOUDY	Water tannin stained.

Name

GHD/BW ID

SINo.

BE Map ID

Upper Anglesea River @ AARC (V notch site)

AV1

235270A

GS4

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow State	Weather conditions	Comments
10/07/2023	8:30	0.138	785	486.7	8.5	8.5	6.1	10.6	10.4	Flowing	Cloudy	Water Milky clear.
7/08/2023	10:05	0.122	867	537.54	9.7	9.71	5.6	8.9	8	Flowing	Cloudy	Water Milky clear.
6/09/2023	11:45	0.107	883	547.46	8.1	8.1	5.3	8.6	8.1	Flowing	Cloudy	Water Milky clear.
12/10/2023	8:00	0.031	959	594.58	8.7	8.7	5.8	10.2	13.4	Flowing	Cloudy	Water Milky clear.
15/11/2023	8:00	DRY	X	X	X	X	X	X	11.5	DRY	Cloudy	Dry River
6/12/2023	10:15	0.12	1027	636.74	7.8	7.82	5.5	14.8	16.9	Flowing	Sunny	Water Milky clear.
16/01/2023	7:50	0.098	1063	659.06	7.4	7.43	5.2	18.4	18.8	Flowing	Sunny	Water Milky clear.
13/02/2024	7:15	DRY	X	X	X	X	X	X	23	DRY	Cloudy	Dry River
12/03/2024	7:50	DRY	X	X	X	X	X	X	19.5	DRY	Cloudy	Dry River
15/04/2024	9:00	DRY	X	X	X	X	X	X	11.3	DRY	Cloudy	Dry River
13/05/2024	9:50	DRY	X	X	X	X	X	X	10.1	DRY	Cloudy	Dry River
11/06/2024	9:40	DRY	X	X	X	X	X	X	11.9	DRY	Cloudy	Dry River

Name

GHD/BW ID

SINo.

BE Map ID

Anglesea River @ Gumflats Road

AV3

235277A

GS6

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow State	Weather conditions	Comments
10/07/2023	7:30	DRY	X	X	X	X	X	X	9.8	dry	Cloudy	No Sampling as pool dry.
7/08/2023	9:50	DRY	X	X	X	X	X	X	3	dry	Cloudy	No Sampling as pool dry.
6/09/2023	12:45	DRY	X	X	X	X	X	X	12	dry	Cloudy	No Sampling as pool dry.
12/10/2023	6:55	DRY	X	X	X	X	X	X	12.1	dry	Cloudy	No Sampling as pool dry.
15/11/2023	6:45	DRY	X	X	X	X	X	X	11.1	dry	Cloudy	No Sampling as pool dry.
6/12/2023	9:15	DRY	X	X	X	X	X	X	17	dry	Cloudy	No Sampling as pool dry.
16/01/2024	7:00	DRY	X	X	X	X	X	X	18.2	dry	Cloudy	No Sampling as pool dry.
13/02/2024	11:30	DRY	X	X	X	X	X	X	27	dry	Cloudy	No Sampling as pool dry.
12/03/2024	6:50	DRY	X	X	X	X	X	X	19.2	dry	Cloudy	No Sampling as pool dry.
15/04/2024	8:00	DRY	X	X	X	X	X	X	10.1	dry	Cloudy	No Sampling as pool dry.
13/05/2024	9:00	DRY	X	X	X	X	X	X	9.9	dry	Cloudy	No Sampling as pool dry.
11/06/2024	8:40	DRY	X	X	X	X	X	X	11.1	dry	Cloudy	No Sampling as pool dry.

