

# GROUNDWATER MONITORING PROGRAM ANNUAL REPORT

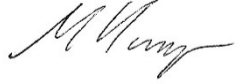

RAW WATER SUPPLY OEMP

1 JULY 2019 TO 30 JUNE 2020

SEPTEMBER 2020



## Revision History

Version	Revision Date	Details	Authorised	
			Name/Position	Signature
1.0	26/08/20	Draft for review	M Haege/Premise Australia Pty Ltd	
1.1	11/09/20	Final	M Haege/Premise Australia Pty Ltd	

## ABBREVIATIONS

AEMP	Aquatic Environmental Monitoring Program
AHR	Annual Hydrology Report
AMS	Adaptive management strategy
AR	Annual Review
BSCSHS	Blackmans Swamp Creek Stormwater Harvesting Scheme
CoA	Condition of approval
DST	Decision Support Tool
EC	Electrical Conductivity
GMP	Groundwater monitoring program
HMP	Hydrology monitoring program
kL	Kilolitre (1,000 litres)
L	Litre (1,000 millilitres)
LOD	Limit of detection
mg/L	Milligrams per litre
ML	Megalitre (1 million litres or 1,000 kilolitres)
ML/day	Megalitres per day
MOP	Macquarie River to Orange pipeline
DP&E	NSW Department of Planning and Environment
OCC	Orange City Council
OEMP	Operation Environmental Management Plan
PA	Project approval
PCSHS	Ploughmans Creek Stormwater Harvesting Scheme
SRG	Stakeholder Reference Group
µg/L	Micrograms per litre
µS/cm	Micro Siemens per centimetre
WAL	Water access licence

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# Background

## 1.1 INTRODUCTION

The Orange Raw Water Supply System is the name used for managing the sources of untreated 'raw' water for the community of Orange. It includes:

- Spring Creek Dam and Suma Park Reservoir
- The Blackmans Swamp Creek stormwater harvesting scheme (BSCSHS)
- The Ploughmans Creek stormwater harvesting scheme (PCSHS)
- Water supply bores
- The Macquarie River to Orange pipeline (MOP)

An Operation Environmental Management Plan (OEMP) has been developed to ensure that the environmental requirements and commitments made during the approvals process for the Macquarie River to Orange pipeline as well as other relevant licensing conditions, are implemented, monitored and reviewed as Orange's Raw Water Supply System is operated. This OEMP was approved by NSW Department of Planning and Environment (DP&E) on 7 September 2016.

The OEMP includes a Groundwater Monitoring Program sub-plan (Appendix J of the OEMP). A requirement of that sub-plan is to prepare the Groundwater Monitoring Program Annual Report.


As required by Condition of Approval (CoA) C5 of the Macquarie River to Orange pipeline Project Approval (PA), this Groundwater Monitoring Program Annual Report is required to support the Annual Review.

## 1.2 SCOPE

The Groundwater Monitoring Program (GMP) Annual Report is prepared to meet the requirements of Section 3.3 (Groundwater Monitoring Reporting) of the *Raw Water Supply OEMP – Attachment J: GMP*, which includes reporting the following:

- Extraction (quantity and duration); and
- Groundwater quality (as specified under Section 3.2.3 of the GMP).

This report covers the 2019-20 water year.

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### 1.3 STRUCTURE

Report structure is outlined in **Table 1.1**.

**Table 1.1 – Report Structure**

Section	Content
Section 1 – Introduction	Provides the scope, objectives, and structure of the report.
Section 2 – Groundwater Monitoring Program Annual Report	Provides the Groundwater Monitoring Program (GMP) Annual Report to meet the requirements of the Groundwater Monitoring Program forming part of the Raw Water Supply OEMP.
Section 3 – Summary	Provides a summary of non-compliances and actions.

# GMP Annual Report

## 2.1 WATER YEAR

The water year being reported is 1 July 2019 to 30 June 2020.

## 2.2 CHANGES TO CONDITIONS, APPROVAL OR LICENCES

The following changes to operating conditions occurred in the 2019-20 water year:

- The action trigger levels for the Shearing Shed Bore were altered as follows:
  - Trigger level 1 was removed;
  - Trigger level 2 was adjusted. Trigger level of 44 m below ground level remained but action was that of the original trigger level 1; and
  - A shutdown alarm was placed on SCADA system at 43 m below ground level.

There were no changes to approvals or licences in the 2019-20 water year.

## 2.3 GROUNDWATER EXTRACTION DATA


### 2.3.1 GROUNDWATER LEVELS

#### 2.3.1.1 Showground Bore

Recorded groundwater levels for Showground Bore are shown in **Figure 1**. Extraction occurred in each month through the water year, with the greatest volumes extracted in winter 2018 and autumn 2019. Groundwater levels remained above 35 m below ground level during pumping which is the level 3 trigger level.

Groundwater levels fell below the level 2 trigger level of 32 m below ground level on one occasion for approximately 4 hours between 5am and 9am on 14 October 2019. This is due to the bore running for the two days prior without stopping. The bore was turned off at 9am on 14 October 2019 and restarted once levels had risen well above the trigger level.

In accordance with the GMP, discussions were held with a hydrogeologist and Council have proposed to add an alarm for when the Showground Bore level falls close to trigger levels. An environmental incident report was not completed following the groundwater falling below trigger levels.

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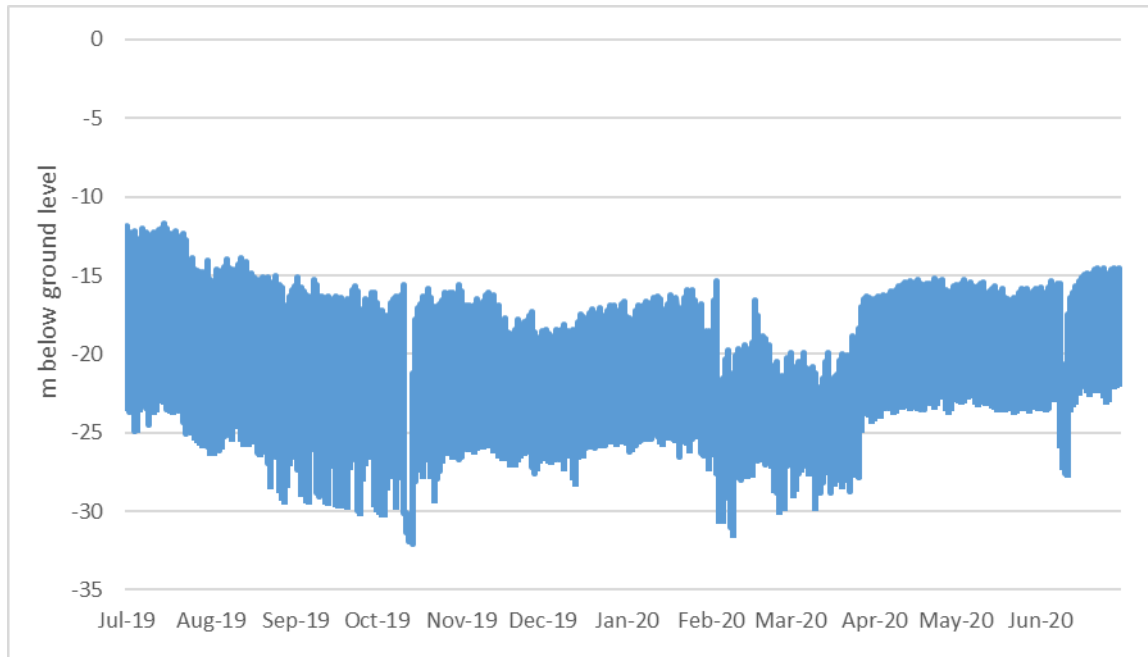


Figure 1: Showground Bore groundwater level

### 2.3.1.2 Margaret Street Bore

Recorded groundwater levels are shown in **Figure 2**. The sensor was not working correctly between July 2019 and April 2020. This was not picked up by Council as the bore was not being used. Prior to extraction, a new sensor was installed, allowing full logging of the level. Extraction from the Margaret Street Bore was carried out from March through to June 2020, with volumes ranging from 1.4 ML to 8.5 ML per month. The bore remained above the level 1 trigger level of 32 m below ground level during pumping.

