

## Appendix D

Surface Water Assessment



# REPORT

**MACH Energy Australia Pty Ltd**  
ABN: 34 608 495 441

**MOUNT PLEASANT OPERATION**  
**Modification 8**

**Surface Water Assessment**

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# 1 INTRODUCTION

## 1.1 Mount Pleasant Operation Overview

The approved Mount Pleasant Operation (MPO) is located in the Upper Hunter Valley of New South Wales (NSW), approximately 3 kilometres (km) north-west of Muswellbrook and approximately 50 km north-west of Singleton (**Map 1**). The village of Aberdeen and locality of Kayuga are also located approximately 5 km north-northeast and 1 km north of the MPO boundary, respectively.

The MPO Development Consent DA 92/97 was granted on 22 December 1999. The MPO was also approved under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2012 (EPBC 2011/5795).

MACH Energy Australia Pty Ltd (MACH Energy) acquired the MPO from Coal & Allied Operations Pty Ltd (Coal & Allied) in 2016. MACH Energy commenced construction activities at the MPO in November 2016 and commenced mining operations in late 2017, in accordance with Development Consent DA 92/97 and EPBC 2011/5795.

MACH Mount Pleasant Operations Pty Ltd manages the MPO as agent for and on behalf of the unincorporated Mount Pleasant Joint Venture between MACH Energy (95% owner) and J.C.D. Australia Pty Ltd (5% owner). Throughout this Surface Water Assessment (SWA), MACH Mount Pleasant Operations Pty Ltd and the unincorporated Mount Pleasant Joint Venture are referred to as MACH.

The MPO as currently approved under Development Consent DA 92/97 (most recently modified by Modification 6) includes a Coal Handling and Preparation Plant (CHPP), a rail loop, spur, conveyor and load-out facility connecting the mine to the Muswellbrook-Ulan Rail Line. The MPO is approved to produce up to 10.5 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal until 22 December 2026 under this consent. Thermal coal products from the MPO are transported by rail to the Port of Newcastle for export or to domestic customers for use in electricity generation.

## 1.2 Modification Overview

MACH proposes a modification to Development Consent DA 92/97, referred to as Modification 8 (the Modification). The Modification proposes:

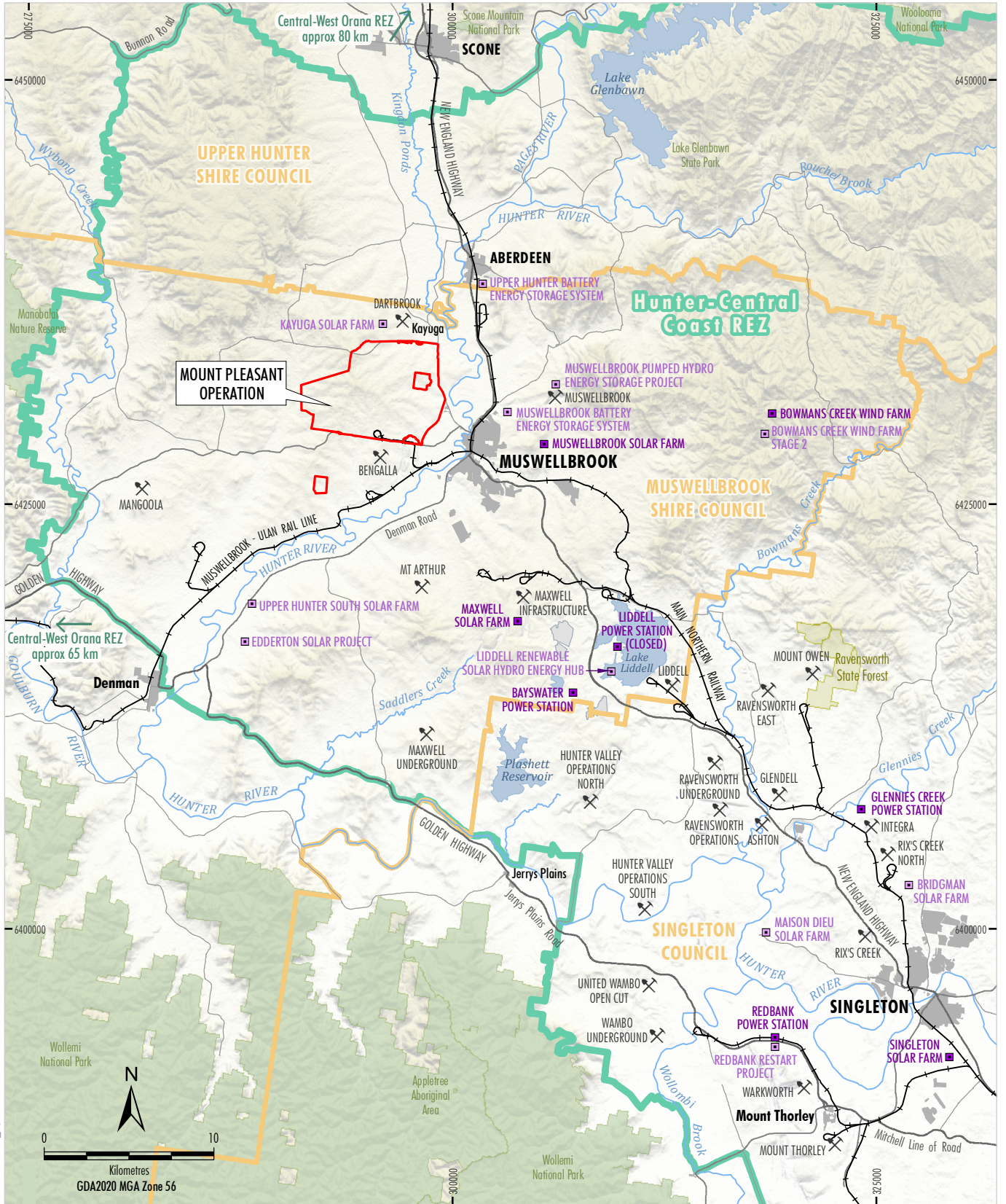
- an extension of permitted (ROM coal) mining operations to 31 December 2032; and
- an increase in the approved ROM coal extraction rate from 10.5 Mtpa to 12.5 Mtpa.

The Modification general arrangement is shown on **Map 2**.

## 1.3 Scope of Work

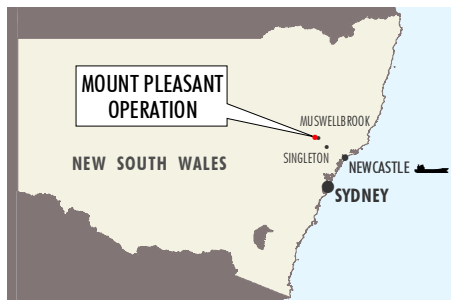
ATC Williams Pty Ltd (ATCW) has been commissioned by MACH to prepare this SWA which forms a component of the Modification application. The scope of the SWA comprised:

- review of the MPO environmental management performance relevant to surface water;
- review of the current and proposed MPO water management system;
- site water and salt balance modelling for the currently approved and existing MPO and the proposed Modification;
- assessment of potential impacts of the proposed modified MPO on surface water resources; and
- review of the surface water management measures and monitoring program relating to the proposed modified MPO.



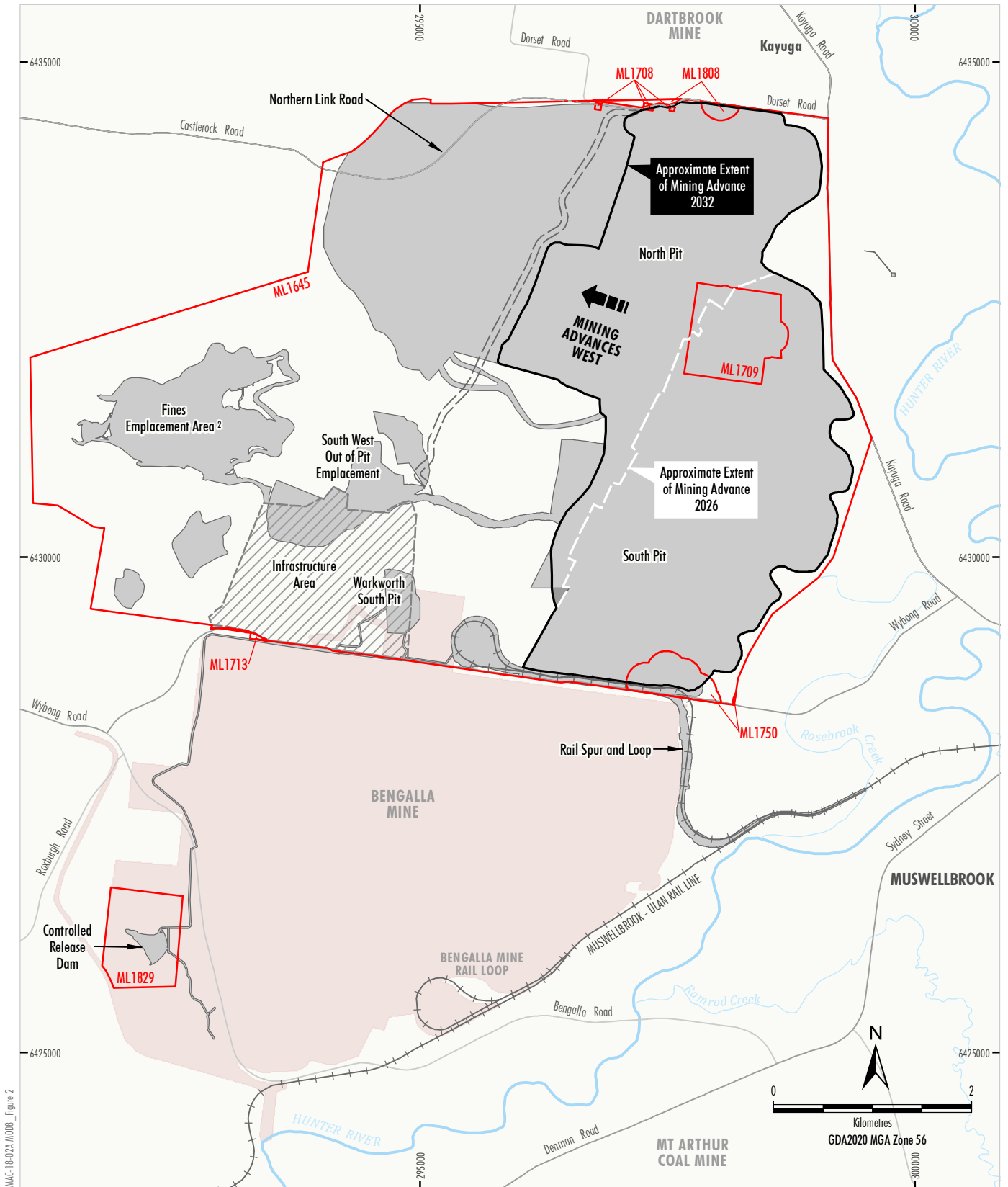
MACH-18-02A.M008\_Figure 1

Source: NSW Spatial Services (2025); EnergyCo (2024)



- LEGEND**
- Mining Operation
  - Existing/Approved Major Energy Generation Site
  - Proposed Major Energy Generation Site
  - Railway
  - National Parks and Wildlife Estate
  - State Forest/Reserve
  - Local Government Boundary
  - Hunter-Central Coast Renewable Energy Zone (REZ)
  - Mining Lease Boundary (Mount Pleasant Operation)

**MACHEnergy**  
 MOUNT PLEASANT OPERATION  
 Location of the Mount Pleasant Operation



MMC-18-02A.M008\_Figure 2

Source: MACH (2025); NSW Spatial Services (2025); Department of Planning and Environment (2016)

**LEGEND**

- Mining Lease Boundary (Mount Pleasant Operation)
- Approved Surface Disturbance Plan - DA 92/97 <sup>1</sup>
- Services Corridor Being Developed Under SSD-10418 to be Used Under the Modification
- Extension of Open Cut Mining and Emplacement Area (Land Lawfully Disturbed under SSD-10418)
- Revised Infrastructure Area Envelope
- Bengalla Mine Approved Disturbance Boundary (SSD-5170)

<sup>1</sup> Excludes some incidental Project components such as water management infrastructure, access tracks, topsoil stockpiles, power supply, temporary offices, other ancillary works and construction disturbance.

<sup>2</sup> The general arrangement of the Fines Emplacement Area has been amended from the area shown in DA 92/97 to reflect as-built structures.

**MACHEnergy**  
MOUNT PLEASANT OPERATION  
Overview of the Modification



## 2 SURFACE WATER RESOURCES AND ENVIRONMENTAL PERFORMANCE

### 2.1 Surface Water Resources

#### 2.1.1 Regional Overview

The MPO is located within the Hunter River catchment, which covers an area of approximately 21,500 square kilometres (km<sup>2</sup>), and includes the major towns of Newcastle, Singleton and Muswellbrook (refer **Map 1**). The Hunter River flows in a south-westerly direction approximately 1 km to the east of the MPO at its nearest location and is regulated by two major storages operated by WaterNSW: the Glenbawn and the Glennies Creek Dams. The Glenbawn Dam is located approximately 16 km upstream of the MPO mining lease boundary, while the Glennies Creek Dam is located on a tributary of the Hunter River approximately 37 km east of the MPO mining lease boundary. Glenbawn Dam has an operating capacity of 750,000 megalitres (ML) with water supplied to the surrounding region for agricultural and industrial purposes. Glenbawn Dam also serves a flood mitigation function with an additional 120,000 ML available for flood storage. Glennies Creek Dam has a capacity of 283,000 ML and provides water supply for irrigation, environmental flows, stock, industry and household needs in the Hunter Valley.

#### 2.1.2 Local Surface Water Systems

The drainage network in the vicinity of the MPO is generally characterised by steep gullies which emanate from areas of higher topography in the surrounding hills to the alluvial floodplains adjacent to the Hunter River (refer **Map 3**).

Rosebrook Creek and two unnamed tributaries of Rosebrook Creek traverse the eastern portion of the MPO and join the Hunter River approximately 3 km downstream of the south-eastern MPO boundary. The pre-mining catchment area of Rosebrook Creek to the confluence with the Hunter River is estimated at 19 km<sup>2</sup>. Multiple unnamed headwater drainage lines traverse the central portion of the MPO which is part of the catchment of Dry Creek (this is an unnamed tributary of the Hunter River however its colloquial name of Dry Creek has been used throughout this report). The western portion of the site lies within the catchment of Sandy Creek. Both Dry Creek and Sandy Creek are tributaries of the Hunter River. The catchment area of Sandy Creek<sup>1</sup> to the confluence with the Hunter River is estimated at 143 km<sup>2</sup>.