Name Anglesea Swamp @ Vegetation Site P7
GHD/BW ID ASP7
SINo. 235280A
BE Map ID

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow State	Weather conditions	Comments
11/07/2023	9:30	0.114	1984	1230	9.22	9.22	3.3	11	11.1	STAGNANT	CLOUDY	Water clear.
7/08/2023	8:00	0.096	2050	1271	10.71	10.71	3.3	5.3	3.1	STAGNANT	CLOUDY	Water clear.
7/09/2023	7:30	0.052	2270	1407	9.12	9.12	3.3	8.9	3.3	STAGNANT	CLOUDY	Water clear.
13/10/2023	7:20	0.014	2520	1562	11.1	11.1	3.4	11.7	11	STAGNANT	CLOUDY	Water clear.
16/11/2023	7:00	BELOW	3600	2232	9.17	9.17	2.8	13.7	13.6	STAGNANT	CLOUDY	Water clear.
7/12/2023	7:50	0.054	2680	1662	10.27	10.27	3.1	14.2	12.1	STAGNANT	CLOUDY	Water clear
17/01/2024	7:30	0.022	1950	1209	7.98	7.98	2.9	19.6	20.1	STAGNANT	CLOUDY	Water clear
14/02/2024	9:45	DRY	X	X	X	X	X	X	17	DRY	CLOUDY	DRY
13/03/2023	11:15	DRY	X	X	X	X	X	X	17	DRY	CLOUDY	DRY
15/04/2024	7:45											No Access due to DEECA Planned burning program
15/05/2024	12:00	BELOW	5070	3143	9.25	9.25	3.2	13.2	10.9	STAGNANT	CLOUDY	Water clear
12/06/2024	13:40	BELOW	4290	2660	9.95	9.95	3.2	11.1	11.5	STAGNANT	CLOUDY	Water clear

Name Anglesea Wetlands @ Allardyle Track
GHD/BW ID AGP2
SINo. 235272A
BE Map ID

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow State	Weather conditions	Comments
10/07/2023	12:15	0.318	2110	1308.2	8.92	8.92	3.4	9.8	10.7	Flowing	Cloudy	Water clear
7/08/2023	11:55	0.288	2120	1314.4	10.91	10.91	3.3	11.9	9.1	Flowing	Cloudy	Water clear
7/09/2023	8:50	0.248	2250	1395	9.35	9.35	3.3	10.5	13.1	Flowing	Cloudy	Water clear
13/10/2023	9:00	0.073	2410	1494.2	11.7	11.7	3.5	14.8	12.5	Stagnant	Cloudy	Water clear
16/11/2023	8:15	DRY	X	X	X	X	X	X	13.6	DRY	CLOUDY	DRY
7/12/2023	8:15	DRY	X	X	X	X	X	X	13	DRY	Sunny	DRY
17/01/2024	8:45	0.094	2272	1408.6	5.9	5.9	3	18.3	19.9	Stagnant	Raining	Water clear
14/02/2024	9:00	DRY	X	X	X	X	X	X	17.1	DRY	CLOUDY	DRY
13/03/2024	11:15	DRY	X	X	X	X	X	X	17.1	DRY	CLOUDY	DRY
15/04/2024	7:45								10.1			No Access due to DEECA Planned burning program
13/05//2024	13:10	DRY	X	X	X	X	X	X	15	DRY	CLOUDY	DRY
11/06/2024	13:45	DRY	X	X	X	X	X	X	12	DRY	CLOUDY	DRY

Name Anglesea River (Marshy Creek) @ Alcoa
GHD/BW ID AV2
SINo. 235260A
BE Map ID GS5

