ANNUAL HYDROLOGICAL REPORT

FY2026

WORSLEY ALUMINA REFINERY

WORSLEY

Prepared for

South32 Worsley Alumina Pty Ltd

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LICENSE COMPLIANCE SUMMARY

Worsley Surface Water License SWL6804141(5) (Appendix A)

Groundwater and other surface water sampling completed at Worsley Operations is legislated via Ministerial Statement 1237 (MS1237). The Worsley Water Management Plan (WMP) summarises these commitments.

MS1237 condition B16-2 requires Worsley Alumina to update and submit the Water Management Plan (WMP version 6.0) and MS1237 condition C1-1 requires Worsley Alumina to not commence ground disturbing activities within the proposal area until the CEO of DWER has confirmed in writing that the management plan meets the requirements of the relevant conditions or as otherwise agreed by the CEO. Confirmation that the WMP met the requirements of the relevant conditions was received from DWER on 11 Feb 2025.

Assessment of Refinery water license compliance is shown below.

Table I: License Compliance Summary

License Requirement	Compliance
A base flow release as per license requirements	Complied
The volume of water taken in any year shall not exceed 5,400,000 kL	Complied
The licensee shall record meter readings monthly from the Freshwater Lake pump station and forward the meter readings, monthly usage and annual volume of water drawn to the Department of Water and Environmental Regulation by 30 September	Complied
The licensee shall undertake monitoring for each parameter and at the frequency identified in Surface Water Monitoring commitment S1	Complied
Water quality is to be compared with the Australian & New Zealand (ANZECC) 2000 Guidelines for Fresh and Marine water quality – Aquatic Ecosystems (SW Australia – Upland Rivers)	Complied

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1.0 INTRODUCTION

This review covers South32 Worsley Alumina Pty Ltd (WAPL) water monitoring for the period July 2025 to June 2026 (FY26). The review has been prepared in accordance with the Alumina Refinery (Worsley) Agreement Act 1973 (WA) (as amended), and the Worsley Surface Water License SWL68041(5) condition R1, issued under the Rights in Water & Irrigation Act (1914).

Refinery surface water monitoring is required by the surface water license SWL68041(5); (Appendix A). Groundwater and other surface water sampling completed at Worsley Operations is legislated via Proponent Conditions 2 & 13 and Proponent Commitment 7 of Ministerial Statement 1237 (MS1237). The Worsley Water Management Plan summarises these commitments and was approved by the OEPA and Worsley EMLG.

Surface Water Licence SWL68041(5) expired on 11 November 2025. At the time of preparing this report, the renewed licence SWL68041(6) had not yet been issued. The Department of Water and Environmental Regulation (DWER) agreed to honour the previous licence while DWER and WAPL are progressing the licence renewal.

The latest version of the Worsley Water Management Plan (Version 6) was released on 10 February 2025.

1.1 License Commitments

The WAPL Refinery Surface Water license SWL6804(5) November 2015 states conditions relating to the extraction and use of water sourced from the Fresh Water Lake (FWL), including the metering and monitoring of nominated sampling points against listed parameters (Appendix A).

Conditions for annual reporting stated in the license include:

W4) The Licensee shall ensure that;

a) The transitional water release strategy agreed upon is implemented and an average flow of 35 m^3/h should be released for the period 15th Dec to the 15th February each year, starting with lower flows from 15th November increasing to 35 m^3/h average by 15th December continued until 15th February, then stepping down to no release by 15th March;
b) The volume of water taken or released each year is measured and reported to the Department;
c) The volume of water taken in the term of the license shall not exceed 26,000,000 kL;
d) The volume of water taken in any year shall not exceed 5,400,000 kL.

M2) The licensee shall record meter readings monthly and forward the meter readings, monthly usage and annual volume of water drawn to the Department of Water by 30 September each year.

R1) Annual reporting of the monitoring data including trend analysis is to be included as part of Annual Environmental Review and Annual Hydrological Monitoring Review prepared by WAPL for the Environmental Management Liaison group (EMLG) associated with WAPL's mining and refinery operations in Boddington and Collie.

In 2021, DWER recommended a new transitional water release strategy which came into effect on 30 September 2021. The water license has not yet been updated to reflect this new strategy.

Introduction

The updated water release strategy states that an average of 35 m^3/h should be released for the period 15th September to the 31st October, decreasing to 28 m^3/h to be released for the period 1st November to the 11th November, decreasing again to 21 m^3/h to be released for the period 12th November to the 22nd November, 14 m^3/h from 23rd November to 3rd December and lastly 7 m^3/h from 4th December to 14th December.

2.0 CLIMATE/RAINFALL

The WAPL Refinery Lease Area is situated in a typical Mediterranean climatic region, comprising cool wet winters and hot dry summers. Maximum average monthly temperatures for the Refinery range from 15 °C in July to 34 °C in February and minimum monthly average temperatures range from 6 °C in July to 19 °C in February.

Meteorological data has been collected onsite since 1980. The current meteorological station was installed onsite and commenced collecting meteorological data in December 2015. The station is a continuous monitoring meteorological station mounted on a 30 m tower that records data from 8 sensors including rainfall, temperatures at 2 m, 6 m and 30 m above ground surface, humidity, solar radiation, wind speed and wind direction data from the same 30 m tower. Rainfall is recorded continuously from a tipping bucket rain gauge.

Historically, evaporation was measured daily using a class "A" evaporation pan with bird guard. However, for the FY26 reporting period, evaporation readings were deemed unreliable due to technical issues with the measurements. As such, for FY26, evaporation rates were obtained from the SILO database as described below.

Long-term average (LTA) rainfall and evaporation data were obtained from the SILO rainfall dataset (Queensland Department of Environment and Science). SILO contains reconstructed climate data across Australia and are based on Bureau of Meteorology (BoM) meteorological stations with missing data infilled based on surrounding BoM stations. The SILO database also contains meteorological data on spatial grids across Australia based on surrounding BoM meteorological station and using mathematical interpolation techniques.

Based on the SILO dataset (-33.25°S and 116.05°N), the LTA annual rainfall for the refinery is about 947 mm (1 January 2000 to 30 June 2026). The median rainfall (50% probability of exceedance) is 993.2 mm. Since the climate in the region has been affected by a long-term drying trend, only the last 25 years of rainfall is considered.

LTA potential evaporation was also obtained from the SILO database. Evaporation rates were based on the "Evap pan" values which are estimated Class A pan evaporation rates derived from climate variables including temperature, humidity, windspeed and radiation. The average yearly evaporation rates are 1,509 mm (2000-2025). Average annual evaporation rates exceed rainfall by a factor of 1.6.

Rainfall during the current review period was higher than the updated LTA with 991.0 mm recorded to 30 June 2026 (Table 1). Estimated evaporation during the review period was higher than the LTA with 1,939.5 mm, recorded to 30 June 2025 (Table 1).

Climate/Rainfall

Table 1: Evaporation and Rainfall

Month	Evaporation (mm)		Rainfall (mm)	
	FY26	LTA	FY26	LTA
July	50.5	49.4	198.5	225.7
August	79.4	60.3	227.5	161.3
September	106.6	81.9	108.0	110.9
October	137.9	119.5	58.0	48.4
November	214.9	167.7	19.5	33.3
December	320.1	220.9	1.0	19.5
January	327.7	238.1	1.5	15.6
February	274.2	196.8	1.5	13.1
March	223.0	165.8	70.5	22.8
April	90.3	97.2	46.0	47.4
May	64.0	64.7	108.5	113.2
June	50.9	46.6	150.5	135.8
Total	**1,939.5**	**1,508.8**	**991.0**	**947.0**

3.0 Surface Water Monitoring Programme

The surface monitoring program comprises the following.

- Water abstraction volumes, release volumes and water levels as measured from the Freshwater Lake (FWL).
- Automatic measurements of flow rates and water quality downstream of the FWL at the Augustus River Gauging Station (ARGS).
- Measurements of surface water quality at the FWL, ARGS and adjacent Hamilton River.

Surface water monitoring locations are shown in Figure 1. The Hamilton sampling point is situated about 6.5 km south of the WAPL boundary and not shown on the map. Surface water sampling locations are summarised in Table 2.

Table 2: Surface water monitoring locations

Monitoring station	Easting	Northing
Augustus River Gauging station (ARGS)	409,060	6,323,871
Hamilton River sampling point (HAR1)	411,538	6,313,821
Freshwater Lake pump intake (FWL)	409,753	6,323,475

Coordinates in MGA GDA94 Zone 50

3.1 Freshwater Lake

The FWL is used as the primary source of fresh water for the Refinery. This water is used for both plant process make-up and for domestic requirements onsite, including fire water, garden reticulation and dust suppression. The lake has a maximum capacity of 6,080 ML. The dead storage of the lake is about 1,000 ML, giving the FWL an available storage capacity of approximately 5,000 ML.

In addition to the FWL, water is also abstracted from the Wellington Dam, but this information is not presented in this report since water abstraction from Wellington Dam does not form part of the license conditions.

In accordance with the DWER license conditions, (W4), WAPL is obliged to release water from the FWL to the Augustus River each year. This water is required to meet riparian rights and for ecological function. The revised scheduled release from DWER came into effect on 30 September 2021. A transitional release is required whereby the release of water starts on 15 September with 35 kL/h, decreasing until 7 kL/h by 15 December. The recommended schedule and flow rates are presented in Table 3:

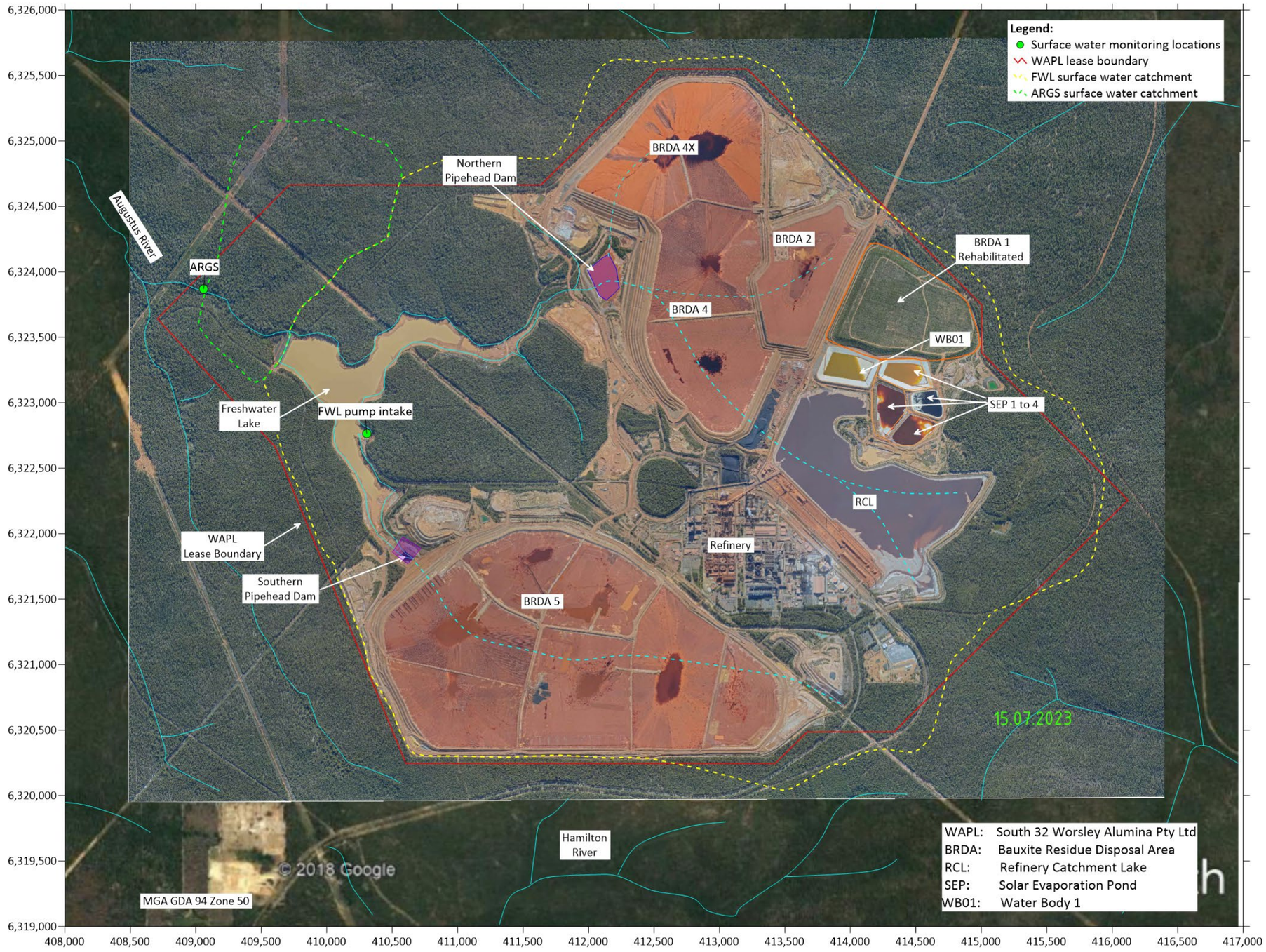

Figure 1: Surface water monitoring locations

Table 3: DWER proposed schedule for FWL release

Schedule	Rate (kL/hr)
15 September to31 October	35
1 November to 11 November	28
12 November to 22 November	21
23 November to 3 December	14
4 December to 14 December	7

Water is normally released to the Augustus River using a mobile surface pump equipped with a flow meter. Since FY24, releases have been directed through a turbidity treatment plant located at the base of the FWL dam wall. This plant was commissioned following elevated turbidity levels recorded at the FWL pump intake in FY23, which prevented downstream discharge at that time.

The installation of the turbidity plant enabled continued water releases to the Augustus River during the FY24 to FY26 reporting periods. Water is pumped to the unit passing through the turbidity plant for treatment. The treated water is then discharged into the Augustus River. An automated turbidity logger, installed within the unit, continuously measures the turbidity levels of released water.

3.2 Surface water flow rates and quality

The Augustus River Gauging Station (ARGS) is a nominated monitoring point in accordance with Surface Water License SWL68041(5). The site comprises a V-notch weir to measure flow depths across the river. An automated multiparameter sonde is installed at the ARGS to measure flow depths and water quality parameters. The multiparameter sonde comprises an Aqua TROLL 600 (In-Situ) and is equipped to measure water depth, temperature, electrical conductivity (EC), Dissolved Oxygen (DO), pH, oxidation-reduction potential (ORP) and turbidity. The sonde is programmed to continuously measuring these parameters at 5-minute intervals.

Water flow rates can be determined by the following equation, considering the geometrical considerations of the V-notch weir.

$$Q = 4.86833 \times 10^{-8} \times D^{2.4802}$$

Where D is the flow depth and Q is the flow rate in m^3/s.

3.3 Surface water quality

The ARGS is the nominated surface water sampling point in accordance with Surface Water License SWL68041(5). In addition, surface water samples are also collected from the FWL at the pump intake location and at the Hamilton River (Figure 1).

The FWL sampling, conducted at the pump inlet, allows for the measurement of water quality to assess the suitability of the water for release to the Augustus River as per license conditions.

Hamilton River (HAR1) is used as a reference site and forms part of an offsite catchment zone, reflecting natural flow and water quality conditions. HAR1 was removed from the license conditions in FY18, but it is still monitored to align with the Worsley Water Management Plan.

Water quality parameters measured at the ARGS, FWL and HAR 1 comprises:

- Monthly laboratory analysis for pH, EC, sodium (Na) and Chloride (Cl).
- Monthly field analysis for pH, EC, dissolved oxygen (DO), turbidity and temperature.
- Bi-yearly analysis for alkalinity (total), bicarbonate, carbonate, calcium, potassium, sulphate, aluminium, iron and magnesium.

Water samples were sent to a NATA accredited water quality testing laboratory for analysis and results are presented in Section 5.

3.4 Wastewater storage facilities

There are several wastewater storage facilities which are used in the management of affected water at the site and these are summarised below (Figure 1). For the FY24 reporting period, water samples were collected from all the wastewater storage facilities, which informed potential hydraulic connection between the storage facilities and the surface and groundwater receptors. These were described in more detail in the FY24 hydrology review.

Pipe Head Dams (NPHD and SPHD)

The PHDs are located downstream of the Bauxite Residue Disposal Areas (BRDAs) and upstream of the FWL. The NPHD receives residue liquor from the northern BRDAs while the SPHD receives liquor from BRDA5.

The purpose of the PHDs is to collect residue liquors from the BRDAs for pumping back to the RCL. The residue liquors typically have a pH of approximately 12. An extensive chemical grout curtain has been installed below the PHD's earth embankment to prevent the downstream migration of the high pH residue liquor.

Four groundwater depression bores have been installed on the upstream face of the NPHD. The purpose of the bores is to lower the groundwater level and reverse the natural groundwater flow direction with the aim of preventing seepage towards the lower parts of the catchment. The water pumped from these bores is also redirected into the RCL. Similarly, liquor pumps located within the SPHD containment area maintain the liquor level below the ambient groundwater levels such that groundwater flow is towards the SPHD containment area.

Several issues were identified with the operation of the PHDs during the FY24 reporting period and these are described in more detail in the FY24 hydrology reviews. Section 6 provides an update of these issues.

Refinery Catchment Lake (RCL)

The RCL is located to the northeast of the refinery (Figure 1) and receives wastewater, liquor and rainfall runoff from the refinery. In addition, the RCL receives process cooling water from the plant and residue liquor from the PHDs. Water stored in the lake is reused in the process plant and recirculated for cooling at the process plant and powerhouse.

Water Body 1 (WB01) is a lined balancing pond for pumping of caustic process water during periods of high water levels in the RCL. The stored water is held within the pond and released to the RCL on

an as-needed basis. WB01 also receive return liquor pumped from the Bauxite Residue Disposal Areas (BRDAs) 4 and 2.

Solar Evaporation Ponds (SEPs)

The SEPs are located to the north of the RCL (Figure 1). SEP 1, 2A and 4 are lined with High Density Polyethylene (HDPE) while SEP 3 is lined with a PVC liner. SEP 1 and SEP 4 were historically used to store un-neutralised acid wastes, and since 2015, these facilities together with SEP2A were used to store oxalate. SEP3 was in operation from 1984 through to 1989 and stored neutralised waste from May 1984 to January 1986. It was then used to store un-neutralised waste acid between January 1986 and August 1989. Since August 1989, SEP3 has been used to store alkaline waste (pH 10) formed through the mixing of oxalate waste. SEP2A was commissioned in 1989 and stored un-neutralised acid wastes. SEP2A was relined in 2021 and now is approved to store oxalate in accordance with recent license amendments.

3.5 FY26 surface water monitoring issues

ARGS monitoring station

The V-notch ceased flowing between 4 January and 26 April 2026, and the logger was removed during this period to prevent damage. Following redeployment, technical issues were identified with the logger and the unit was sent for repair. The logger was reinstalled in May 2026.

Following redeployment, logger pH readings were lower than the expected baseline range. These readings are considered likely to reflect instrument or calibration issues rather than a change in river water quality. The logger will be recalibrated and repaired if required during FY27.

Persistent fouling issues were also observed at the logger installation, resulting in occasional artificial spikes in turbidity, including during June 2026. The logger is therefore cleaned frequently to minimise the occurrence of erroneous turbidity measurements.

Turbidity plant pumping data

There were issues with the flow meter at the turbidity treatment plant pumping station between 5 November and 15 December 2025, and release rates could therefore not be reliably determined for this period. However, downstream flows continued to be measured at the Augustus River Gauging Station (ARGS), and these data were used to assess compliance with the required environmental release rates.

4.0 WATER ABSTRACTION, LEVELS AND FLOWS

4.1 Freshwater Lake

The total water pumped from the FWL during this reporting period (1 July 2025 to 30 June 2026) totalled 1,273,075 kL (Table 4), which is less than the license maximum limit of 5,400,000 kL per annum. The FY26 abstraction represents 24% of the maximum abstraction limit.

The abstraction volumes were about half the FY25 water abstraction rates, which was mainly attributed to increased pumping of make-up water from the Wellington Dam.

The total water abstraction from 1 November 2015 to 30 November 2025, which marks the end of the 10-year licence period, was 20,353,219 kL, which is 78.3% of the 10-year license allowance of 26,000,000 kL (Table 4).

Table 4: Monthly and Yearly FWL Abstraction

Month	Monthly abstraction (kL)		Year	Yearly abstraction (kL)
	FY25	FY26		
July	117,963	96,400	Nov 2015 to Jul 2016	2,106,971
August	91,720	98,178	FY17	1,883,701
September	26,671	82,056	FY18	1,728,359
October	65,132	62,738	FY19	2,060,286
November	105,060	78,181	FY20	1,574,342
December	125,569	94,627	FY21	1,291,809
January	144,952	104,699	FY22	1,370,073
February	332,302	128,019	FY23	3,387,299
March	602,431	134,655	FY24	1,869,634
April	574,554	194,136	FY25	2,663,191
May	389,731	100,636	Jul 2025 to Nov 2026	417,554
June	87,106	98,750	Total	20,353,219
Total	2,663,191	1,273,075		

Long-term FWL water levels have fluctuated because of seasonal rainfall. Since FY23, water levels within the FWL were lower compared to previous years because a higher water abstraction from the FWL for FY23 and FY24, water levels fluctuated between 230 m AHD and 235 m AHD reaching a peak in October 2025 (Figure 2). However, water levels decreased substantially by the end of FY25 because of increased abstraction from the FWL. Water levels recovered in FY26 but only reached a maximum of 231.7 m in September 2025 before decreasing again towards the end of FY26.

Note, erroneous water level data related to the Jetty meter installation in December 2025 were excluded from the dataset.

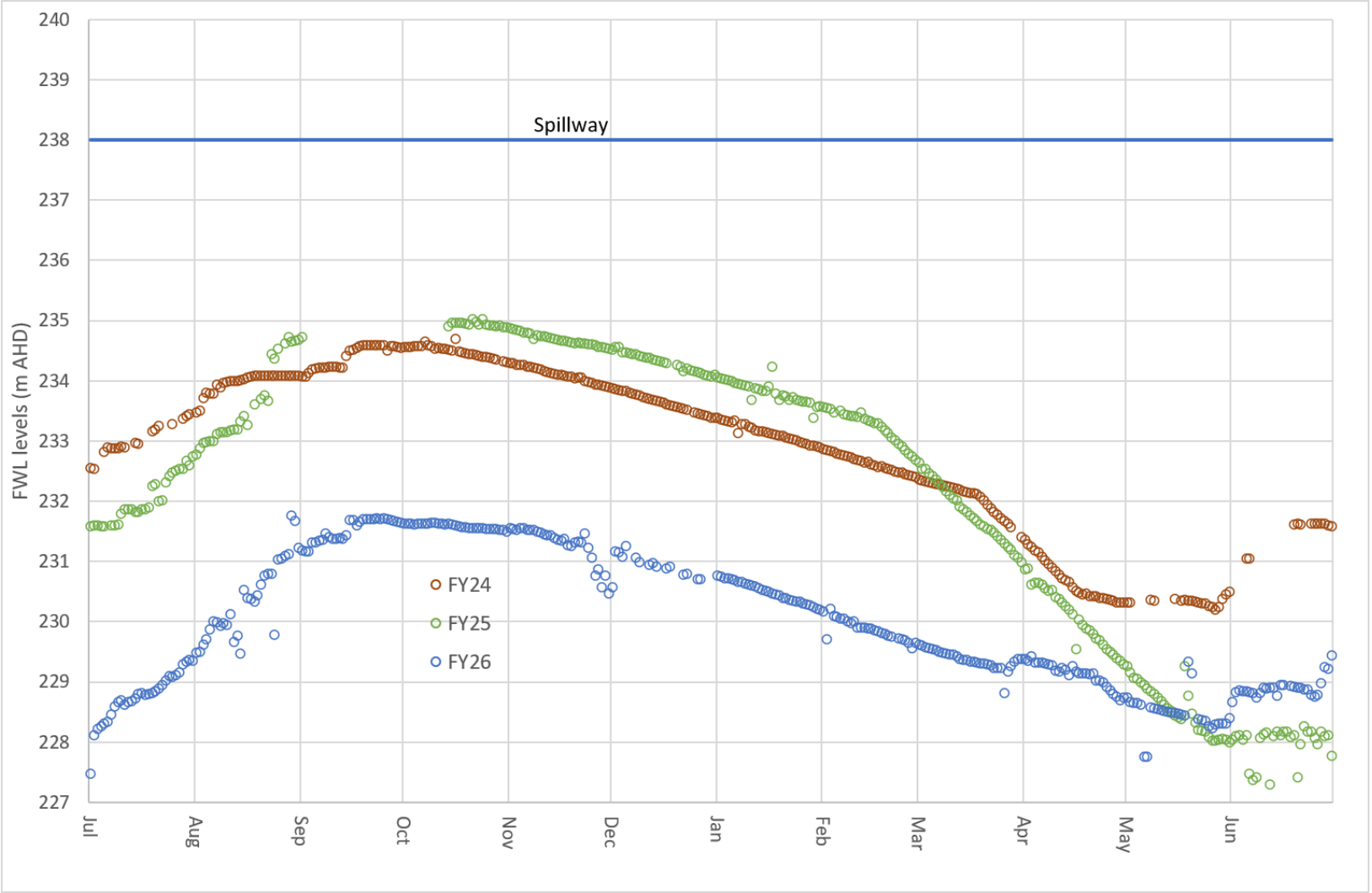

Figure 2: Freshwater Lake Levels

4.2 Augustus River Gauging Station

During the FY26 reporting period, measured flow rates were generally similar to the FY24 period and lower than the FY25 period.