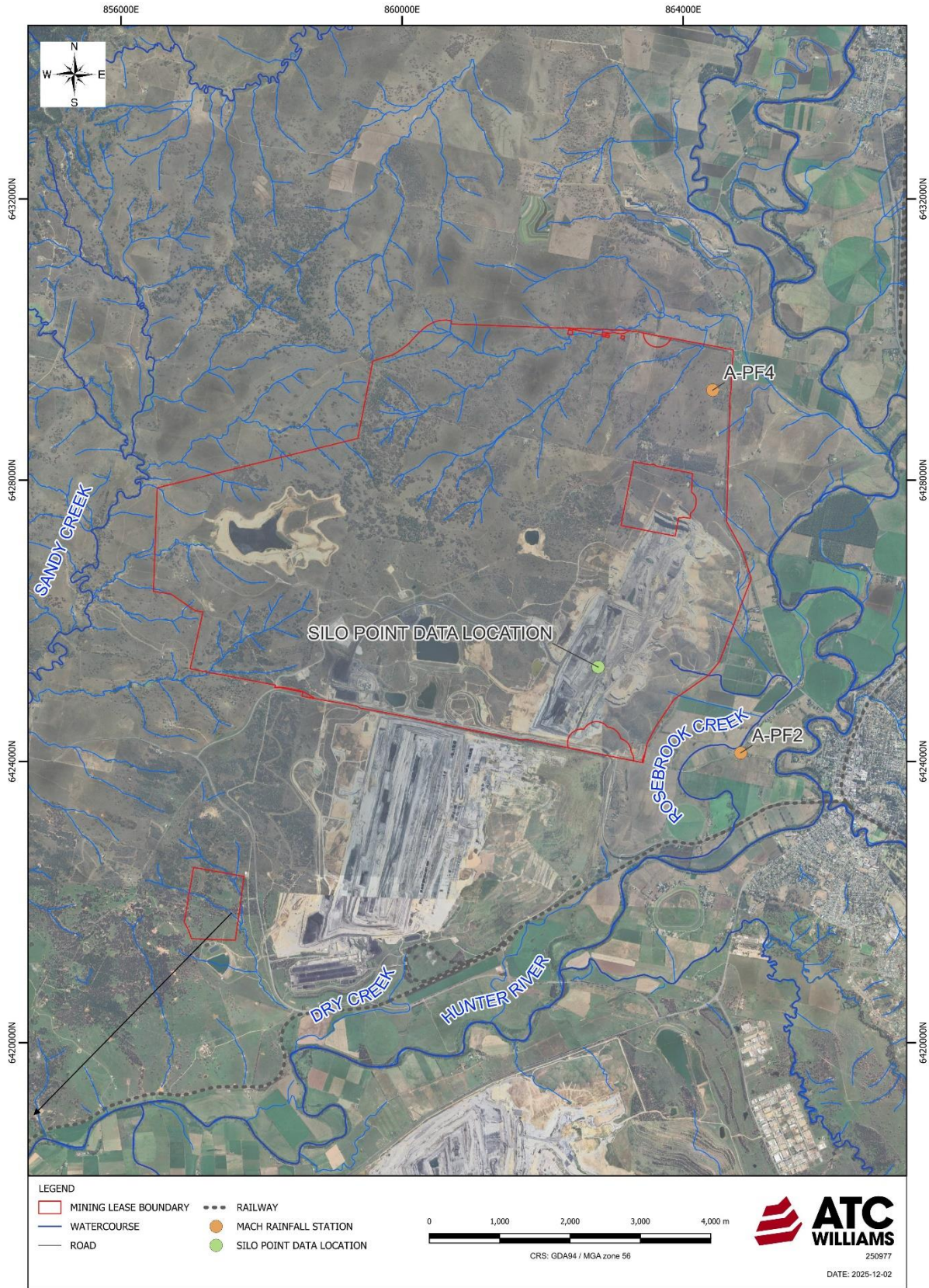
The Dry Creek Project, implemented by the adjacent Bengalla Mine, was designed to divert Dry Creek around the Bengalla Mine. The Dry Creek Project comprises a dam, a pump station and pipeline and a protective contour levee to release water from the pipeline into an unnamed tributary of the Hunter River. The Bengalla Mining Company (BMC) monitors water quality at sites on unnamed drainage lines and the Hunter River, downstream of the MPO (BMC, 2023). Mangoola Coal Operations Pty Limited (a subsidiary of Glencore) also undertakes surface water and stream health monitoring in Sandy Creek downstream of the MPO (Glencore, 2022).

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<sup>1</sup> It should be noted that there is more than one Sandy Creek in the Muswellbrook area, one upstream of the MPO and Muswellbrook and one west and downstream of the MPO. References to Sandy Creek in this SWA relate to the Sandy Creek west and downstream of the MPO.



### MAP 3: SURFACE WATER SYSTEMS AND RAINFALL MONITORING STATIONS





## 2.2 Rainfall and Evaporation

MACH operates meteorological stations at Kayuga Road (A-PF4, previously known as M-WS4) and Wybong Road (A-PF2, previously known as M-WS2) that measure rainfall, wind speed and direction, temperature, solar radiation, relative humidity and atmospheric pressure (refer **Map 3** for locations). Data has been recorded at A-PF4 since January 2019 and at A-PF2 since July 2019. The total annual rainfall recorded at each station and sourced from Scientific Information for Land Owners (SILO) Point Data<sup>2</sup> is presented in **Table 1** for the period July 2019 to December 2024.

**TABLE 1: TOTAL ANNUAL RAINFALL**

Year	Total Annual Rainfall (mm)		
	Kayuga Road (A-PF4)	Wybong Road (A-PF2)	SILO Point Data (-32.25, 150.85)
2019	357.2	-	342.9
2020	786.1	826.8	808.6
2021	901.8	850.8	919.2
2022	885.2	917.8	937.3
2023	432.4	461.2	437.6
2024	634.8	638.4	690.1

mm = millimetres.

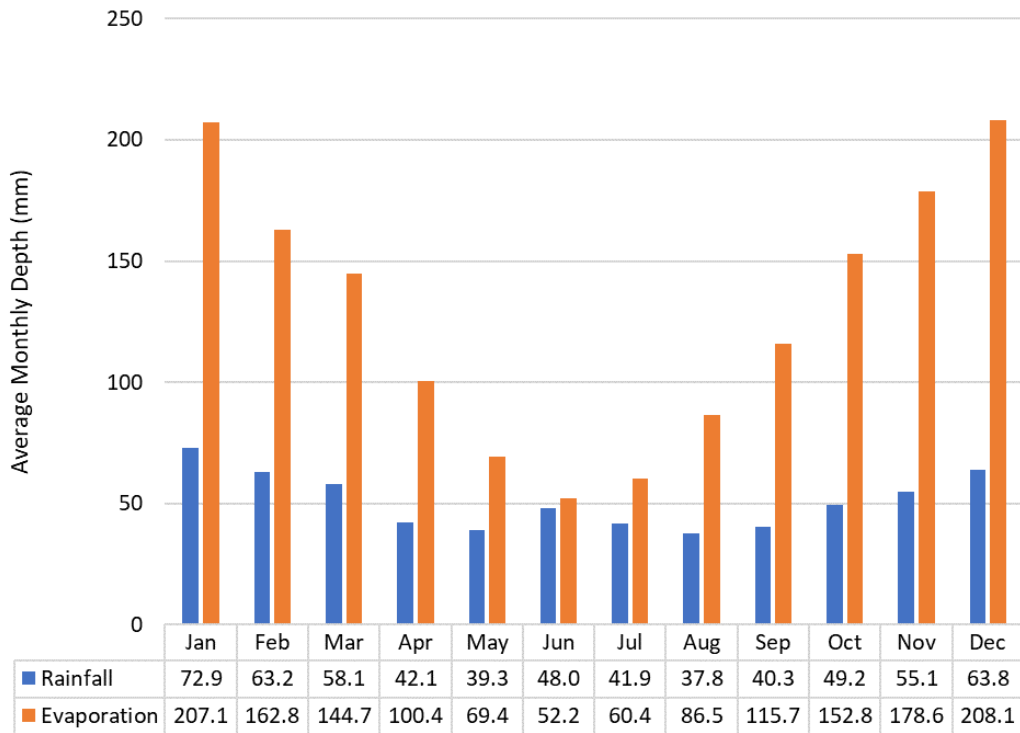
As shown in **Table 1**, the total rainfall recorded in 2024 was 635 mm at A-PF4 and 638 mm at A-PF2. For the period of record, total annual rainfall calculated from SILO Point Data was generally within or close to the range of total annual rainfall recorded at the MPO rainfall stations.

Average monthly rainfall and pan evaporation, calculated from long-term data obtained from the SILO Point Data for the MPO location, is illustrated in **Graph 1**. The data shows that rainfall is typically spread throughout the year, although monthly totals tend to be higher in the summer months. Based on the SILO Point Data, the long-term (136 years) average annual rainfall at the MPO is 612 mm, while long-term average annual pan evaporation is 1,539 mm – i.e. average annual pan evaporation is more than two and a half times that of average annual rainfall.

<sup>2</sup> The SILO Point Data is a system which provides synthetic daily climate data sets for a specified point by interpolation between surrounding point records held by the Bureau of Meteorology (BoM) – Queensland Government (2024).



**GRAPH 1: SILO POINT DATA - AVERAGE MONTHLY RAINFALL AND PAN EVAPORATION**



## 2.3 Surface Water Compliance

Water management at the MPO is undertaken in accordance with the Water Management Plan (MACH, 2025). Several licences and permits apply to water management at the MPO, primarily:

- Water Access Licences (WALs) issued under the *Water Management Act 2000*.
- Discharge credits held under the *NSW Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002*.
- Environment Protection Licence (EPL) 20850 issued under Part 3 of the *NSW Protection of the Environment Operations Act 1997* by the NSW Environment Protection Authority (EPA).

### 2.3.1 Water Access Licences

Surface water in the vicinity of the MPO is regulated by the *Water Sharing Plan for the Hunter Regulated River Water Source 2016* and the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2022* administered under the *Water Management Act 2000*.

MACH holds a total of 4,106.7 unit shares for the Hunter Regulated River Water Source under the *Water Sharing Plan for the Hunter Regulated River Water Source 2016*, as follows:

- 961 units of Regulated River (High Security).
- 2,947 units of Regulated River (General Security).
- 125.7 units of Supplementary.
- 73 units of Domestic and Stock.

MACH also holds 41 unit shares for the Muswellbrook Water Source and 20 unit shares for the Dart Brook Water Source under the *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources 2022*.



### 2.3.2 Hunter River Salinity Trading Scheme

The Hunter River Salinity Trading Scheme (HRSTS) is managed by the EPA under the *Protection of the Environment Operations (Hunter River Salinity Trading Scheme) Regulation 2002*.

The HRSTS prohibits the discharge of saline water during periods of low flow in the Hunter River and controls discharge of saline water during periods of high flow such that specific salinity targets at various points in the river are not exceeded.

Participants in the HRSTS are able to acquire HRSTS discharge credits at auction every two years. Credits are also able to be temporally traded between participants at any time per private negotiations. Each credit entitles the holder to a share of the available salt discharge capacity announced by WaterNSW during high flow periods. The amount of saline water that may be discharged from a given discharge licence holder is determined by reference to the salinity of the discharge waters, the river flow, the number of credits held and any overriding limit that may be applied as a condition of an EPL.

MACH currently holds 70 discharge credits with no controlled discharge to the Hunter River undertaken to date (MACH, pers. comm., 2 October 2025).

### 2.3.3 Environment Protection Licence 20850

Licensed discharge to the Hunter River would occur from the Mine Water Dam (MWD) at Point 16 (refer **Map 4**) in accordance with the HRSTS and EPL 20850. During discharge, conductivity would be monitored continuously with pH and total suspended solids (TSS) monitored daily in accordance with EPL 20850. The discharge water quality pH and TSS limits, as defined in EPL 20850 for Point 16, are presented in **Table 2**.

**TABLE 2: POINT 16 DISCHARGE WATER QUALITY LIMITS**

Parameter	Units of Measure	100 Percentile Concentration Limit
pH	pH	6.5 – 9.5
TSS	mg/L	120

mg/L = milligrams per litre.

Several storages at the MPO were constructed for the primary function of managing site runoff. Overflow to the receiving environment from some water storages is permitted as follows:

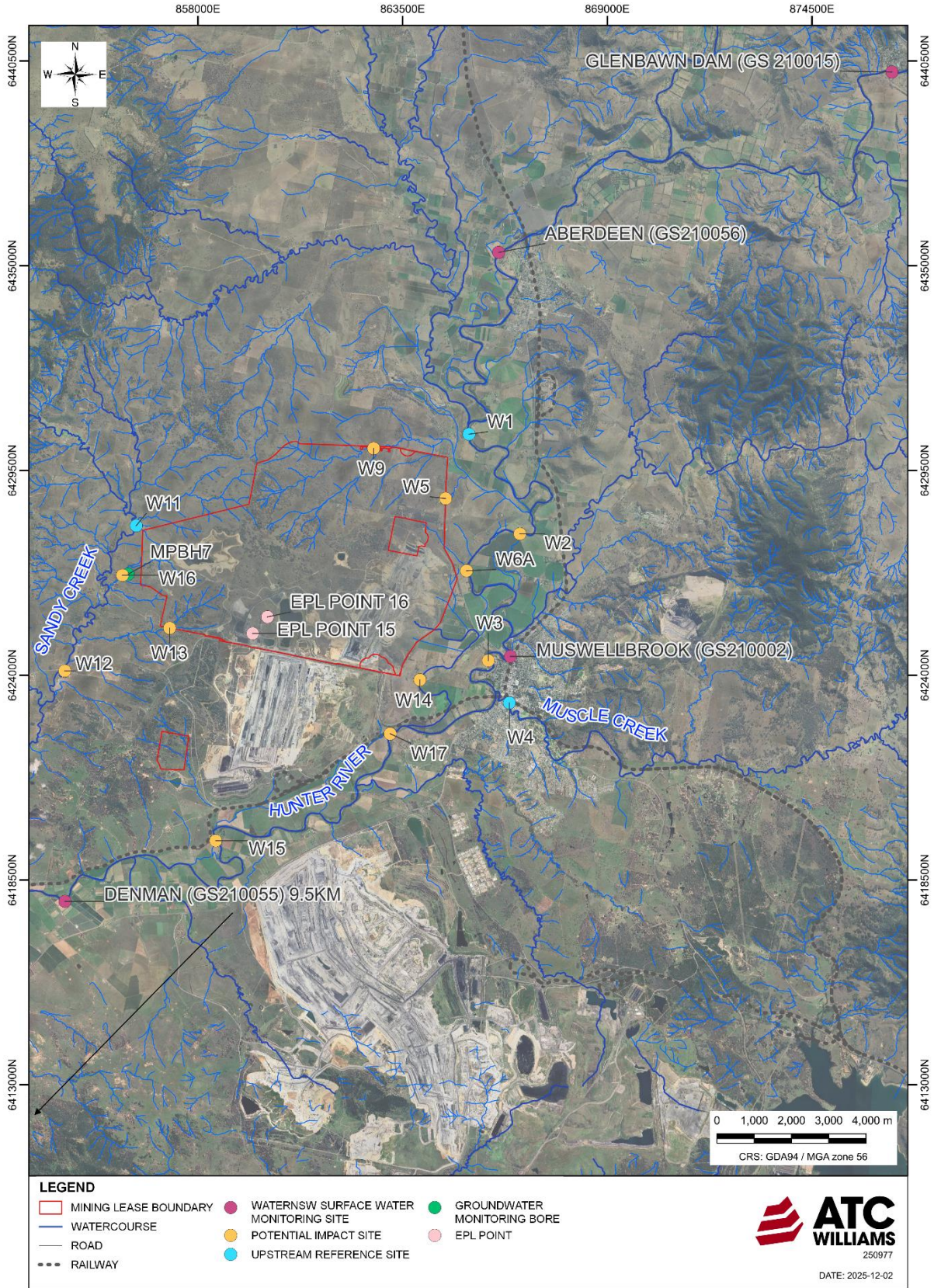
- Sediment Dams – designed in accordance with Landcom (2004) and Department of Energy and Climate Change (DECC) (2008) - overflow permitted if the preceding 5-day total rainfall exceeds the 90<sup>th</sup> percentile, 5-day duration rainfall depth (39.4 mm for the MPO); and,
- Environment Dam 3 (ED3) and Rail Loop Dam 2 (RLD 2) – designed to contain runoff from a 1% Annual Exceedance Probability (AEP) design rainfall event – overflow may occur during rainfall events in excess of the 1% AEP.

MACH manages the inventory of all storages in order to reduce the potential for uncontrolled discharge/overflow (MACH, 2025). Water quality monitoring of site storages is undertaken as described in **Section 2.7.1**.