Date	Time (EST)	Gauge Height (m)	EC (µS/cm)	TDS (mg/L)	DO (mg/L) (Top)	DO (mg/L) (Bottom)	pH	Water Temperature (°C)	Air Temperature (°C)	Flow State	Weather conditions	Comments
10/07/2023	12:45	0.057	2780	1723.6	8.92	8.92	3.16	12.5	14.2	Flowing	Cloudy	Water very clear
7/08/2023	12:30	0.04	2810	1742.2	10.91	10.91	3.06	9.3	13.2	Flowing	Cloudy	Water very clear
7/09/2023	9:45	0.04	2870	1779.4	10.71	10.71	3.25	10.9	13.4	Flowing	Cloudy	Water very clear
13/10/2023	9:25	0.005	2890	1791.8	10.9	10.9	3.29	14	13.8	Flowing	Cloudy	Water very clear
16/11/2023	10:45	BELOW	3300	2046	9.17	9.17	2.97	19.4	17.9	Stagnant	Cloudy	Water very clear
7/12/2023	10:00	BELOW	3220	1996.4	9.72	9.72	2.97	19.5	22	Stagnant	Sunny	Water very clear
29/01/2024	8:15	BELOW	3700	2294	6.46	6.46	2.95	23.3	17	Stagnant	Sunny	Water very clear
14/02/2024	8:00	BELOW	3073	1905.3	2.94	2.94	2.6	16.4	17	Stagnant	Sunny	Water very clear
13/03/2024	7:45	DRY	X	X	X	X	X	X	17	DRY	Cloudy	DRY
16/04/2024	8:30	DRY	X	X	X	X	X	X	8	DRY	Cloudy	DRY
15/05/2024	10:20	DRY	X	X	X	X	X	X	11.1	DRY	Cloudy	DRY
12/06/2024	11:15	DRY	X	X	X	X	X	X	10	DRY	Cloudy	DRY

Appendix D

Surface water quality results - laboratory testing

						Alkalinity			Anions by IC		Total Metals by ICP				pH
Catchment	Site	Date	Time (EST)	TDS (mg/L)	EC (µS/cm)	Total Alkalinity (mg CaCO ₃ / L)	Bicarbonate Alkalinity (mg CaCO ₃ / L)	Carbonate Alkalinity (mg CaCO ₃ / L)	Chloride (mg/L)	Sulphate (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	pH (Lab)
Salt Creek	SV3	13/02/2024	840	180	260	2	2	2	89	5	0.5	6.3	0.6	40	5.3
		3/07/2024	1105	160	270	<2	<2	<2	76	<10	0.4	6.1	0.6	37	5.3
	SV1	13/02/2024	905	260	340	13	13	2	110	10	5	11	2	53	6.3
		3/07/2024	1145	160	330	<2	<2	<2	90	13	1.9	7.5	1.1	44	5.1
	SV4	13/02/2024	1030	200	260	16	16	2	74	10	4	10	3	51	6.4
		4/07/2024	1210	130	220	<6	<6	<2	67	29	1.3	4.9	1.1	29	6.2
	SV2	14/02/2024	720	Dry											
		4/07/2024	1030	Dry											
Anglesea River	AV1	13/02/2024	715	Dry											
		3/07/2024	855	Dry											
	AV3	13/02/2024	1130	Dry											
		3/07/2024	750	Dry											
	AV2	19/02/2024	700	2300	3900	2	2	2	850	610	44	87	22	420	3
		4/07/2024	1030	Dry											
	AGP1-B	Not required													