The average monthly flow rates for the FY24, FY25 and FY26 periods are presented in Table 5. Flow rates were lower for all months compared to FY25 except for May and June 2025 where FY26 flow rates were higher.

Table 5: Monthly Average Flow at ARGS

Month	ARGS average monthly flow rates (kL/hr)		
	FY24	FY25	FY26
July	38.0	44.9	15.3
August	49.0	112.1	44.1
September	48.3	62.7	29.9
October	43.8	30.0	11.8
November	31.2	35.0	30.8
December	16.0	8.2	16.8
January	2.0	3.8	0.0
February	NM	0.3	0.0
March	NM	0.3	0.0
April	NM	0.5	0.5
May	19.4	2.1	7.3
June	22.3	7.6	15.0

NM: Not measured

4.3 Freshwater Lake Release

As discussed in earlier hydrological review reports, persistent high turbidity levels in the FWL prevented the direct release of FWL water to the downstream Augustus River. Instead, water was released after treatment by a turbidity treatment plant at the base of the FWL dam wall. Flow rates, pH and turbidity levels were measured at the discharge location of the treatment plant using a flow meter and water quality sonde.

In previous hydrology reviews, FWL release was reported at the dam wall (pre-FY24) and at the turbidity plant (FY24), with seepage represented by an assumed rate. For the FY25 and FY26 review periods, release estimates have been expanded to include flow data from the Augustus River Gauging Station (ARGS). The use of ARGS data provides a more accurate representation of total water release to the environment, as these flow rates also incorporate a quantitative estimate of seepage from the FWL.

There were issues with the flow meter at the turbidity treatment plant pumping station and release rates could therefore not be reliably determined However, downstream flows continued to be measured at the Augustus River Gauging Station (ARGS), and these data were used to assess compliance with the required environmental release rates.

Table 6 presents the DWER guideline release rates and the observed release rates at the ARGS.

Table 6: FY26 FWL release rates (kL/hr)

Schedule	DWER guidelines	ARGS flow rates
15 September to 31 October	35	18.1
1 November to 11 November	28	22.5
12 November to 22 November	21	33.8
23 November to 3 December	14	35.4
4 December to 14 December	7	31.7

Figure 3 shows the cumulative flow rates at the ARGS compared to DWER guidelines. The figure shows that flow rates at the ARGS were initially lower than the DWER releases guideline at the start of the release guidelines, but there were higher releases during the latter part of the release period. The total release volume of 53.9 ML is slightly lower than the DWER guidelines of 56.8 ML.

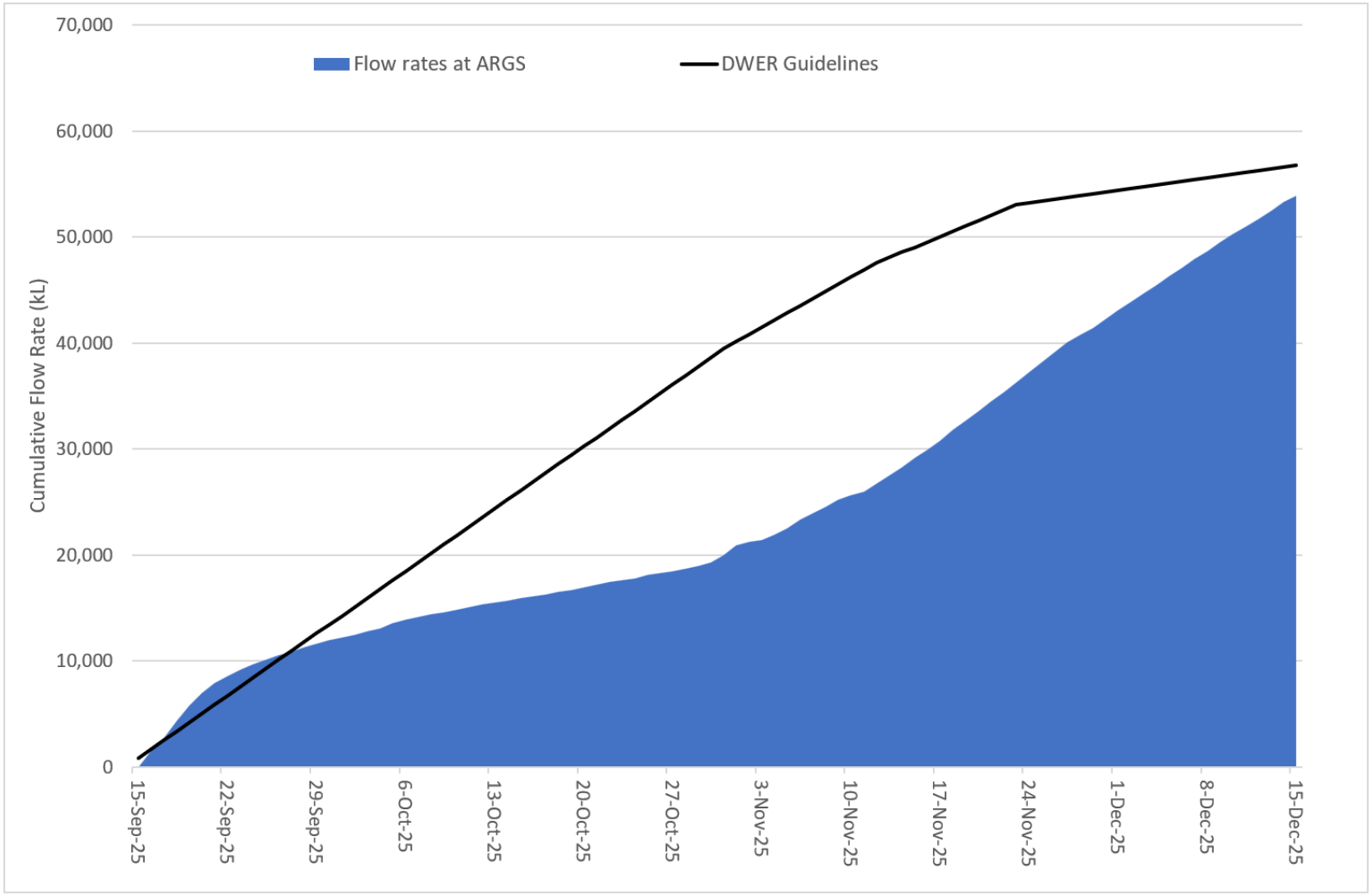

Figure 3: Flow rates at the ARGS during the release period

5.0 SURFACE WATER QUALITY

Surface water quality results were compared to the ANZECC default trigger values for south-west Australia for slightly disturbed ecosystems (ANZECC, 2000). Water quality results were compared to physical and chemical stressors (Table 3.3.6 of ANZECC), salinity and turbidity (Table 3.3.6 of ANZECC) and toxicants (Table 3.4.1 of ANZECC).

Freshwater lake water quality was compared to "Freshwater Lakes and Reservoirs" criteria while water quality at the Augustus River Gauging Station was compared to the "Upland River" criteria.

5.1 Freshwater Lake Water Quality

Monthly laboratory water quality results are provided in Table 7 while field analysis results are provided in Table 8. Quarterly water quality results are presented in Table 9.

Quarterly trends of analysed parameters are shown in Figure 4. These parameters provide an indication of potential anomalous changes in FWL water quality.

Elevated turbidity levels in the FWL persisted during the review period with values higher than the ANZECC guidelines set at 20 NTU. As described in the previous studies WAPL investigated the cause of the high turbidity levels in the FWL and determined that the turbidity was caused due to a combination of upstream construction works and ineffective existing sedimentation ponds which are situated between the construction works and the FWL. A site visit by Dr Jan Vermaak on 25 June 2026 also identified that the general low water levels within the FWL could contribute to the increased turbidity with exposed sediment within the FWL basin potentially being mobilised.

Although several actions were already undertaken to improve the FWL water quality, including the construction of sediment control structures, persistent high turbidity continued through the FY26 period.

The high turbidity levels necessitated the implementation of a turbidity treatment plant in FY24 to allow FWL release as per DWER guidelines, addressed earlier in the report.

Apart from turbidity, monitoring results during this review period are comparable to previous review periods and baseline data. The trends in the water quality are still well within the historical water quality ranges.

Apart from turbidity and one DO reading on 14 October 2025, the measurements are within the range presented within the ANZECC 2000 guidelines for South-Western Australia aquatic ecosystems guideline values for lakes, reservoirs and wetlands.

Table 7: Monthly FWL Water Quality (Laboratory)

Month	EC (µS/cm)	pH	Na (mg/L)	Cl (mg/L)	Al (mg/L) (total)
ANZECC	**ND**	**ND**	**ND**	**ND**	**0.08**
22 Jul 2025	243	7.49	40	46	NM
20 Aug 2025	222	7.51	35	40	0.04
23 Sep 2025	202	7.45	33	38	NM
13 Oct 2025	203	7.61	32	38	NM
05 Nov 2025	201	7.54	31	40	0.02
15 Dec 2025	217	7.51	36	41	NM
27 Jan 2026	230	7.65	38	44	NM
09 Feb 2026	233	7.47	37	47	<0.01
17 Mar 2026	241	7.54	62	50	NM
22 Apr 2026	244	7.67	39	48	NM
25 May 2026	241	7.47	34	49	0.01
02 Jul 2026	237	7.51	35	45	NM

ND: Not determined, NM: Not measured

Table 8: Monthly FWL Water Quality (Field)

Month	EC (µS/cm)	pH	DO (ppm)	Turbidity (NTU)	Temperature (°C)
ANZECC	**300-1,500**	**6.5-8.0**	**<7.3***	**20**	**ND**
22 July 2025	185	7.48	10.16	185	12.1
20 Aug 2025	139	6.66	10.54	291	12.9
23 Sep 2025	193	7.67	9.79	293	19.9
14 Oct 2026	NM	7.20	6.58	279	NM
5 Nov 2025	195	7.17	9.36	388	19.5
15 Dec 2025	215	7.43	8.26	119	25.9
27 Jan 2026	222	7.57	NM	64	21.3
9 Feb 2026	245	7.48	8.73	NM	25.9
17 Mar 2026	232	NM	8.73	12	NM
22 Apr 2026	211	NM	8.77	71	19.0

NM: Not measured, ND: Not determined

*ANZECC refers to DO>90% which is equivalent to about >7.3 ppm

Table 9: Quarterly FWL Water Quality

Parameter	Unit	20 Aug 2025	11 Nov 2025	9 Feb 2026	25 May 2026
Total alkalinity	mg/L	24	22	22	29
Bicarbonate	mg/L	24	22	22	29
Carbonate	mg/L	<1	<1	<1	<1
Calcium	mg/L	4	4	4	4
Iron	mg/L	0.05	<0.05	<0.05	<0.05
Magnesium	mg/L	3	3	4	4
Potassium	mg/L	1	1	2	1
Sulphate	mg/L	12	13	14	15
TDS (calculated)	mg/L	144	131	151	157

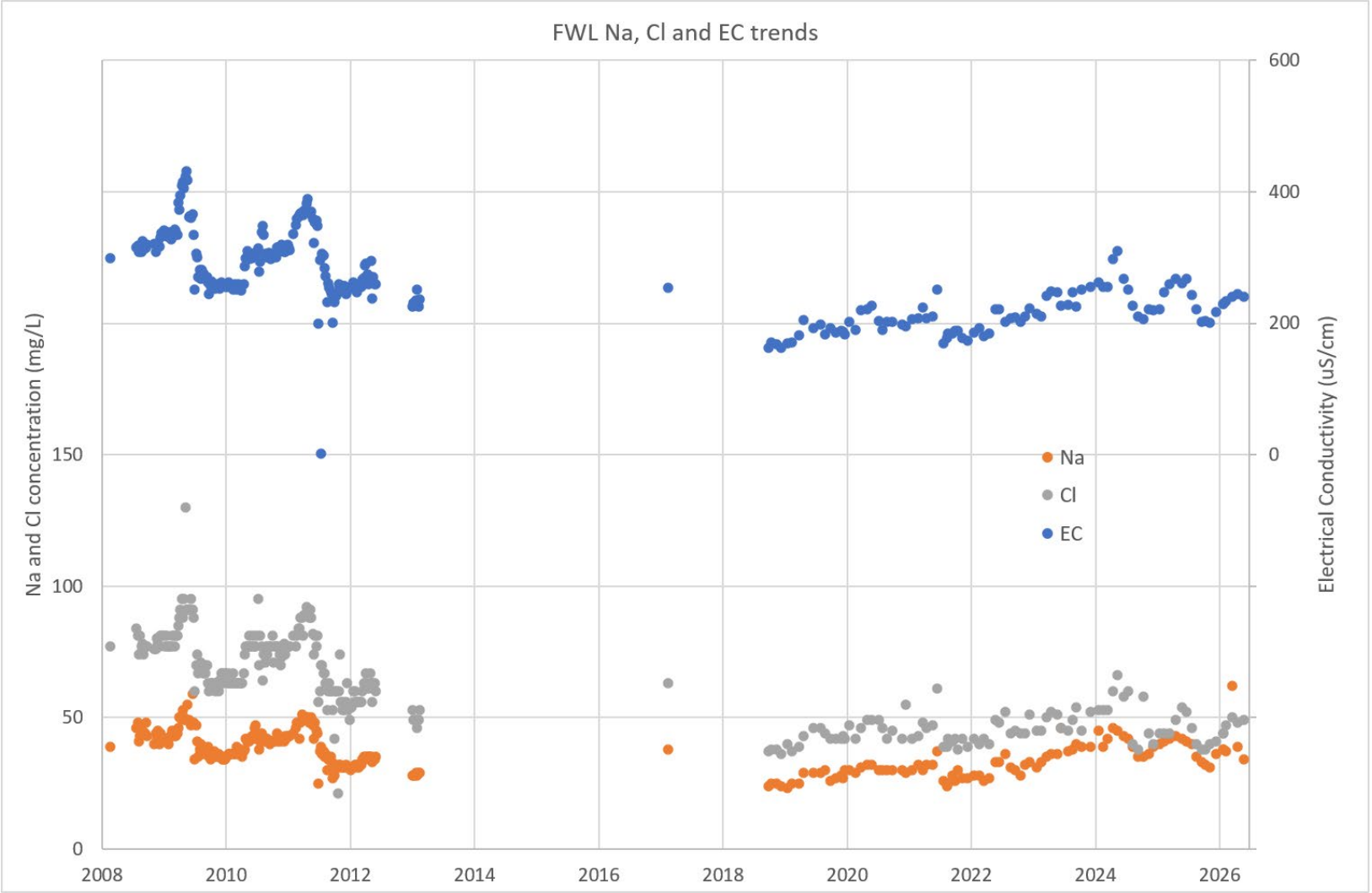

Figure 4: FWL long-term water quality trends

5.2 Augustus River Water Quality

Augustus River water quality samples are taken from the ARGS.

Monthly laboratory water quality results are provided in Table 10 while field analysis results are provided in Table 11. Quarterly water quality results are presented in Table 12.

All parameters were within the ANZECC guidelines, except dissolved oxygen (DO) on 23 September 2025 and turbidity on 20 August 2025. The high turbidity measured in August 2025 likely coincided with a spike of turbidity, which sometimes occurs following large rainfall events, and this should be viewed in terms of the general turbidity trends described in more detail below.

Long-term trends of analysed parameters are shown in Figure 5. The results show a continuous gradual downward trend since 2011, likely the result of continuous release of water from the FWL in accordance with the license conditions. In FY26, there were higher values recorded in May and July 2026, but water quality values have remained within the historical ranges.

Table 10: Monthly ARGS Water Quality

Month	EC (µS/cm)	pH	Na (mg/L)	Cl (mg/L)	Al (mg/L) (total)
ANZECC	**ND**	**ND**	**ND**	**ND**	**0.08**
22 Jul 2025	259	6.86	39	58	NM
20 Aug 2025	204	6.92	31	46	0.11
23 Sep 2025	222	6.92	34	47	NM
13 Oct 2025	245	7.29	36	54	NM
05 Nov 2025	231	7.37	34	50	<0.01
15 Dec 2025	236	7.48	28	46	NM
25 May 2026	334	5.43	37	55	0.06
02 Jul 2026	297	6.36	39	60	NM

ND: Not determined, NM: Not measured

Table 11: Monthly ARGS Water Quality (Field)

Month	EC (µS/cm)	pH	DO (ppm)	Turbidity (NTU)	Temperature (°C)
ANZECC	**300-1,500**	**6.5-8.0**	**<7.3***	**20**	**ND**
1 Jul 2025	180	7.05	8.9	10.1	11.1
22 Jul 2025	185	6.91	10.5	1.8	10.1
20 Aug 2025	139	6.66	8.5	291	12.9
23 Sep 2025	173	7.18	5.8	2.8	14.6
5 Nov 2025	210	7.08	8.2	0.1	17.5
2 Dec 2025	240	6.74	8.2	8.5	24.2
15 Dec 2025	237	7.24	7.8	7.5	27.0

Table 12: Quarterly ARGS Water Quality

Parameter	Unit	20 Aug 2025	5 Nov 2025	25 May 2026
Total alkalinity	mg/L	9	23	1
Bicarbonate	mg/L	9	23	1
Carbonate	mg/L	<1	<1	<1
Calcium	mg/L	3	4	8
Iron	mg/L	0.35	<0.05	<0.05
Magnesium	mg/L	4	4	7
Potassium	mg/L	1	1	2
Sulphate	mg/L	10	11	58
TDS (calculated)	mg/L	133	150	217

Data logger results for FY26 are presented in Figures 6, 7 and 8. Note that the river stopped flowing between 4 January 2026 and 26 April 2026, hence the reason for the missing data. Following redeployment, technical issues were identified with the logger and the unit was sent for repair. The logger was reinstalled in May 2026, hence there are some missing data in April and May 2026.

Figure 6 shows that the EC varies between 150 and 350 µS/cm with lower EC values occurring in the wet winter months and the higher EC values occurring in the dryer summer months. These trends fall within the expected range and there are no deleterious trends in EC values.

pH ranges between 5.0 and 7.1, with the lower pH measurements recorded after the instrumentation issues have been resolved in June 2026. These lower pH values could be related instrumentation calibration issues and will be assessed in more detail in FY27, noting that the pH trends are not considered deleterious.

The turbidity levels show some variability, ranging between <5 and 40 NTU with occasional spikes of higher turbidity, but average turbidity levels remained below 20 NTU. However, the monitoring data shows an increase in turbidity in June 2026. It is not clear whether this increase is related to actual turbidity values or fouling of the instrument. If it is not related to instrument error, the turbidity seems to be unrelated to the activities of the operations since there were no releases from the FWL in June 2026.

Average EC, pH and turbidity measurements (except for June 2026) are within the range presented within the ANZECC 2000 guidelines for South-Western Australia aquatic ecosystems guideline values for upland rivers.