Wastewater from offices, workshops and bath houses is collected and treated via an on-site sewage treatment plant (STP). Effluent is treated to meet the *Australian Guidelines for Water Recycling* (Environment Protection and Heritage Council, 2006) in addition to NSW Health Department and local council requirements (MACH, 2025). Treated effluent may be pumped to the mine water management system to supplement CHPP usage, vehicle wash down and stockpile dust suppression. Monitoring of water quality associated with the treated effluent is undertaken at Point 15 (refer **Map 4**) in accordance with EPL 20850.



### MAP 4: WATER MONITORING SITES





## 2.4 Surface Water Monitoring Program

MACH conducts water quality and stream health monitoring at locations within and adjacent to the MPO. Stream health monitoring is detailed in the Water Management Plan (MACH, 2025).

Water quality monitoring is undertaken for three suites of parameters as follows:

- Suite 1: pH, electrical conductivity (EC), TSS and total dissolved solids (TDS).
- Suite 2: pH, EC, TSS, total metals, turbidity, dissolved oxygen, total phosphorus and total nitrogen.
- Suite 3: total metals, alkalinity, major cations and anions.

The water quality monitoring site locations are shown on **Map 4**, while the water quality monitoring program is summarised in **Table 3**.

Water quality and streamflow monitoring is also undertaken by WaterNSW at three gauging stations on the Hunter River in the vicinity of the MPO. The locations of the WaterNSW gauging stations are shown on **Map 4**.

**TABLE 3: WATER QUALITY MONITORING PROGRAM**

Watercourse	Site	Type	Parameters	Frequency
Hunter River	W1	Upstream reference site	Suite 1	Monthly & event based
			Suite 2	Minimum annually
			Suite 3	Minimum annually
	W2, W3, W6A	Potential impact sites	Suite 1	Monthly ( <i>Baseline</i> ) Monthly & event based ( <i>When development is within sub-catchment</i> )
			Suite 2	Minimum annually
			Suite 3	Minimum annually
	W15, W17	Potential impact sites	Suite 1	Monthly & event based
			Suite 2	Minimum annually
			Suite 3	Minimum annually
Muscle Creek	W4	Upstream reference site	Suite 1	Monthly and event based
			Suite 2	Minimum annually
Unnamed Tributaries (west of Hunter River)	W5, W9	Potential impact sites	Suite 1	Event based ( <i>Baseline</i> ) Monthly & event based ( <i>When development is within sub-catchment</i> )
			Suite 2	Minimum annually
			Suite 3	Minimum annually
Rosebrook Creek	W14	Potential impact site	Suite 1	Monthly & event based
			Suite 2	Minimum annually
			Suite 3	Minimum annually



**TABLE 3 (CONT.): WATER QUALITY MONITORING PROGRAM**

Watercourse	Site	Type	Parameters	Frequency
Sandy Creek	W11	Upstream reference site	Suite 1	Monthly & event based
			Suite 2	Minimum annually
			Suite 3	Minimum annually
	W12	Potential impact site	Suite 1	Event based ( <i>Baseline</i> ) Monthly & event based ( <i>When development is within sub-catchment</i> )
			Suite 2	Minimum annually
			Suite 3	Minimum annually
Unnamed Tributaries (east of Sandy Creek)	W13, W16	Potential impact sites	Suite 1	Event based ( <i>Baseline</i> ) Monthly & event based ( <i>When development is within sub-catchment</i> )
			Suite 2	Minimum annually
			Suite 3	Minimum annually

## 2.5 Surface Water Flow Regime

### 2.5.1 Streamflow Monitoring

During monitoring site visits, the presence of water (ponded or flowing) at each site has been recorded, with the site records used to provide an indication of surface flow conditions at each monitoring location. The frequency of site visits where ponded or flowing water was present is listed in **Table 4**.

**TABLE 4: FREQUENCY OF PONDED OR FLOWING WATER**

Site	Number of Site Visits	Number of Visits with Water Present	Frequency of Visits with Water Present
W5	318	20	6%
W9	320	34	11%
W13	107	48	45%
W14	116	9	8%
W16	86	67	78%

The data presented in **Table 4** indicates that the local drainages monitored within and adjacent to the MPO are ephemeral, with water present between 6% (W5) and 78% (W16) of the time.

Streamflow monitoring in the vicinity of the MPO is undertaken by WaterNSW at three gauging stations on the Hunter River (refer **Map 4**). The monitoring sites and streamflow records for the period of monitoring to September 2025 are summarised in **Table 5**. Flow duration curves for each monitoring site are presented in **Graph 2**.

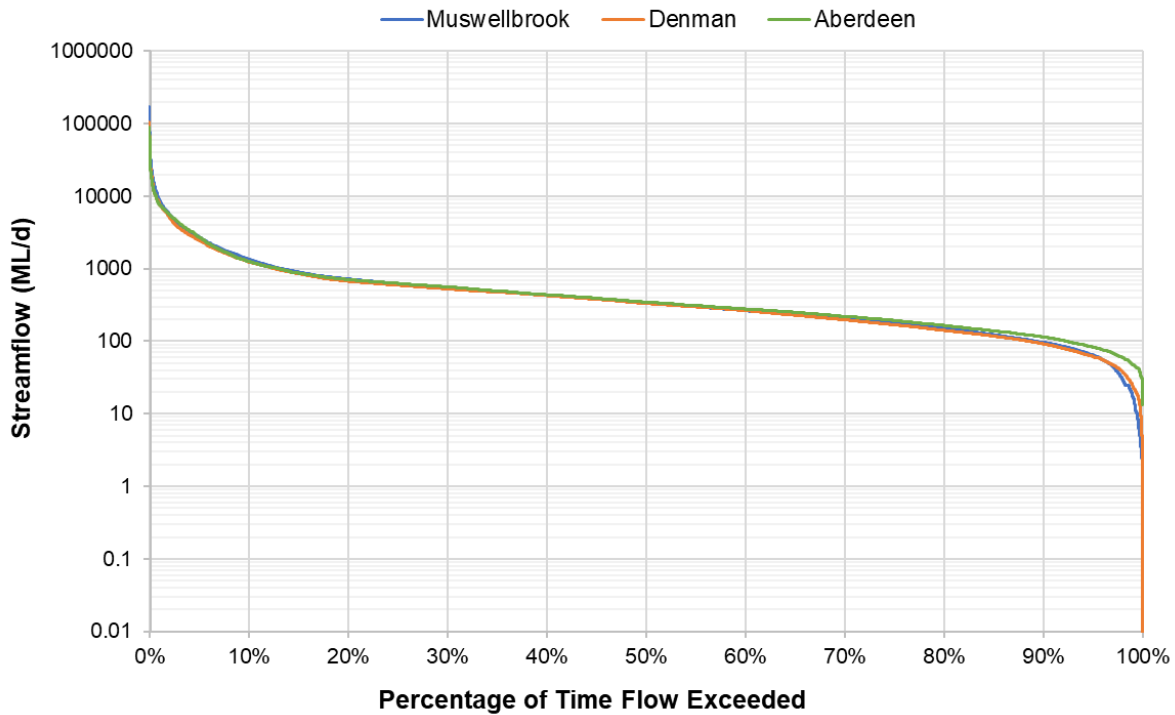


**TABLE 5: HUNTER RIVER STREAMFLOW SUMMARY**

Monitoring Site	Monitoring Commenced	Percentage of Days with Data	Catchment Area (km <sup>2</sup> )	Daily Flow (ML/day)*		
				Minimum	Median	Maximum
Aberdeen (GS 210056)	1959	70%	3,090	13.3	344	89,682
Muswellbrook (GS 210002)	1913	70%	4,220	0	337	171,422
Denman (GS 210055)	1959	83%	4,530	0	331	105,725

\* Data source: <https://realtimedata.waternsw.com.au/> - accessed 16 October 2025, ML/day = megalitres per day.

**GRAPH 2: HUNTER RIVER FLOW DURATION CURVES**



Due to regulated releases from Glenbawn Dam, the Hunter River is near perennial in the vicinity of the MPO. As illustrated in **Graph 2**, a streamflow rate greater than 1 ML/day has been recorded approximately 99% of the time.

**Graph 2** illustrates that the streamflow rates upstream (Aberdeen) and downstream (Denman) of the MPO are fairly consistent with little variability between the sites, as would be expected given the highly regulated nature of the river flow.

### 2.5.2 Flooding

The easternmost extent of the MPO mine landform is located outside of the 1% AEP flood extent for the Hunter River (MACH, 2025). The potential for the MPO mine landform to result in changes to flood depth, extent or velocity in the vicinity of the MPO is considered to be negligible (MACH, 2025).

The MPO MOD 4 rail spur crosses the Hunter River floodplain, within the 1% AEP flood extent (MACH, 2025). The MOD 4 rail infrastructure has been designed to meet a range of flood risk management performance criteria, as defined in the Water Management Plan (MACH, 2025).



## 2.6 Surface Water Quality

### 2.6.1 Site Specific Triggers

As documented in the Water Management Plan (MACH, 2025), water quality site-specific trigger levels have been developed for specific monitoring sites where sufficient monitoring data has permitted. Generally, in accordance with the Australian and New Zealand Governments (ANZG) (2018) and Australian and New Zealand Environment and Conservation Council and Agriculture and Resources Management Council of Australia and New Zealand (ANZECC & ARMCANZ) (2000) guidelines, trigger values were derived based on the 20<sup>th</sup> and 80<sup>th</sup> percentile<sup>3</sup> of the site-specific baseline monitoring data recorded over at least two years of monthly sampling (i.e. 24 data points).

The site-specific trigger levels specified in the Water Management Plan (MACH, 2025) are presented in **Table 6**.

**TABLE 6: SURFACE WATER QUALITY TRIGGER LEVEL**

Site	pH	EC (µS/cm)*	TSS (mg/L)
	20 <sup>th</sup> – 80 <sup>th</sup> Percentile Trigger Values	80 <sup>th</sup> Percentile Trigger Value	80 <sup>th</sup> Percentile Trigger Value
<b>Hunter River</b>			
W1 (reference site)	6.5 – 8.2	529	60
W2	6.5 – 8.3	539	60
W6A	6.5 – 8.4	496	81
W17	6.5 – 8.1	650	85
W15	6.5 – 8	460	64
<b>Sandy Creek</b>			
W11 (reference site)	6.5 – 8	7,050	10
W12	6.5 – 8.1	6,420	30
<b>Muscle Creek</b>			
W4 (reference site)	6.5 – 8	2,480	11

\* µS/cm = microSiemens per centimetre.

As defined in the Water Management Plan (MACH, 2025), a surface water quality response protocol is implemented in the event that:

- a water quality indicator at a downstream water monitoring location (potential impact site) is above (or outside the range of) the trigger value for three consecutive sampling events; and
- a water quality indicator at a downstream water monitoring location is above (or outside the range of) the corresponding upstream monitoring location (upstream reference site) sampled on the same day.

The surface water quality response protocol comprises further investigation of the potential cause of the water quality trigger exceedance and the implementation of mitigation and management measures in the event of a mining-related impact.

### 2.6.2 Regional Water Quality

Near continuous long-term records of EC have been recorded at the WaterNSW Hunter River monitoring sites within the vicinity of the MPO – Hunter River downstream of Glenbawn Dam (GS 210015), Aberdeen (GS 210056), Muswellbrook (GS 210002) and Denman (GS 210055). **Table 7** presents

<sup>3</sup> 20<sup>th</sup> percentile for pH only.



summary statistics of the continuous EC data recorded at the WaterNSW Hunter River monitoring sites. For comparative purposes, the ANZECC & ARMCANZ (2000) default guideline value for upland rivers in NSW is also presented. The calculated statistics have been derived from long-term daily average EC values and are presented for two periods: baseline (prior to the commencement of mining activities at the MPO) and post-commencement of mining (October 2017 to October 2025).

The data presented in **Table 7** illustrates that EC values have tended to increase with distance downstream on the Hunter River, with a median EC of 338  $\mu\text{S}/\text{cm}$  recorded at the Hunter River downstream of Glenbawn Dam (GS 210015) and a median EC of 529  $\mu\text{S}/\text{cm}$  recorded at the Hunter River at Denman (GS 210055) during the baseline period. Higher median EC values were recorded at all sites post October 2017 as compared to the baseline period, including at sites upstream of the MPO. The maximum EC values recorded at the Hunter River at Aberdeen (GS 210056), Hunter River at Muswellbrook (GS 210002) and Hunter River at Denman (GS 210055) were also higher post October 2017 in comparison to the baseline period. It is noted that Hunter River at Aberdeen (GS 210056) is located upstream of potential influences associated with MPO activities. Further assessment of the Hunter River water quality results is provided in **Section 2.6.3.1**.

During the baseline period, the median EC value recorded at Aberdeen (GS 210056) exceeded the ANZECC & ARMCANZ (2000) default guideline value while the 20<sup>th</sup> percentile EC values recorded at Muswellbrook (GS 210002) and Denman (GS 210055) exceeded the ANZECC & ARMCANZ (2000) default guideline value.

**TABLE 7: HUNTER RIVER ELECTRICAL CONDUCTIVITY SUMMARY STATISTICS**

Data/Statistic	Hunter Downstream Glenbawn Dam (210015)*	Aberdeen (GS 210056)*	Muswellbrook (GS 210002)*	Denman (GS 210055)*
ANZECC & ARMCANZ (2000) default guideline value ( $\mu\text{S}/\text{cm}$ )	350	350	350	350
<i>Baseline Period</i>				
Period of record	May 1996 – Sep 2017	Mar 1998 – Sep 2017	Feb 1992 – Sep 2017	Feb 1993 – Sep 2017
No. of days of data	7,641	6,967	9,005	8,646
Minimum ( $\mu\text{S}/\text{cm}$ )	57	68	94	121
20 <sup>th</sup> percentile ( $\mu\text{S}/\text{cm}$ )	310	342	375	415
Median ( $\mu\text{S}/\text{cm}$ )	338	389	450	529
80 <sup>th</sup> percentile ( $\mu\text{S}/\text{cm}$ )	446	499	603	685
Maximum ( $\mu\text{S}/\text{cm}$ )	1,112	776	1,014	1,178
<i>Post-Commencement of Mining at MPO</i>				
Period of record	Oct 2017 – Oct 2025			
No. of days of data	2,707	2,949	2,949	2,949
Minimum ( $\mu\text{S}/\text{cm}$ )	108	146	161	175
20 <sup>th</sup> percentile ( $\mu\text{S}/\text{cm}$ )	316	360	394	438
Median ( $\mu\text{S}/\text{cm}$ )	369	431	515	573
80 <sup>th</sup> percentile ( $\mu\text{S}/\text{cm}$ )	513	579	731	796
Maximum ( $\mu\text{S}/\text{cm}$ )	999	784	1,135	1,512

\* Data source: <https://realtimedata.waternsw.com.au/> - accessed 27 October 2025



Grab sample records at the Hunter River at Aberdeen (GS 210056), Muswellbrook (GS 210002) and Denman (GS 210055) are summarised in **Table 8**. For comparative purposes, the ANZECC & ARMCANZ (2000) and ANZG (2018) default guideline values are also presented. It is noted that data is unavailable for the Hunter River at Aberdeen (GS 210056) from June 2003 and at the Hunter River at Denman (GS 210055) from February 2006.

The data presented in **Table 8** indicates that the water quality in the Hunter River is predominately circumneutral to alkaline, although slightly acidic conditions have been recorded historically at Muswellbrook (GS 210002) with a minimum value of pH 6.3 recorded. The EC values presented in **Table 8** are consistent with those presented in **Table 7**, with the median EC value increasing with distance downstream on the Hunter River.