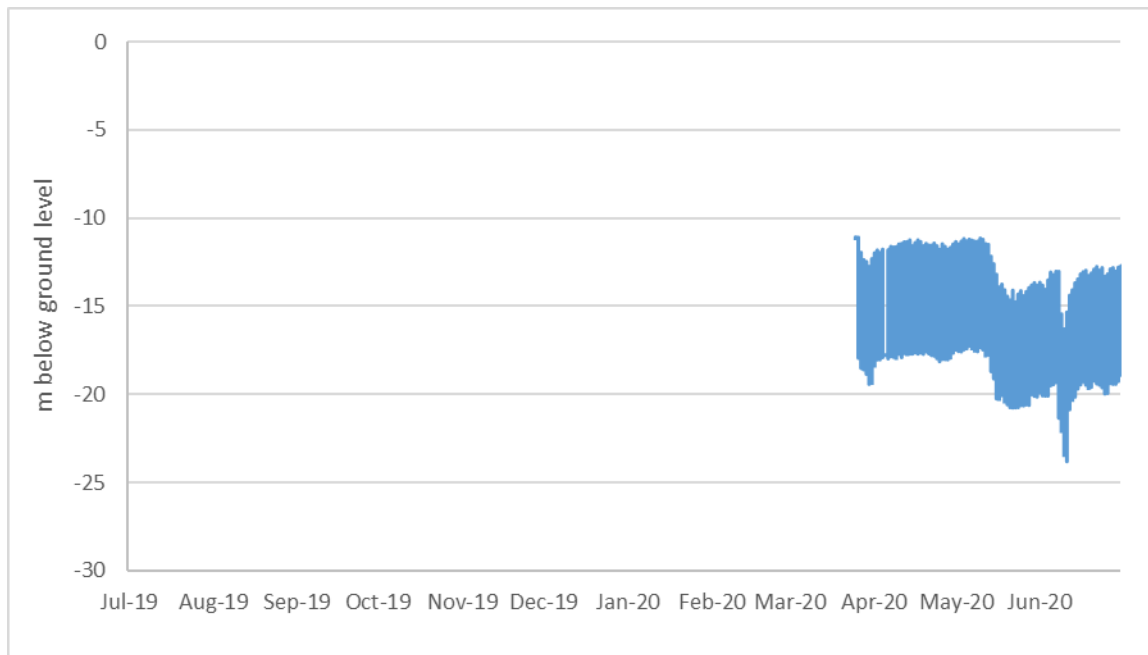



Figure 2: Margaret Street Bore groundwater level

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### 2.3.1.3 Clifton Grove Bores

#### Bore No. 5

Bore No. 5 was not utilised for water supply purposes due to draw down issues.

Minor amounts were extracted from Bore No. 5 for water quality sampling and maintenance. The extraction in December brought the groundwater level down to 40 m below ground level, which is below the level 3 trigger of 28 m below ground level. The groundwater level generally remained between 7 to 9 m below ground level, which is above the trigger 1 level (10 m below ground level).

In accordance with the GMP, discussions were held with a hydrogeologist and no further action was required due to drought conditions. An environmental incident report was not completed following the groundwater falling below trigger levels.