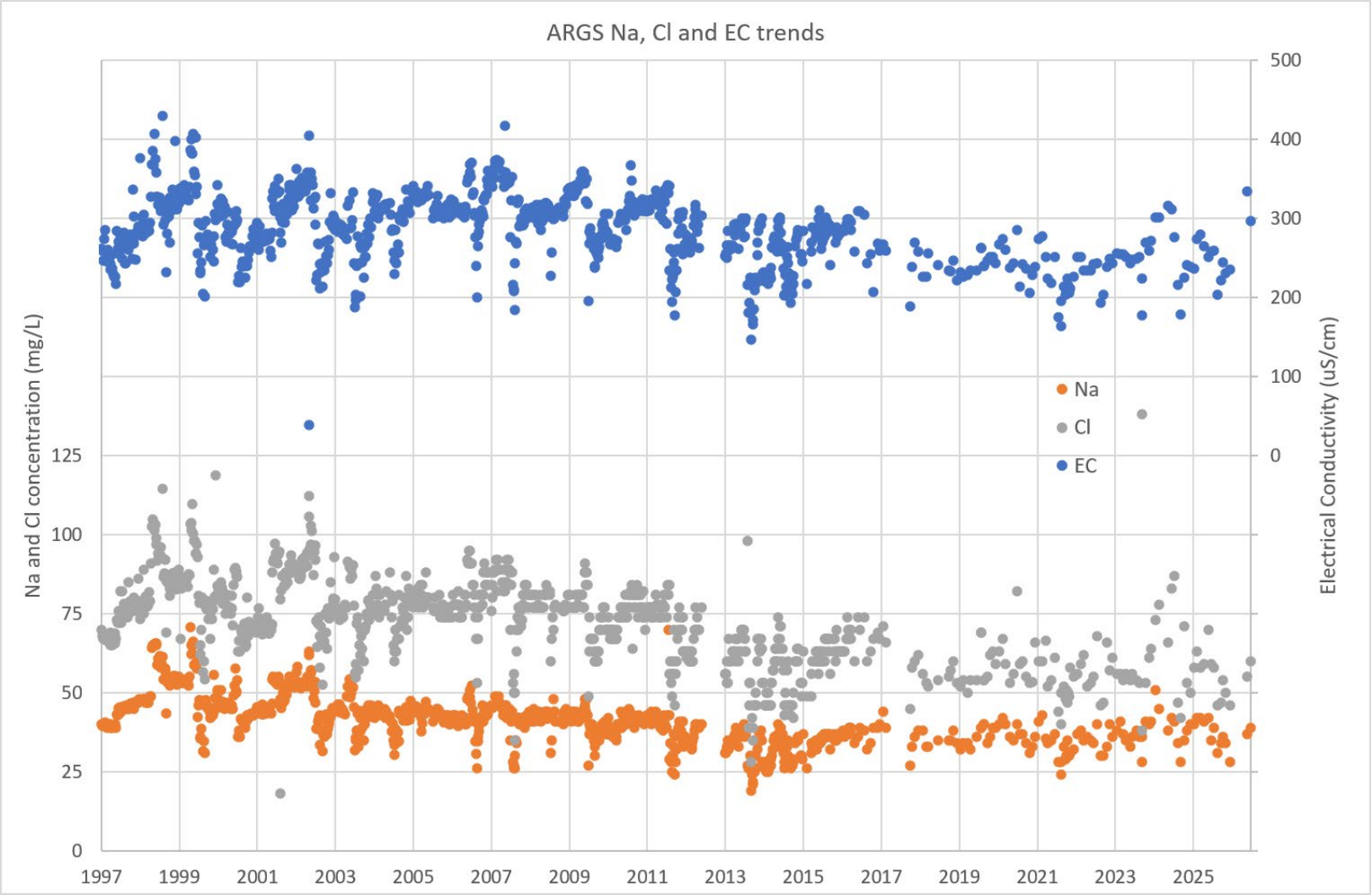

Figure 5: ARGS Long-term water quality trends

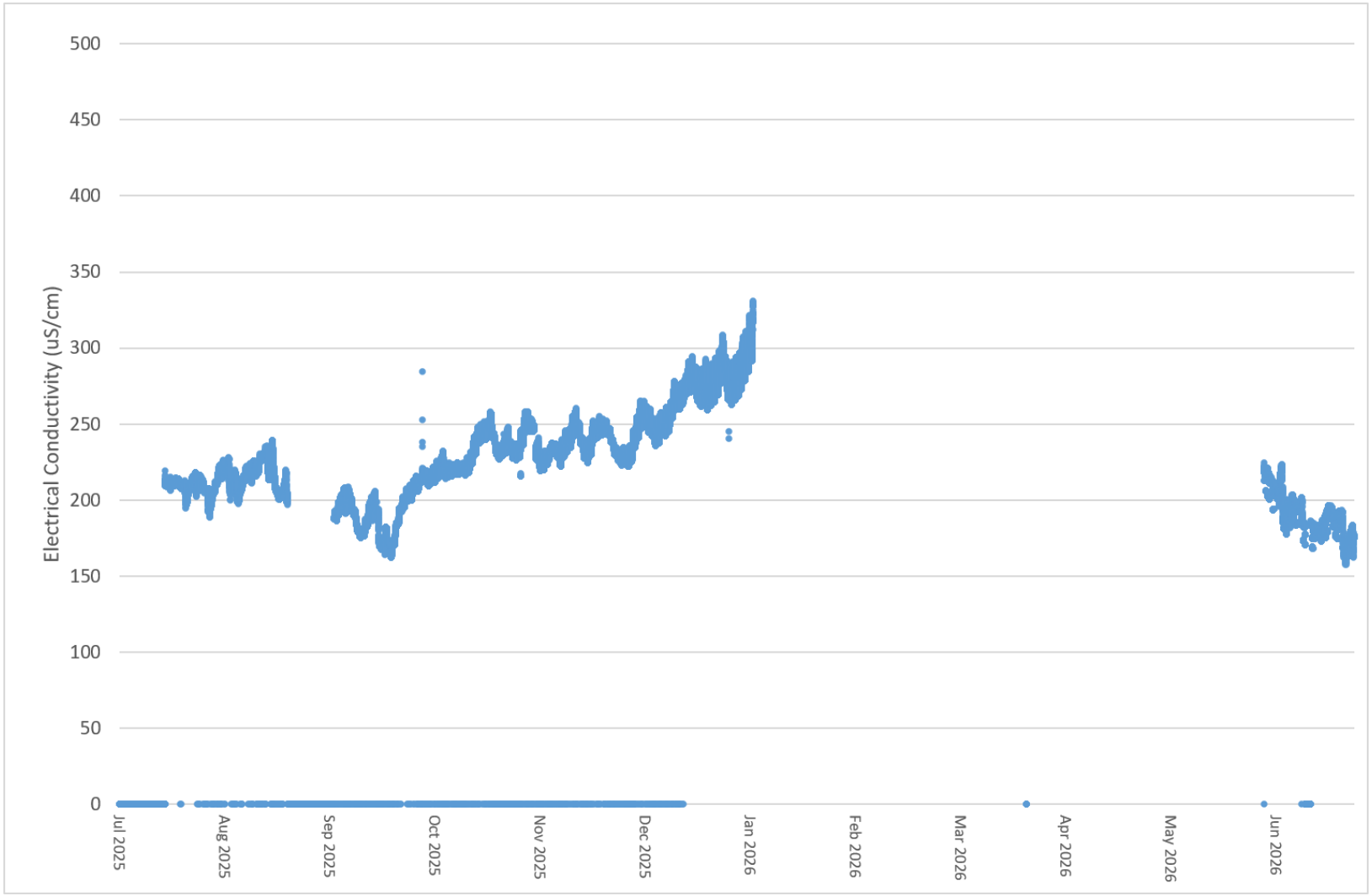

Figure 6: ARGS EC logger data: FY26

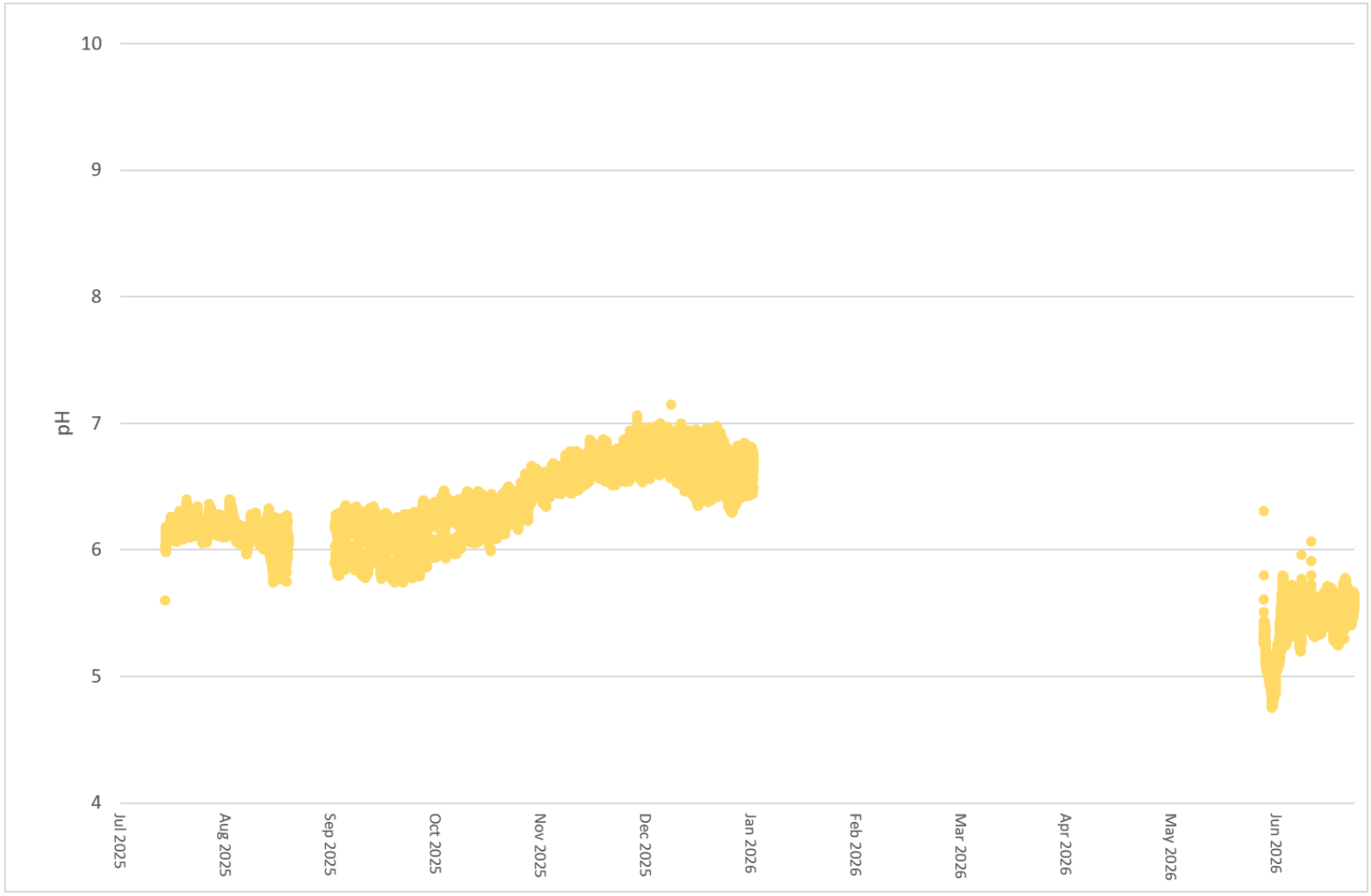

Figure 7: ARGS pH logger data: FY26

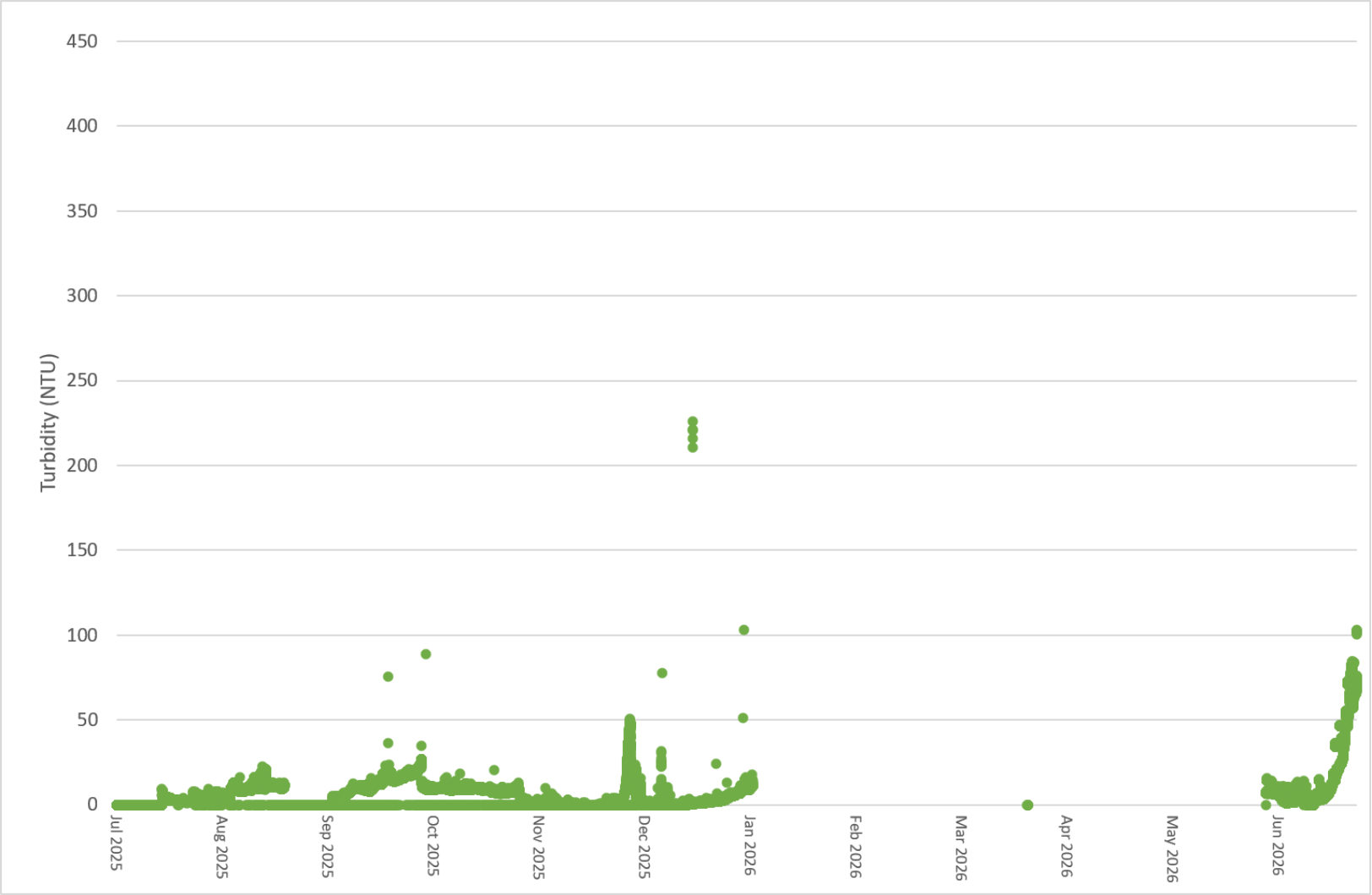

Figure 8: ARGS turbidity logger data: FY26

5.3 Hamilton River Water Quality

Monthly laboratory water quality results are provided in Table 13 while field analysis results are provided in Table 14. Quarterly water quality results are presented in Table 15. Long-term trends of analysed parameters are shown in Figure 8.

Monitored pH, EC and turbidity in the Hamilton River during flow periods were found to be consistent with previous years and with conditions required to sustain healthy aquatic communities in the catchment area.

The river stopped flowing during the months of January to June 2026, therefore no samples could be collected for analysis.

Table 13: Monthly HAR1 Water Quality

Month	EC (µS/cm)	pH	Na (mg/L)	Cl (mg/L)	Al (mg/L)
20 Aug 2025	324	7.19	48	72	0.05
23 Sep 2025	365	7.10	55	83	0.01
13 Oct 2025	476	7.36	70	110	NM
5 Nov 2025	527	7.19	79	132	<0.01
2 Jul 2026	511	6.83	71	123	NM

NM: Not measured

Table 14: Monthly HAR1 Water Quality (Field)

Month	EC (µS/cm)	pH	DO (ppm)	Turbidity (NTU)	Temperature (°C)
20 Aug 2025	207	6.29	9.32	0.2	13.2
23 Sep 2025	277	7.13	9.06	0.7	13.3
5 Nov 2025	466	6.84	7.61	2.4	16.6

Table 15: Quarterly HAR1 Water Quality

Parameter	Unit	20 Aug 2025	5 Nov 2025
Total alkalinity	mg/L	13	29
Bicarbonate	mg/L	13	29
Carbonate	mg/L	<1	<1
Calcium	mg/L	5	9
Iron	mg/L	0.08	0.08
Magnesium	mg/L	6	10
Potassium	mg/L	2	2
Sulphate	mg/L	12	17
TDS (calculated)	mg/L	211	343

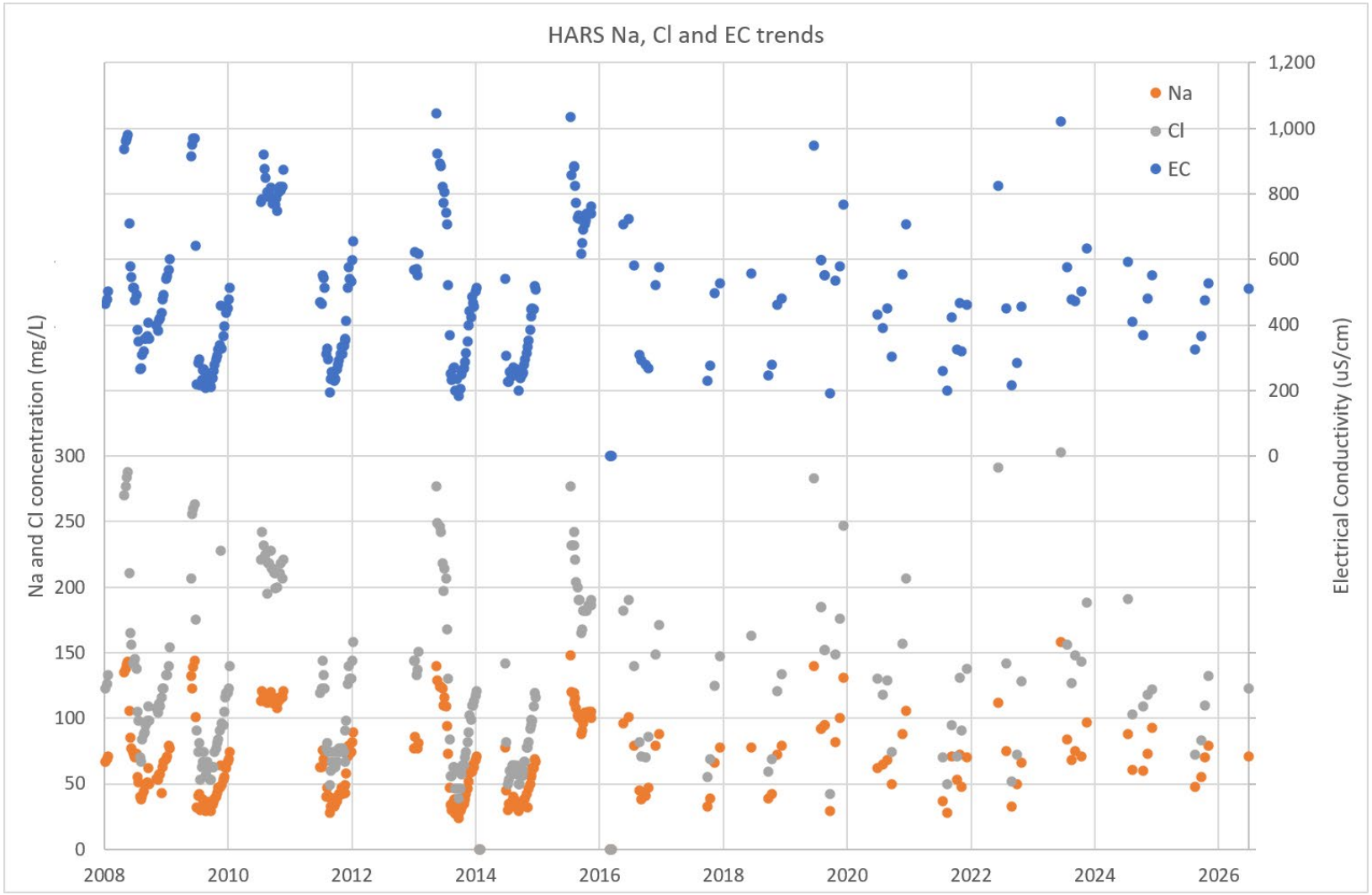

Figure 9: HAR1 Long-term water quality trends

6.0 GROUNDWATER MONITORING NETWORK

6.1 Baseline groundwater data

Baseline groundwater data was collected between 1980 and 1983, prior to the commencement of WAPL Refinery operations in 1984. To strengthen their understanding of baseline conditions, WAPL subsequently drilled additional monitoring bores across the site.

The monitoring record shows a high degree of natural variability, which provides a valuable reference for long-term trend analysis. When comparing baseline water quality data to the ANZECC Aquatic Ecosystems guideline trigger values, it is noted that some concentrations fall outside the guideline ranges. This highlights the importance of baseline data and the long-term trending of continuous water monitoring at the WAPL operations.

6.2 Groundwater monitoring program

The monitoring dataset comprises 303 sampling locations, including 260 groundwater monitoring bores. Over time, many of these bores have been destroyed due to ongoing development, leaving 107 active sampling locations, of which 92 are groundwater monitoring bores.

From this dataset, a subset targeted groundwater monitoring bores were selected to detect possible down-gradient groundwater contamination from the SPHD, NPHD, RCL, SEPs and the refinery complex. The targeted groundwater monitoring bores were selected considering their spatial distribution, representation of all hydrostratigraphic units and historical groundwater trends. The monitoring program also includes four up-gradient background groundwater monitoring bores and sampling locations from underflows that are used to identify potential contamination trends.

These targeted groundwater monitoring bores were initially selected based on a comprehensive review of the hydrogeological conditions at the site (GRM, 2019). Since then, groundwater conditions have been reassessed through annual reviews, and the network has been expanded as required.

The groundwater monitoring program comprises the following:

- 34 Targeted groundwater monitoring bores.
- 32 In-situ water quality sensors.
- Two wastewater underflow streams

Note that telemetry and conventional monitoring bores are shared.

The FY25 monitoring program incorporates 3 new monitoring bores described in more detail in the FY25 hydrological review. Two of these, M114sR and M117sR, were installed to replace two blocked monitoring bores, M114s and M117s, while one, RCL2s, is a new monitoring bore installed based on previous recommendations.

Groundwater monitoring network

For FY26, groundwater sampling was also carried out in an additional 10 groundwater monitoring bores (in addition to the targeted monitoring bores) as part of the ongoing assessment of groundwater conditions at the site. This is described in more detail later in this report.

Groundwater sampling was carried out using low flow sampling techniques. As part of the field program, the groundwater sampler also measured the standing water level in the monitoring bores (prior to sampling) and collected field measurements of EC and pH of the groundwater.

Automated water quality sondes are installed in all groundwater monitoring bores except R26A, a background bore, and NVM22s. In FY24, the sonde in NVM22s became stuck and, although it was retrieved in June 2025, it was decided not to reinstall it due to the risk of recurrence.

The automated sondes are programmed to measure water levels, EC and temperature at 6-hour intervals. Fourteen sondes form part of the Trigger Response Action Plan, described in more detail in Section 6.3.

The groundwater monitoring network is shown in Figure 10 and locations are summarised in Table 16. Sampling frequency and the list of analytes are detailed in Table 17.