**TABLE 8: HUNTER RIVER WATER QUALITY SUMMARY – WATERNSW GRAB SAMPLES**

Parameter (mg/L unless otherwise stated)	Default Guideline Value	Aberdeen (GS 210056)				Muswellbrook (GS 210002)				Denman (GS 210055)			
		Mar 1972 – June 2003				Apr 1971 – Sept 2025				June 1971 – Feb 2006			
		No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum
pH (pH Units)	6.5 – 8 <sup>‡</sup>	28	7.5	8.2	9.2	898	6.3	8.1	9.8	48	7.6	8.2	9.2
EC (µS/cm)	350 <sup>‡</sup>	50	110	360	4,630	1151	1	440	3,350	108	186	485	824
TSS	-	-	-	-	-	302	0.0	10	884	1	3	-	3
Turbidity (NTU <sup>^</sup> )	25 <sup>‡</sup>	26	1	2	39	1020	0.22	5	1754	48	1	5	76
TDS	2,000 <sup>*</sup>	-	-	-	-	33	133	162	215	-	-	-	-
Sulphate	1,000 <sup>*</sup>	8	14	27	38	259	2	27	140	11	22	30	62
Chloride	-	19	14	28	54	271	12	39	115	23	29	59	102
Calcium	-	8	25	33	59	268	10	37	77	12	27	38	54
Magnesium	-	8	15	20	29	268	4	25	48	12	19	25	37
Sodium	115 <sup>*</sup>	19	19	29	48	81	10	36	83	-	-	-	-
Potassium	-	8	0.8	0.9	1.7	81	1	2	7	-	-	-	-
Total Boron	0.94 <sup>†</sup>	1	0.14	-	0.14	68	<0.01	0.1	740	1	0.21	-	0.21
Total Iron	10 <sup>*</sup>	1	0.014	-	0.01	117	0.019	0.17	98	4	0.026	-	0.47
Total Manganese	1.9 <sup>†</sup>	-	-	-	-	65	<0.01	0.05	0.2	-	-	-	-
Total Zinc	0.008 <sup>†</sup>	1	0.006	-	0.006	23	0.003	0.03	0.15	2	0.002	-	0.018
Ammonia as N	0.9 <sup>†</sup>	102	<0.01	0.01	0.06	184	<0.01	0.01	0.35	131	<0.01	0.01	0.13
Nitrate	2.4 <sup>†</sup>	3	0.06	-	0.184	221	<0.01	0.3	7	3	0.42	-	0.52
Phosphorus	0.02 <sup>‡</sup>	16	0.02	0.04	0.06	704	<0.01	0.07	4.5	46	0.02	0.08	0.29

† ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems); ‡ ANZECC & ARMCANZ (2000) default guideline value for Upland Rivers in NSW; \* ANZECC & ARMCANZ (2000) default guideline value for primary industries.

<sup>^</sup> Nephelometric Turbidity Units.



A maximum total iron concentration of 98 mg/L was recorded at Muswellbrook (GS 210002) in 1989. The median and maximum total zinc concentrations recorded at Muswellbrook (GS 210002) and the maximum concentration recorded at Denman (GS 210055) exceeded the default guideline value for protection of aquatic ecosystems at the 95% level of species protection, while the median and maximum concentrations of phosphorus recorded at all sites exceeded the aquatic ecosystems default guideline value. It is noted that the majority of default guideline value exceedances recorded at the Hunter River at Muswellbrook (GS 210002) occurred prior to the commencement of mining activities at the MPO (October 2017).

### 2.6.3 Site Specific Water Quality

#### 2.6.3.1 Hunter River and Muscle Creek

##### Physicochemical Properties

The pH, EC and TSS values recorded at the MACH monitored Hunter River monitoring sites and the Muscle Creek reference site are illustrated on **Graph 3** to **Graph 5** for the period of record. The cumulative rainfall residual<sup>4</sup> is also presented, calculated from SILO Point Data daily rainfall for a location in close proximity to MPO (refer **Map 3**). The cumulative rainfall residual was calculated for the period 2000 to 2025 to illustrate climatic trends over the monitoring period.

The data presented in **Graph 3** illustrates circumneutral to slightly alkaline pH conditions for sites on the Hunter River, with median values for all sites ranging between 7.6 and 8.1. The pH values recorded at the Muscle Creek reference site (W4) also indicate near-neutral to slightly alkaline conditions, ranging between pH 6.7 and pH 8.3. The pH values have been generally consistent over the period of record, with no discernible change in trend evident following the commencement of mining activities at the MPO.

The data presented in **Graph 4** shows that the EC values recorded at Hunter River monitoring sites prior to 2020 ranged between 180  $\mu\text{S}/\text{cm}$  to 880  $\mu\text{S}/\text{cm}$ , with both the maximum and minimum EC values recorded at upstream reference site W1. Post-2020 the EC values recorded at Hunter River monitoring sites ranged from 167  $\mu\text{S}/\text{cm}$  to 1146  $\mu\text{S}/\text{cm}$ .

Lower and less variable EC values tend to be recorded in the Hunter River downstream of Glenbawn Dam during below average rainfall periods when flows in the Hunter River are mainly due to release of relatively fresh water from Glenbawn Dam. Increases in the Hunter River EC during above average rainfall periods are considered to reflect flushing of accumulated salts in tributary streams and low volumes of release from Glenbawn Dam (Zhang et. al., 2016).

The EC values recorded at reference site W4 on Muscle Creek have been mostly higher than that of the Hunter River monitoring sites, ranging from 106  $\mu\text{S}/\text{cm}$  to 5,580  $\mu\text{S}/\text{cm}$  over the period of record. The EC values recorded at W4 on Muscle Creek tend to decline during periods of below average rainfall and increase during periods of above average rainfall. This is considered to reflect a higher EC groundwater contribution to Muscle Creek during periods of above average rainfall.

An increasing trend in EC values was recorded at reference site W4 on Muscle Creek from early 2020 to mid-2023 which, in combination with a reduction in release from Glenbawn Dam to the Hunter River<sup>5</sup> (i.e. reduced dilution), likely contributed to increased EC values recorded at monitoring sites W15 and W17 on the Hunter River, located downstream of Muscle Creek, during this period.

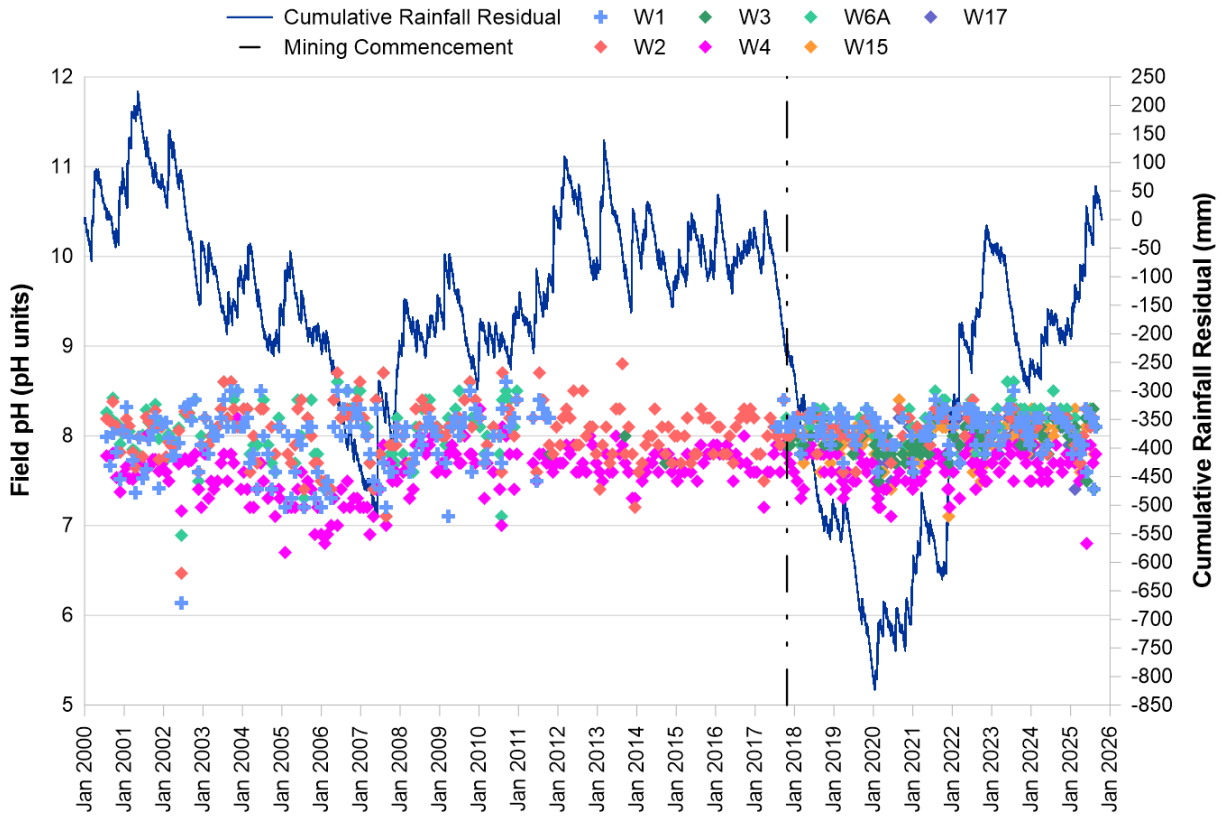
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<sup>4</sup> The cumulative rainfall residual was calculated as the cumulative deviation from the average daily rainfall where positive (upward) slope in the plot indicates periods of above average rainfall and negative (downward) slope indicates periods of below average rainfall.

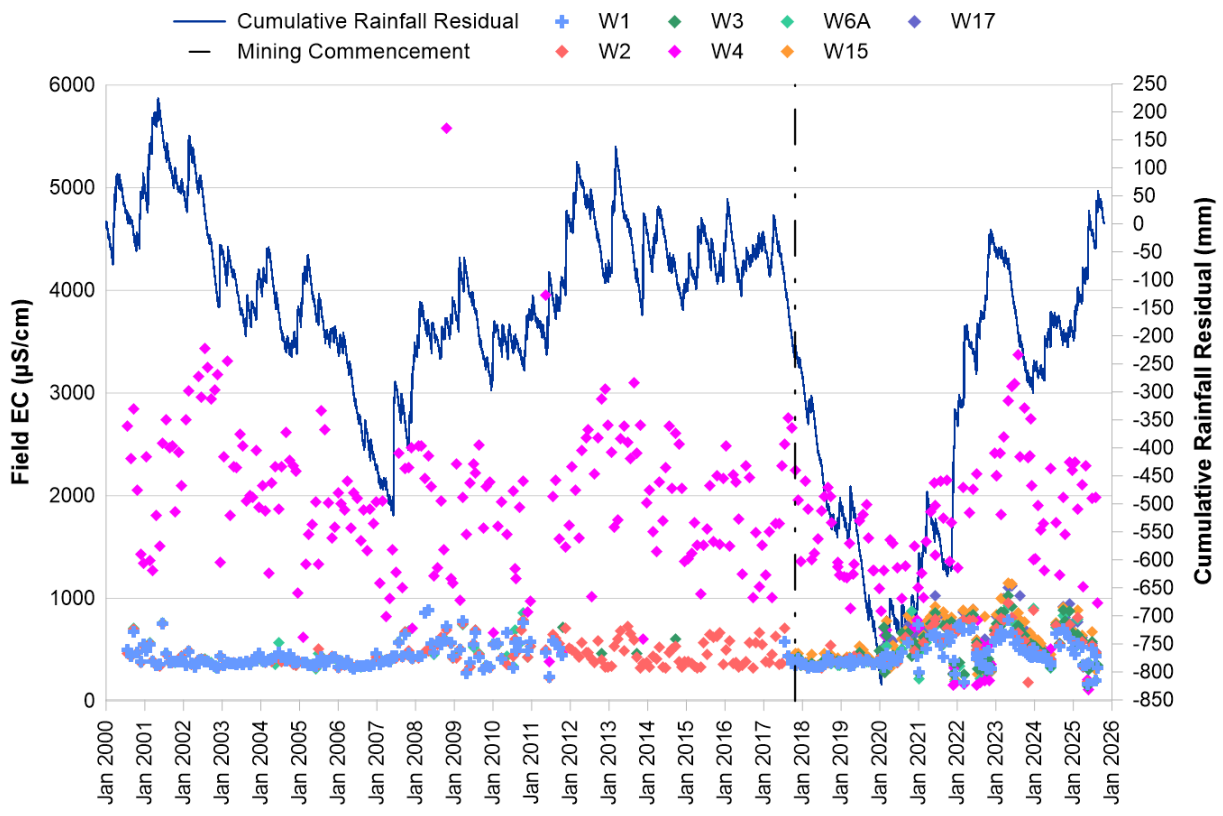
<sup>5</sup> Based on Hunter River streamflow records and Glenbawn Dam releases (accessed from WaterNSW on 9 October 2025), annual streamflow for 2023 was the lowest recorded since 2020.



**GRAPH 3: HUNTER RIVER AND MUSCLE CREEK – FIELD pH**



**GRAPH 4: HUNTER RIVER AND MUSCLE CREEK – FIELD EC**



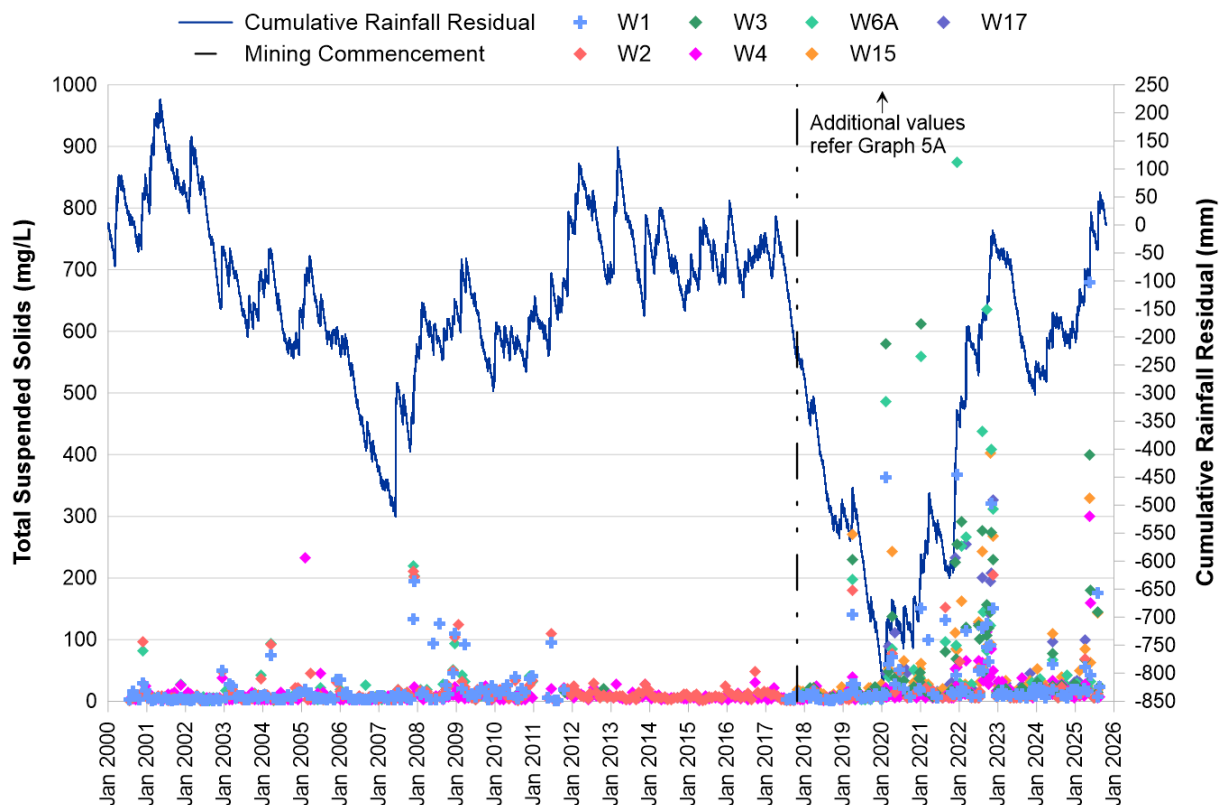


As illustrated in **Graph 4**, similarly elevated EC values were recorded at W2 and W6A between 2008 and 2010 (prior to the commencement of mining activities at the MPO) as were recorded from 2020 (post the commencement of mining activities at the MPO). Records of EC are not available for W15 prior to 2017 and W17 prior to 2020, however, it is noted that the maximum EC value recorded at W15 in April 2023 (1,146  $\mu\text{S}/\text{cm}$ ) was only slightly higher than the maximum EC value of 1,112  $\mu\text{S}/\text{cm}$  recorded historically at the WaterNSW Hunter River gauging station located downstream of Glenbawn Dam (GS210015) and upstream of the MPO. It is noted that no controlled discharge from the MPO has been undertaken to date and MPO sediment dam overflow events which occurred in December 2021 and March 2022 were of minor magnitude (refer **Section 2.7.3**).