Appendix E

Groundwater quality results - laboratory testing

						Alkalinity				Major Ions					Ionic Balance		
Bore	Date	pH	TDS (mg/L)	EC (µS/cm)	Sulphate as SO4 (mg/L)	Carbonate as CaCO3	Bicarbonate as CaCO3 (mg/ L)	Hydroxide as CaCO3	Alkalinity (total) as CaCO3	Calcium (mg/L)	Chloride (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Total Cations (meq/l)	Total Anions (meq/L)	Ionic Balance
Inter-aquifer Flow Monitoring																	
119348	31/07/2023	8.0	787.0	1300.0	<1,000	<1	119.0	<1	119.0	16.0	354.0	11.0	26.0	221.0	12.0	12.4	1.6
	30/01/2024	7.5	632.0	1330.0	<1,000	<1	118.0	<1	118.0	15.0	364.0	10.0	26.0	197.0	10.8	12.6	7.8
NB2	4/07/2023	6.3	1550.0	2460.0	116,000	<1	65.0	<1	65.0	75.0	701.0	52.0	21.0	279.0	20.7	23.5	6.3
	23/01/2024	6.1	1400.0	2320.0	114,000	<1	64.0	<1	64.0	75.0	697.0	56.0	21.0	287.0	21.4	23.3	4.3
SB2	4/07/2023	6.1	1820.0	3170.0	180,000	<1	42.0	<1	42.0	30.0	889.0	67.0	42.0	394.0	25.2	29.7	8.1
	22/01/2024	5.9	1040.0	2100.0	123,000	<1	45.0	<1	45.0	19.0	595.0	54.0	36.0	244.0	16.9	20.2	8.9
P15	18/07/2023	5.6	579.0	867.0	61,000	<1	17.0	<1	17.0	5.0	254.0	20.0	14.0	128.0	7.8	8.8	5.7
	29/01/2024	5.8	478.0	919.0	58,000	<1	15.0	<1	15.0	4.0	247.0	17.0	14.0	114.0	6.9	8.5	10.1
Saline Intrusion Monitoring																	
P14	20/07/2023	6.92	805	944	2,000	<1	140	<1	140	15	231	10	38	139	8.59	9.36	4.27
	24/01/2024	7.4	405	844	4,000	<1	82	<1	82	8	203	9	47	94	6.43	7.45	7.33
Swamp GDE																	
WTOB2	3/07/2023	4.22	2140	3330	369,000	<1	<1	<1	<1	53	834	68	31	417	27.2	31.2	6.91
	18/01/2024	4.28	1680	2970	338,000	<1	<1	<1	<1	53	842	70	29	405	26.8	30.8	6.99
P7B	3/07/2023	4.5	760	1340	82,000	<1	<1	<1	<1	17	356	26	6	163	10.2	11.7	6.9
	18/01/2024	3.89	678	1480	91,000	<1	<1	<1	<1	21	387	34	7	193	12.4	12.8	1.55
P8	3/07/2023	5.41	1210	2240	126,000	<1	7	<1	7	43	637	49	15	274	18.5	20.7	5.74
	18/01/2024	5.42	1570	2200	126,000	<1	2	<1	2	44	608	56	16	314	20.9	19.8	2.6
WTOB3	5/07/2023	6.2	923	1640	65,000	<1	20	<1	20	5	439	25	3	232	12.5	14.1	6.24
	23/01/2024	6.39	841	1560	71,000	<1	18	<1	18	5	428	29	3	256	13.8	13.9	0.23
P17	5/07/2023	7.06	778	328	5,000	<1	173	<1	173	27	328	23	4	184	11.3	12.8	6.07
	22/01/2024	6.87	1050	305	2,000	<1	172	<1	172	35	305	26	5	172	11.5	12.1	2.48
P1	5/07/2023	6.34	372	483	14,000	<1	27	<1	27	4	110	8	2	70	3.95	3.93	0.25
	22/01/2024	5.99	925	418	<1000	<1	37	<1	37	3	101	8	2	68	3.82	3.59	3.09
WTOB1	3/07/2023	5.77	879	364	57,000	<1	29	<1	29	7	364	20	3	196	10.6	12	6.35
	22/01/2024	5.22	829	397	68,000	<1	10	<1	10	7	397	26	3	212	11.8	12.8	4.17
Upper Anglesea Swamp and Trigger Level Site																	
P19	17/07/2023	6.27	783	1240	22,000	<1	35	<1	35	13	348	18	23	166	9.94	11	4.95
	18/01/2024	6.55	658	1230	20,000	<1	42	<1	42	13	340	20	24	180	10.7	10.8	0.5
P12	17/07/2023	6.93	714	1130	9,000	<1	49	<1	49	12	319	14	25	159	9.31	10.2	4.41
	18/01/2024	6.73	611	1140	9,000	<1	55	<1	55	12	315	15	26	170	9.89	10.2	1.39
P16	05/072023	5.06	534	298	13,000	<1	1	<1	1	<1	67	7	<1	39	2.27	2.18	2.06
	22/01/2024	5.33	898	350	12,000	<1	2	<1	2	<1	89	9	1	50	2.94	2.8	-

Appendix F

Monitoring and Assessment Program Update

1. Purpose

Under the bulk entitlement for the Anglesea borefield, Barwon Water has established a comprehensive Monitoring and Assessment Program (MAP) that has been independently reviewed by independent experts and approved by the Minister for Water.