Groundwater monitoring network

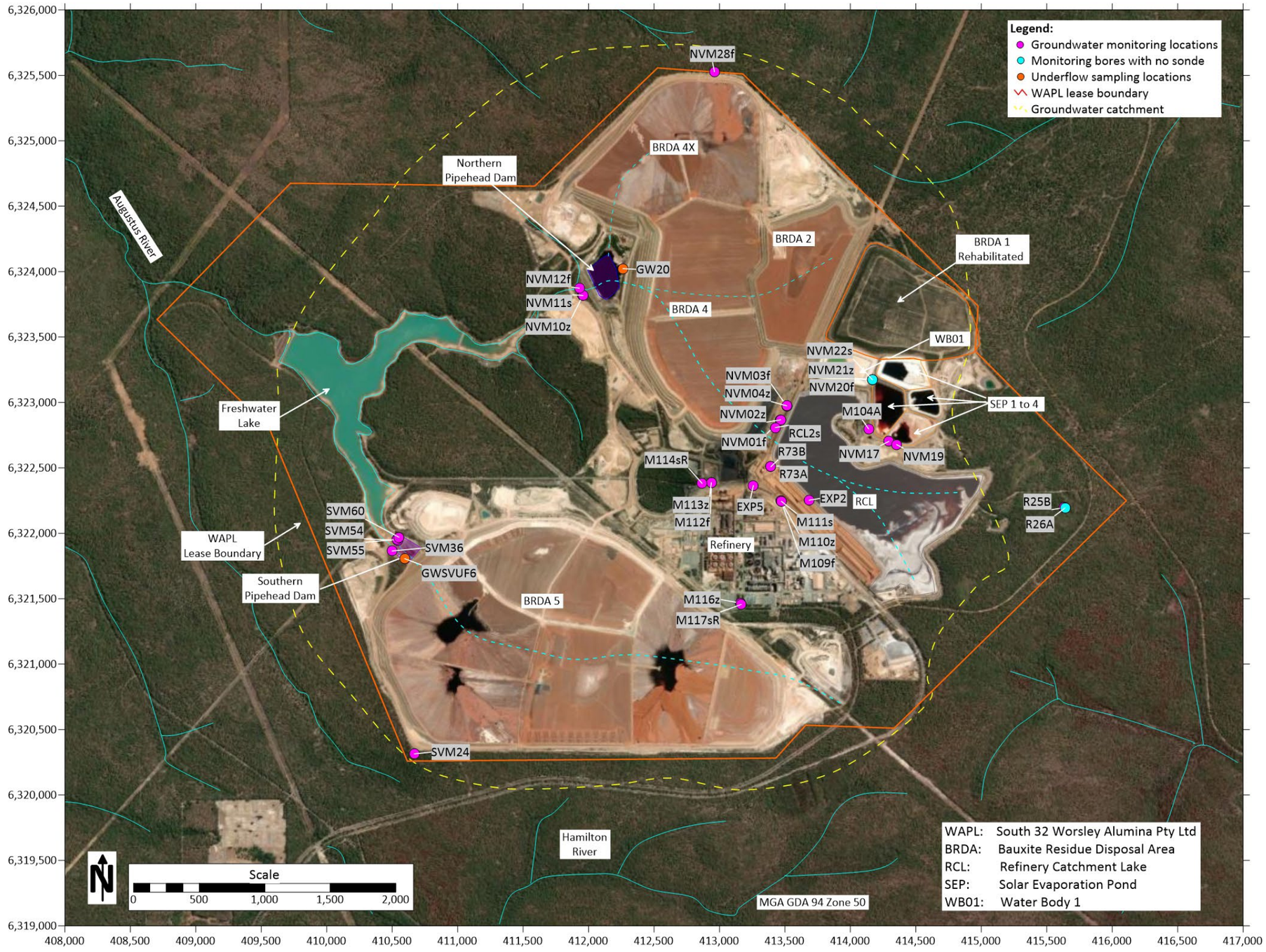

Figure 10: Groundwater monitoring network

Table 16: Groundwater Monitoring Bores

Name	Aquifer	Easting	Northing	Elevation	Slotted interval	In-situ sensors
South Pipe Head Dam						
SVM36	Fractured	410,499	6,321,865	241.8	16.4 -23.4	05/08/2021 30/06/2026
SVM60	Fractured	410,552	6,321,970	242.5	17.9 – 24.9	05/08/2021 30/06/2026
SVM54	Zersatz	410,539	6,321,947	240.6	7.5 -14.5	01/07/2021 30/06/2026
SVM55	Shallow	410,539	6,321,953	240.6	4.0 -5.8	06/08/2021 30/06/2026
North Pipe Head Dam						
NVM12f	Fractured	411,930	6,323,873	243.4	44.0 – 50.0	01/07/2021 30/06/2026
NVM11s	Shallow	411,958	6,323,817	245.1	6.0 – 10.0-	01/07/2021 30/06/2026
NVM10z	Zersatz	411,957	6,323,817	245.1	21.0 – 27.7	01/07/2021 30/06/2026
RCL and Refinery						
NVM01f	Fractured	413,466	6,322,866	281.0	38.2-44.2	01/07/2021 30/06/2026
NVM02z	Zersatz	413,467	6,322,867	281.0	30.0-36.0	01/07/2021 30/06/2026
M117sR*	Shallow	413169	6321459	294.4	4.9-10.9	21/06/2025 30/06/2026
M116z	Zersatz	413,162	6,321,466	296.7	21.3-27.3	01/07/2021 30/06/2026
M112f	Fractured	412,939	6,322,387	286.8	33.4-45.4	01/07/2021 30/06/2025
M113z	Zersatz	412,938	6,322,387	286.7	19.9-31.9	01/07/2021 30/06/2025
M114sR	Shallow	412,869	6,322,383	290.5	5.0-11.00	21/06/2025 30/06/2026
M111s	Shallow	413,472	6,322,244	289.2	4.0-13.0	03/11/2021 30/06/2026
M110z	Zersatz	413,471	6,322,246	289.2	20-23	01/11/2022 30/06/2026
M109f	Fractured	413,472	6,322,246	289.2	24.6-30.6	01/11/2022 30/06/2026
EXP02	ND	413,686	6,322,253	286.5	26.3 - 32.3	01/11/2022 30/06/2025
EXP05	ND	413,260	6,322,364	291.1	26.0 - 32.0	01/11/2022 30/06/2025
R73A	ND	413,393	6,322,509	286.6	ND	01/11/2022 30/06/2026
R73B	ND	413,393	6,322,509	286.7	ND	01/11/2022 30/06/2026
NVM03f	Fractured	413,515	6,322,972	279.9	59.0 - 62.0	01/11/2022 30/06/2026
NVM04z	Zersatz	413,516	6,322,974	279.9	32.1 - 38.1	01/11/2022 30/06/2026
RCL2s*	Shallow	413,427	6,322,808	277.3	5.0-11.0	21/06/2025 30/06/2026

Table 16: Groundwater Monitoring Bores (contd.)

Name	Aquifer	Easting	Northing	Elevation	Slotted interval	In-situ sensors
SEP monitoring bores						
NVM22s	Shallow	414,168	6,323,173	297.5	9.0-21.0	01/07/2022 30/06/2024
NVM21z	Zersatz	414,169	6,323,174	297.6	33 - 39	01/11/2022 30/06/2026
NVM20f	Fractured	414,170	6,323,175	297.7	44.9 - 53.9	01/11/2022 30/06/2026
M104A	ND	414,141	6,322,797	291.4	6.0 - 33.0	01/11/2022 30/06/2026
NVM17	ND	414,154	6,322,554	294.7	12.0 - 17.0	01/11/2022 30/06/2026
NVM19	ND	414,213	6,322,530	294.8	12.0 - 17.0	01/11/2022 30/06/2026
Background monitoring bores						
R26A	Zersatz	415,640	6,322,194	298.2	4.5-38.0	None
R25B	Fractured	415,634	6,322,197	298.3	38.0-48.0	01/07/2021 30/06/2026
SVM24	Fractured	410,669	6,320,314	268.7	31.2-36.2	01/07/2021 30/06/2026
NVM28f	Fractured	412,961	6,325,529	307.5	38.0-40.5	01/07/2021 30/06/2026
Underflows						
GWSVU6		410,596	6,321,806			None
GW20		412,262	6,324,023			None

Table 17: Groundwater Monitoring Program

Frequency	Analysis Required	Analysis type
Real-time (6-hour interval)	Water Level, EC, Temp °C	Monitoring bore datalogger
In response to trigger / alert	Water Level (WL), EC, Temp °C, pH and DO	Field
	pH, EC, Alkalinity, K, Na, Ca, Mg, Fe, Al, Cl, SO4, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Sn, Zn, and Hg (Calculated Results: TDS, NA/CL, HCO3, CO3, OH),	Laboratory

6.3 Trigger Response and Action Plan

Trigger and action values – Telemetered bores

Water quality results are compared to site specific triggers derived from the baseline monitoring data shown in Table 18. Any adverse trends or exceedances of these triggers results in the initiation of an investigation to determine the validity, source, cause, and extent of any potential contamination event. The Worsley Water Management Plan contains the Trigger Response Action Plan that will be activated in the event of a reading exceeding the trigger level.

Table 18: Baseline Levels for Telemetered Bores

Monitoring bore	Electrical Conductivity (µS/cm)	Groundwater levels (m)
NVM01f	818	12.2
NVM02	640	15.0
NVM11s	942	1.7
NVM10z	672	1.8
NVM12f	424	0.9
SVM54	3,338	3.4
SVM55	2,230	2.7
M112f	562	3.2
M113z	450	3.1
M114s	1,992	3.1
M116z	536	11.7
M111s	3,220	4.6
SVM36	631	3.6
SVM60	560	4.0

Trigger and action values – groundwater telemetry sensors

A reassessment of the trigger levels were carried out in 2023 for all monitoring bores equipped with telemetry sensors to establish new trigger and action level. The trigger level reassessment was carried out for the following:

- EC value exceedances for all monitoring bores equipped with telemetry sensors.
- Groundwater depth exceedances for monitoring bores at the North and South Pipe Head Dams (PHDs).

EC trigger values were set to identify elevated EC values which could be an early indication of groundwater contamination. The EC trigger values were determined considering the natural range of groundwater quality at each of the respective monitoring bores.

An upper-level EC value was determined for each of the monitoring bores, which represents the 75% percentile probability of non-exceedance. Trigger and action values were selected as follows:

- A trigger value set at 10% higher than the upper-level EC value. This value indicates that EC readings are likely outside the range of normal EC fluctuations, and which could be indicative of potential groundwater contamination.
- An action value is set at 20% higher than the upper-level EC value. If the hydrogeological assessment indicated groundwater contamination, WAPL should proceed with addressing this contamination in line with the WAPL water management plan.

Groundwater level exceedances have been redefined in terms of the following criteria:

- The North and South PHDs water levels should remain deeper than the groundwater levels as measured in the surrounding monitoring bores. This will ensure that any potential contaminated water from the PHDs will not seep into the downstream groundwater and FWL.
- Groundwater levels downstream of the RCL, refinery and SEPs should not increase within the vegetation root zone as this may affect vegetation health.

No trigger levels have been established for groundwater depth. However, water levels in the PHDs should be managed to remain low, which will maintain a negative groundwater hydraulic gradient, providing an additional barrier to flow into the surrounding groundwater. Recommendations for monitoring PHD water levels are presented later in this report.

Table 19: Trigger and Action Levels for Telemetered Bores

Monitoring bore	Electrical Conductivity (µS/cm)		
	Upper level	Trigger	Action
NVM10z	400	440	480
NVM11s	920	1,010	1,100
NVM12f	470	510	560
M111s	920	1,010	1,100
M112f	420	460	500
M113z	360	390	430
M114s	920	1,010	1,100
M116z	470	510	560
NVM22s	920	1,010	1,100
NVM01f	780	860	940
NVM02z	660	720	790
SVM36	470	520	570
SVM54	820	900	980
SVM55	650	720	790
SVM60	450	500	550

Trigger and action values – groundwater laboratory quality samples

Trigger and action values were also determined for the groundwater quality samples. The trigger levels for telemetered monitoring bores were determined for rapid assessment of potential groundwater contamination while the groundwater laboratory quality samples aim to identify long-term groundwater quality trends. As such, trigger levels (e.g. EC values are different to that of the telemetered bores.

A three-step verification method is used for identifying and detecting possible process liquor contamination in groundwater:

1. An increasing trend in groundwater EC levels, using the 2019 sampling record as a baseline dataset.
2. An increasing trend in the Alkalinity/TDS ratio.
3. An increasing trend of the Na/Cl concentration ratio.

Table 20 shows the adopted trigger and action values that forms part of the WAPL Water Management Strategy. The increase in EC values is used as a key indicator for trigger assessments.

The action values are set to a 20% increase in EC levels over a two-year period, confirming increasing trends and using the 2019 sampling record as the baseline value. In addition, Na/Cl and Alkalinity/TDS ratios should also show a continued increasing trend.

If trigger values are reached, WAPL is to investigate the reasons behind the increasing trend and assess the current water management practices at the relevant facility. Resampling and analysis might be required to confirm the water quality parameters.

If action values are reached, WAPL is to initiate a full groundwater sampling and analysis program for all groundwater monitoring bores around the facility of concern. WAPL should then initiate remediation measures, which could include the installation of groundwater abstraction bores or a change in the operating strategy (e.g., keeping PHDs at a lower water level).

Table 20: Groundwater Laboratory Quality: Trigger Values

Name	Trigger values		Action values	
	EC value (µS/cm)	Na/Cl and Alkalinity/TDS ratios	EC value (µS/cm)	Na/Cl and Alkalinity/TDS ratios
SVM36	640	Increasing trend	770	Increasing trend
SVM60	570		690	
SVM54	950		1,140	
SVM55	860		1,030	
NVM12f	570		690	
NVM11s	790		950	
NVM10z	500		600	
NVM01f	1,160		1,400	
NVM02z	970		1,160	
M111s	930		1,120	
M116z	560		670	
M112f	610		730	
M113z	470		560	
M114s	TBD		TBD	

*Monitoring bore is blocked and should be removed from the monitoring program

6.4 FY26 groundwater monitoring program

During the FY26 period, groundwater samples were collected from all targeted monitoring bores Samples were also collected from two underflow locations and an additional 10 monitoring sites.

The expanded sampling program was initiated in response to declining water quality trends at SPHD, and the southwest corner of BRDA5 with the aim of delineating the extent of potentially affected zones. Four additional monitoring bores were also sampled at NPHD, RCL, the refinery, and the SEPs area.

The targeted groundwater monitoring bores are listed in Table 16. A summary of the additional groundwater monitoring results is provided in Table 21, and the locations of all FY26 sampling sites are shown in Figure 11.

Table 21: Additional groundwater monitoring bores sampled for FY26

Name	Aquifer	Easting	Northing	Elevation	Slotted interval	In-situ sensors
BRDA5						
SVM30	Zersatz	410,564	6,320,462	270.7	14.8-20.0	None
SVM33	Fractured	410,487	6,320,648	271.3	23.0-29.0	None
South Pipehead Dam						
SVM38	Zersatz	410,485	6,321,886	240.0	18.7-25.7	None
SVM48	Zersatz	410,522	6,321,937	242.3	15.8-22.8	None
SVM53	Shallow	410,550	6,321,931	240.2	3.0-4.6	None
SVM62	Shallow	410,574	6,321,962	239.6	5.8-23.0	None
North Pipehead Dam						
NVM27s	Shallow	412,122	6,324,330	257.1	7.0-10.0	None
RCL and refinery						
M107z	Zersatz	413,786	6,321,482	294.1	10.2-19.2	None
M108f	Fractured	413,783	6,321,482	294.0	27.7-34.2	None
SEPs						
M105A	Shallow	414,074	6,322,874	289.7	6.0-33.0	None

Groundwater monitoring network

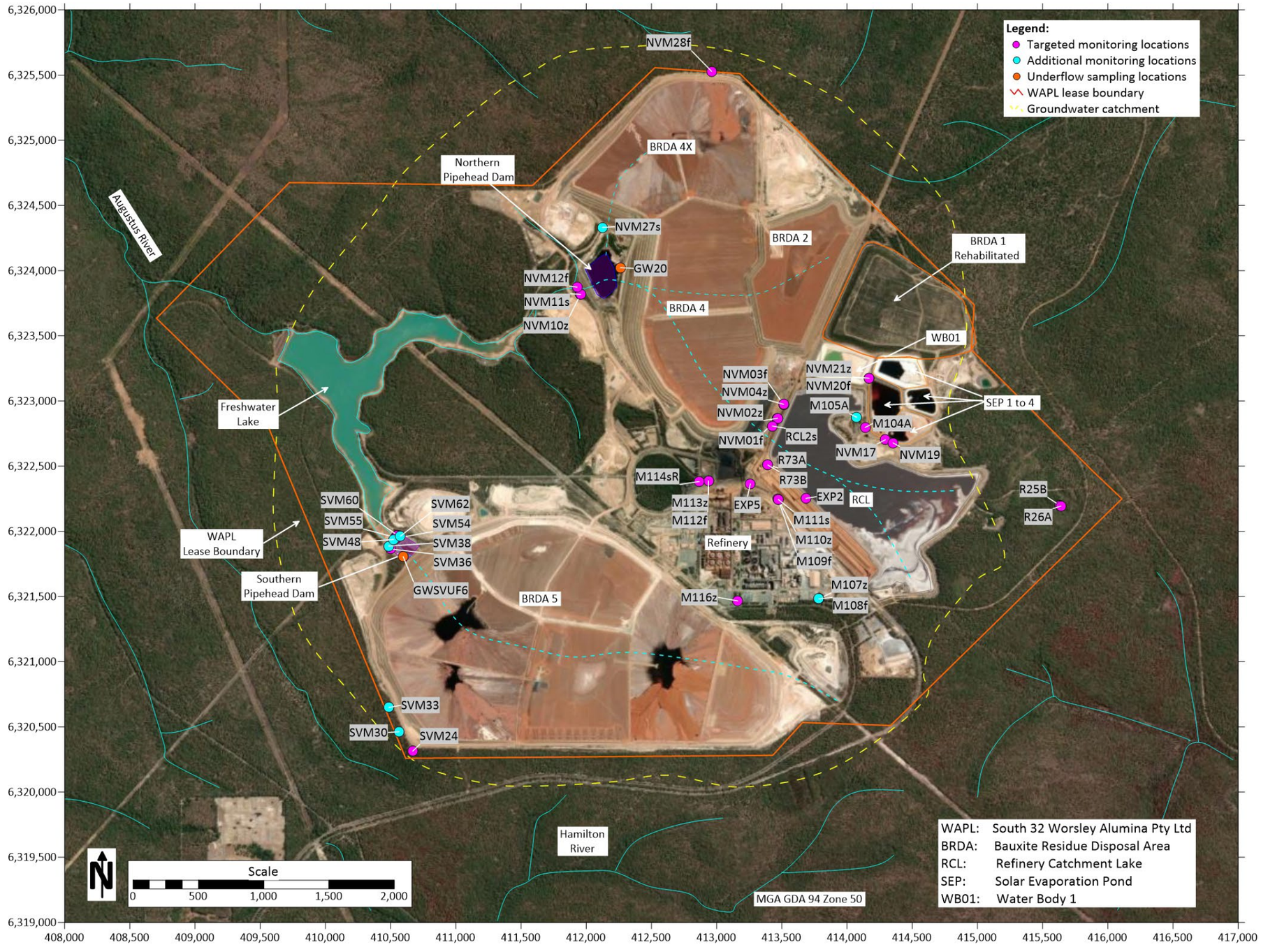

Figure 11: FY26 monitoring locations

6.5 Monitoring issues

The following is issues were noted during the FY26 monitoring program:

- The monitoring bore, M117sR, was dry at the time of sampling.
- The EC data showed a gradual “drift”. The sensors were recalibrated every 4 months with EC values re-adjusted to the correct value. This recalibration caused small data “jumps” that is evident from the graphs.
- For the background monitoring bores, SVM24, showed unusual low EC values for part of the year. These were inspected and recalibrated during the reporting period.
- For the NPHD, NVM12f showed unusual low EC values for part of the year. These were inspected and recalibrated during the reporting period.
- For the SPHD, SVM55 had missing data between July and October 2025. SVM54 showed unusual low EC values for part of the year. These were inspected and recalibrated during the reporting period.
- For the refinery, the sonde at M114sR was installed in October 2025. M114sR showed unusual low EC values for part of the year and there was missing data from March to June 2026. These were inspected and recalibrated during the reporting period.
- For the RCL, there were missing data at M111s for the period April to June 2026.
- For the SEP, there are missing data from M104A between July and October 2025.

Despite these issues, the data is considered comprehensive enough to assess water quality trends and carry out an impact assessment.

7.0 GROUNDWATER MONITORING RESULTS

7.1 Telemetry Water Quality Results

Table 22 and Table 23 present the average monthly EC values at the equipped monitoring bores. Average water levels are shown in Table 24. The following is evident from these values.

- At the SPHD, there were consistent exceedances recorded at SVM60 for nine of the 12 months while occasional exceedances were also recorded at SVM55. These were assessed within the broader water quality assessments and described in more detail below.
- There were no exceedences at the NPHD
- There were EC exceedances at M114sR for 5 out of the 12 months, noting issues with the sonde described in Section 6.5 which limited a full assessment of the year. There was also occasional exceedences at M111s, M112f and NVM01f. The exceedences at M111s and M114sR are related to known issues at the RCL and these are being assessed in more detail as outlined below.
- Even though there are no EC trigger levels set at various at monitoring bores, high EC values were observed at the southern part of the RCL at R73A and R73B, which is also related to known issues and described in more detail below.
- High EC values also occur at NVM21z and M104A at the SEPs. It is also noted that NVM22s is not currently equipped with a sonde. The high EC values are related to known issues at the SEPs and are described in more detail below.
- Water levels increased to within 4.0 m from the ground surface at M112f for the months August to October 2025.
- It is noted that trigger water levels have not yet been defined, and these are the subject to recommendations shown later in this report.

Figures 12 to 17 shows the EC trends for the dataloggers. The results are summarised below:

- For the background monitoring bores, EC values for all background monitoring data (Figure 12) are within the expected EC range with no significant trend.
- At the NPHD (Figure 13), NVM11s showed an initial decrease in EC levels in August and September 2025 before increasing again in November 2025, after which it remained stable. This EC trend was also observed in previous hydrological reviews and is probably seasonal, representing the influx of fresh rainfall recharge into the shallow hydrostratigraphic unit during the wet season.
- There are no other significant EC trends at the NPHD.
- At the SPHD (Figure 14), there is an increase of EC in March 2026 which is attributed to instrumentation error. After recalibration, SVM55 showed another increase in EC for the months April and May 2026 before decreasing again. There is also a slight increase at SVM54 in April 2026 before stabilising.
- There are no other significant EC trends at the SPHD.
- For the northern RCL area and the refinery (Figure 15), no significant EC trend was observed, except at M114sR which shows variation in EC values, though trends could not be ascertain with confidence because of instrumentation issues.

- For the southern RCL area (Figure 16), the EC values at M111s shows significant variation throughout the year. This is consistent with past behaviour of this monitoring bore and is related to existing known issues at the RCL described in more detail below.
- The SEP monitoring bores (Figure 17) shows a gradual increasing EC trends at NVM21z. NVM21z is slotted within the saprock zoned directly below the shallow hydrostratigraphic unit (NVM22s) which has high EC values based on water quality samples described below. Hence the increasing EC values represent a gradual movement of high EC groundwater into the saprock zone.
- M104A shows decreasing EC values in November 2025, returning to lower levels for the remaining period. This is also consistent with past monitoring behaviour at the monitoring bore. There is a potential link between this monitoring bore and known issues at the SEPs which is described in more detail below.
- There are no significant EC trends in the other SEP monitoring bores.