The data presented in **Graph 5** indicates that TSS concentrations recorded at sites in the Hunter River prior to 2018 were typically less than 50 mg/L, with a maximum concentration of 232 mg/L recorded at W4 in 2005. The TSS concentrations have tended to increase during periods of above average rainfall that followed a prolonged period of below average rainfall (first flush effects). From 2020 to 2022, elevated concentrations of TSS were recorded at times at all Hunter River sites, with a maximum of 3,550 mg/L TSS recorded at monitoring site W15 in mid-January 2020 (refer **Graph 5A**). This elevated concentration was recorded following high rainfall which occurred immediately post a significant and prolonged below average rainfall period. It is noted that MPO sediment dam overflow events which occurred in December 2021 and March 2022 were of minor magnitude (refer **Section 2.7.3**).

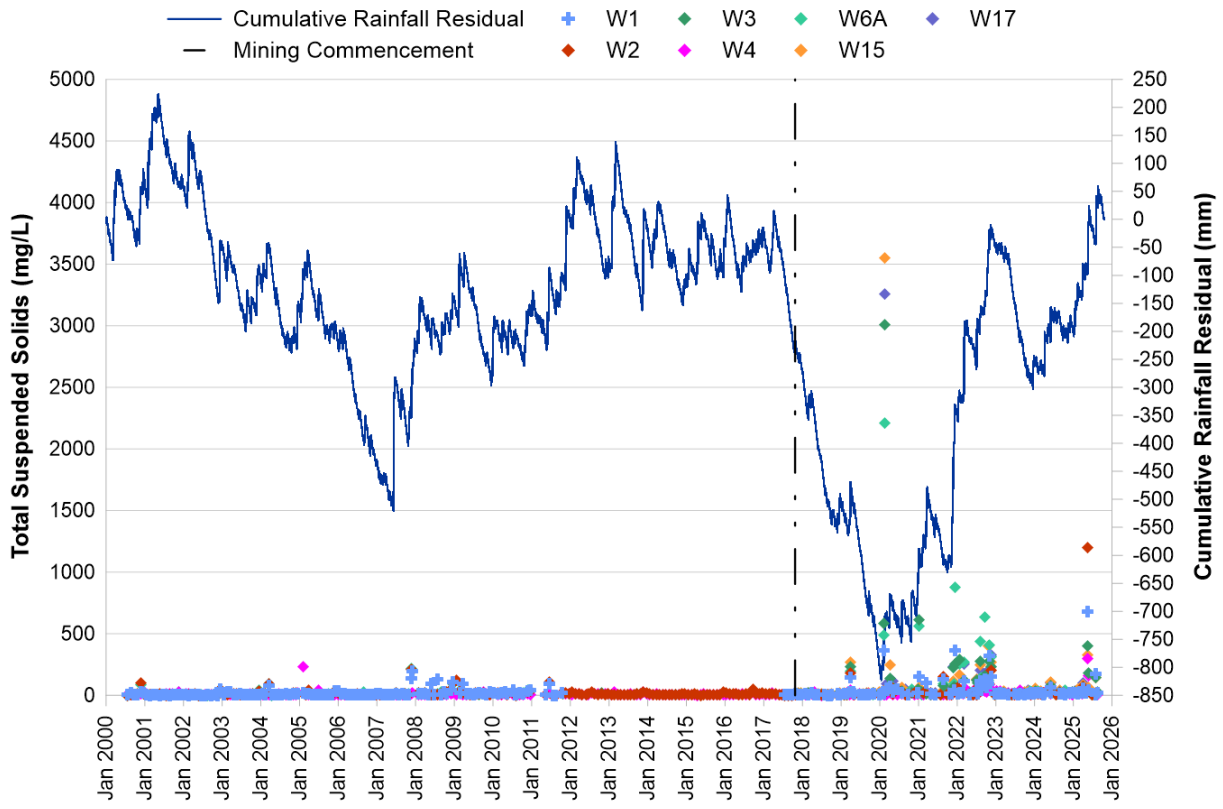
Concentrations of TSS declined in 2023 during a period of below average rainfall, with some increases recorded at times of above average rainfall from 2024 to 2025. It is noted that the 2025 maximum TSS concentrations were recorded at upstream reference sites W1 and W2.

**GRAPH 5: HUNTER RIVER AND MUSCLE CREEK – TSS**





**GRAPH 5A: HUNTER RIVER AND MUSCLE CREEK – TSS**



Total Metals

Summary statistics of monitored total metals for monitoring sites on the Hunter River and Muscle Creek are presented in **Appendix A** in comparison to the ANZG (2018) default guideline values for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems).

The water quality summary statistics presented in **Appendix A** indicate that the median concentrations of total arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, silver and zinc were close to or below the limit of detection at the majority of sites. Total aluminium concentrations typically exceeded the ANZG (2018) default guideline value while some exceedances of the ANZG (2018) default guideline values for total chromium, copper, nickel, strontium and zinc were recorded at several sites, including upstream reference site W1 on the Hunter River. Maximum total iron concentrations of 10.4 mg/L and 15.5 mg/L were recorded at monitoring sites W1 and W6A respectively.

Concentrations of total metals recorded at downstream monitoring site W15 on the Hunter River were generally within the range of concentrations recorded at upstream reference site W1 on the Hunter River.

Summary

Based on the monitored water quality data for the period of record, it is considered that the MPO activities have had no discernible impact on the Hunter River water quality within the vicinity of the MPO.

**2.6.3.2 Sandy Creek**

Physicochemical Properties

The pH, EC and TSS values recorded at the MACH monitored Sandy Creek monitoring sites (W11 and W12) and local tributaries that discharge to Sandy Creek (W13 and W16) are illustrated on **Graph 6** to **Graph 8** for the period of record.



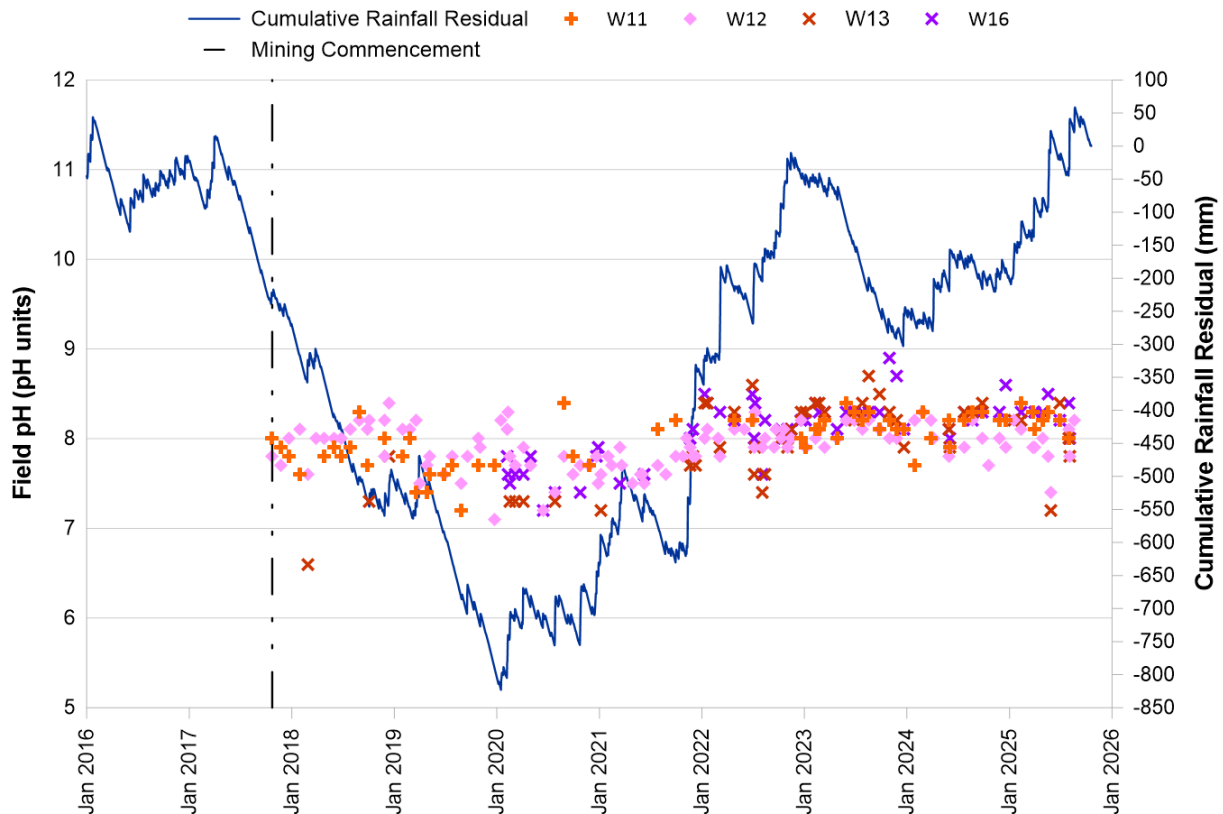
The data presented in **Graph 6** illustrates near-neutral to slightly alkaline pH conditions for sites on Sandy Creek and local tributaries, with median values for all sites ranging between pH 7.9 and pH 8.2. A slightly increasing trend in pH was recorded from late 2021 during a period of above average rainfall.

The data presented in **Graph 7** shows that recorded EC values have been highly variable over the period of record, with values ranging from 81 to 12,090  $\mu\text{S}/\text{cm}$ . Groundwater levels at monitoring site MPBH7 (refer **Map 4**), adjacent to Sandy Creek and screened within alluvial sediments, have been recorded as shallow as 1.8 metres (m) below ground level indicating likely surface water-groundwater connectivity at this location. The EC values recorded at monitoring bore MPBH7 from 2020, located adjacent to monitoring site W16 on a tributary of Sandy Creek, ranged between 9,970 and 14,450  $\mu\text{S}/\text{cm}$ . As such, it is considered that groundwater contribution to Sandy Creek and associated tributaries likely results in elevated surface water EC values at times.

The TSS concentrations presented in **Graph 8**, recorded at Sandy Creek monitoring sites (W11 and W12), indicate that TSS concentrations have been variable over the period of record ranging from 1 mg/L to 860 mg/L. The TSS concentrations recorded at local tributaries that discharge to Sandy Creek (W13 and W16) have ranged from 6 mg/L to 6,830 mg/L (refer **Graph 8** and **Graph 8A**). Elevated TSS concentrations have been recorded following prolonged below average rainfall conditions when samples were collected from shallow pools rather than flowing surface water. Elevated TSS concentrations have also been recorded during high rainfall events, likely due to first flush effects. The TSS value of 6,830 mg/L recorded at monitoring site W13 in 2018 was an outlier, with the sample collected from a very shallow pool. For the remainder of the monitoring period, TSS concentrations were recorded below 224 mg/L at W13.

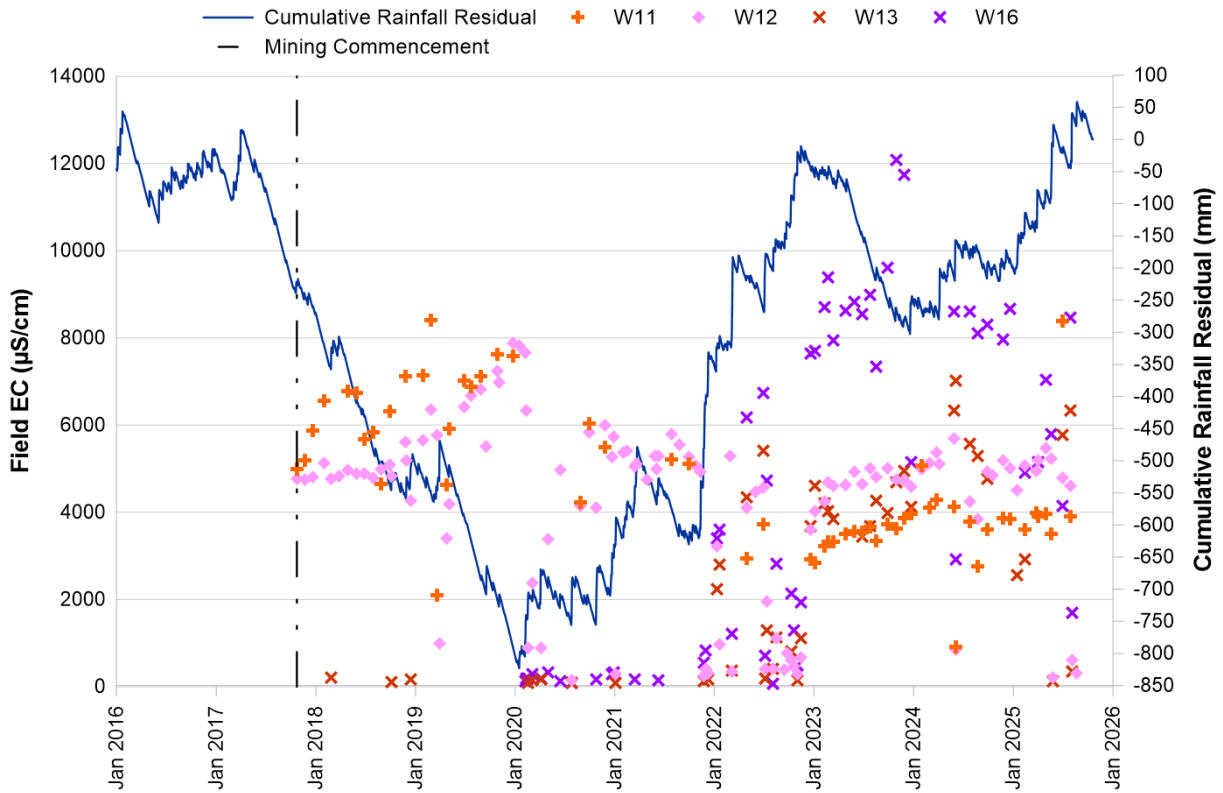
Based on the monitoring data recorded to date, it is considered that pH, EC and TSS are naturally elevated at times in the Sandy Creek catchment, with elevated values unlikely related to MPO activities.