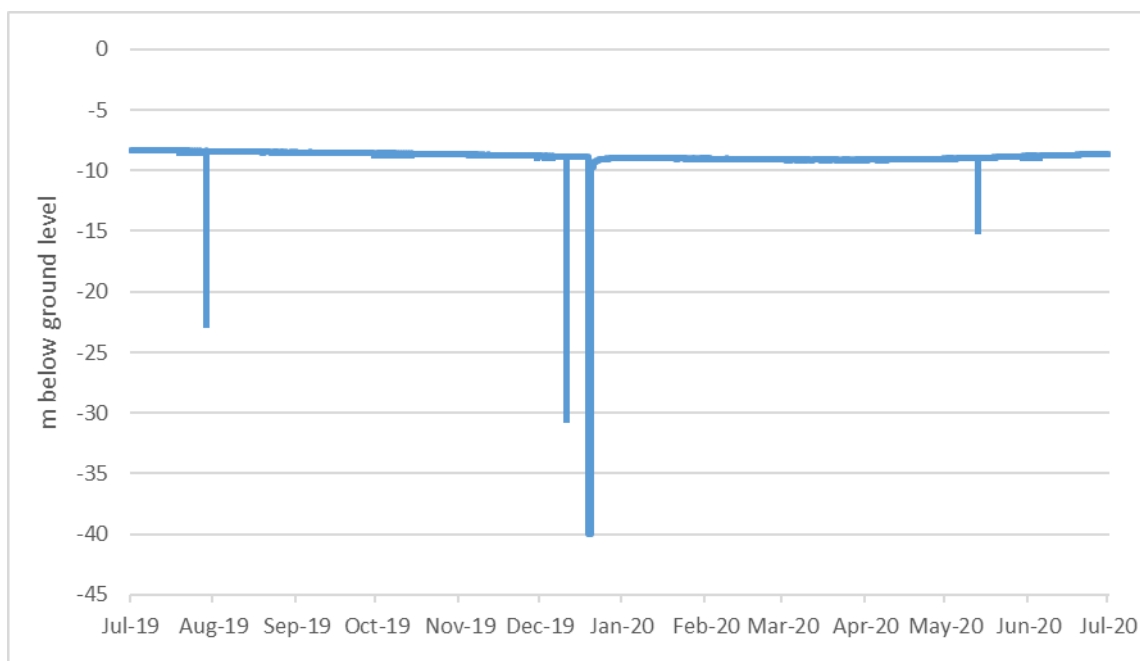


Figure 3: Bore 5 groundwater level

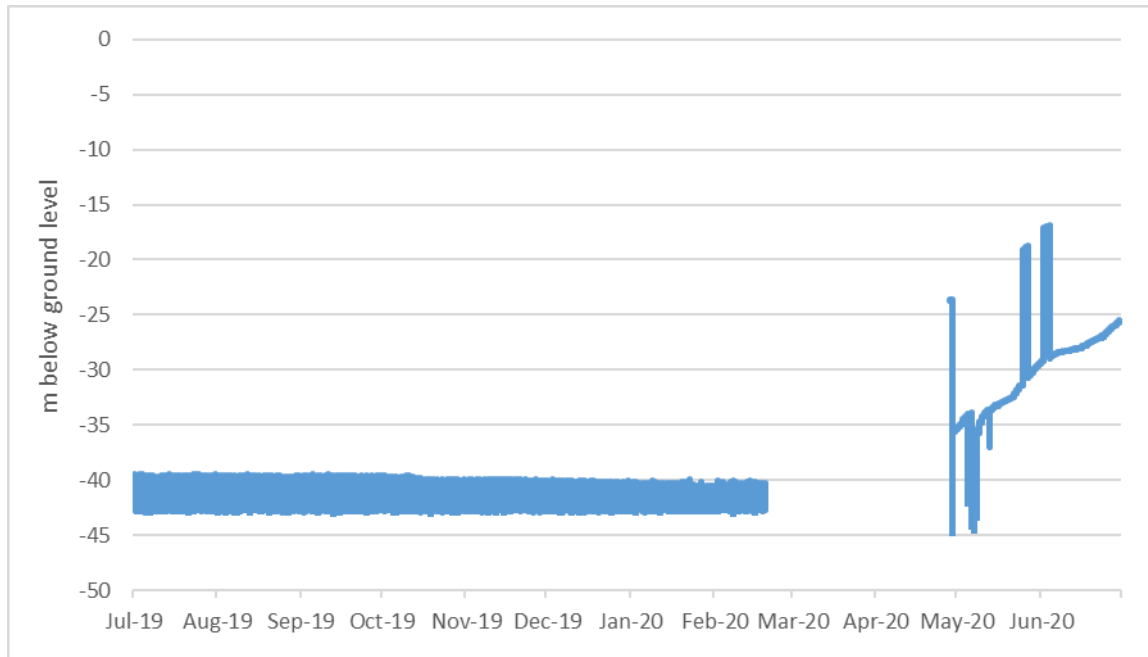
#### Shearing Shed Bore

Groundwater from the Shearing Shed Bore was used to supplement the town water supply via transfer to Suma Park Dam.

Recorded groundwater levels are shown in **Figure 4**. Extraction from Shearing Shed Bore was carried out in each month of the water year, with extraction volumes gradually decreasing towards July. Replacement of the bore pump and casing was undertaken between 21 February and 3 April 2020. Following this replacement, the level sensor was not recording correctly which was rectified in May 2020.

Trigger levels for the Shearing Shed Bore were modified during the 2019-20 water year, which meant that the groundwater level fell just below the level 1 trigger level of 44 m below ground level during pumping in May 2020. This most likely occurred due to differences in the bore screen efficiency causing more draw down in the bore hole compared to the old bore casing which had large holes.

In accordance with the GMP, discussions were held with a hydrogeologist and no further action was required due to drought conditions. An environmental incident report was not completed following the groundwater falling below trigger levels.




**Figure 4:** Shearing Shed groundwater level

**2.3.2 MONTHLY AND ANNUAL VOLUMES**

**2.3.2.1 Showground Bore**

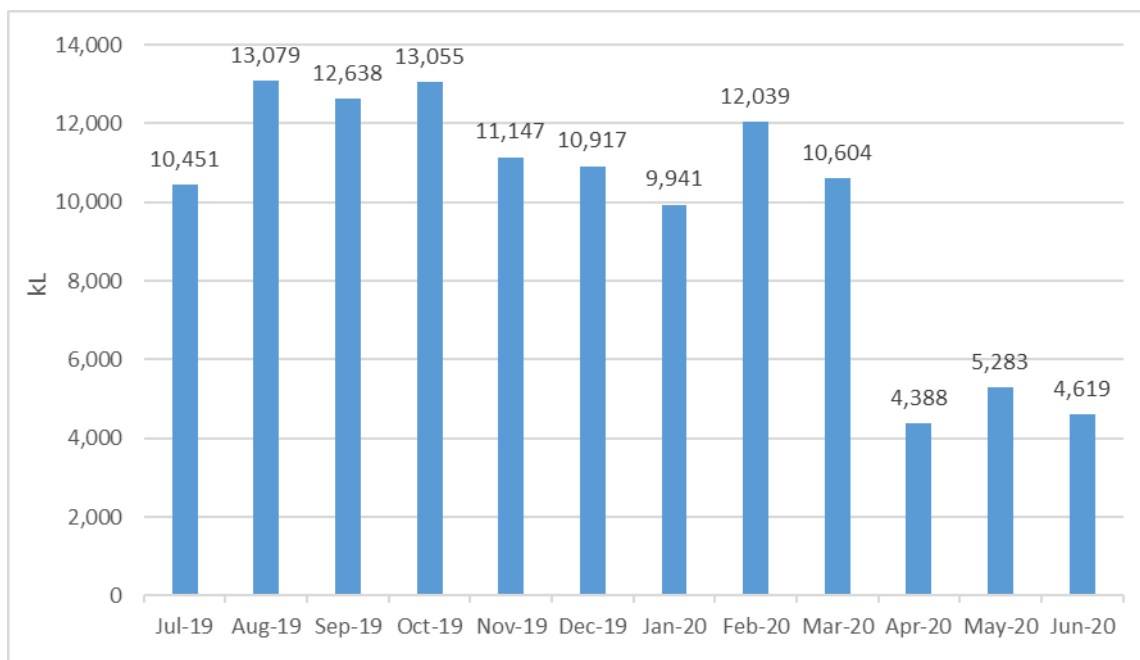
Groundwater from the Showground Bore is piped to the Orange Sewage Treatment Plant (STP). This is replacing a potable water source and is being used for wash down and other non-potable uses. Extraction from this bore totalled 118.16 ML and was reasonably consistent throughout the water year ranging from 4.6 ML in June 2020 to 13.1 ML in August and October 2019.

Extraction volumes are provided in **Figure 5** and **Table 2.1**.

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**Table 2.1 – Showground Bore Extraction**

2019	Total (ML)	2020	Total (ML)
Jul	10.5	Jan	9.9
Aug	13.1	Feb	12.0
Sep	12.6	Mar	10.6
Oct	13.1	Apr	4.4
Nov	11.1	May	5.3
Dec	10.9	Jun	4.6
<b>Grand Total (ML)</b>		<b>118.2</b>	



**Figure 5: Showground Bore Extraction (Source: Monthly Extraction Reports)**

**2.3.2.2 Margaret Street Bore**

Groundwater from the Margaret Street bore has been used in conjunction with Showground Bore and piped to the Orange STP. A total of 22.14 ML was transferred, ranging from 1.4 ML in March 2020 to 8.5 ML in May 2020.

Monthly extraction volumes are provided in **Figure 6** and **Table 2.2**.