Table 22: Average Monthly Groundwater Electrical Conductivity (µS/cm): PHDs and SEP

Month	NPHD			SPHD				SEP				
	NVM10z	NVM11s	NVM12f	SVM36	SVM54	SVM55	SVM60	NVM20f	NVM21z	M104A	NVM17	NVM19
Trigger value	**440**	**1,010**	**510**	**520**	**900**	**720**	**500**	**ND**	**ND**	**ND**	**ND**	**ND**
Action Value	**480**	**1,100**	**560**	**570**	**980**	**790**	**550**	**ND**	**ND**	**ND**	**ND**	**ND**
July 2025	383	479	301	433	ND	ND	532	259	2,595	813	415	511
Aug 2025	395	171	ND	455	ND	ND	532	244	2,654	ND	408	504
Sep 2025	420	198	196	467	243	439	532	244	2,691	ND	405	504
Oct 2025	389	512	386	469	490	470	528	248	2,705	1,297	399	509
Nov 2025	390	682	395	469	480	507	532	250	2,753	1,261	401	499
Dec 2025	388	727	397	469	478	531	531	246	2,814	835	405	498
Jan 2026	387	746	395	471	479	548	529	246	2,854	719	412	497
Feb 2026	386	760	405	483	477	561	529	248	2,904	650	418	499
Mar 2026	384	764	411	405	496	745	520	303	2,785	630	429	513
Apr 2026	382	753	417	436	573	802	487	296	2,833	586	418	495
May 2026	381	738	417	466	506	658	490	296	2,832	600	419	494
Jun 2026	381	658	405	486	ND	718	490	296	2,832	638	414	500

ND=Not determined

Table 23: Average Monthly Groundwater Electrical Conductivity (µS/cm): RCL

Month	RCL and refinery														
	EXP02	EXP05	M109f	M110z	M111s	M112f	M113z	M114sR	M116z	NVM01f	NVM02z	NVM03f	NVM04z	R73A	R73B
Trigger value	**ND**	**ND**	**ND**	**672**	**1,010**	**460**	**390**	**ND**	**510**	**860**	**720**	**ND**	**ND**	**ND**	**ND**
Action Value	**ND**	**ND**	**ND**	**ND**	**1,100**	**500**	**430**	**ND**	**560**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
July 2025	ND	ND	334	447	1,302	433	354	ND	432	753	558	629	555	1,721	1,670
Aug 2025	ND	ND	ND	431	752	490	357	ND	443	756	472	629	ND	1,724	1,645
Sep 2025	ND	ND	ND	427	379	562	359	1,636	444	758	417	630	ND	1,766	1,649
Oct 2025	ND	ND	325	425	511	451	352	1,630	447	844	398	633	404	1,800	1,645
Nov 2025	ND	ND	325	ND	680	448	350	1,764	436	866	395	634	400	1,799	1,665
Dec 2025	ND	ND	324	ND	471	448	350	1,736	436	866	401	629	398	1,788	1,661
Jan 2026	ND	ND	324	442	381	448	348	526	451	857	415	620	417	1,764	1,643
Feb 2026	ND	ND	323	454	853	448	347	23	473	848	449	620	432	1,753	1,630
Mar 2026	ND	ND	335	399	996	448	346	23	459	768	497	623	440	1,748	1,660
Apr 2026	ND	ND	308	386	ND	448	344	ND	456	757	541	624	418	1,746	1,738
May 2026	ND	ND	308	386	ND	448	340	ND	454	756	541	625	397	1,718	1,731
Jun 2026	ND	ND	314	383	ND	448	344	1,321	454	759	530	625	360	1,787	1,691

ND=Not determined

Table 24: Average Monthly Groundwater Levels (m below ground level)

Month	NPHD			RCL and refinery							SPHD			
	NVM10z	NVM11s	NVM12f	NVM01f	NVM02z	M111s	M112f	M113z	M114s	M116z	SVM36	SVM54	SVM55	SVM60
July 2025	2.8	3.4	3.4	6.2	6.0	6.0	4.6	9.2	ND	14.4	5.8	7.6	ND	5.6
Aug 2025	2.1	6.4	6.4	5.6	5.4	5.3	3.5	8.2	ND	13.5	5.1	7.6	ND	5.0
Sep 2025	2.1	1.7	1.7	5.0	4.7	5.0	3.1	7.7	5.2	12.6	4.7	3.5	3.5	4.9
Oct 2025	2.5	1.8	1.8	4.8	4.5	5.0	3.7	8.3	6.2	12.5	5.8	4.1	3.7	5.6
Nov 2025	2.6	1.9	1.9	4.8	4.5	5.1	4.2	8.8	7.6	12.8	5.7	4.3	3.9	5.7
Dec 2025	2.8	2.1	2.1	4.9	4.7	5.3	4.6	9.2	8.3	13.0	5.3	4.5	4.2	6.0
Jan 2026	3.1	2.5	2.5	5.1	4.9	9.9	5.0	9.7	8.9	13.4	4.1	4.6	4.4	6.3
Feb 2026	3.5	2.9	2.9	5.4	5.2	5.5	5.5	10.1	8.9	13.9	5.3	4.8	4.6	6.5
Mar 2026	3.8	3.2	3.2	5.6	5.5	5.5	5.9	10.5	8.9	14.3	6.0	5.1	4.8	6.6
Apr 2026	3.2	2.5	2.5	5.9	5.7	18.5	6.1	10.6	8.9	14.6	7.0	5.9	4.8	6.4
May 2026	3.2	2.5	2.5	6.0	5.8	ND	6.2	10.8	8.9	14.7	5.7	7.4	4.6	6.2
Jun 2026	2.9	2.1	2.1	5.9	5.7	ND	6.0	10.6	8.9	14.6	5.2	ND	4.3	5.7

ND: Not determined

Trigger values not determined but water levels within 4 m from ground surface highlighted

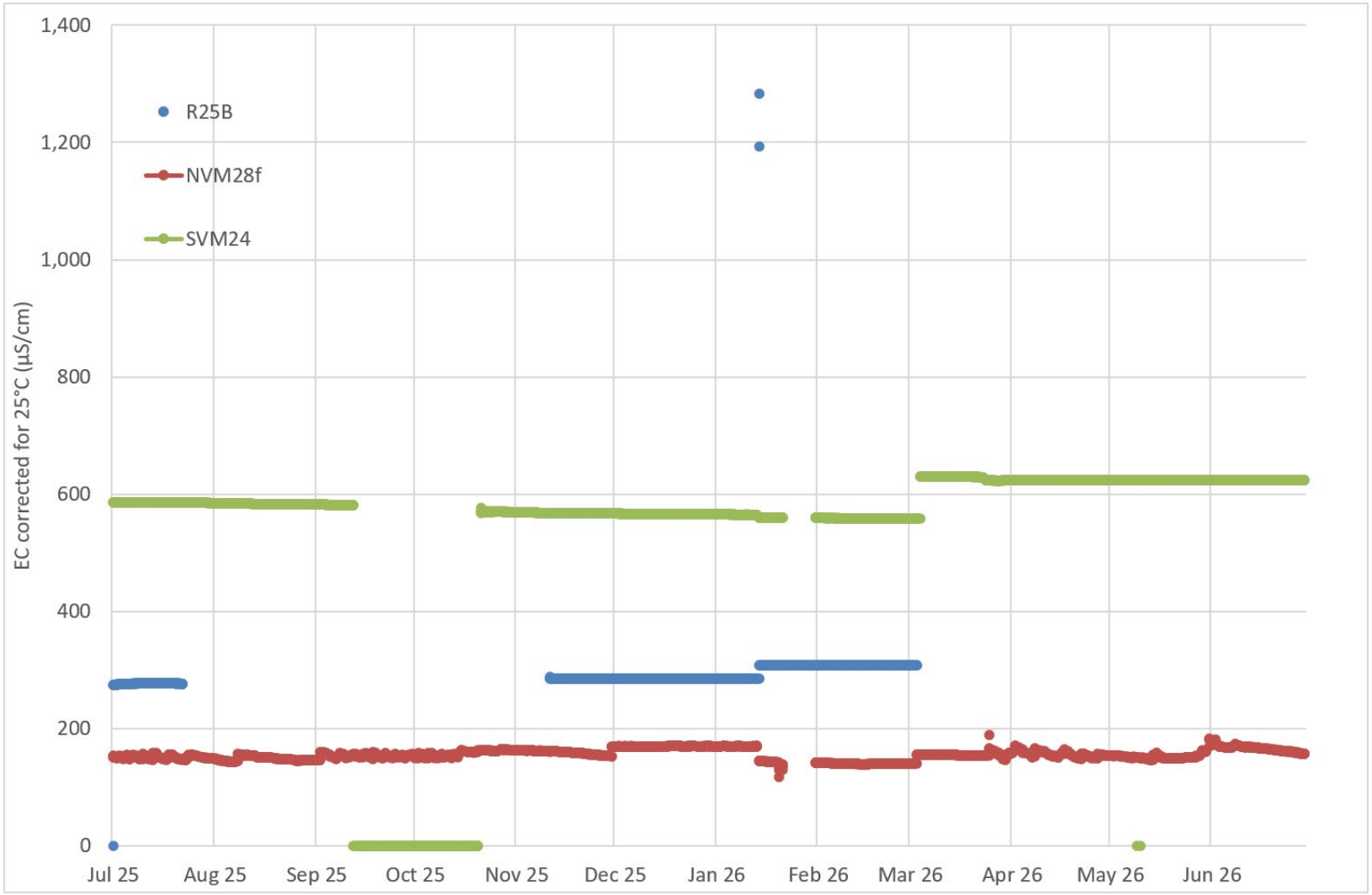

Figure 12: EC value trends: Background monitoring bores

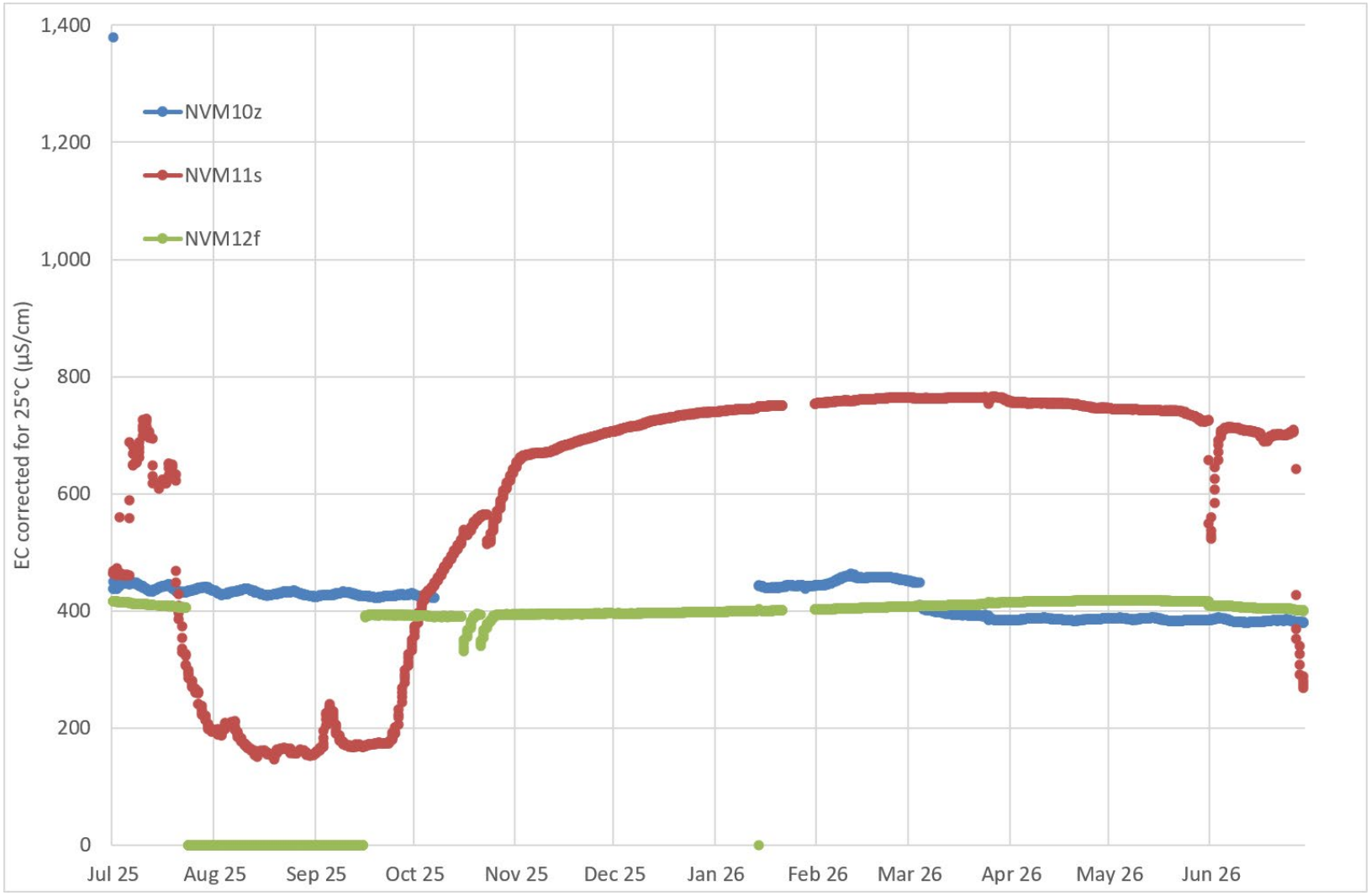

Figure 13: EC value trends: Monitoring bores downgradient of NPHD

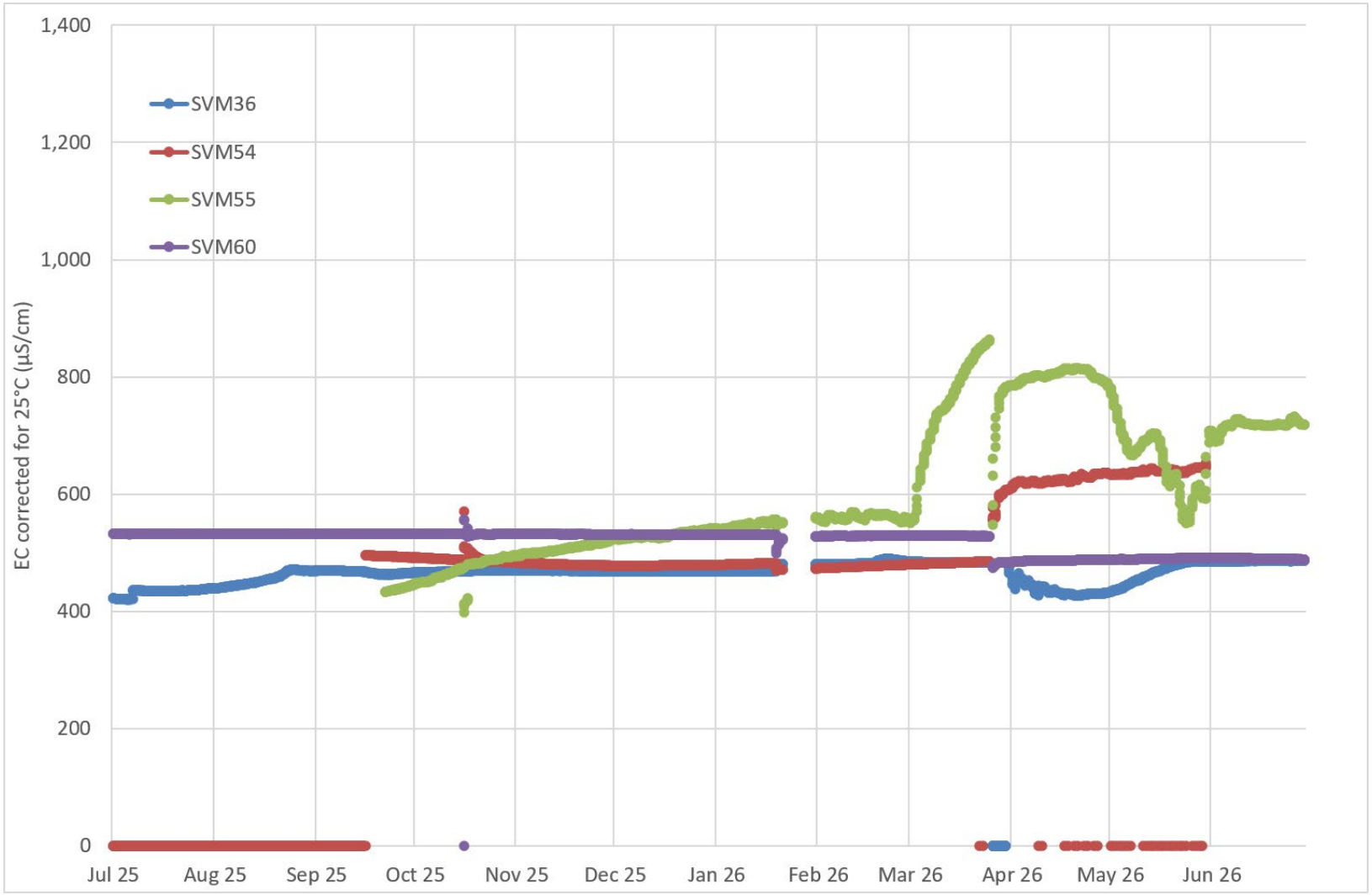

Figure 14: EC value trends: Monitoring bores downgradient of SPHD

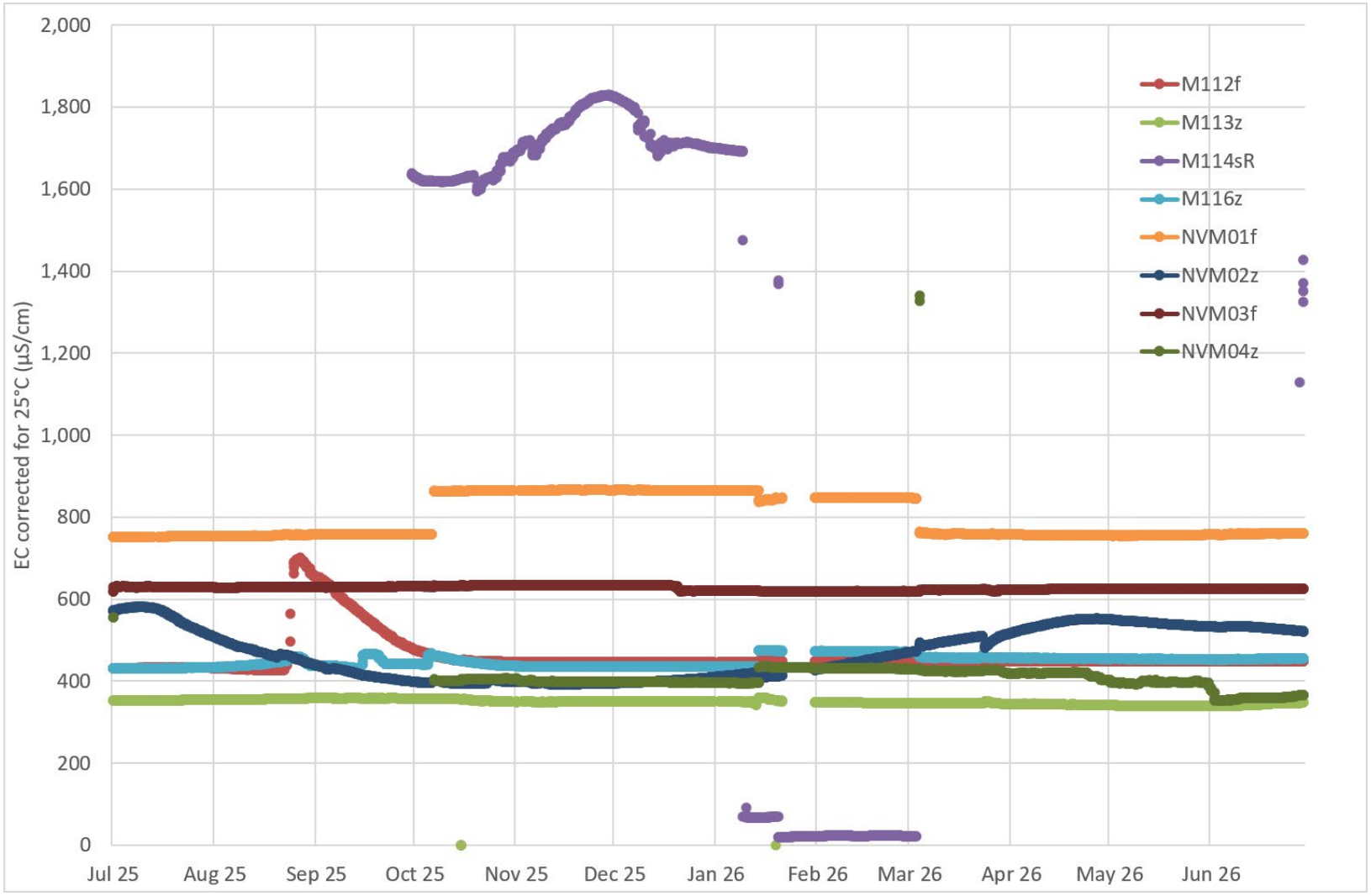

Figure 15: EC value trends: Monitoring bores downgradient of the north RCL and refinery.

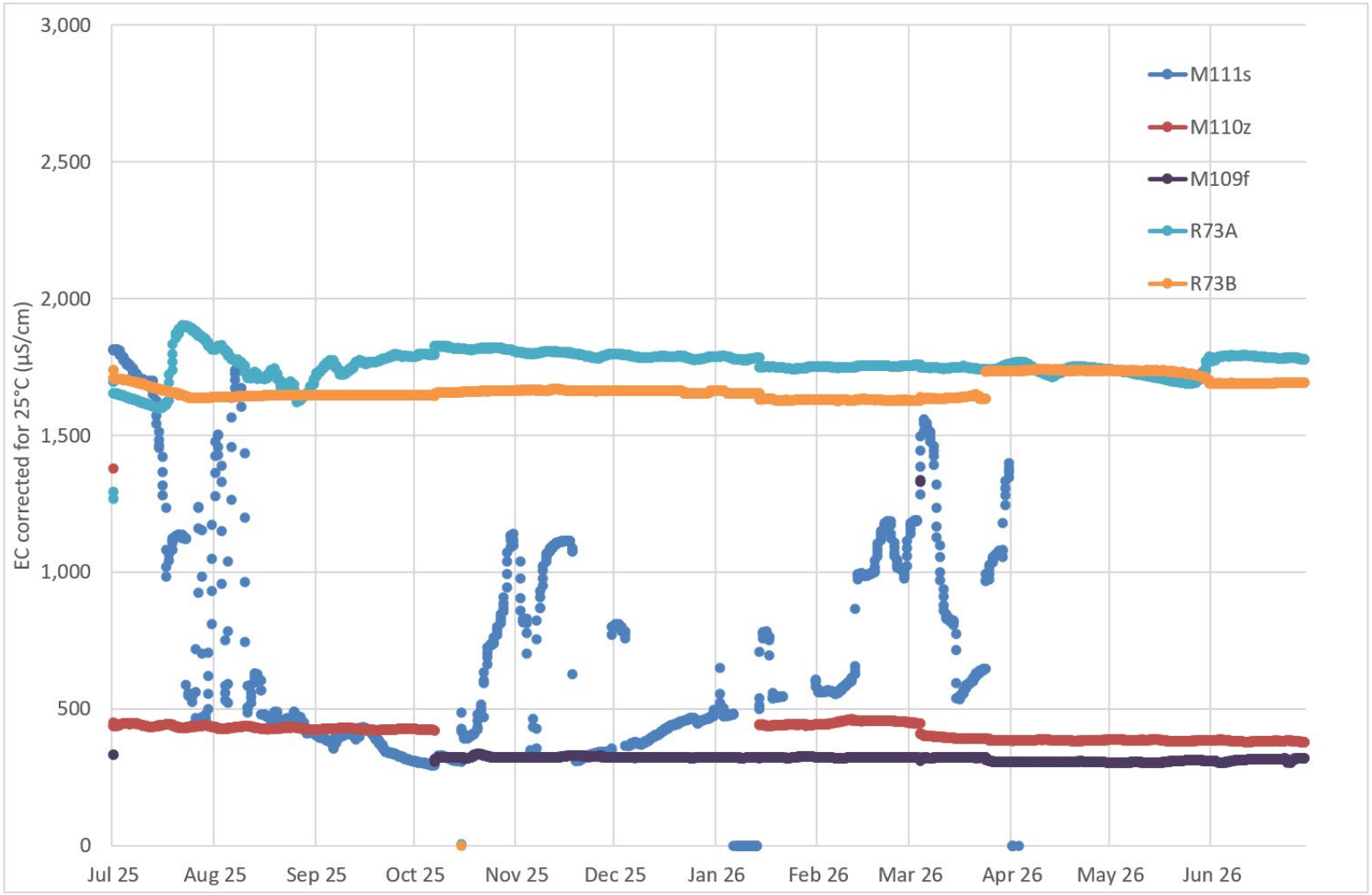

Figure 16: EC value trends: Monitoring bores downgradient of the south RCL

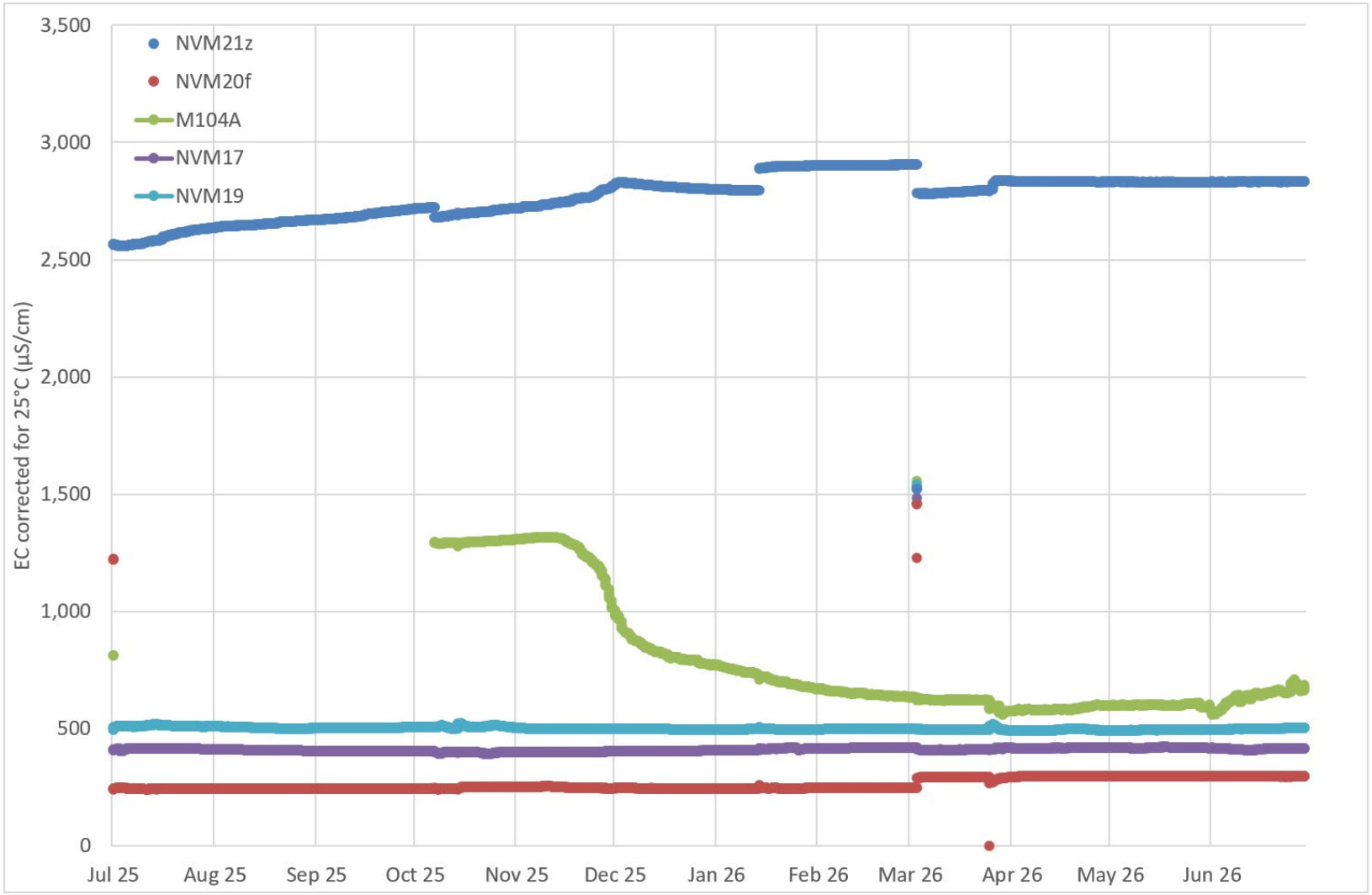

Figure 17: EC value trends: Monitoring bores downgradient of the SEPs

7.2 Groundwater Sampling Programme

The groundwater sampling program carried out during FY26 comprised field parameters and laboratory analysis. Two full rounds and one limited sampling round water carried out during FY26, with the limited round undertaken in January 2026 following trigger values being reached in some of the bores. In addition, an oxalate sampling round was carried out in all monitoring bores around the SEPs.