**GRAPH 6: SANDY CREEK – pH**

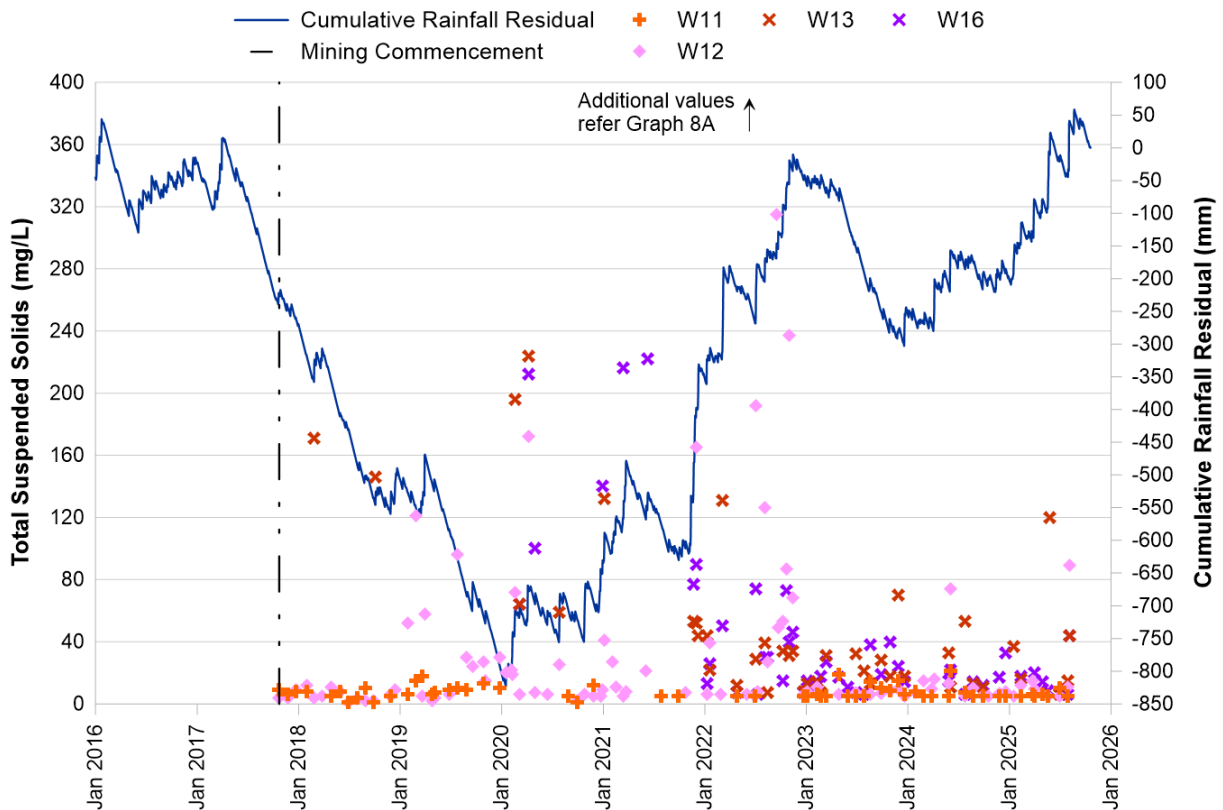




**GRAPH 7: SANDY CREEK – FIELD EC**

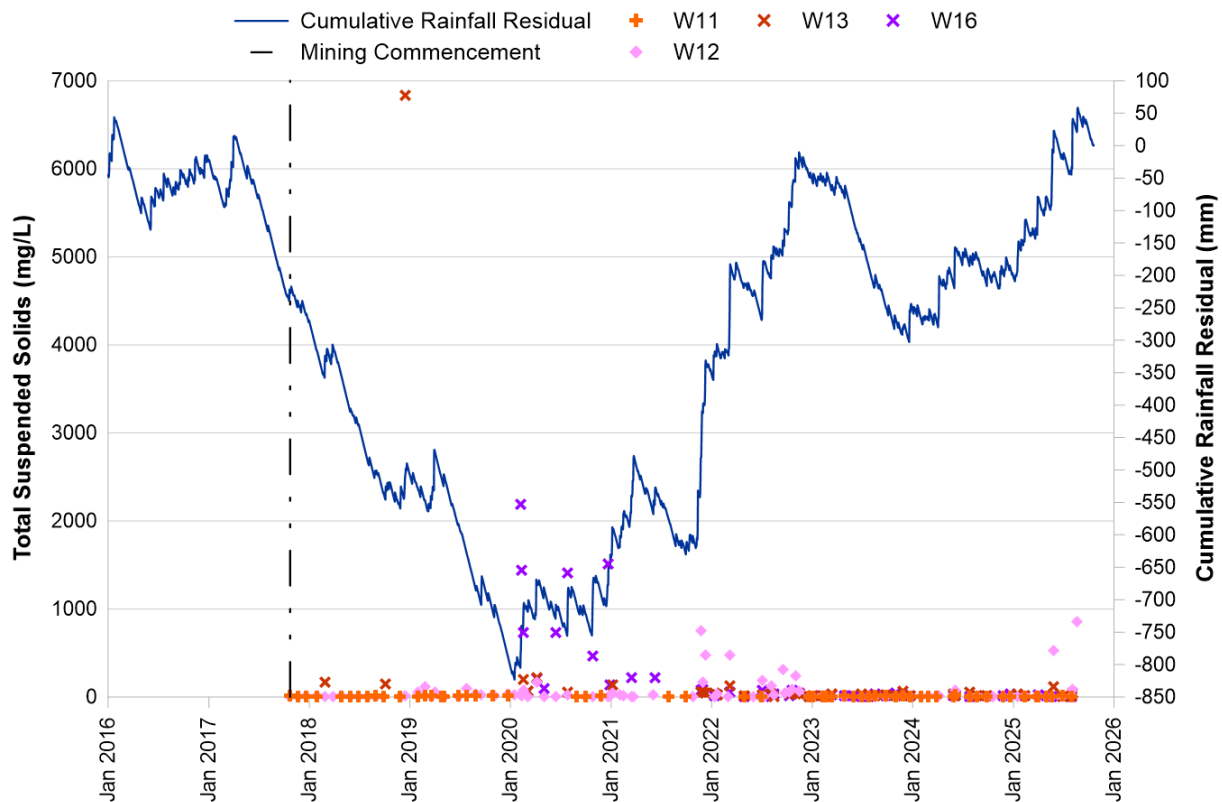


**GRAPH 8: SANDY CREEK – TSS**





**GRAPH 8A: SANDY CREEK – TSS**



Total Metals

Summary statistics of monitored total metals for sites on Sandy Creek and its tributaries are presented in **Appendix A2** in comparison to the ANZG (2018) default guideline values for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems).

The water quality summary statistics presented in **Appendix A2** indicate that total metal concentrations have tended to increase from W11 (upstream) to W12 (downstream) on Sandy Creek. It is noted, however, that access to W11 has been restricted at times resulting in less samples collected at W11 than at W12. Some exceedances of the ANZG (2018) default guideline values for total copper and total zinc were recorded at W11, while some exceedances of the ANZG (2018) default guideline values for total aluminium, chromium, copper, lead, nickel and zinc were recorded at W12.

Few total metal records are available for monitoring site W16, located on a tributary of Sandy Creek, however, the available data indicates exceedances of the ANZG (2018) default guideline values for total aluminium, chromium, copper, lead, nickel and zinc. The maximum concentrations of total metals recorded at monitoring site W16 occurred in early February 2020. A maximum total aluminium concentration of 87.7 mg/L and total iron concentration of 84.6 mg/L were recorded at monitoring site W16 at this time, occurring during a period of above average rainfall following a prolonged and significant below average rainfall period. Field records indicate that monitoring site W16 was dry prior to the February 2020 sampling event and that elevated concentrations of TSS containing colloidal clay particles were present at the time of sampling. It is noted that the Fines Emplacement Area and associated Environment Dam 2 (ED2) are located upstream of monitoring site W16, however, no discharge / overflow occurred from these storages prior to or during February 2020 (MACH Energy, 2021).

Summary

Based on the monitored water quality data for the period of record, it is considered that the MPO activities have had no discernible impact on the water quality of Sandy Creek within the vicinity of the MPO.

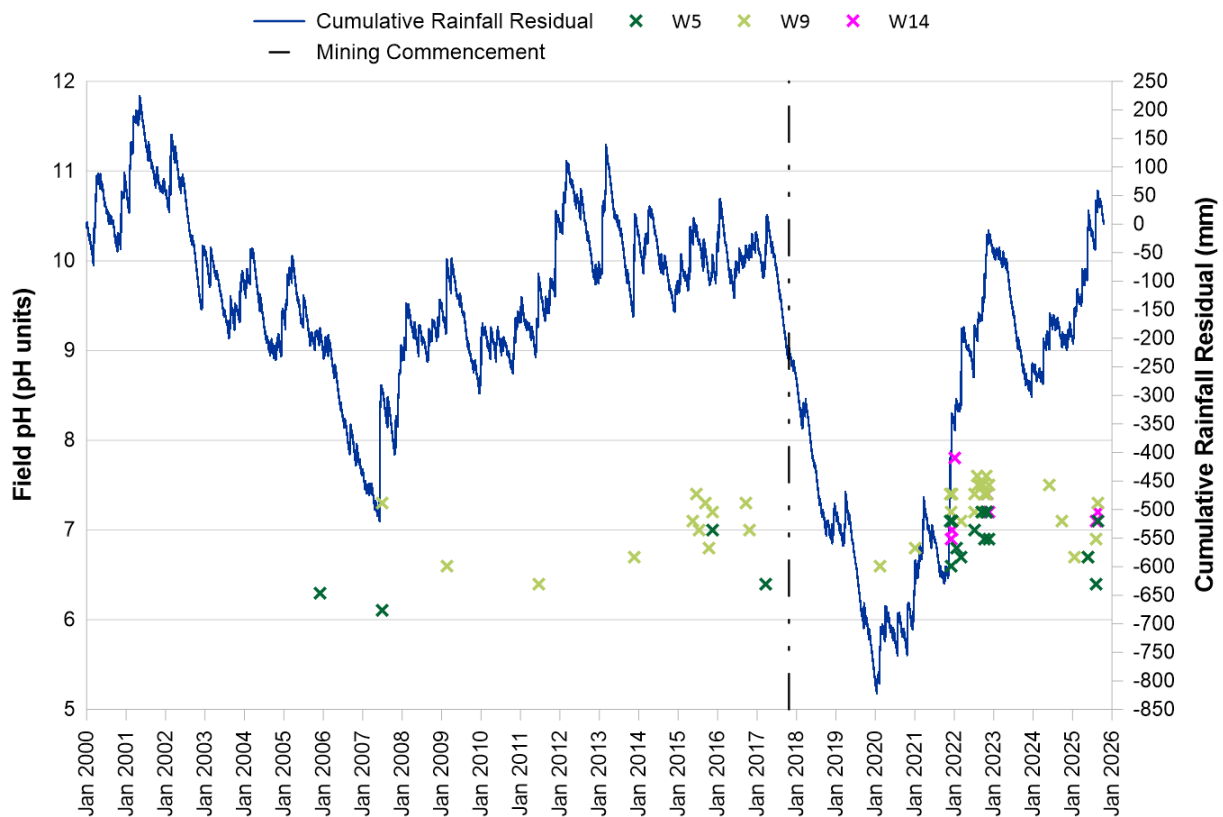


### 2.6.3.3 Unnamed Tributaries of the Hunter River

#### Physicochemical Properties

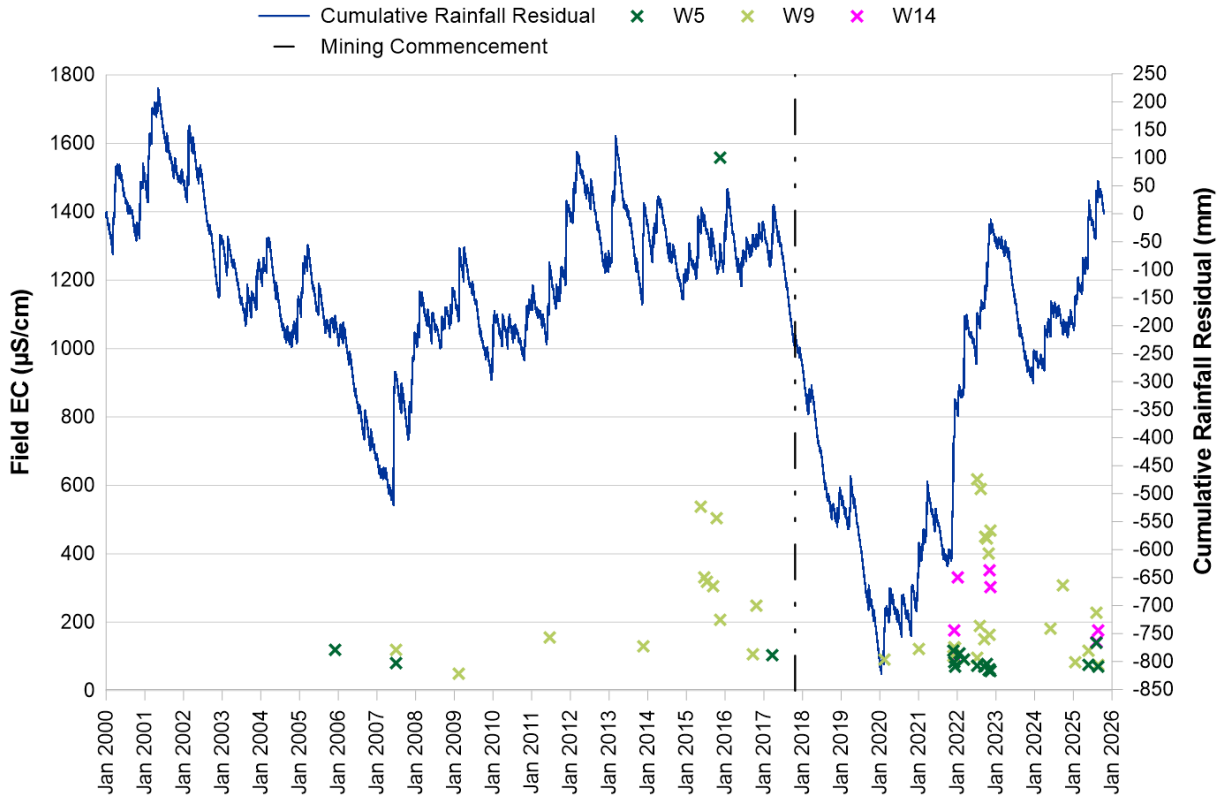
The pH, EC and TSS values recorded at W5, W9 and W14 located on unnamed tributaries are shown on **Graph 9** to **Graph 11** for the period of record. The monitoring data shows that the pH recorded in unnamed tributaries within and adjacent to the MPO has ranged from slightly acidic to slightly alkaline. The EC values have been recorded predominately below 700  $\mu\text{S}/\text{cm}$  with negligible indication of a change in trend recorded following the commencement of MPO activities. Consistent with that recorded at other local tributary sites, elevated TSS concentrations have been recorded following prolonged below average rainfall conditions when samples were collected from shallow pools rather than flowing surface water. There is negligible indication of a change in trend in TSS concentrations recorded following the commencement of MPO activities.