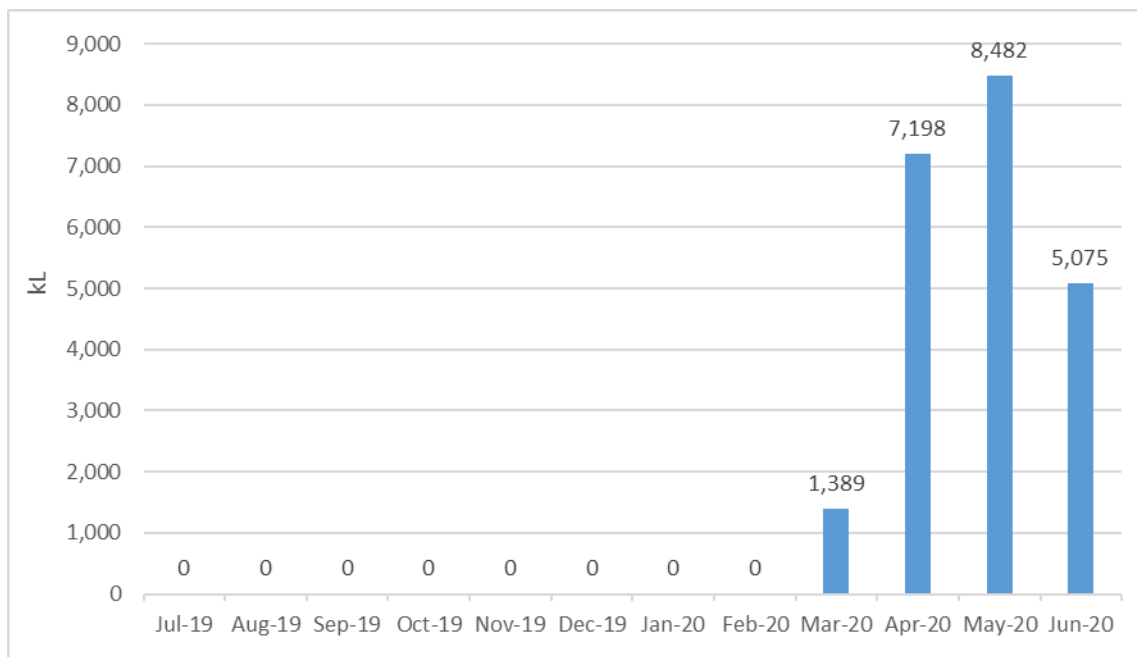


Figure 6: Margaret Street Bore Extraction (Source: Monthly Extraction Reports)

Table 2.2 – Margaret Street Bore Extraction

2019	Total (ML)	2020	Total (ML)
Jul	0	Jan	0
Aug	0	Feb	0
Sep	0	Mar	1.39
Oct	0	Apr	7.20
Nov	0	May	8.48
Dec	0	Jun	5.08
<b>Grand Total (ML)</b>		<b>22.14</b>	

### 2.3.2.3 Clifton Grove Bores

#### Bore No. 5

Bore No. 5 was not utilised other than extraction for water quality sampling and maintenance.

Extraction volumes are provided in **Figure 7** and **Table 2.3**.

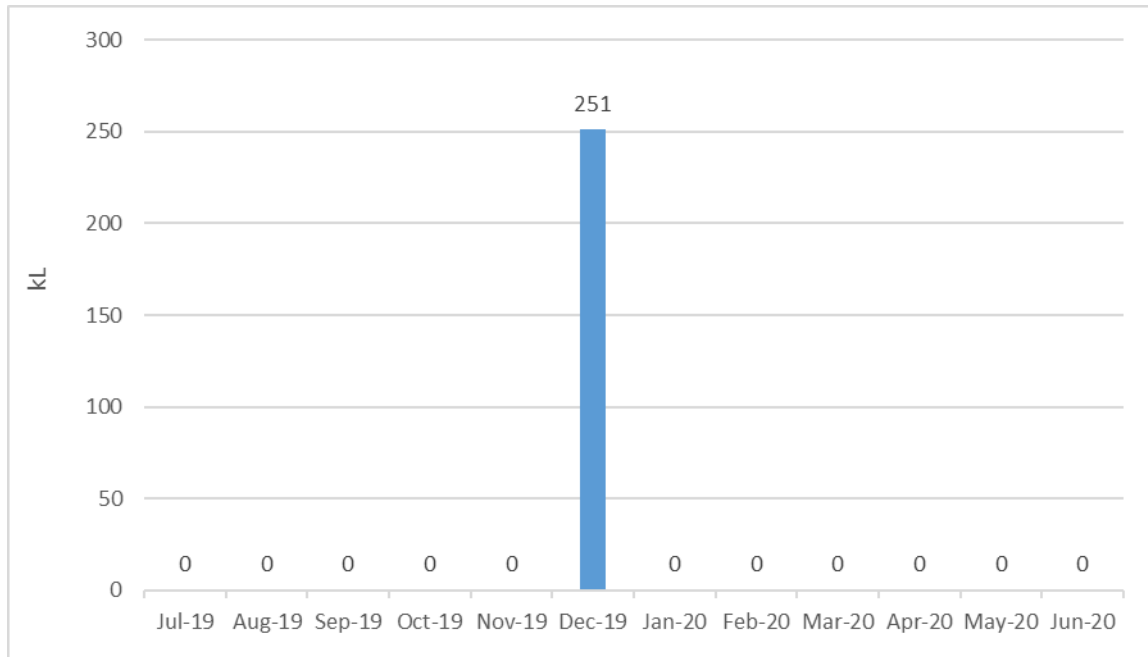


Figure 7: Bore No. 5 Extraction (Source: Monthly Extraction Reports)

Table 2.3 – Bore No. 5 Extraction

2019	Total (ML)	2020	Total (ML)
Jul	0	Jan	0
Aug	0	Feb	0
Sep	0	Mar	0
Oct	0	Apr	0
Nov	0	May	0
Dec	0.251	Jun	0
<b>Grand Total (ML)</b>		<b>0.251</b>	

**Shearing Shed Bore**

Shearing Shed Bore has been used to supplement the town water supply via transfer to Suma Park Reservoir. No extraction occurred in March 2020 due to the replacement of the bore and piping. A total of 12.9 ML was transferred ranging from 0.09 ML in May 2020 to 1.75 ML in July 2019. Monthly extraction volumes are provided in **Figure 8** and **Table 2.4**.

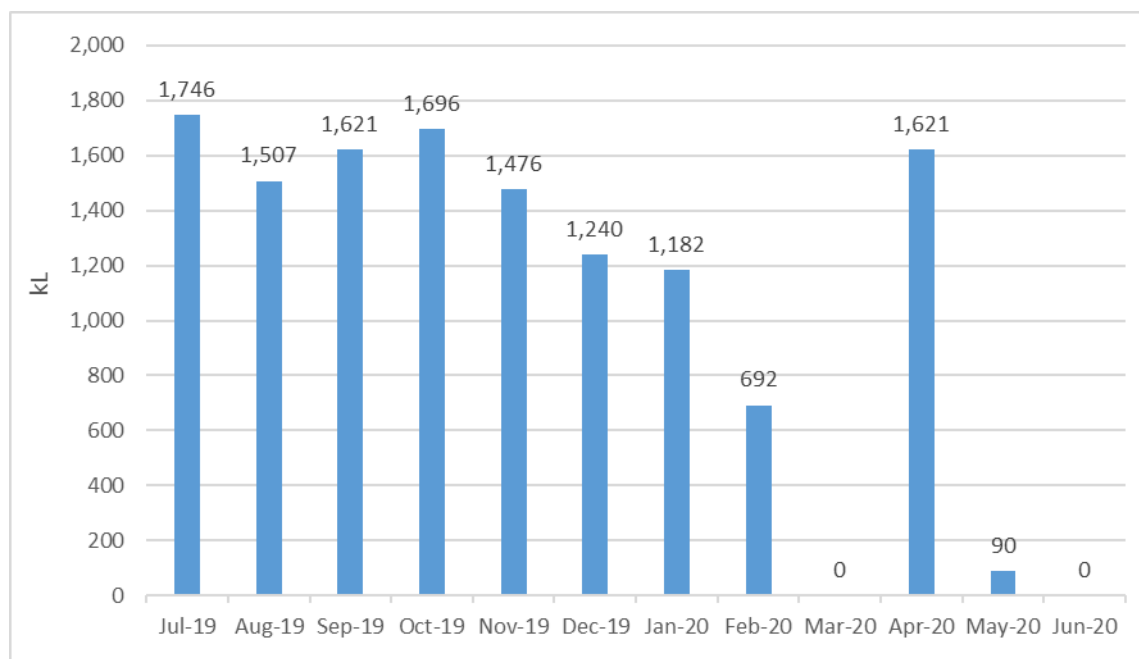


Figure 8: Shearing Shed Bore Extraction (Source: Monthly Extraction Reports)