- The first full sampling round was carried out in October 2025.
- The limited sampling round was carried out in January 2026.
- The second full round was undertaken in March 2026.
- The oxalate sampling round was carried out in March 2026.

7.2.1 Field Parameters Results

Field monitoring results are summarised in Table 25 and Table 26 for the respective sampling rounds. Results are compared with the water quality of the wastewater facilities described in Section 5.4.

Electrical Conductivity

The October 2025 sampling round showed that, with several notable exceptions, groundwater EC values generally ranged between approximately 166 and 899 µS/cm. Higher EC values were primarily associated with the previously identified affected groundwater zones at the SEPs and RCL.

The principal elevated EC values recorded during the October 2025 sampling round were:

- NVM22s and NVM21z, situated downgradient of the SEPs, recorded EC values of 11,047 µS/cm and 8,310 µS/cm, respectively. These values confirm the substantially elevated salinity associated with the previously identified SEP affected groundwater zone.
- M104A, also situated downgradient of the SEPs, recorded an EC value of 1,312 µS/cm.
- M114sR, R73A, R73B and RCL2s, associated with the RCL affected groundwater zone, recorded elevated EC values ranging from 1,729 to 2,273 µS/cm.
- NVM01f recorded a moderately elevated EC value of 864 µS/cm.

The March 2026 sampling round showed broadly similar spatial trends:

- NVM22s and NVM21z remained substantially elevated, with EC values of 10,483 µS/cm and 6,927 µS/cm, respectively.
- EC at M104A decreased from 1,312 µS/cm in October 2025 to 667 µS/cm in March 2026.
- Elevated EC values persisted at M114sR, R73A, R73B and RCL2s, ranging from 1,730 to 2,837 µS/cm.
- EC at NVM01f decreased from 864 µS/cm in October 2025 to 794 µS/cm in March 2026.

The field EC results therefore continue to indicate two principal localised areas of affected groundwater associated with the RCL and SEPs, consistent with previous hydrological reviews.

pH

Groundwater pH during both monitoring rounds was generally slightly acidic to neutral. Most measurements ranged between approximately pH 4.5 and 7.4, although several lower values were recorded. No groundwater samples recorded strongly alkaline conditions indicative of direct bauxite liquor influence.

During the October 2025 monitoring round, pH values below 4.5 were recorded at:

- NVM22s, downgradient of the SEPs, with a pH of 3.4.
- M104A and NVM19, also downgradient of the SEPs, with pH values of 4.2.
- M107z in the refinery area, with a pH of 4.3.
- R26A, an upgradient background monitoring bore, with a pH of 4.4.

During the March 2026 monitoring round, pH values below 4.5 were recorded at:

- NVM22s, with a pH of 3.4.
- M104A and NVM19, with pH values of 4.0.

The occurrence of low-pH groundwater at both SEP monitoring bores and background locations confirms that pH alone cannot be used to distinguish groundwater affected by historical SEP releases from naturally acidic groundwater. The groundwater quality results and interpretation of these trends are discussed further in Section 8.

Table 25: Monitoring Results: Field Data: October 2025

Bore ID	Date	Water Level (m)	Temperature (C°)	Dissolved Oxygen (%)	Electrical Conductivity (uS/cm)	pH
EXP2	14/10/2025	3.54	19.5	3.2	236	5.1
EXP5	16/10/2025	9.01	20.1	1.3	899	4.8
GWSVUF6	16/10/2025	NA	20.9	72.3	1,809	6.9
M104A	14/10/2025	7.27	19.2	8.2	1,312	4.2
M105A	14/10/2025	4.85	20.6	4.1	458	5.3
M107Z	17/10/2025	5.97	22.0	10.4	170	4.3
M108F	17/10/2025	5.87	19.5	7.6	211	5.6
M109F	16/10/2025	6.13	22.4	1.6	357	4.9
M110Z	16/10/2025	6.15	22.1	8.4	440	4.9
M111S	15/10/2025	5.05	21.2	2.8	327	5.6
M112F	15/10/2025	8.58	20.0	8.9	472	5.7
M113Z	15/10/2025	8.14	21.5	1.7	516	5.1
M114SR	15/10/2025	5.83	20.6	2.4	1,729	6.9
M116Z	17/10/2025	12.52	20.5	3.1	499	5.0
NVM01F	15/10/2025	5.00	21.0	5.1	864	6.4
NVM02Z	15/10/2025	4.53	20.6	12.4	412	6.5
NVM03F	15/10/2025	3.91	19.3	2.6	633	6.7
NVM04Z	15/10/2025	4.36	19.2	2.9	617	5.5
NVM10Z	16/10/2025	2.40	18.1	4.1	380	5.3
NVM11S	16/10/2025	2.48	17.7	6.5	520	4.7
NVM12F	16/10/2025	1.72	17.5	2.4	475	6.5
NVM17	14/10/2025	10.08	19.1	11.7	412	4.8
NVM19	14/10/2025	10.07	14.7	18.3	456	4.2
NVM20F	14/10/2025	12.98	20.0	2.0	377	5.0
NVM21Z	14/10/2025	12.75	20.4	5.9	8,310	5.2
NVM22S	14/10/2025	12.35	20.3	9.1	11,047	3.4
NVM27S	17/10/2025	4.85	17.7	84.8	180	5.7
NVM28F	15/10/2025	15.25	15.7	5.3	166	6.0
R25B	14/10/2025	10.99	17.7	5.7	301	6.1
R26A	14/10/2025	11.67	18.6	2.0	179	4.4
R73A	15/10/2025	6.27	19.3	2.2	1,931	6.3
R73B	15/10/2025	6.17	19.2	1.6	1,758	6.2
RCL2S	15/10/2025	2.60	20.9	2.0	2,273	6.9
SVM24	17/10/2025	12.09	19.0	3.6	624	6.4
SVM30	17/10/2025	14.58	19.9	21.9	593	7.0
SVM33	17/10/2025	13.12	18.2	13.8	271	6.2
SVM36	16/10/2025	4.47	20.9	3.6	525	6.9
SVM38	16/10/2025	3.21	20.7	8.8	534	6.9
SVM48	16/10/2025	4.57	21.9	8.0	312	5.5
SVM53	16/10/2025	3.11	24.2	38.6	293	6.2
SVM54	16/10/2025	4.08	20.7	10.4	754	6.1
SVM55	16/10/2025	3.57	21.8	4.5	528	6.1
SVM60	16/10/2025	5.40	20.9	5.1	553	6.6
SVM62	16/10/2025	5.59	21.4	3.8	770	6.4

NA: Not applicable, NM: Not measured

Table 26: Monitoring Results: Field Data: January and March 2026

Bore ID	Date	Water Level (m)	Temperature (C°)	Dissolved Oxygen (%)	Electrical Conductivity (uS/cm)	pH
EXP2	24/03/2026	4.11	18.3	35.5	232	5.1
EXP5	24/03/2026	9.51	19.1	32.9	865	4.8
GWSVUF6	26/03/2026	NA	17.7	49.1	1491	6.6
M104A	25/03/2026	8.42	21.5	33.8	667	4.0
M105A	25/03/2026	7.23	19.3	33.7	460	5.3
M107Z	23/03/2026	9.81	17.1	31.3	156	4.5
M108F	23/03/2026	9.70	16.3	29.0	195	5.9
M109F	24/03/2026	6.62	20.5	31.6	335	5.0
M110Z	24/03/2026	6.65	20.7	33.5	385	5.0
M111S	24/03/2026	5.73	22.2	33.7	723	6.1
M112F	24/03/2026	10.99	18.9	33.7	447	5.8
M113Z	19/01/2026	9.76	24.2	2.3	575	4.9
M113Z	24/03/2026	10.55	20.1	32.7	513	5.2
M114SR	24/03/2026	10.38	20.9	24.3	1732	6.8
M116Z	23/03/2026	14.38	16.3	43.7	435	5.5
NVM01F	19/01/2026	5.25	24.5	6.2	909	6.4
NVM01F	24/03/2026	5.94	18.2	13.7	794	6.5
NVM02Z	24/03/2026	5.67	17.9	33.7	532	6.1
NVM03F	23/03/2026	5.18	18.6	12.9	606	6.7
NVM04Z	23/03/2026	5.22	18.6	18.4	584	5.4
NVM10Z	25/03/2026	3.93	17.2	15.1	365	5.4
NVM11S	25/03/2026	3.96	18.2	29.2	773	4.5
NVM12F	25/03/2026	3.38	16.6	14.8	485	6.6
NVM17	25/03/2026	10.60	19.9	25.2	439	4.7
NVM19	25/03/2026	10.55	20.4	25.3	531	4.0
NVM20F	25/03/2026	13.1	18.6	42.9	289	4.9
NVM21Z	25/03/2026	12.85	19.6	46.9	6927	5.3
NVM22S	25/03/2026	12.48	20.8	76.5	10483	3.4
NVM27S	25/03/2026	6.10	19.7	19.1	193	5.4
NVM28F	25/03/2026	15.94	16.8	36.5	176	6.1
R25B	26/03/2026	11.80	16.8	13.1	293	6.3
R26A	26/03/2026	12.61	17.5	13.7	200	4.8
R73A	24/03/2026	7.41	18.8	40.4	1835	6.3
R73B	24/03/2026	7.34	18.2	28.6	1730	6.3
RCL2S	24/03/2026	3.42	16.8	31.2	2837	6.5
SVM24	23/03/2026	13.29	16.9	30.8	574	6.5
SVM30	23/03/2026	15.22	19.8	51.4	651	7.1
SVM33	23/03/2026	13.23	17.0	44.9	249	6.3
SVM36	26/03/2026	5.63	17.4	54.2	468	7.0
SVM38	26/03/2026	4.22	18.6	39.6	495	6.9
SVM48	26/03/2026	6.16	20.8	57.7	305	5.7
SVM53	26/03/2026	4.37	24.6	24.7	485	6.1
SVM54	26/03/2026	5.04	20.5	33.8	734	6.1
SVM55	26/03/2026	4.75	22.4	30.6	786	6.1
SVM60	19/01/2026	6.24	22.5	2.2	511	7.4
SVM60	26/03/2026	6.67	17.6	46.9	480	6.9
SVM62	26/03/2026	7.80	21.1	15.2	706	6.6

NA: Not applicable, NM: Not measured

7.2.2 Laboratory Analysis

The laboratory results were used to assess the potential impacts on groundwater, which could potentially be caused by the seepage from the wastewater facilities or other release mechanisms into the groundwater. The focus is potential caustic liquor releases, which is characterised by high pH, high alkalinity concentrations and elevated Na/Cl ratios.

The laboratory results were used to compare water quality results to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality by the Australian and New Zealand Environment and Conservation Council (ANZECC, 2000) for freshwater ecosystems. A 90% level of protection has been adopted for groundwater sampling points.

The laboratory results are presented in Appendix B.

Results were also compared with the trigger and action values as described in Section 4.2 and the results are summarised in Table 28. The increasing trend of EC values is used as the key indicator of potential contamination, but all three verification steps (increasing EC values, increasing Na/Cl ratios and increasing alkalinity/TDS ratios) is required to positively identify process liquor contamination.

Background monitoring bores

Background groundwater quality remained fresh during FY26, with TDS concentrations generally between 110 and 400 mg/L and pH between 6.5 and 7.3. R26A remained the exception, with naturally low pH of 4.6 to 5.1 and alkalinity of about 1 mg/L. Na/Cl ratios generally ranged between 0.5 and 0.8.

R26A continued to show natural aluminium and copper exceedances, while isolated copper and zinc exceedances were also recorded at NVM28f.

These exceedances are interpreted to be natural, caused by acidic groundwater conditions that mobilise metals from the surrounding geological materials. The low-pH groundwater is also interpreted to be naturally occurring and related to intense palaeo-leaching processes, as described in the FY25 hydrology review.

Table 27: Water Quality Trend Analysis

Bore ID	Trigger/ Action EC (µS/cm)	Sample Date	EC (µS/cm)	Total alkalinity (mg/L)	TDS (mg/L)	Alkalinity/ TDS	Sodium (mg/L)	Chloride (mg/L)	Sodium/ Chloride	Comment
South Pipe Head Dam										
SVM36	T: 640	16 Oct 2025	549	164	318	0.52	59	66	0.89	No significant trend
	A: 770	26 Mar 2026	532	178	329	0.54	58	67	0.87	
SVM54	T: 950	16 Oct 2025	632	69	448	0.15	36	64	0.56	Decreasing EC & TDS trend
	A: 1,140	26 Mar 2026	596	54	430	0.13	34	63	0.54	
SVM55	T: 860	16 Oct 2025	415	84	251	0.33	23	26	0.88	Fluctuating EC, TDS and Na/Cl trend
	A: 1,030	26 Mar 2026	595	38	440	0.09	33	57	0.58	
SVM60	T: 570	16 Oct 2025	574	154	342	0.45	51	61	0.83	No significant trend
	A: 690	19 Jan 2025	548	144	332	0.43	52	60	0.87	
		26 Mar 2026	546	165	340	0.49	51	60	0.85	
North Pipe Head Dam										
NVM10z	T: 500	16 Oct 2025	416	26	250	0.10	57	102	0.46	No significant trend
	A: 600	25 Mar 2026	415	34	263	0.13	56	104	0.54	
NVM11s	T: 790	16 Oct 2025	591	2	297	0.01	90	174	0.52	Fluctuating EC & TDS trend
	A: 950	25 Mar 2026	837	4	445	0.01	125	255	0.49	
NVM12f	T: 570	16 Oct 2025	532	149	307	0.49	52	78	0.67	No significant trend
	A: 690	25 Mar 2026	547	171	339	0.50	54	77	0.70	
RCL and Refinery										
EXP02	T: ND	14 Oct 2025	252	9	136	0.07	35	64	0.55	No significant trend
	A: ND	24 Mar 2026	251	12	169	0.07	35	64	0.55	
EXP05	T: ND	16 Oct 2025	935	3	487	0.02	139	301	0.46	No significant trend
	A: ND	24 Mar 2026	939	7	558	0.05	136	287	0.47	
M109f	T: ND	16 Oct 2025	350	13	172	0.08	50	88	0.57	No significant trend
	A: ND	24 Mar 2026	347	18	196	0.09	49	90	0.54	
M110z	T: ND	16 Oct 2025	447	14	236	0.06	79	80	0.99	No significant trend
	A: ND	24 Mar 2026	394	18	233	0.08	69	79	0.87	
M111s	T: ND	15 Oct 2025	337	58	200	0.29	49	41	1.20	High Na/Cl ratios, fluctuating, seasonal trends
	A: ND	24 Mar 2026	674	153	404	0.38	96	51	1.88	
M112f	T: 610	15 Oct 2025	513	59	301	0.20	52	108	0.48	No significant trend
	A: 730	24 Mar 2026	499	62	319	0.19	51	111	0.46	
M113z	T: 470	15 Oct 2025	540	32	269	0.12	81	115	0.70	EC exceeding trigger and action value, stable
	A: 560	19 Jan 2026	583	36	307	0.12	97	118	0.82	
		24 Mar 2026	562	35	313	0.11	62	114	0.54	
M114sR	T: ND	15 Oct 2025	1,810	617	1,200	0.51	428	30	14.27	Very high Na/Cl, but stable
	A: ND	24 Mar 2026	1,830	660	1,340	0.49	428	29	14.76	
M116z	T: 560	17 Oct 2025	518	16	312	0.05	62	153	0.41	No significant trend
	A: 670	23 Mar 2026	514	23	324	0.07	57	130	0.44	
NVM01f	T: 860	15 Oct 2025	912	165	542	0.30	87	192	0.45	EC exceeding trigger value, stable
	A: 940	19 Jan 2026	905	165	542	0.30	93	176	0.53	
		24 Mar 2026	896	169	566	0.30	89	187	0.48	
NVM02z	T: 720	15 Oct 2025	435	113	254	0.44	34	35	0.97	Increase in Alk and Na/Cl since FY25
	A: 790	24 Mar 2026	602	109	337	0.32	62	101	0.61	
NVM03f	T: ND	15 Oct 2025	681	171	376	0.45	64	107	0.60	No significant trend
	A: ND	24 Mar 2026	667	177	398	0.44	62	106	0.58	
NVM04z	T: ND	15 Oct 2025	655	34	379	0.09	88	188	0.47	No significant trend
	A: ND	23 Mar 2026	660	32	394	0.08	84	186	0.45	
RCL2s	T: ND	15 Oct 2025	2,330	836	1,480	0.56	482	92	5.24	High EC, TDS and Na/Cl
	A: ND	24 Mar 2026	3,250	736	2,170	0.34	715	265	2.70	
R73A	T: ND	15 Oct 2025	2,050	258	1,240	0.21	406	85	4.78	Persistent high Na/Cl ratios
	A: ND	24 Mar 2026	2,020	264	1,340	0.20	387	82	4.72	
R73B	T: ND	15 Oct 2025	1,890	219	1,100	0.20	371	112	3.31	Persistent high Na/Cl ratios
	A: ND	24 Mar 2026	1,910	231	1,230	0.19	356	118	3.02	

Table 27: Water Quality Trend Analysis (Continued)

Bore ID	Trigger/ Action EC (µS/cm)	Sample Date	EC (µS/cm)	Total alkalinity (mg/L)	TDS (mg/L)	Alkalinity/ TDS	Sodium (mg/L)	Chloride (mg/L)	Sodium/ Chloride	Comment
SEPs										
NVM22s	T: ND	14 Oct 2025	11,400	<1	12,800	<0.01	1,060	1,370	0.77	Very high EC and TDS
	A: ND	25 Mar 2026	10,800	<1	13,500	<0.01	959	1,450	0.66	
NVM21z	T: ND	14 Oct 2025	8,820	38	7,900	<0.01	709	1,200	0.59	Persistent high TDS, decrease from FY25
	A: ND	25 Mar 2026	7,360	42	7,400	<0.01	630	1,140	0.55	
NVM20f	T: ND	14 Oct 2025	413	8	219	0.04	49	91	0.54	No significant trend.
	A: ND	25 Mar 2026	321	8	187	0.04	46	84	0.55	
M104A	T: ND	14 Oct 2025	1,450	< 1	712	< 0.01	185	473	0.39	Fluctuating, seasonal EC and TDS
	A: ND	25 Mar 2026	684	< 1	396	< 0.01	79	203	0.39	
NVM17	T: ND	14 Oct 2025	449	< 1	224	< 0.01	62	122	0.51	No significant trend
	A: ND	25 Mar 2026	460	< 1	279	< 0.01	68	127	0.54	
NVM19	T: ND	14 Oct 2025	547	< 1	263	< 0.01	71	166	0.43	No significant trend
	A: ND	25 Mar 2026	562	< 1	285	< 0.01	68	156	0.44	

South Pipe Head Dam

Groundwater quality at the SPHD remained broadly comparable to background groundwater across SVM36, SVM38, SVM48, SVM53, SVM54, SVM55, SVM60 and SVM62. TDS concentrations generally ranged between about 160 and 450 mg/L and pH was mostly slightly acidic to neutral. Na/Cl ratios were generally between about 0.5 and 0.9. The main exception was SVM53, where a Na/Cl ratio of 1.31 was recorded in October 2025, decreasing to 0.80 in March 2026. This isolated elevated ratio was not accompanied by high TDS or alkaline pH and therefore does not provide clear evidence of bauxite liquor influence. Several minor zinc exceedances were recorded across the SPHD monitoring network but are considered consistent with natural background variability.

Overall, the expanded monitoring dataset does not indicate persistent or widespread bauxite liquor impacts downgradient of the SPHD. The generally lower Na/Cl ratios compared with earlier monitoring periods coincide with repairs to the groundwater interception bores and improved management of SPHD water levels, both of which are intended to maintain containment and limit downgradient groundwater movement.

BRDA5 southern corner

Groundwater quality at the southern corner of BRDA5 remained broadly comparable to background groundwater. At SVM24, SVM30 and SVM33, TDS concentrations ranged from about 190 to 400 mg/L and pH was generally neutral to slightly alkaline, ranging from about 6.6 to 7.8. Minor zinc exceedances were recorded at some locations, but these are considered consistent with natural background variability.

Na/Cl ratios remained elevated at SVM30 and SVM33 during part of FY26. Ratios at SVM30 were about 1.00 in October 2025 and 0.75 in March 2026, while SVM33 remained elevated at about 1.27 to 1.29. SVM24 remained lower at about 0.51. The elevated ratios at SVM30 and SVM33 may indicate minor mixing with bauxite liquor; however, the low TDS concentrations, generally neutral pH and absence of a broader supporting geochemical signature indicate that any liquor influence is likely to be very limited. Overall, there is no evidence of significant deterioration in groundwater quality at the southern corner of BRDA5 during FY26.

North Pipe Head Dam

Groundwater quality at the NPHD remained broadly comparable to background groundwater during FY26. TDS concentrations ranged from about 106 to 445 mg/L, while Na/Cl ratios remained below 0.8 at NVM10z, NVM11s, NVM12f and NVM27s. This continues to provide little evidence of bauxite liquor influence.

NVM11s remained the main anomalous bore, with low pH of about 5.2–5.3 in laboratory samples and field pH of about 4.5–4.7, together with elevated aluminium, copper and iron concentrations. These exceedances are interpreted to be associated with naturally acidic groundwater and palaeo-leached materials, consistent with the interpretation developed during the FY25 review. NVM27s also recorded an isolated zinc exceedance, but otherwise showed low TDS and background-type chemistry.

Although EC remained relatively elevated at NVM11s, and NVM12f remained near previous trigger levels, the consistently low Na/Cl ratios, low TDS concentrations and absence of alkaline groundwater indicate no conclusive evidence of bauxite liquor release from the NPHD during FY26.