The objective of the MAP is to protect environmental values and the health of groundwater dependent ecosystems, whilst also continuing to collect data to build our understanding of the long-term sustainability of groundwater resources in the Anglesea area.

The following section provides an update on the MAP for the reporting period of the annual report.

2. Groundwater level monitoring

Groundwater level monitoring has been conducted at a daily frequency at 42 observation bores during the 2023-2024 reporting period. For the three trigger bores P8, P17 and P19 Barwon Water has maintained daily monitoring and installed telemetry for constant oversight.

3. Groundwater quality monitoring

As the Anglesea Borefield was not operated during 2023-2024, weekly field salinity and temperature monitoring for production bores (GW1-GW7) was not required.

Field and laboratory water quality parameters required for both deep and shallow observation bores under the MAP were recorded in 2023-2024.

4. Surface water flow & level monitoring

The monitoring and assessment program has seven surface water flow monitoring sites, with four located in the Salt Creek catchment and three located in the Anglesea River catchment. All sites have permanent data loggers recording on a minimum daily frequency.

Surface water level is also monitored with a data logger located in a pool in Salt Creek and three sites in the Anglesea River, two of which have data loggers and one that is measured monthly during field sampling.

5. Surface water quality monitoring

The MAP has identified 11 water quality monitoring sites across the Salt Creek and Anglesea River catchments. Monitoring consists of laboratory testing twice-yearly along with monthly field sampling. The frequency of this sampling does not change in relation to activation of the borefield and has all been completed throughout 2023-2024.

6. Aquatic ecology monitoring

The aquatic ecology monitoring consists of two components and includes macroinvertebrate and Southern Pygmy Perch sampling.

Macroinvertebrate sampling is required in Spring every third year at all 11 sites across the catchment. This was completed in Spring 2022.

A combination of Southern Pygmy Perch and macroinvertebrate sampling is also required to be conducted on an annual basis at a select number of sites across the catchment.

This component of the MAP does not change during operation of the borefield and all required monitoring was completed during 2023-2024.

7. Terrestrial ecology monitoring

Terrestrial ecology monitoring also comprises of two components, including monitoring of both frog assemblages and vegetation.

When taking groundwater, the MAP requires monitoring of frogs annually. Frog surveys were conducted in spring 2022.

For vegetation monitoring, when taking groundwater, Barwon Water is required to undertake vegetation assessments annually in spring at six sites in the Anglesea Swamp and four sites in the Anglesea Estuary. This was also conducted in spring 2022.

When not taking groundwater, the above monitoring is to be undertaken every second year. As such no terrestrial monitoring was undertaken in spring 2023.

8. Acid sulfate soil investigations

To further understand the distribution of acid sulfate soils across the Salt Creek and Anglesea River catchment, Monash University were been contracted by Barwon Water to undertake soil sampling for potential acid sulfate soils. This report was completed in December 2020. A copy of the full report and summary report can be found on the Barwon Water website.

9. Land level surveying

Barwon Water has 30 survey monitoring points covering the area of likely drawdown of groundwater levels in the Lower Eastern View Formation (LEVF). This regional subsidence network is surveyed annually. If land subsidence levels are recorded outside the permitted range of 20mm for two consecutive surveys at three survey locations or more, we must investigate further and change borefield operations as required.

10. Rainfall gauging

Rainfall is recorded via rain gauges at three sites across the catchment. This data is downloaded on a monthly basis and maintained in accordance with approved Bureau of Meteorology standards.

11. Failure of monitoring infrastructure

During the 2023-2024 period, there were six failures of data loggers that were replaced with new replacement loggers.

Appendix G

Shallow observation bore water level versus salinity level