Table 2.4 – Shearing Shed Bore Extraction

2019	Total (ML)	2020	Total (ML)
Jul	1.7	Jan	1.2
Aug	1.5	Feb	0.7
Sep	1.6	Mar	0.0
Oct	1.7	Apr	1.6
Nov	1.5	May	0.1
Dec	1.2	Jun	0.0
<b>Grand Total (ML)</b>		<b>12.87</b>	

### 2.3.3 EXTRACTION LIMIT COMPLIANCE


Orange City Council currently holds the following Water Access Licences (WALs):

- WAL 30283 authorising groundwater extraction of 182 ML/annum from the Clifton Grove Bores (Shearing Shed Bore and Bore No. 5).
- WAL 29148 authorising groundwater extraction of 280 ML/annum from the Showground and Margaret Street bores.

The volume extracted in the 2019-20 water year was 13.12 ML for WAL 30283 and 140.75 ML for WAL 29148, which is below the licence limit.

### 2.3.4 EXTRACTION MONITORING COMPLIANCE

Groundwater extraction volumes were recorded by flow meters and daily records were maintained in Monthly Extraction Reports, consistent with Condition MW0633-00001 on WAL 30283 and Condition MW0633-00001 on WAL 29148.

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Level sensor failure is evident in the data. This is addressed in **Section 3.1**.

## **2.4 GROUNDWATER QUALITY DATA**

A summary of groundwater quality data during the reporting period is provided in **Table 2.5**.

The GMP requires groundwater quality sampling to be undertaken quarterly in August, November, February, and May.

The sampling of groundwater bores was undertaken three times in the water year in July and December 2019 and May 2020.

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**Table 2.5 – Groundwater Quality Data Summary 2019-20**

	Shearing Shed Bore			Margaret Street Bore			Clifton Grove Bores					
	July 19	Dec 19	May 20	July 19	Dec 19	May 20	Showground Bore			Bore No. 5		
							July 19	Dec 19	May 20	July 19	Dec 19	May 20
pH	7.19	7.52	6.75	7.12	7.64	7.67	7.19	7.72	7.49	7.51	7.8	7.77
Electrical Conductivity (µS/cm)	520	526	601	856	860	776	851	847	738	701	705	621
Total Dissolved Solids (mg/L)	236	302	410	450	540	476	435	502	446	374	392	364
Turbidity (NTU)	6.4	8.8	47.4	0.2	0.2	0.2	<0.1	<0.1	<0.1	60.7	99.1	54
Faecal Coliforms (cfu/100mL)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Aluminium (total) (mg/L)	<0.01	<0.01	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	5.37	8.66	<0.01
Fluoride (mg/L)	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	<0.1	<0.1	<0.1
Iron (total) (mg/L)	1.48	0.19	5.68	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	11.6	18.3	0.11
Manganese (total) (mg/L)	1.1	1.21	10.2	<0.001	<0.001	0.003	<0.001	<0.001	0.004	0.104	0.236	0.006
Arsenic (total) (mg/L) *	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Pesticides (µg/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Sodium (mg/L)	25	24	21	21	21	21	19	19	19	37	12	14
Sulphate (mg/L)	39	37	217	44	44	44	45	45	40	7	6	7
Selenium (total) (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Hardness (mg/L)	198	193	245	379	377	378	379	368	366	378	296	310
Cyanide (mg/L)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Nitrate as N (mg/L)	<0.01	0.03	0.07	4.62	4.87	4.98	4.77	4.65	5.44	0.85	1.06	0.87

## 2.5 MONITORING TRENDS

This Groundwater Monitoring Program Annual Report is the fourth completed since the implementation of the raw water supply OEMP. Ten groundwater samples have been taken since early 2017.

Cyanide and pesticides have remained consistently below the level of reporting in all sample locations. Arsenic concentrations have remained at, if not below, the level of reporting at all sample locations.

Faecal coliforms also have remained consistently below the level of reporting, excluding samples in May 2017 and February 2018. Bore No. 5 recorded 1 CFU/100mL in both May 2017 and February 2018, and Showground bore, and Shearing Shed bore recorded 36 and 2 CFU/100mL in May 2017, respectively.

The turbidity of Bore No 5 is higher than the other three bores, which is possibly causing elevated metal concentrations (principally iron, manganese and aluminium). The low annual extraction is likely to be contributing to the elevated turbidity. The Shearing Shed Bore also shows elevated iron and manganese.

Data for metals is insufficient for trend analysis. The OEMP will be updated to specify testing for total metals in groundwater samples to obtain a consistent database for trend analysis.