RCL and refinery

During FY26, groundwater quality at the RCL and refinery continued to show a localised bauxite liquor influence, broadly consistent with the FY25 interpretation. The principal affected monitoring bores remained M111s, M114sR, R73A, R73B and RCL2s, which recorded comparatively elevated EC/TDS concentrations and Na/Cl ratios above 1.0.

The strongest liquor signatures remained at M114sR, R73A, R73B and RCL2s, while groundwater pH remained neutral to slightly acidic, indicating that any bauxite liquor entering the groundwater has been substantially neutralised.

The remaining monitoring bores generally showed lower TDS concentrations and Na/Cl ratios below 1.0. However, EC trigger exceedances were recorded at M113z and NVM01f, with M113z also exceeding the Worsley action value. M113z is the deeper monitoring bore adjacent to the known affected shallow bore M114s/M114sR, and the exceedance is therefore consistent with the recognised affected zone rather than indicating a new area of impact. Management and investigation actions are already in progress for this area.

Several minor aluminium, copper and zinc exceedances were also recorded, particularly at naturally lower-pH monitoring locations, and are considered more consistent with natural metal mobilisation than with bauxite liquor impacts.

Overall, the FY26 results indicate that the affected groundwater zone remains localised around the RCL/refinery, although the M113z exceedance confirms the need for continued assessment of vertical migration within the known affected area.

SEPs

Groundwater quality at the SEPs during FY26 continued to confirm a localised affected groundwater zone centred on NVM22s and NVM21z. NVM22s remained strongly affected, with TDS concentrations of about 12,800 to 13,500 mg/L, pH of about 3.4, and substantial aluminium, iron, copper, nickel, lead and zinc concentrations.

NVM21z also remained affected, with TDS concentrations of about 7,400 to 7,900 mg/L, elevated magnesium and manganese concentrations of 25 to 32 mg/L, and elevated nickel and zinc. The chemistry remains consistent with the previously identified historical spent-acid affected groundwater and downward migration from the shallow aquifer into the deeper zersatz zone. In addition, the water quality sonde at NVM21z shows a gradual increasing EC trend, consistent with continued deterioration of groundwater quality within the deeper zersatz zone.

M104A continued to show evidence of more limited impact, with acidic groundwater and elevated EC/TDS relative to background, although concentrations decreased between the two FY26 sampling rounds, consistent with the decreasing trend observed in the water quality sonde data.

NVM17, NVM19, NVM20f and M105A generally recorded relatively low TDS concentrations of about 190 to 320 mg/L, despite locally low pH and minor aluminium, copper, nickel or zinc exceedances. These results do not provide clear evidence that the principal affected groundwater zone has expanded to these monitoring bores, and some metal exceedances may reflect natural mobilisation under low-pH groundwater conditions.

Oxalate was analysed in samples from all SEP monitoring bores during FY26 and was detected only at NVM21z. This result was unexpected, particularly as oxalate was not historically stored in the SEPs during the period when the spent-acid releases occurred and was not detected in the overlying shallow monitoring bore NVM22s.

Accordingly, no interpretation regarding the source or significance of the oxalate detection is made at this stage. All SEP monitoring bores have since been resampled for oxalate to confirm the result and assess its distribution, with the findings to be presented in the FY27 hydrology review.

7.3 Oxalate sampling

Oxalate analysis was undertaken at the SEP monitoring bores during FY26 and the results are presented in Table 28. Sodium oxalate was detected only at NVM21z, at a reported concentration of 180 ppm, while results for the remaining SEP monitoring bores were below the laboratory detection limit.

The result at NVM21z is unexpected and is not presently considered sufficient to confirm the presence or source of oxalate-affected groundwater, as it represents a single detection and could potentially reflect sampling error, laboratory analytical error or interference associated with the high dissolved salt concentrations in the groundwater.

The results are therefore considered inconclusive at this stage. Duplicate sampling and further laboratory analysis will be undertaken during FY27 to confirm the presence or absence of oxalate and to assess any implications for the SEP affected groundwater zone.

Table 28: Oxalate sampling results

Sample ID	pH	Sodium Oxalate ($Na_2C_2O_4$), ppm	Sodium Sulphate (Na_2SO_4), ppm
M104A	3.7	<LOD	23
NVM17	4.4	<LOD	55
NVM19	3.3	<LOD	12
NVM20f	4.8	<LOD	13
NVM105A	5.1	<LOD	13
NVM21z	5.0	180	2,074
NVM22s	3.3	<LOD	12,323

LOD = Limit of detection

8.0 ASSESSMENT OF IMPACTS

8.1 Augustus River turbidity

Turbidity levels within the FWL remained elevated during FY26, with no significant change in overall conditions compared with the previous reporting period. The elevated turbidity continues to complicate FWL releases and necessitates treatment before discharge to the Augustus River. The continued low water levels within the FWL have also exposed sediment along parts of the lake basin, which represents an additional potential source of turbidity during rainfall and runoff events.

At the Augustus River Gauging Station, turbidity levels remained generally low, with occasional short-term spikes following rainfall events, as expected. Higher turbidity readings were also recorded during June 2026, although these are considered likely to have resulted from sensor fouling rather than a sustained deterioration in river water quality. There were no significant operational changes during FY26 that would be expected to increase sediment or turbidity loads to the Augustus River.

Overall, no significant environmental impacts from turbidity were observed in the Augustus River. Continued operation of the turbidity treatment plant is recommended while turbidity levels within the FWL remain elevated.

8.2 Augustus River water quality

The water quality of the Augustus River remained within the expected historical range during FY26, with no significant environmental impacts observed. EC, sodium and chloride concentrations remained stable and comparable to the FY25 monitoring period. No deleterious water quality trends were identified and no additional work is recommended beyond ongoing routine monitoring.

8.3 Groundwater quality results: Background and natural processes

Groundwater quality across the site remained generally fresh during FY26, with relatively low TDS concentrations and no significant change from previous monitoring periods. Overall, the monitoring results do not indicate any widespread deterioration in background groundwater quality.

Some monitoring bores continue to exhibit naturally low-pH groundwater associated with localised zones of intense palaeo-leaching, as described in the FY25 review. These conditions have reduced the natural buffering capacity and can mobilise naturally occurring aluminium, copper and zinc from the surrounding geological materials. Associated guideline exceedances are therefore generally interpreted as natural rather than operational impacts, except where groundwater is affected by historical SEP releases.

8.4 Groundwater bauxite liquor impacts at the RCL

No bauxite liquor, characterised by pH greater than 12, was detected at any groundwater monitoring location.

Groundwater monitoring continues to confirm a localised affected zone at the RCL, first identified during the FY22 and FY23 hydrological reviews. The affected bores comprise M111s, R73A, R73B,

M114sR and RCL2s, which show elevated TDS concentrations and Na/Cl ratios while groundwater pH remains slightly acidic to neutral.

The current interpretation remains that a limited amount of RCL wastewater has entered the groundwater and has been substantially neutralised by the naturally acidic groundwater, resulting in elevated sodium, sulphate, EC and TDS without development of strongly alkaline groundwater conditions.

The affected zone remains localised, with no clear evidence of significant expansion during FY26. The assessed risk to the downgradient environment therefore remains low. Ongoing assessment and management of this affected groundwater zone are being addressed through the current RCL work programme, as outlined later in this report.

8.5 Groundwater bauxite liquor impacts at the SPHD, NPHD and southern corner of the BRDA5

The groundwater downgradient of the NPHD, SPHD and southern corner of BRDA5 remained broadly comparable to background groundwater quality during FY26. Some monitoring bores continue to show early warning indicators, including elevated Na/Cl ratios at the SPHD and BRDA5 and elevated EC at the NPHD, but these are not accompanied by a consistent broader geochemical signature. Potential bauxite liquor impacts in these areas therefore remain inconclusive and, if present, are considered very limited.

FWL water levels remained low during FY26 and are expected to remain below historical levels for the foreseeable future. Historically, the FWL formed part of the containment system by limiting downgradient groundwater movement. Given the lower FWL levels, this control can no longer be relied upon to the same extent in future.

Greater emphasis will therefore be required on source controls, particularly maintaining low operating water levels within the PHDs and ensuring effective operation of the groundwater interception systems. Work undertaken during FY26 included repair and operation of interception bores, particularly at the SPHD. However, further assessment is likely to be required to confirm the effectiveness of these interception systems under conditions where high FWL water levels are no longer available as an additional hydraulic barrier.

Overall, the impact on the downgradient environment remains assessed as very low, as groundwater quality remains generally good and no clear evidence of significant offsite migration has been identified.

8.6 Groundwater impacts at the SEPs

Groundwater monitoring during FY26 continued to confirm a localised affected groundwater zone at the SEPs, centred on NVM22s and NVM21z. NVM22s remained strongly affected, with very high TDS concentrations, low pH and substantial metal concentrations. NVM21z also remained affected, with elevated TDS and metal concentrations. The water quality sonde at NVM21z continued to show a gradual increase in EC, supporting the interpretation of ongoing migration of affected groundwater from the shallow aquifer into the deeper zersatz zone.

M104A water quality remains inconclusive, while the remaining SEP monitoring bores show no evidence of further lateral expansion of the affected groundwater zone during FY26.

The interpretation remains that historical releases of non-neutralised acid wastewater from the SEPs resulted in a localised zone of affected groundwater, with the strongest impacts occurring in the shallow aquifer at NVM22s and evidence of downward migration into the deeper zersatz zone at NVM21z. Although the short-term risk of off-lease groundwater contamination remains low due to the slow rate of groundwater movement and existing engineered barriers, continued downward migration increases the longer-term risk that affected groundwater could enter the fractured bedrock aquifer.

Potential impacts associated with the unexpected oxalate detection at NVM21z are still being assessed and will be addressed in the FY27 hydrology review.

Further hydrogeological and modelling studies have now commenced to better define groundwater movement, contaminant migration and the longer-term risk associated with the affected zone. These studies will inform the development and assessment of potential mitigation and remediation measures and are described in more detail later in this report.

8.7 Further work: Numerical groundwater model update

A numerical groundwater model update has commenced to incorporate the groundwater monitoring and water quality information collected during the past three years, with particular focus on the RCL, SEPs and PHDs. The model will be recalibrated using the updated monitoring dataset and expanded to include solute transport modelling of selected conservative chemical species.

The updated model will be used to support the next stage of work, including:

1. assessment and design of remediation measures for the affected groundwater zone at the SEPs;
2. assessment of remediation, mitigation or management options for the affected groundwater zone at the RCL; and
3. assessment of the effectiveness of the PHD groundwater interception systems under conditions where historically high FWL water levels can no longer be relied upon as an additional hydraulic control.

The modelling will therefore provide the technical basis for assessing longer-term contaminant migration and selecting appropriate groundwater management and remediation measures.

9.0 Conclusions and Recommendations

9.1 Conclusions

The WAPL operations complied with all the water license conditions for the FY26 period.

The existing Surface Water Licence expired in November 2025, and renewal of the licence is currently being finalised with DWER. WAPL continued to implement the established monitoring, abstraction and environmental release requirements while progressing the licence renewal with DWER.

Environmental releases to the Augustus River continued to be undertaken via the turbidity treatment plant. Turbidity within the FWL remained elevated, with no significant improvement compared with FY25, and continued low lake levels have exposed areas of sediment that may contribute additional turbidity during runoff events. Turbidity and general water quality in the Augustus River remained within the expected historical range, with no significant environmental impacts identified.

Background groundwater quality remained generally fresh and unchanged from previous monitoring periods. Naturally low-pH groundwater continues to occur within localised zones of intense palaeo-leaching, resulting in natural mobilisation of aluminium, copper, zinc and other metals at some monitoring locations.

No strongly alkaline groundwater indicative of direct bauxite liquor contamination was detected. However, monitoring continued to confirm a localised affected groundwater zone at the RCL, principally at M111s, M114sR, R73A, R73B and RCL2s. The affected zone remains localised and the assessed risk to the downgradient environment remains low. EC trigger exceedances were also recorded at M113z and NVM01f, with M113z exceeding the action value. M113z is situated beneath the known affected M114s area and is being addressed through the existing RCL work programme.

At the SEPs, monitoring continued to confirm a localised affected groundwater zone centred on NVM22s and NVM21z, associated with historical spent-acid releases. NVM21z continues to show a gradual increasing EC trend, indicating downward migration of affected groundwater into the deeper zersatz zone. M104A remains inconclusive, while the remaining SEP monitoring bores show no evidence of further lateral expansion of the affected groundwater zone. Oxalate was unexpectedly detected at NVM21z and is being reassessed. Potential impacts associated with this result will be addressed in the FY27 hydrology review.

Groundwater quality downgradient of the NPHD, SPHD and southern corner of BRDA5 remained broadly comparable to background conditions. Some early warning indicators remain, including elevated Na/Cl ratios and EC values, but there is no conclusive evidence of significant bauxite liquor impacts. With FWL water levels expected to remain below historical levels, the FWL can no longer be relied upon to the same extent as a hydraulic control. Future containment will therefore place greater reliance on maintaining low PHD water levels and effective operation of the groundwater interception systems.

A numerical groundwater model update has commenced to further assess groundwater flow and contaminant migration at the RCL, SEPs and PHDs. The modelling will inform remediation of the affected groundwater zone at the SEPs, remediation or management options at the RCL, and assessment of interception bore effectiveness at the PHDs under lower FWL water-level conditions.

9.2 FY26 recommendations

The following is recommended to be included in the FY27 monitoring round.

- Oxalate should be added to the routine laboratory analytical suite for SEP monitoring bores.
- Dissolved organic carbon (DOC) should also be included at the SEP monitoring bores to provide supporting information on dissolved organic loading and potential geochemical effects associated with oxalate-bearing groundwater.

The replacement monitoring bores have now been installed and the groundwater water-quality sondes have been replaced as they reach the end of their service life. No additional monitoring infrastructure is recommended at this stage.

Priority 2 monitoring bores were previously proposed to further delineate the affected groundwater zones at the RCL and SEPs. However, sufficient information is considered available to progress the numerical groundwater model, and installation of these bores can reasonably be deferred until the modelling is completed. The model results can then be used to refine the required bore locations and ensure that any additional monitoring targets the remaining areas of uncertainty.

At the PHDs, operating pump levels and upper and lower operating surfaces provide a practical basis for assessing containment performance, and additional continuous pond water level monitoring is not considered necessary at this stage.

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Signatures

Groundwater Resource Management Pty Ltd

Dr Jan Vermaak

Principal Hydrogeologist

Doc Ref: J2618R01-Rev1 FY26 hydrology review.docx

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ANZECC (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. National Water Quality Management Strategy. October 2000

GRM (2019). Review of the groundwater monitoring program: Worsley Alumina Refinery. Technical Memorandum to Craig Kimpton, 17 October 2019.

GRM (2023). Hydrogeological Assessment at the Refinery Catchment Lake and Solar Evaporation Ponds, Worsley Alumina Refinery. Report to South 32 Worsley Alumina Ltd Pty. November 2023

GRM (2025) Borehole Completion Report: Priority 1 Monitoring Bores M114sR, M117sR and RCL2s, Worsley Refinery. Report to South 32 Worsley Alumina Pty Ltd, 24 August 2025.

South 32 Worsley Alumina (2021). Water Management Plan, MS719 Management Plan. Internal WAPL document.

APPENDIX A

LICENSE TO TAKE WATER

Government of Western Australia
Department of Water

Instrument No. SWL68041(5)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	South32 Worsley Alumina Pty Ltd		
Description of Water Resource	Brunswick Brunswick 1	**Annual Water Entitlement**	2600000 kL
Location of Water Source	Lot 5314 Mornington		

Authorised Activities	**Taking of water for**	**Location of Activity**
	Water for Industrial purposes	Lot 5314 Mornington Lot 5315, Lot 5316 and Lot 5317 Mornington

Duration of Licence	From 11 November 2015 to 11 November 2025

This Licence is subject to the following terms, conditions and restrictions:

1 The Licensee - South32 Worsley Alumina Pty Ltd is to comply with the 'Surface Water Take, Use and Monitoirng Rules pursuant to SWL68041(5) dated 11 November 2015' and any amendments made by or with the approval of the Department.

End of terms, conditions and restrictions

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.

Surface Water Licence - SWL68041(5)
Take, Use and Monitoring Rules
11 November 2015

Licensee(s): **SOUTH32 WORSLEY ALUMINA PTY LTD**

Location of Water Source: **LOT 5314 MORNINGTON**
FRESH WATER LAKE – AUGUSTUS RIVER

Take and Use:

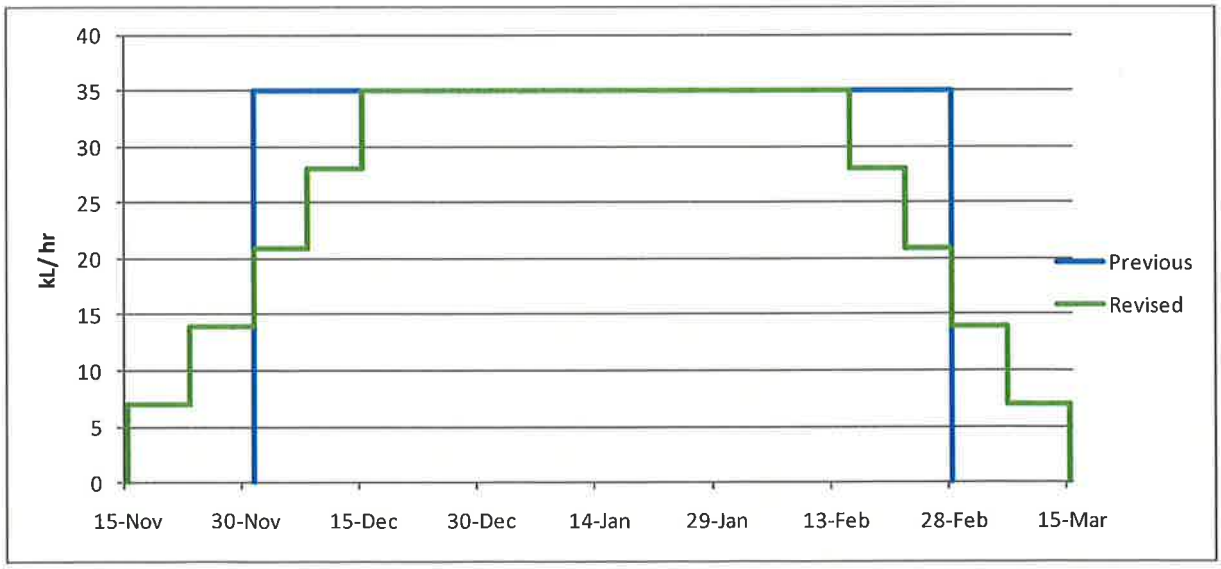
W 1) The annual water entitlement in this licence is an average yearly volume over the term of the licence.

W 2) The annual water year for water taken under this licence is defined as 1 July to 30 June next.

W 3) The Licensee may, subject to W4, take all surface water flowing into the Fresh Water Lake (FWL) Dam.

W 4) The Licensee shall ensure that;

a) The transitional water release strategy agreed upon is implemented and an average flow of 35m^3/h should be released for the period 15th Dec to the 15th February each year, starting with lower flows from 15th November increasing to 35m^3/h average by 15th December continued until 15th February, then stepping down to no releases by 15th March. *(Figure 1 below is a guide to stepping up and down releases.)*



b) the volume of water taken or released each year is measured and reported to the Department;
c) the volume of water taken in the term of the licence shall not exceed 26,000,000 kl;
d) the volume of water taken in any year shall not exceed 5,400,000 kl;

W 5) That should the licensee's take of water adversely affect the water resources, existing biodiversity or ecological processes of the Augustus River, the Department of Water may reduce the amount that can be taken.

Metering:

M 1) The Licensee shall install and maintain a cumulative water meter of a type authorised under the Rights in Water and Irrigation (Approved Meters) Order 2009 to each pump location and the meters must be installed in accordance with the meter manufacturer's specifications.

M 2) The Licensee shall record meter readings monthly and forward the meter readings, monthly usage and annual volume of water drawn to the Department of Water, PO Box 261 Bunbury 6231 by 30 September each year.

M 3) The Licensee shall provide by email an updated spread sheet detailing current and historical water use to the DoW Bunbury office quarterly in October, January, April and July for the quarter ending September, December, March and June respectively each year. The Licensee shall provide a total history of fresh water use to the DoW with the Annual Hydrological report by the 30 September each year.

Metering Locations:

Lot 5314

- Fresh Water Lake Pump Station.

Surface Water Monitoring:

S 1) The Licensee shall undertake monitoring for each parameter and at the frequency identified in the table below from each of the nominated sampling points:

Nominated sampling point	Parameters	Frequency
FWL Pump Station	Water Level volume	Weekly
	pH, EC, Temp, Na, Cl,	Monthly
	SO4, K, Ca, mg, Fe, Al, Alkalinity	Quarterly
Augustus River Gauging Station	Water Level, flow rate, DO, pH, EC, Temp.	From 1 January 2009 Continuously – logged[#]
	Summer Base Flow Releases	From 1 January 2009 Continuously – logged 15/11 to 15/3 each year.
	Na, Cl	Monthly
	SO4, K, Ca, Mg, Fe, Al, Alkalinity, DO % sat., DO	Quarterly
	Hydrograph and Table of Discharge Volume ML/month	Annually
	Hydrograph and Table of Discharge Volume ML/month for the period 1/12 to 28/2 each year.	Annually

[#] *(Continuously logged means a maximum log interval of 10 minutes)*

S 2) All methods and equipment used in water quality sampling should be undertaken in accordance with the Australian Standard AS/NZS 5667 (1998) and wherever possible, a NATA registered laboratory should undertake the analyses, using NATA accredited analysis methods.

S 3) Water quality is to be compared with the Australian & New Zealand Guidelines for Fresh and Marine WQ – Aquatic Ecosystems (SW Australia – Upland Rivers).

S 4) Water Quality results and comparison with ANZECC 2000 guidelines are to be forwarded to the Department of Water, PO Box 261 Bunbury 6231 by 30 September each year.

Licensee Commitments:

C 1) The Licensee is to continue the timed collection and daily downloading of real time water level and flow data from the Augustus River gauging station (ARGS – 612024).

C 2) The transitional water release strategy (as per condition W4) shall be continued unless otherwise approved by the department.

C 3) The Licensee is to implement the control program and procedures to receive, log and interpret flow data from the Augustus River gauging station and issue instructions to controller on a daily basis.

C 4) The Licensee is to manage and operate the outlet works at the base of FWL dam wall so that calibrated volumes (ML/day) can be released to meet ecological requirements.

Reporting:

R 1) Annual reporting of the above monitoring data including trend analysis is to be included as part of Annual Environmental Review and Annual Hydrological Monitoring Review prepared by South32 Worsley Alumina Pty Ltd for the Environmental Management Liaison Group (EMLG) associated with mining and refinery operations in Boddington and Collie.

End of terms, conditions and restrictions.