**GRAPH 9: UNNAMED TRIBUTARIES OF THE HUNTER RIVER – pH**

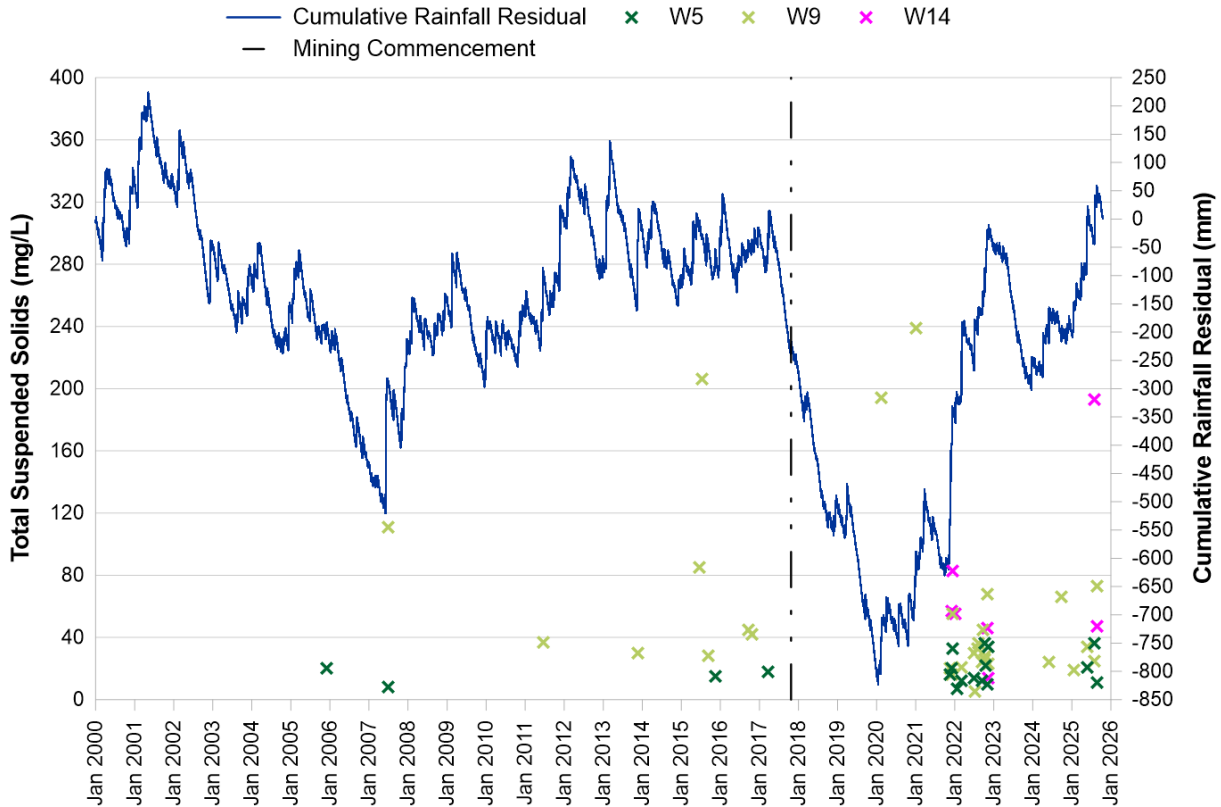




**GRAPH 10: UNNAMED TRIBUTARIES OF THE HUNTER RIVER – FIELD EC**



**GRAPH 11: UNNAMED TRIBUTARIES OF THE HUNTER RIVER – TSS**





## Total Metals

Summary statistics of constituents monitored at W5, W9 and W14 located on unnamed tributaries of the Hunter River are presented in **Appendix A3** in comparison to the ANZG (2018) default guideline values for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems).

Due to the ephemeral nature of these drainage lines (refer **Section 2.5.1**), few total metal records are available for each site. Consistent with monitoring records for reference site W4 on Muscle Creek, the concentrations of total aluminium, chromium, copper and zinc were elevated at times, at some or all of the sites, in comparison to the ANZG (2018) default guideline values.

## Summary

Based on the monitored water quality data for the period of record to date, it is considered that the MPO activities have had no discernible impact on the water quality of unnamed tributaries within or adjacent to the MPO.

## **2.7 Site Storages Water Quality**

### 2.7.1 Monitoring Program

The water quality of MPO site storages is monitored monthly where sufficient water volume permits. Sediment dams are also monitored daily during discharge / overflow events and for five days thereafter (MACH, 2025).

The locations of a subset of site storages, the monitoring results of which are discussed further in **Section 2.7.2**, are shown in **Map 5**. The storages shown in **Map 5** are those which have the potential to overflow to the downstream receiving environment and for which water quality monitoring records are available.

### 2.7.2 Water Quality Summary

As discussed in **Section 2.3.3**, several storages at the MPO were constructed for the primary function of managing site runoff. Water quality summaries for storages where overflow would report off-site are presented in **Table 9** and **Table 10**. It is noted that MACH manages the inventory of all storages in order to reduce the potential for uncontrolled discharge or overflow.

These water quality records reflect the characteristics of mine site water quality, rather than the water quality of controlled discharge which would be undertaken in accordance with the HRSTS and EPL 20850 (noting that no controlled discharge has been undertaken to date).

The data presented in **Table 9** indicates that the pH of the site storages is predominantly alkaline.

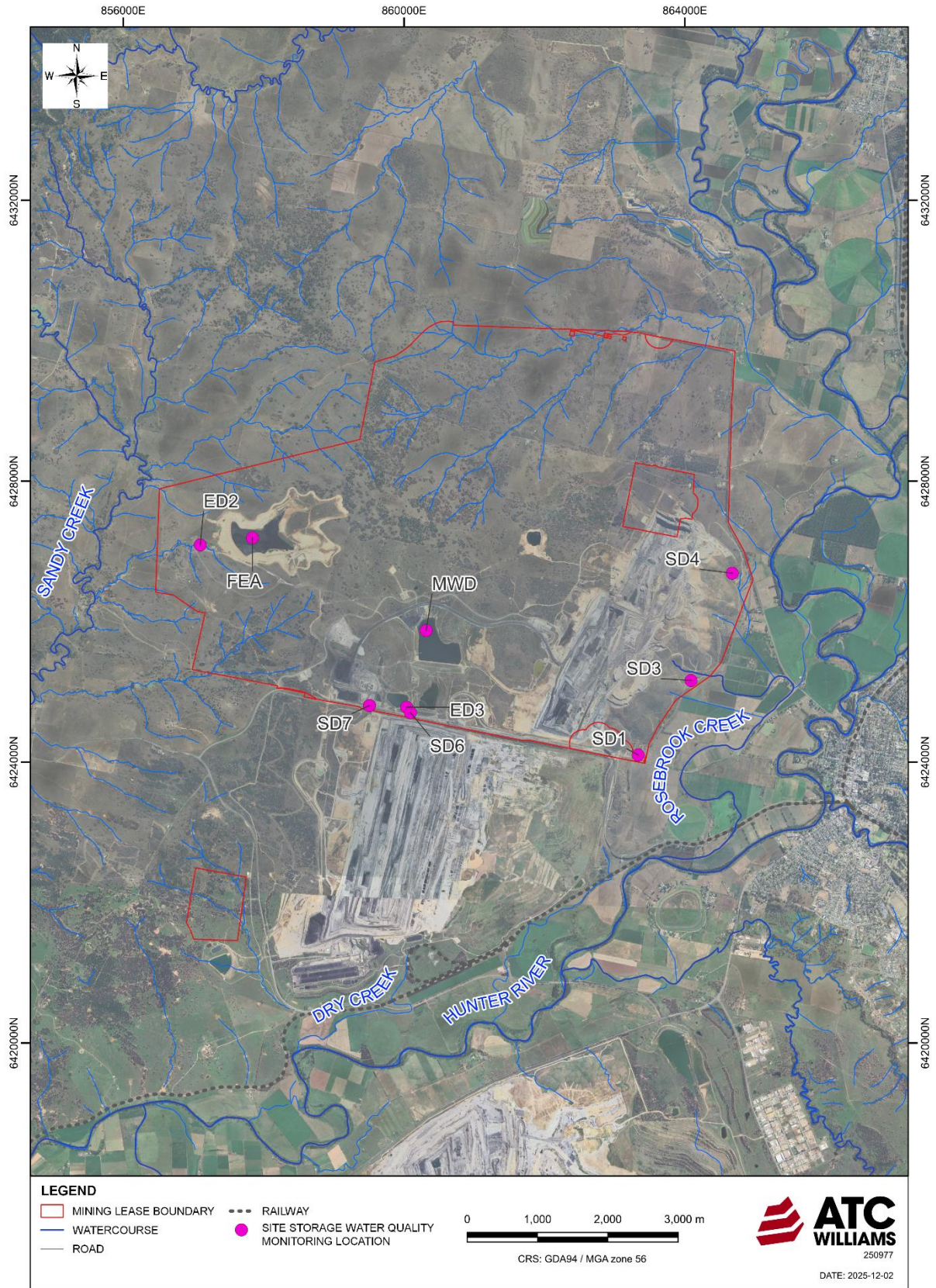
The median EC values of sediment dams SD1, SD3 and SD4 ranged between 614  $\mu\text{S}/\text{cm}$  and 730  $\mu\text{S}/\text{cm}$  while the median EC of environment dams ED2 and ED3 were 4,790  $\mu\text{S}/\text{cm}$  and 1,641  $\mu\text{S}/\text{cm}$  respectively. Higher EC values recorded at ED2, which is actively pumped to the mine water management system, are considered reflective of seepage from the Fines Emplacement Area which reports to a subsurface seepage collection system at the toe of the embankment and ED2. The EC values recorded at the MWD ranged from 385  $\mu\text{S}/\text{cm}$  and 3,630  $\mu\text{S}/\text{cm}$ , with a median EC of 2,040  $\mu\text{S}/\text{cm}$ .

Median TSS ranged from 5 mg/L at the MWD to 84 mg/L at SD3, while oil and grease concentrations were typically low (5 mg/L or less), except for SD4 and the Fines Emplacement Area where maximum values of 7 mg/L and 9 mg/L were recorded, respectively.

The data in **Table 10** shows that the median concentrations of total cadmium, lead, mercury, selenium and silver were at or below the limited of detection in the majority of site storages. Detectable concentrations of some metals including total aluminium, barium, copper, iron, manganese and strontium were recorded in the site storages. It is noted that the concentrations of total metals recorded in the site storages were generally within the range of total metals concentrations recorded in adjacent surface water systems (refer **Section 2.6.3** and **Appendix A**).



# MAP 5: SUBSET OF SITE WATER STORAGES WITH WATER QUALITY MONITORING





**TABLE 9: SITE STORAGES WATER QUALITY SUMMARY – PHYSICOCHEMICAL PARAMETERS**

Storage	Variable	Field pH	Field EC (µS/cm)	TSS (mg/L)	TDS (mg/L)	Turbidity (NTU)	Oil & Grease (mg/L)
ED2	No. of Samples	75	75	75	75	65	64
	Minimum	8.1	410	5	388	2.3	1
	Median	8.7	4,790	11	2,790	10	2
	Maximum	9.3	5,630	360	3,400	550	5
ED3	No. of Samples	84	84	84	84	77	73
	Minimum	8.1	304	1	174	1	1
	Median	8.6	1,641	9	1,035	7.5	2
	Maximum	9.6	3,640	307	2,520	1,000	5
SD1	No. of Samples	79	79	79	79	69	68
	Minimum	7.5	296	5	220	1.2	1
	Median	8.7	614	42	403	95	2
	Maximum	9.7	1,988	1,230	1,190	2,000	5
SD3	No. of Samples	56	56	56	56	49	48
	Minimum	7.7	368	5	288	18	1
	Median	8.6	660	84	418	111	2
	Maximum	9.6	1,422	1,340	888	2,500	5
SD4	No. of Samples	35	35	35	35	29	29
	Minimum	7.4	403	5	320	16	1
	Median	8.7	730	53	448	85	2
	Maximum	9.6	1,363	518	784	800	7
MWD	No. of Samples	72	72	71	71	61	60
	Minimum	7.9	385	5	214	0.8	1
	Median	8.6	2,040	5	1,200	2.6	2
	Maximum	8.9	3,630	36	2,700	55	5
FEA	No. of Samples	74	75	75	75	65	64
	Minimum	7.5	374	<5	170	1.9	<1
	Median	8.5	2,460	9	1,590	7.8	2
	Maximum	9.2	4,420	108	3,200	180	9

SD = Sediment Dam. MWD = Mine Water Dam. ED = Environment Dam. FEA = Fines Emplacement Area.



**TABLE 10: SITE STORAGES WATER QUALITY SUMMARY – TOTAL METALS**

Parameter (mg/L)	ED2				ED3				MWD			
	No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum
Aluminium	20	0.05	0.30	0.78	24	0.02	0.11	1.84	37	<0.01	0.05	0.3
Arsenic	20	<0.001	<0.001	0.002	24	<0.001	<0.001	0.003	37	<0.001	<0.001	0.003
Barium	20	0.051	0.09	0.154	24	0.012	0.06	0.086	37	0.035	0.055	0.077
Boron	20	0.06	0.12	0.15	24	0.05	0.075	0.13	37	0.05	0.07	0.12
Cadmium	20	<0.0001	<0.0001	0.0002	23	<0.0001	<0.0001	0.0002	37	<0.0001	<0.0001	0.0002
Chromium	20	<0.001	<0.001	0.002	23	<0.001	<0.001	0.002	37	<0.001	<0.001	<0.001
Copper	20	<0.001	<0.001	0.002	24	<0.001	<0.001	0.004	37	<0.001	<0.001	0.003
Iron	20	<0.05	0.25	0.89	24	<0.05	0.14	2.17	37	<0.05	<0.05	1.44
Lead	20	<0.001	<0.001	<0.001	23	<0.001	<0.001	<0.001	37	<0.001	<0.001	<0.001
Lithium	20	0.024	0.057	0.08	24	0.004	0.024	0.052	37	0.002	0.031	0.057
Manganese	20	0.006	0.017	0.065	24	0.005	0.023	0.082	37	0.007	0.039	0.462
Mercury	19	<0.0001	<0.0001	<0.0001	20	<0.0001	<0.0001	<0.0001	36	<0.0001	<0.0001	<0.0001
Nickel	20	0.003	0.004	0.006	24	<0.001	0.003	0.006	37	<0.001	0.008	0.026
Selenium	20	<0.01	<0.01	<0.01	23	<0.01	<0.01	<0.01	37	<0.01	<0.01	<0.01
Silver	18	<0.001	<0.001	0.005	20	<0.001	<0.001	0.005	36	<0.001	<0.001	0.005
Strontium	20	0.228	0.938	1.4	24	0.53	1.46	4.5	37	0.308	2.55	4.51
Zinc	20	<0.005	<0.005	0.016	24	<0.005	<0.005	0.01	37	<0.005	<0.005	0.081



**TABLE 10 (CONT.): SITE STORAGES WATER QUALITY SUMMARY – TOTAL METALS**

Parameter (mg/L)	SD1				SD3				SD4			
	No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum
Aluminium	18	0.18	1.42	6.4	14	0.34	2.01	15.9	11	0.24	2.46	10.8
Arsenic	18	<0.001	<0.001	0.003	14	<0.001	<0.001	0.004	11	<0.001	<0.001	0.005
Barium	18	0.04	0.084	0.12	14	0.034	0.103	0.164	11	0.05	0.11	0.15
Boron	18	<0.05	<0.05	0.08	14	<0.05	<0.05	0.09	11	0.05	0.07	0.13
Cadmium	18	<0.0001	<0.0001	0.0002	13	<0.0001	<0.0001	0.0002	11	<0.0001	<0.0001	0.0002
Chromium	18	<0.001	<0.001	0.005	14	<0.001	0.0015	0.01	11	<0.001	0.002	0.008
Copper	18	<0.001	0.0035	0.011	14	<0.001	0.006	0.014	11	0.002	0.006	0.018
Iron	18	0.1	1.21	5.36	14	0.18	1.32	9.3	11	0.28	1.3	9.65
Lead	18	<0.001	<0.001	0.004	14	<0.001	<0.001	0.007	11	<0.001	<0.001	0.007
Lithium	18	<0.001	0.0025	0.01	13	<0.001	0.002	0.01	11	<0.001	0.003	0.01
Manganese	18	0.006	0.03	0.084	14	<0.01	0.05	0.14	11	0.011	0.039	0.306
Mercury	17	<0.0001	<0.0001	<0.0001	13	<0.0001	<0.0001	<0.0001	11	<0.0001	<0.0001	<0.0001
Nickel	18	<0.001	0.003	0.006	14	<0.001	0.004	0.011	11	0.002	0.004	0.014
Selenium	18	<0.01	<0.01	<0.01	13	<0.01	<0.01	<0.01	11	<0.01	<0.01	<0.01
Silver	17	<0.001	<0.001	<0.001	13	<0.001	<0.001	0.005	11	<0.001	<0.001	0.005
Strontium	18	0.26	0.42	0.8	14	0.28	0.47	0.91	11	0.298	0.45	0.768
Zinc	18	<0.005	<0.005	0.02	14	0.005	0.008	0.025	11	<0.005	0.008	0.033



**TABLE 10 (CONT.): SITE STORAGES WATER QUALITY SUMMARY – TOTAL METALS**

Parameter (mg/L)	Fines Emplacement Area			
	No. of Samples	Minimum	Median	Maximum
Aluminium	20	<0.01	0.06	0.31
Arsenic	21	<0.001	0.002	0.011
Barium	21	0.028	0.049	0.084
Boron	21	0.05	0.1	0.16
Cadmium	21	<0.0001	<0.0001	0.0002
Chromium	21	<0.001	<0.001	0.002
Copper	21	<0.001	<0.001	0.002
Iron	21	<0.05	<0.05	0.27
Lead	21	<0.001	<0.001	<0.001
Lithium	21	0.003	0.045	0.08
Manganese	21	0.007	0.092	0.46
Mercury	20	<0.0001	<0.0001	<0.0001
Nickel	21	0.002	0.006	0.037
Selenium	21	<0.01	<0.01	0.013
Silver	19	<0.001	<0.001	0.005
Strontium	21	0.37	2.26	8.2
Zinc	21	<0.005	<0.005	0.007



### 2.7.3 Controlled Discharge / Overflow

As stated in **Section 2.3.2**, no controlled discharge has been undertaken from the MPO to date (MACH, 2025).