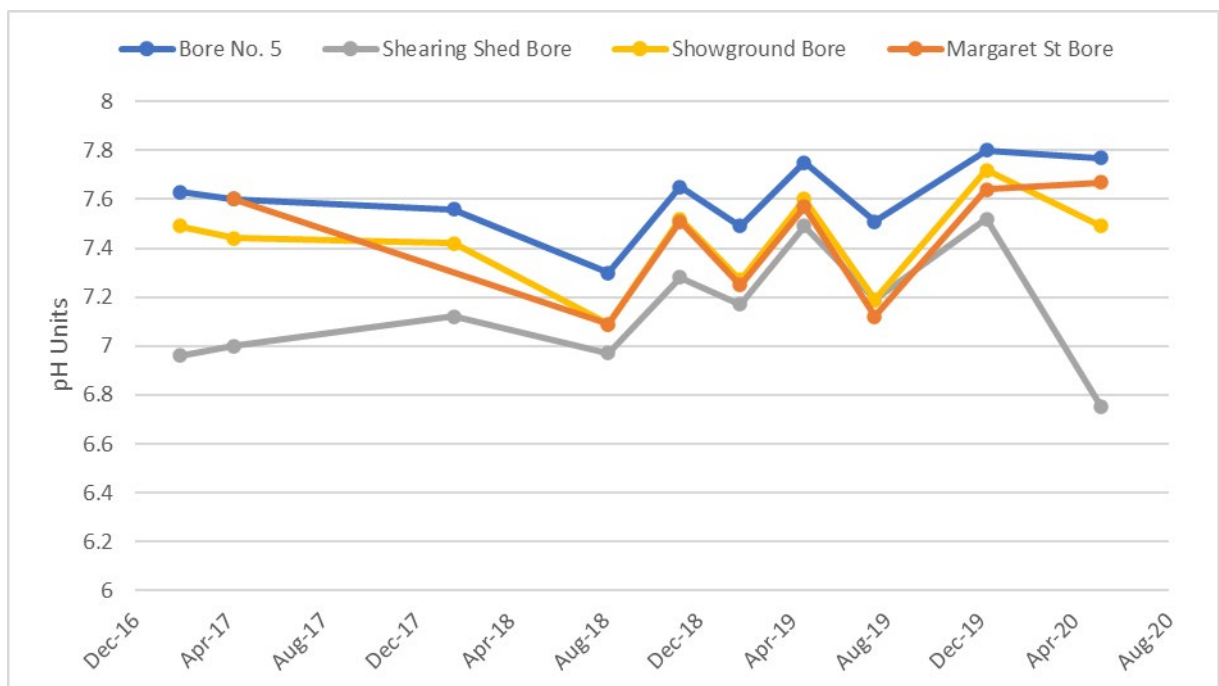
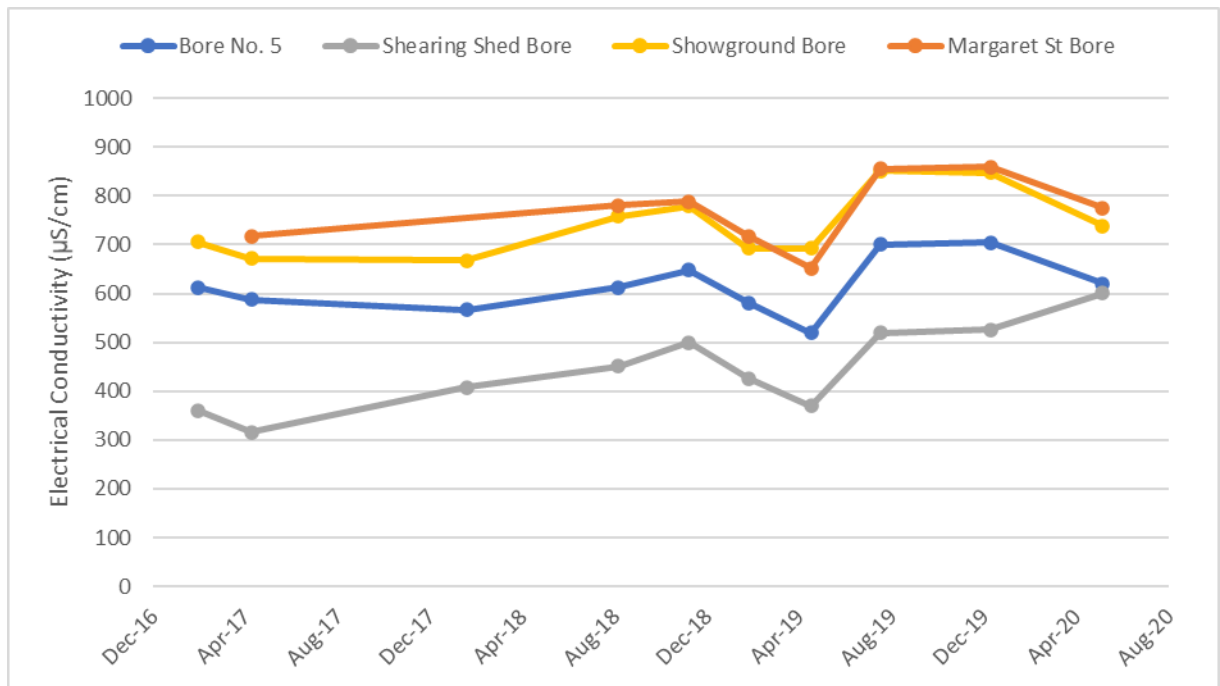
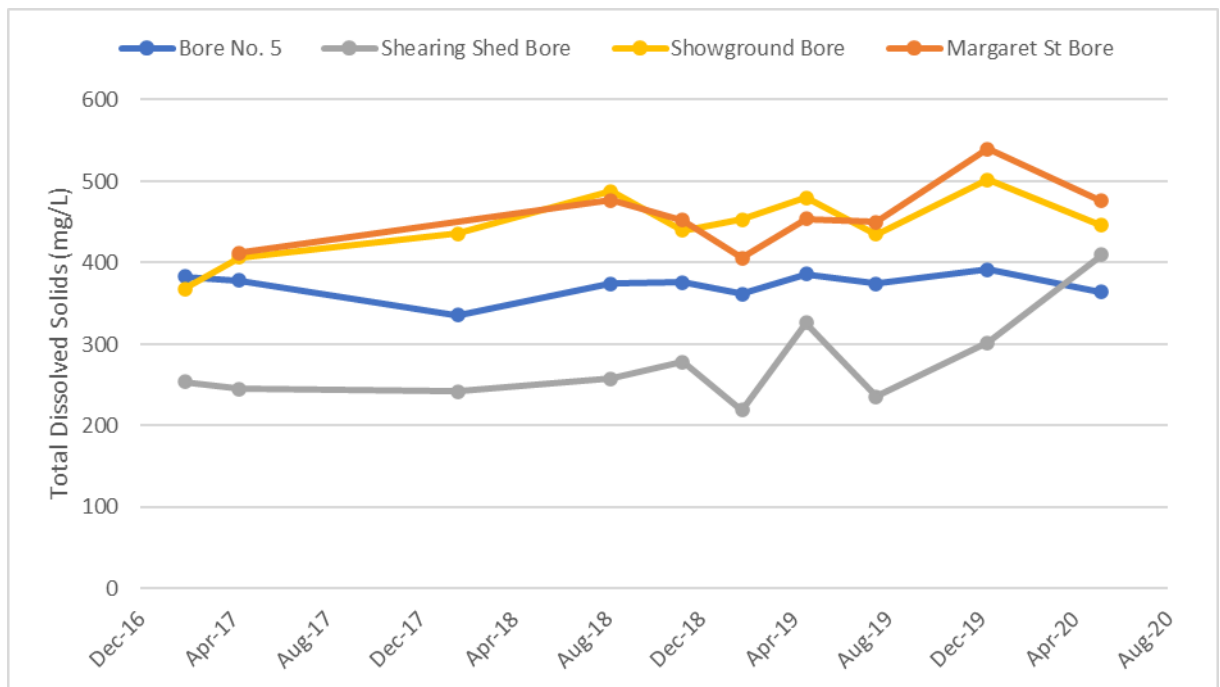