APPENDIX B

LABORATORY RESULTS

Sample Point	Sample Date	Aluminium	Arsenic	Bicarbonate Alkalinity as CaCO3	Cadmium	Calcium	Carbonate Alkalinity as CaCO3	Chloride	Chromium	Copper	Dissolved Oxygen - Field (percent)	Electrical Conductivity - Field	Electrical Conductivity @ 25°C	Fluoride	Hydroxide Alkalinity as CaCO3	Ionic Balance	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Nitrate as N	Nitrite	Nitrite + Nitrate as N	pH	pH (field)	Potassium	Selenium	Silicon as SiO2	Sodium	Sodium Chloride Ratio	Sulfate	Temperature (field)	Total Alkalinity as CaCO3	Total Anions	Total Cations	Total Dissolved Solids	Zinc
ANZECC		**0.08**	**0.094**		**0.0004**					**0.002**								**0.0056**		**2.500**	**0.0019**	**0.013**								**0.018**										**0.015**
EX02	14 Oct 2025	0.01	0.001	9	0.0001	3	1	64	0.001	0.006	3.2	236	252	0.1	1	0.47	0.35	0.001	5	0.027	0.0001	0.005	0.03	0.01	0.03	5.42	5.14	1	0.010	15.6	35	0.55	5	19.5	9	2.09	2.11	136	0.013
	24 Mar 2026	0.01	0.001	12	0.0001	3	1	64	0.001	0.026	35.5	232	251	0.1	1	0.94	0.62	0.001	5	0.031	0.0001	0.001	0.01	0.01	0.01	5.82	5.12	1	0.004	16.8	35	0.55	5	18.3	12	2.15	2.11	169	0.012
EXP5	16 Oct 2025	0.05	0.001	3	0.0001	10	1	301	0.001	0.009	1.3	899	935	0.1	1	3.88	0.10	0.001	17	0.623	0.0001	0.007	0.01	0.01	0.01	5.13	4.75	4	0.010	17.6	139	0.46	7	20.1	3	8.70	8.05	487	0.020
	24 Mar 2026	0.04	0.001	7	0.0001	10	1	287	0.001	0.023	32.9	865	939	0.1	1	3.38	0.09	0.001	16	0.607	0.0001	0.004	0.05	0.01	0.05	5.51	4.79	4	0.004	17.8	136	0.47	7	19.1	7	8.38	7.83	558	0.033
GWSVUF6	16 Oct 2025	0.05	0.034	531	0.0001	9	1	253	0.001	0.001	72.3	1,809	1,880	1.6	1	0.79	14.50	0.001	16	0.183	0.0001	0.002	0.01	0.01	0.01	7.38	6.88	3	0.010	23.9	403	1.59	93	20.9	531	19.70	19.40	1,110	0.005
	26 Mar 2026	0.05	0.014	404	0.0001	10	1	251	0.001	0.001	49.1	1,491	1,670	1.0	1	1.75	16.00	0.001	17	0.203	0.0001	0.003	0.01	0.01	0.01	7.38	6.64	3	0.004	25.0	339	1.35	104	17.7	404	17.30	16.70	1,050	0.005
M104A	14 Oct 2025	2.91	0.001	1	0.0001	13	1	473	0.001	0.019	8.2	1,312	1,450	0.3	1	7.26	12.60	0.004	29	0.822	0.0001	0.035	0.01	0.01	0.01	4.26	4.18	4	0.010	43.3	185	0.39	18	19.2	1	13.70	11.90	712	0.197
	25 Mar 2026	3.72	0.001	1	0.0001	3	1	203	0.001	0.039	33.8	667	684	0.2	1	1.15	11.30	0.011	14	0.072	0.0001	0.003	0.08	0.01	0.08	4.02	3.99	1	0.004	51.5	79	0.39	8	21.5	1	5.89	5.76	396	0.038
M105A	14 Oct 2025	0.01	0.001	15	0.0001	8	1	101	0.001	0.002	4.1	458	466	0.1	1	2.62	4.86	0.001	7	0.104	0.0001	0.020	0.01	0.01	0.01	5.36	5.29	4	0.010	33.7	58	0.57	31	20.6	15	3.79	3.60	266	0.032
	25 Mar 2026	0.02	0.001	22	0.0001	9	1	123	0.001	0.003	33.7	460	504	0.1	1	2.08	1.91	0.001	10	0.141	0.0001	0.002	0.02	0.01	0.02	5.83	5.25	5	0.004	46.0	66	0.54	9	19.3	22	4.10	4.27	319	0.019
M107Z	17 Oct 2025	0.37	0.001	1	0.0001	1	1	41	0.001	0.019	10.4	170	167	0.1	1	2.16	0.08	0.001	3	0.004	0.0001	0.003	0.07	0.01	0.07	4.54	4.30	1	0.010	6.6	23	0.56	7	22.0	1	1.30	1.25	78	0.013
	23 Mar 2026	0.52	0.001	1	0.0001	1	1	41	0.001	0.015	31.3	156	169	0.1	1	1.35	0.20	0.001	3	0.007	0.0001	0.001	0.06	0.01	0.06	4.84	4.49	1	0.004	6.7	23	0.56	6	17.1	1	1.28	1.25	89	0.033
M108F	17 Oct 2025	0.01	0.001	41	0.0001	8	1	40	0.001	0.001	7.6	211	221	0.2	1	0.87	0.05	0.001	4	0.004	0.0001	0.003	0.03	0.01	0.03	5.98	5.63	3	0.010	45.3	29	0.73	4	19.5	41	2.03	2.07	152	0.013
	23 Mar 2026	0.01	0.001	46	0.0001	9	1	39	0.001	0.001	29.0	195	222	0.1	1	0.33	0.05	0.001	4	0.006	0.0001	0.002	0.07	0.01	0.07	6.49	5.85	3	0.004	45.9	29	0.74	4	16.3	46	2.10	2.12	153	0.012
M109F	16 Oct 2025	0.01	0.001	13	0.0001	5	1	88	0.001	0.003	1.6	357	350	0.1	1	0.60	1.41	0.001	6	0.082	0.0001	0.004	0.01	0.01	0.01	5.34	4.89	1	0.010	7.1	50	0.57	8	22.4	13	2.91	2.94	172	0.005
	24 Mar 2026	0.01	0.001	18	0.0001	5	1	90	0.001	0.008	31.6	335	347	0.1	1	2.32	1.45	0.001	6	0.083	0.0001	0.001	0.01	0.01	0.01	5.78	4.99	2	0.004	7.1	49	0.54	8	20.5	18	3.06	2.93	196	0.015
M110Z	16 Oct 2025	0.01	0.001	14	0.0001	2	1	80	0.001	0.003	8.4	440	447	0.1	1	1.15	0.05	0.001	4	0.035	0.0001	0.003	0.01	0.01	0.01	5.33	4.85	2	0.010	7.1	79	0.99	62	22.1	14	3.83	3.92	236	0.006
	24 Mar 2026	0.02	0.001	18	0.0001	2	1	79	0.001	0.004	33.5	385	394	0.1	1	0.88	0.21	0.001	4	0.031	0.0001	0.001	0.02	0.01	0.02	5.69	5.02	2	0.004	7.3	69	0.87	40	20.7	18	3.42	3.48	233	0.012
M111S	15 Oct 2025	0.01	0.001	58	0.0001	11	1	41	0.001	0.001	2.8	327	337	0.1	1	2.15	0.05	0.001	6	0.022	0.0001	0.008	0.16	0.01	0.16	6.22	5.56	1	0.010	4.0	49	1.20	36	21.2	58	3.06	3.20	200	0.014
	24 Mar 2026	0.01	0.001	153	0.0001	15	1	51	0.001	0.001	33.7	723	674	0.1	1	2.02	20.90	0.001	18	0.077	0.0001	0.001	0.01	0.01	0.01	6.82	6.07	2	0.004	2.8	96	1.88	107	22.2	153	6.72	6.46	404	0.011
M112F	15 Oct 2025	0.01	0.001	59	0.0001	19	1	108	0.001	0.001	8.9	472	513	0.1	1	0.90	0.05	0.001	16	0.064	0.0001	0.009	0.14	0.01	0.14	6.45	5.69	2	0.010	28.8	52	0.48	13	20.0	59	4.50	4.58	301	0.006
	24 Mar 2026	0.01	0.001	62	0.0001	19	1	111	0.001	0.003	33.7	447	499	0.1	1	0.65	0.05	0.001	16	0.056	0.0001	0.004	0.06	0.01	0.06	6.41	5.79	3	0.004	29.7	51	0.46	12	18.9	62	4.62	4.56	319	0.018
M113Z	15 Oct 2025	0.01	0.001	32	0.0001	6	1	115	0.001	0.003	1.7	516	540	0.1	1	0.71	0.05	0.001	9	0.031	0.0001	0.007	0.01	0.01	0.01	5.63	5.05	2	0.010	15.4	81	0.70	32	21.5	32	4.55	4.61	269	0.008
	19 Jan 2026	0.01	0.001	36	0.0001	5	1	118	0.001	0.017	2.3	575	583	0.1	1	2.03	0.05	0.001	10	0.017	0.0001	0.003	0.02	0.01	0.02	5.58	4.90	2	0.004	15.5	97	0.82	52	24.2	36	5.13	5.34	307	0.024
	24 Mar 2026	0.01	0.001	35	0.0001	15	1	114	0.001	0.001	32.7	513	562	0.1	1	3.80	0.13	0.001	12	0.030	0.0001	0.004	0.01	0.01	0.01	5.93	5.19	4	0.004	14.9	62	0.54	47	20.1	35	4.89	4.54	313	0.005
M114SR	15 Oct 2025	0.52	0.001	617	0.0001	7	1	30	0.001	0.001	2.4	1,729	1,810	0.1	1	0.34	14.00	0.001	3	0.026	0.0001	0.001	0.01	0.01	0.01	7.35	6.94	3	0.010	2.1	428	14.27	300	20.6	617	19.40	19.30	1,200	0.005
	24 Mar 2026	0.07	0.001	660	0.0001	7	1	29	0.001	0.003	24.3	1,732	1,830	0.1	1	1.58	9.12	0.001	4	0.167	0.0001	0.002	0.02	0.01	0.02	7.62	6.78	4	0.004	3.3	428	14.76	289	20.9	660	20.00	19.40	1,340	0.009
M116Z	17 Oct 2025	0.01	0.001	16	0.0001	12	1	153	0.001	0.002	3.1	499	518	0.1	1	4.17	0.08	0.001	12	0.029	0.0001	0.004	0.01	0.01	0.01	5.82	5.02	3	0.010	26.9	62	0.41	5	20.5	16	4.74	4.36	312	0.010
	23 Mar 2026	0.01	0.001	23	0.0001	15	1	130	0.001	0.008	43.7	435	514	0.1	1	0.06	0.14	0.001	11	0.017	0.0001	0.003	0.10	0.01	0.10	6.09	5.51	4	0.004	26.8	57	0.44	5	16.3	23	4.23	4.24	324	0.021
NVM01F	15 Oct 2025	0.01	0.001	165	0.0001	54	1	192	0.001	0.001	5.1	864	912	0.2	1	2.98	0.18	0.001	22	0.433	0.0001	0.008	0.01	0.01	0.01	7.15	6.42	6	0.010	52.2	87	0.45	12	21.0	165	8.96	8.44	542	0.010
	19 Jan 2026	0.01	0.001	165	0.0001	54	1	176	0.001	0.002	6.2	909	905	0.2	1	1.84	0.05	0.001	23	0.406	0.0001	0.009	0.01	0.01	0.01	7.00	6.37	6	0.004	53.6	93	0.53	10	24.5	165	8.47	8.79	542	0.030
	24 Mar 2026	0.01	0.001	169	0.0001	55	1	187	0.001	0.001	13.7	794	896	0.2	1	1.36	0.05	0.001	23	0.347	0.0001	0.005	0.02	0.01	0.02	7.09	6.49	6	0.004	52.5	89	0.48	12	18.2	169	8.90	8.66	566	0.012
NVM02Z	15 Oct 2025	0.01	0.001	113	0.0001	47	1	35	0.001	0.001	12.4	412	435	0.1	1	4.22	0.05	0.001	6	0.005	0.0001	0.002	2.94	0.01	2.94	7.20	6.51	2	0.010	4.3	34	0.97	37	20.6	113	4.02	4.37	254	0.005
	24 Mar 2026	0.01	0.001	109	0.0001	44	1	101	0.001	0.001	33.7	532	602	0.1	1	1.20	0.05	0.001	11	0.132	0.0001	0.001	0.22	0.01	0.22	6.73	6.11	3	0.004	17.0	62	0.61	34	17.9	109	5.73	5.87	337	0.013
NVM03F	15 Oct 2025	0.01	0.001	171	0.0001	43	1	107	0.001	0.001	2.6	633	681	0.2	1	0.27	2.41	0.001	16	0.182	0.0001	0.004	0.01	0.01	0.01	7.03	6.70	6	0.010	49.6	64	0.60	1	19.3	171	6.43	6.40	376	0.005
	23 Mar 2026	0.01	0.001	177	0.0001	44	1	106	0.001	0.001	12.9	606	667	0.2	1	0.63	2.25	0.001	17	0.175	0.0001	0.002	0.01	0.01	0.01	7.41	6.67	6	0.004	49.1	62	0.58	1	18.6	177	6.53	6.45	398	0.005
NVM04Z	15 Oct 2025	0.01	0.001	34	0.0001	15	1	188	0.001	0.001	2.9	617	655	0.1	1	2.54	0.69	0.001	14	0.461	0.0001	0.011	0.01	0.01	0.01	5.86	5.50	3	0.010	29.4	88	0.47	6	19.2	34	6.11	5.80	379	0.016
	23 Mar 2026	0.01	0.001	32	0.0001	14	1	186	0.001	0.002	18.4	584	660	0.1	1	4.45	0.46	0.001	13	0.477	0.0001	0.003	0.01	0.01	0.01	6.21	5.43	3	0.004	30.3	84	0.45	6	18.6	32	6.01	5.50	394	0.025
NVM10Z	16 Oct 2025	0.01	0.001	26	0.0001	9	1	102	0.001	0.002	4.1	380	416	0.1	1	1.97	0.05	0.001	8	0.088	0.0001	0.004	0.01	0.01	0.01	5.92	5.27	3	0.010	32.7	57	0.56	6	18.1	26	3.52	3.66	250	0.008
	25 Mar 2026	0.01	0.001	34	0.0001	9	1	104	0.001	0.003	15.1	365	415	0.1	1	1.60	0.05	0.001	8	0.085	0.0001	0.002	0.02	0.01	0.02	6.25	5.36	3	0.004	33.0	56	0.54	6	17.2	34	3.74	3.62	263	0.015
NVM11S	16 Oct 2025	0.05	0.001	2	0.0001	1	1	174	0.001	0.007	6.5	520	591	0.1	1	1.34	14.60	0.001	6	0.019	0.0001	0.005	0.02	0.01	0.02	5.18	4.69	1	0.010	5.3	90	0.52	21	17.7	2	5.38	5.24	297	0.010
	25 Mar 2026	0.24	0.001	4	0.0001	1	1	255	0.001	0.017	29.2	773	837	0.1	1	1.56	24.70	0.002	9	0.028	0.0001	0.002	0.05	0.01	0.05	5.30	4.47	1	0.004	6.6	125	0.49	25	18.2	4	7.79	7.55	445	0.014
NVM12F	16 Oct 2025	0.01	0.001	149	0.0001	27	1	78	0.001	0.001	2.4	475	532	0.2	1	0.75	0.05	0.001	17	0.316	0.0001	0.013	0.03	0.01	0.03	7.05	6.45	6	0.010	52.3	52	0.67	3	17.5	149	5.24	5.16	307	0.014
	25 Mar 2026	0.01	0.001	171	0.0001	30	1	77	0.001	0.001	14.8	485	547	0.3	1	0.97	1.64	0.001	19	0.274	0.0001	0.002	0.02	0.01	0.02	7.51	6.61	6	0.004	51.9	54	0.70	4	16.6	171	5.67	5.56	339	0.012
NVM17	14 Oct 2025	0.07	0.001	1	0.0001	4	1	122	0.001	0.007	11.7	412	449	0.2	1	0.09	0.94	0.001	8	0.265	0.0001	0.012	0.01	0.01	0.01	5.10	4.77	1	0.010	12.0	62	0.51	7	19.1	1	3.59	3.58	224	0.108
	25 Mar 2026	0.08	0.001	1	0.0001	4	1	127	0.001	0.009	25.2	439	460	0.1	1	1.77	1.14	0.001	8	0.243	0.0001	0.004	0.03	0.01	0.03	5.21	4.70	1	0.004	10.8	68	0.54	6	19.9	1	3.71	3.84	279	0.016
NVM19	14 Oct 2025	1.04	0.001	1	0.0001	1	1	166	0.001	0.040	18.3	456	547	0.2	1	3.64	13.50	0.001	8	0.088	0.0001	0.052	0.05	0.01	0.05	4.31	4.18	1	0.010	15.3	71	0.43	10	14.7	1	4.89	4.55	263	0.085
	25 Mar 2026	1.04	0.001	1	0.0001	1	1	156	0.001	0.041	25.3	531	562	0.1	1	1.32	12.40	0.008	8	0.041	0.0001	0.004	0.07	0.01	0.07	3.95	4.00	1	0.004	16.2	68	0.44	8	20.4	1	4.57	4.45	285	0.039
NVM20F	14 Oct 2025	0.03	0.001	8	0.0001	13	1	91	0.001	0.003	2.0	377	413	0.1	1	1.77	0.05	0.001	8	0.113	0.0001	0.005	0.01	0.01	0.01	5.40	4.99	3	0.010	15.3	49	0.54	32	20.0	8	3.39	3.52	219	0.005
	25 Mar 2026	0.03	0.001	8	0.0001	4	1	84	0.001	0.008	42.9	289	321	0.1	1	2.45	0.27	0.001	7	0.043	0.0001	0.001	0.01	0.01	0.01	5.64	4.91	3	0.004	14.2	46	0.55	9	18.6	8	2.72	2.85	187	0.007
NVM21Z	14 Oct 2025	0.25	0.001	38	0.0001	580	1	1,200	0.001	0.010	5.9	8,310	8,820	0.1	1	0.88	0.05	0.001	623	31.800	0.0001	0.078	0.01	0.01	0.01	5.63	5.21	18	0.010	51.7	709	0.59	3,600	20.4	38	110.00	112.00	7,900	0.097
	25 Mar 2026	0.05	0.001	42	0.0001	498	1	1,140	0.001	0.008	46.9	6,927	7,360	0.1	1	0.30	5.29	0.001	570	25.200	0.0001	0.037	0.01	0.01	0.01	6.01	5.29	17	0.004	46.9	630	0.55	3,170	19.6	42	99.00	99.60	7,400	0.082
NVM22S	14 Oct 2025	959.00	0.056	1	0.0002	76	1	1,370	0.013	0.337	9.1	11,047	11,400	0.2	1	0.01	380.00	0.04	97	1.260	0.0001	0.135	0.02	0.01	0.02	3.42	3.36	29	0.010	18.2	1060	0.77	7,060	20.3	1	186.00	186.00	12,800	0.910
	25 Mar 2026	895.00	0.046	1	0.0001	69	1	1,450	0.014	0.343	76.5	10,483	10,800	0.2	1	3.25	403.00	0.025	87	1.240	0.0001	0.092	0.01	0.01	0.01	3.43	3.44	25	0.014	17.5	959	0.66	6,960	20.8	1	186.00	174.00	13,500	0.787
NVM27S	17 Oct 2025	0.01	0.001	4	0.0001	2	1	52	0.001	0.001	84.8	180	198	0.1	1	2.04	0.05	0.001	4	0.005	0.0001	0.004	0.13	0.01	0.13	6.04	5.70	2	0.010	8.1	28	0.54	4	17.7	4	1.63	1.70	106	0.061
	25 Mar 2026	0.01	0.001	6	0.0001	2	1	51	0.001	0.001	19.1	193	198	0.1	1	0.94	0.05	0.001	4	0.002	0.0001	0.001	0.53	0.01	0.53	6.08	5.35	2	0.004	8.2	26	0.51	4	19.7	6	1.64	1.61	118	0.008
NVM28F	15 Oct 2025	0.01	0.001	54	0.0001	9	1	27	0.001	0.001	5.3	166	194	0.1	1	0.12	0.05	0.001	6	0.057	0.0001	0.003	0.02	0.01	0.02	6.46	5.95	2	0.010	44.5	21	0.78	3	15.7	54	1.90	1.91	130	0.017
	25 Mar 2026	0.02	0.001	56	0.0001	9	1	26	0.001	0.016	36.5	176	195	0.1	1	0.73	0.05	0.001	6	0.057	0.0001	0.005	0.01	0.01	0.01	6.87	6.05	2	0.004	45.6	21	0.81	4	16.8	56	1.94	1.91	131	0.053
R25B	14 Oct 2025	0.01	0.001	64	0.0001	15	1	58	0.001	0.001	5.7	301	332	0.1	1	1.69	0.05	0.001	8	0.003	0.0001	0.002	0.04	0.01	0.04	6.69	6.05	5	0.010	41.3	37	0.64	6	17.7	64	3.04	3.14	197	0.011
	26 Mar 2026	0.01	0.001	69	0.0001	16	1	56	0.001	0.001	13.1	293	329	0.1	1	2.44	0.05	0.001	8	0.408	0.0001	0.006	0.01	0.01	0.01	7.05	6.32	5	0.004	42.7	38	0.68	6	16.8	69	3.08	3.24	216	0.010
R26A	14 Oct 2025	1.13	0.001	1	0.0001	1	1	38	0.001	0.008	2.0	179	189	0.1	1	4.27	0.05	0.001	3	0.151	0.0001	0.008	0.01	0.01	0.01	4.57	4.41	1	0.010	12.8	24	0.63	20	18.6	1	1.49	1.37	110	0.008
	26 Mar 2026	0.23	0.001	1	0.0001	2	1	46	0.001	0.012	13.7	200	210	0.1	1	2.51	0.05	0.001	5	0.289	0.0001	0.004	0.03	0.01	0.03	5.09	4.76	2	0.004	19.2	28	0.61	19	17.5	1	1.69	1.78	146	0.009
R73A	15 Oct 2025	0.01	0.001	258	0.0001	10	1	85	0.001	0.001	2.2	1,931	2,050	0.1	1	0.78	2.07	0.001	12	0.016	0.0001	0.003	0.01	0.01	0.01	6.53	6.28	3	0.010	1.1	406	4.78	575	19.3	258	19.50	19.20	1,240	0.005
	24 Mar 2026	0.01	0.001	264	0.0001	14	1	82	0.001	0.001	40.4	1,835	2,020	0.1	1	3.63	2.09	0.001	12	0.011	0.0001	0.001	0.02	0.01	0.02	6.91	6.25	3	0.004	1.2	387	4.72	596	18.8	264	20.00	18.60	1,340	0.005
R73B	15 Oct 2025	0.01	0.001	219	0.0001	11	1	112	0.001	0.001	1.6	1,758	1,890	0.1	1	0.04	3.75	0.001	12	0.043	0.0001	0.007	0.01	0.01	0.01	6.54	6.23	3	0.010	1.6	371	3.31	490	19.2	219	17.70	17.80	1,100	0.006
	24 Mar 2026	0.01	0.001	231	0.0001	10	1	118	0.001	0.001	28.6	1,730	1,910	0.1	1	5.41	8.16	0.001	12	0.036	0.0001	0.004	0.02	0.01	0.02	6.92	6.27	3	0.004	1.5	356	3.02	531	18.2	231	19.00	17.00	1,230	0.012
RCL2S	15 Oct 2025	0.01	0.001	836	0.0001	48	1	92	0.001	0.001	2.0	2,273	2,330	0.1	1	1.92	0.05	0.001	17	1.220	0.0001	0.007	0.01	0.01	0.01	7.30	6.85	4	0.010	6.1	482	5.24	314	20.9	836	25.80	24.90	1,480	0.005
	24 Mar 2026	0.01	0.001	736	0.0001	47	1	265	0.001	0.001	31.2	2,837	3,250	0.1	1	1.39	21.50	0.001	30	3.760	0.0001	0.009	0.01	0.01	0.01	7.09	6.45	4	0.004	7.5	715	2.70	617	16.8	736	35.00	36.00	2,170	0.028
SVM24	17 Oct 2025	0.01	0.001	156	0.0001	42	1	108	0.001	0.001	3.6	624	662	0.1	1	3.56	1.15	0.001	26	0.432	0.0001	0.002	0.01	0.01	0.01	6.88	6.44	4	0.010	59.1	55	0.51	5	19.0	156	6.27	6.73	387	0.010
	23 Mar 2026	0.01	0.001	161	0.0001	40	1	103	0.001	0.001	30.8	574	653	0.1	1	1.21	1.55	0.001	24	0.415	0.0001	0.001	0.01	0.01	0.01	7.33	6.53	4	0.004	62.8	53	0.51	5