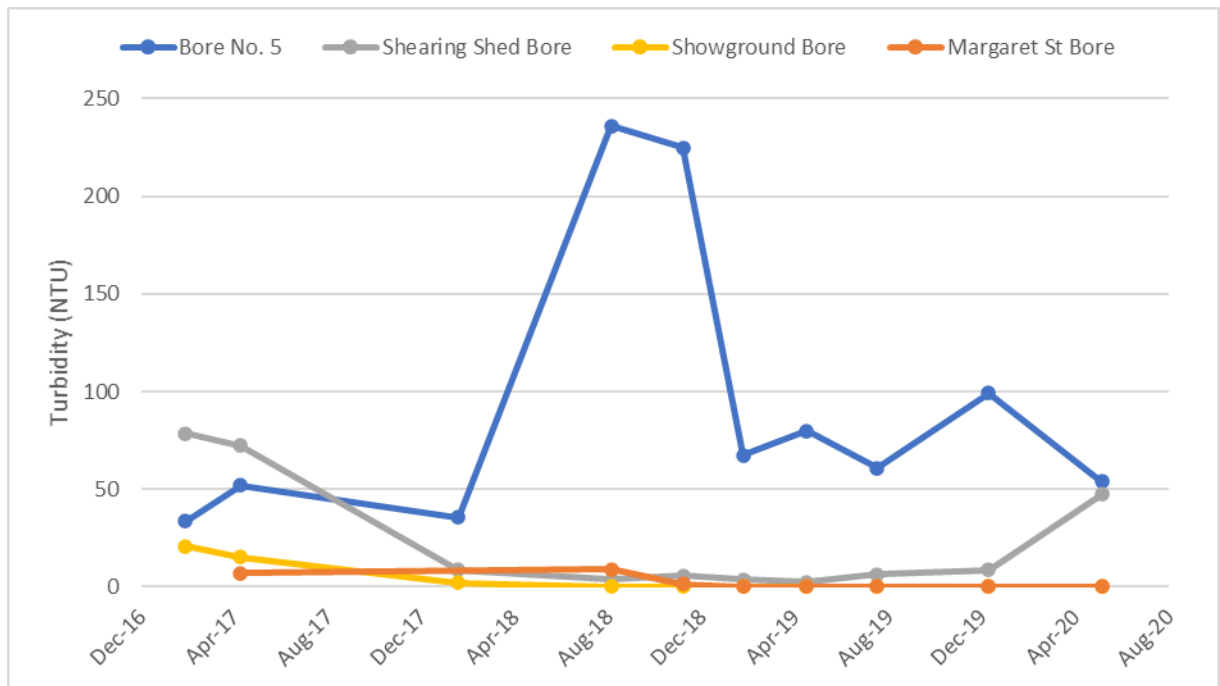
Figure 9: Groundwater pH sample



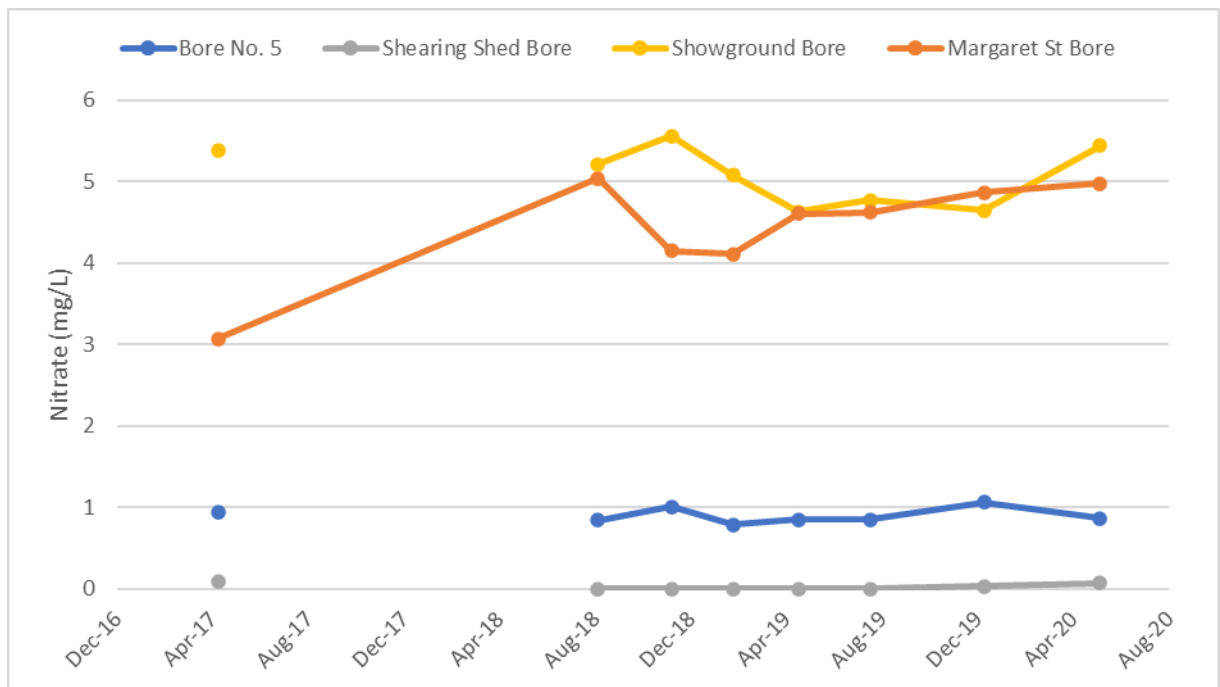
**Figure 10: Groundwater electrical conductivity results**



**Figure 11: Groundwater total dissolved solids concentration**



**Figure 12: Groundwater turbidity**



**Figure 13: Groundwater nitrate**

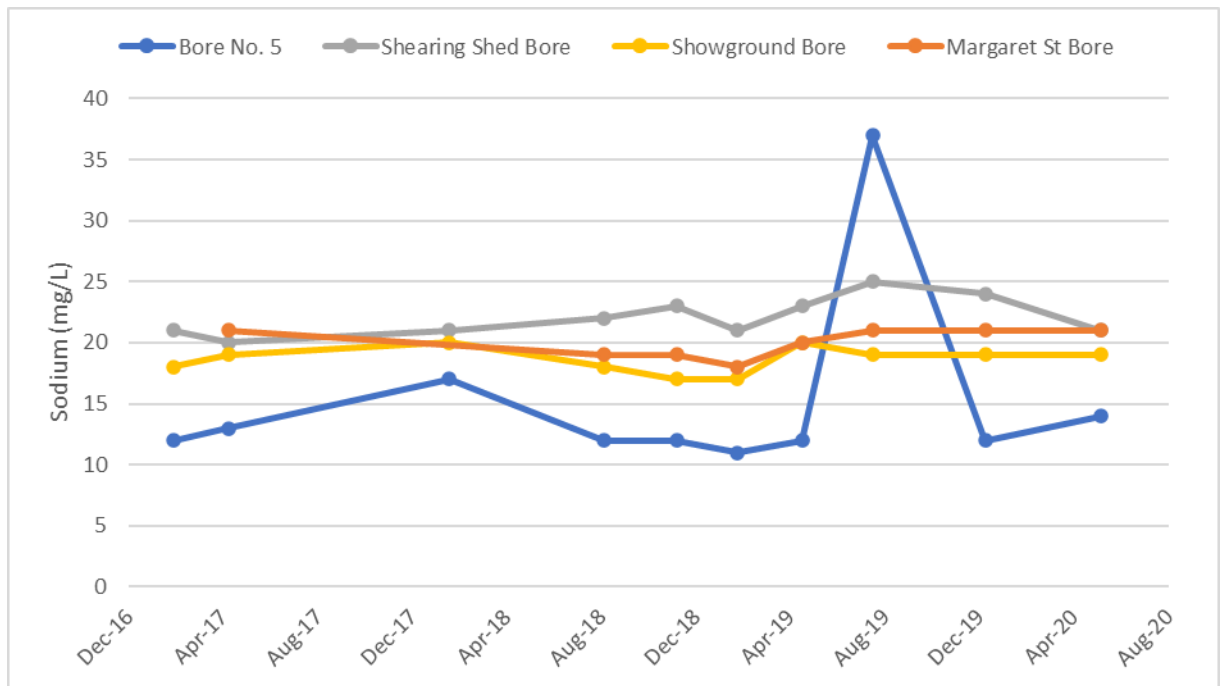


Figure 14: Groundwater sodium

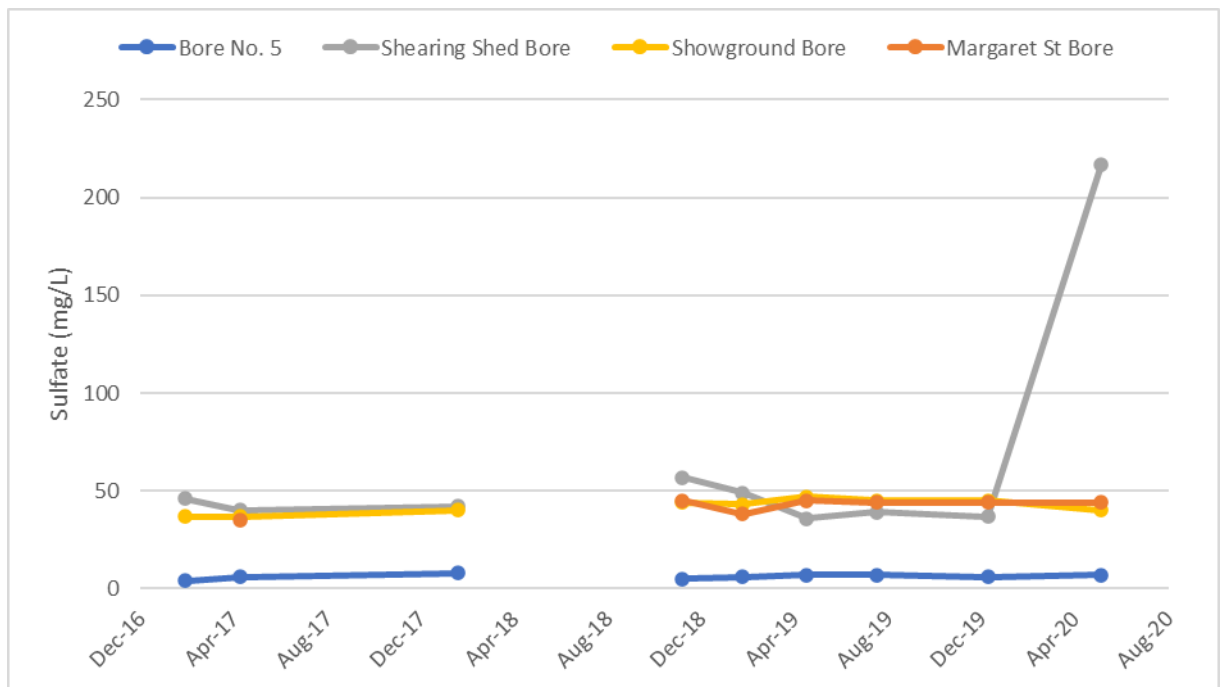



Figure 15: Groundwater sulfate

## 2.6 PREDICTIONS VS. ACTUAL IMPACTS

Raw water for town water supply purposes was extracted from the existing surface water storage system and groundwater bores (Showground Bore, Margaret Street Bore and Shearing Shed Bore) throughout the 2019-20 water year. This was consistent with the defined DST operating rules which identified that external water sources would be required in the water year analysis.

The operation of bores was generally consistent with the OEMP Groundwater Monitoring Program and extraction volumes were within licence limits. Some groundwater trigger levels were exceeded, and discussions were held with a hydrogeologist. It was considered that groundwater levels and aquifer behaviour were variable due to drought conditions and no further action was required.

There are no impact predictions made for the operation of the bores against which actual performance can be compared.

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# Summary

## 3.1 ENVIRONMENTAL PERFORMANCE

### 3.1.1 GROUNDWATER LEVELS

Showground Bore reached level two trigger level during pumping. Following this occurrence Council plan to implement an alarm for the Showground Bore to alert when the bore level is dropping close to the trigger level. This will allow Council to turn the bores off prior to the trigger level being reached and for groundwater levels to recover.

Shearing Shed Bore reached level one trigger level during pumping. This was following the installation of the new bore pump and casing. An alarm/automated shutdown will be installed to alert when the bore level is dropping close to the trigger level.

Margaret Street Bore level remained above the trigger one level during all pumping.

Bore No 5 was not utilised for water supply, however it was used during the three sampling rounds and for maintenance. These minor extractions did cause the water level to drop below trigger levels, however, frequent extraction is not undertaken from this bore due to the draw down. Groundwater levels remained above the trigger level for the remainder of the year when the bore was not in use.

### 3.1.2 EXTRACTION


Groundwater was extracted for the purposes of town water supply in the 2019-20 water year. The volume extracted was 13.1 ML for WAL 30283 and 140.75 ML for WAL 29148, which is below the licence limits of 182 ML and 280 ML, respectively.

### 3.1.3 GROUNDWATER QUALITY

The quality of Bore No 5 is more turbid than the other bores, which is possibly causing elevated metal concentrations (principally iron, manganese, and aluminium). This may be due to the lack of extraction from the bore. The Shearing Shed Bore also shows elevated iron and manganese.

Salinity in all bores shows a slight upwards trend, which may be caused by the dry conditions experienced over the last few years.

Other than the above, trend analysis of groundwater quality shows there are no obvious adverse trends due to the extraction of water for town supply.

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## 3.2 NON-COMPLIANCE SUMMARY AND ACTIONS

### 3.2.1 NON-COMPLIANCES

The following improvement measures were implemented by OCC during the 2019-20 water year to address non-compliances identified in the 2018-19 Annual Review:

- The implementation of a data management and scheduling system progressed; and
- Updated the COC forms to include correct parameters.

A summary of non-compliances for the 2019-20 water year and actions taken (or proposed) is provided in **Table 3.1**.

**Table 3.1 – Non-Compliance Summary**

Non-Compliance	Section	Risk Level	Action Taken or Proposed
Only three of four sampling rounds undertaken in water year and timing was different to the program outlined in the GMP.	<b>Section 2.4</b>	<b>Administrative non-compliance</b>	OCC to implement scheduling system to ensure all monitoring is undertaken.  Consider changing the program to specify quarterly sampling rather than specific months in the GMP.
An Environmental Incident Report was not prepared following the exceedance of trigger levels.	<b>Section 2.3.1</b>	<b>Administrative non-compliance</b>	OCC to review the GMP and procedures relating to groundwater trigger levels.
Incomplete level data for Margaret Street Bore and Shearing Shed bore due to failed sensors.	<b>Section 2.3.1.2</b>	<b>Low</b>	OCC fixed both level sensors in early 2020.

### 3.2.2 IMPROVEMENT MEASURES

Improvement measures have been identified from minor operational issues noted during the water year. These issues are not a non-compliance with environmental requirements or approval/licensing conditions but have been identified to improve future management of the raw water supply system. The improvement measures are outlined in **Table 3.2**.

**Table 3.2 – Improvement Measure Summary**

Issue	Section	Proposed Improvement Measure
Showground Bore reaching trigger level 1	<b>Section 2.3.1.1</b>	OCC propose to install an alarm for Showground Bore to alert when the groundwater is approaching a trigger level
Mismatch recording of total versus dissolved metals in groundwater sampling	<b>Section 2.5</b>	Update to Attachment J: GMP of the Orange Raw Water Supply System OEMP to state that the groundwater samples shall be sampled for both total and dissolved metal concentrations. Results will be reported for total metals only.
Amendment to BIMPs trigger levels	<b>Section 2.2</b>	Update to Attachment J: GMP of the Orange Raw Water Supply System OEMP to reflect new trigger levels