Overflow from some water storages, such as sediment dams and environment dams, may occur when rainfall exceeds the design event. Overflow from dams SD1, SD4, SD6, SD7, ED2 and TSB2 (since decommissioned) has occurred. The details of the overflow events that have occurred prior to November 2025 are summarised in **Table 11**.

**TABLE 11: SUMMARY OF OVERFLOW EVENTS**

Storage	Date of Overflow Event	Approximate Spill Duration (hours)	Estimated Spill Volume (ML): Less Than
SD1	8-9 March 2022	27	10
SD4	9 December 2021	10	0.5
	8 March 2022	23	1.15
	21 October 2022	20.5	-
SD6	9 December 2021	4	0.15
	8 March 2022	4	0.15
SD7	9 December 2021	4	0.29
	8 March 2022	4	0.3
ED2	9 December 2021	6	0.3
TSB2	8 March 2022	6	0.3

As shown in **Table 11** the estimated overflow volume during these periods was negligible in comparison to the median recorded flow rate of the Hunter River at Muswellbrook (337 ML/day, refer **Table 5**).

**Table 12** presents the water quality of overflow from the dams monitored during the overflow events.

The water quality data presented in **Table 12** illustrates that:

- the pH values of overflows from all storages ranged from pH 7.2 to pH 8.6;
- the average EC of the overflow from SD1 and SD4 was 327  $\mu\text{S/cm}$ , with a maximum EC value of 420  $\mu\text{S/cm}$  recorded;
- the average EC of overflow from SD6 and SD7 was 248  $\mu\text{S/cm}$ , with a maximum EC value of 371  $\mu\text{S/cm}$  recorded;
- the EC value of the overflow from ED2 was 1,000  $\mu\text{S/cm}$  (recorded in December 2021); and
- TSS concentrations in excess of 1,100 mg/L were recorded for specific overflow events from SD6, SD7 and TSB2.

The EC values recorded at upstream reference site W11 on Sandy Creek, located upstream of ED2, have ranged between approximately 2,000 and 8,400  $\mu\text{S/cm}$  (refer **Graph 7**). As such, the EC value of 1,000  $\mu\text{S/cm}$  recorded in overflow from ED2 was less than that of EC values recorded naturally in Sandy Creek within the vicinity of the MPO.

The TSS concentration of the upstream reaches of the Hunter River has been generally less than 500 mg/L, based on median values recorded for Hunter River monitoring sites W1 and W2. The TSS concentrations recorded for SD6, SD7 (December 2021 overflow event) and TSB2 (March 2022 overflow event) were elevated in comparison. A flow rate of 17,835 ML/day was recorded at the Hunter River at Muswellbrook (GS 210002) at the time of the December 2021 overflow event and 9,532 ML/day at the time of the March 2022 overflow event. Considering the Hunter River at Muswellbrook (GS 210002) flow rates at the time of overflow and the comparatively lower overflow volumes, it is likely that significant dilution occurred. As such, it is considered that impacts to the water quality of the Hunter River were likely negligible.



**TABLE 12: WATER QUALITY RESULTS FROM OVERFLOW EVENTS**

Storage	Parameter	Water Quality for Overflow Events		
		December 2021	March 2022	October 2022
SD1	pH	No Overflow	7.2	No Overflow
	TSS (mg/L)		21	
	Turbidity		Slightly turbid	
	Electrical Conductivity (µS/cm)		147	
SD4	pH	7.8	7.8	7.6
	TSS (mg/L)	17	222	124
	Turbidity	30 NTU	Slightly turbid	Slightly turbid
	Electrical Conductivity (µS/cm)	420	390	350
SD6	pH	8.6	8	No Overflow
	TSS (mg/L)	2,230	352	
	Turbidity	Slightly Turbid	Slightly turbid	
	Electrical Conductivity (µS/cm)	164	199	
SD7	pH	8.5	8.3	No Overflow
	TSS (mg/L)	1,180	414	
	Turbidity	Slightly Turbid	Slightly turbid	
	Electrical Conductivity (µS/cm)	258	371	
ED2	pH	8.2	No Overflow	No Overflow
	TSS (mg/L)	15		
	Turbidity	21 NTU		
	Electrical Conductivity (µS/cm)	1,000		
TSB2	pH	No Overflow	7.9	No Overflow
	TSS (mg/L)		1,640	
	Turbidity		Slightly turbid	
	Electrical Conductivity (µS/cm)		254	



### 3 SURFACE WATER MANAGEMENT SYSTEM

#### 3.1 Overview

Surface water management and monitoring at the MPO is undertaken in accordance with the Site Water Balance, Erosion and Sediment Control Plan, Surface Water Management and Monitoring Plan and Groundwater Management Plan, which are components of the Water Management Plan (MACH, 2025).

The Site Water Balance describes the water management system at the MPO, tracks site water storage requirements through current water balance model predictions and outlines the on-site responsibilities with regard to the site water balance (e.g. monitoring of site water usage).

The Erosion and Sediment Control Plan outlines the erosion and sediment control strategy for the MPO including erosion and sediment control measures, design criteria and provisions for reporting on the effectiveness and performance of the system.

The Surface Water Management Plan outlines:

- the existing surface water conditions and baseline data relevant to the MPO;
- surface water impact assessment criteria and triggers;
- surface water management measures; and
- surface water monitoring.

The Surface Water Management and Monitoring Plan includes:

- trigger action response protocols for downstream impacts to flow, water quality and stream health;
- processes to deal with complaints related to surface water;
- the surface water impact investigation protocol; and
- a response plan, in the event that an investigation conclusively attributes an adverse impact on an existing surface water supply user to the MPO.

The proposed modified MPO site water management system would be designed and managed to:

- protect the integrity of local and regional water resources;
- separate runoff from undisturbed, rehabilitated and mining-affected areas;
- operate reliably throughout the life of the MPO in all seasonal conditions, including both extended high and low rainfall periods;
- provide water for use in mining operations that is of sufficient volume and quality;
- prioritise the re-use of water on-site; and
- manage groundwater inflows and CHPP process water on-site.

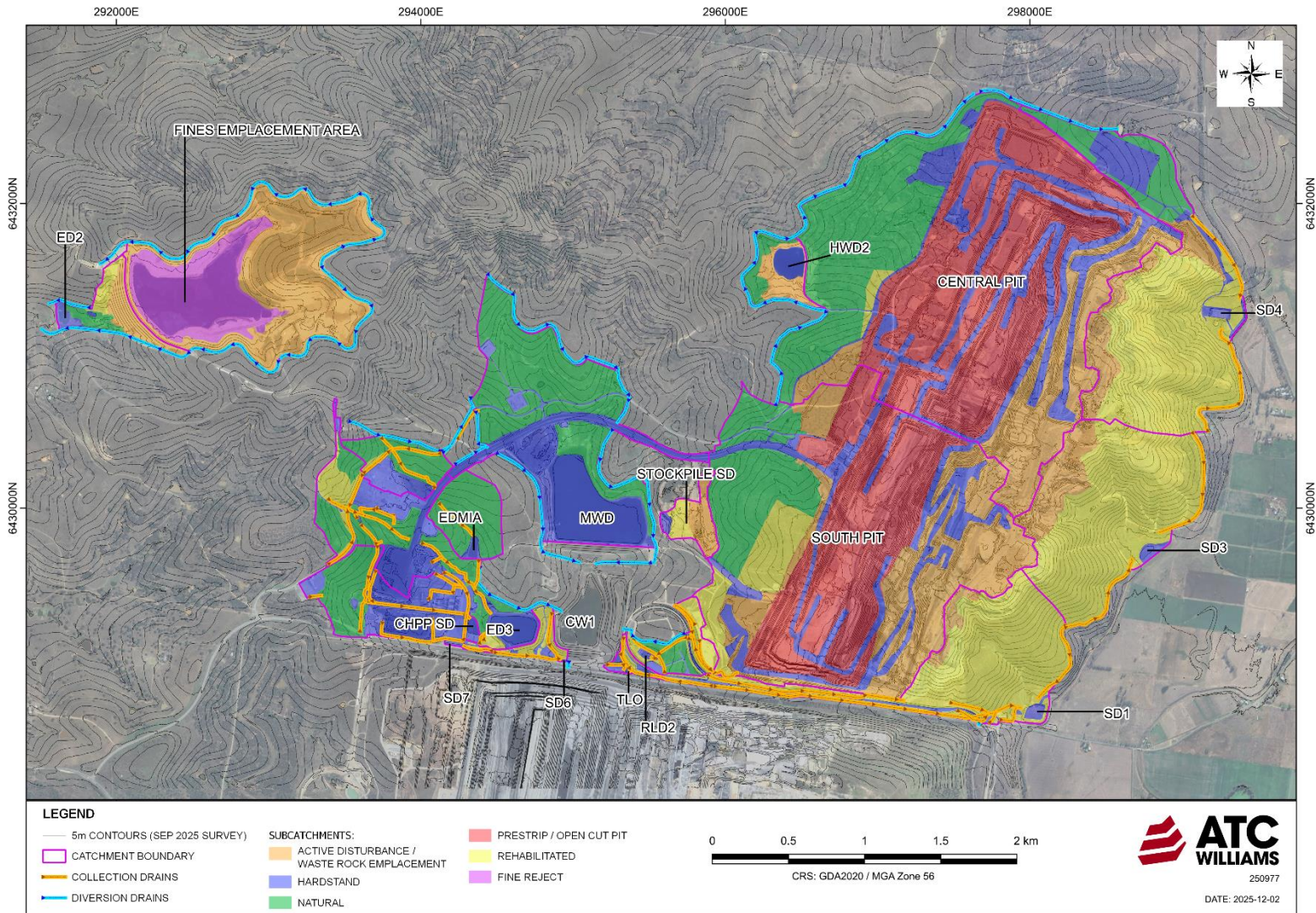
#### 3.2 Existing Operational Water Management System

The existing MPO water management system is comprised of a number of dams, the South Pit and Central Pit and the Fines Emplacement Area, together with a system of pumped transfers and drains. The locations of the site water storages and associated sub-catchment boundaries as of September 2025 are shown in **Map 6**.

**Schematic 1** shows a representation of the existing and proposed modified MPO water management system storages and inter-linkages.

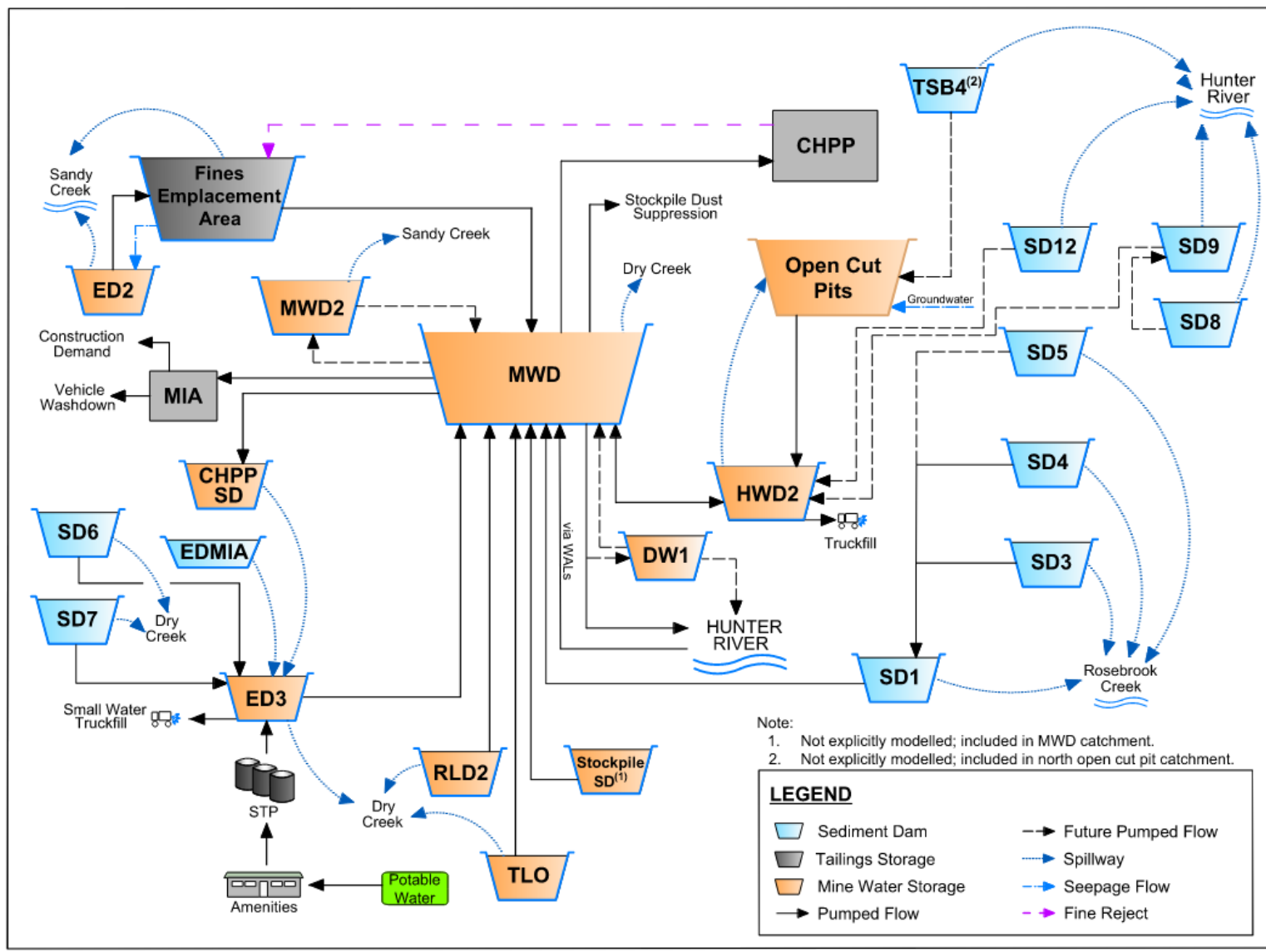


MAP 6: EXISTING SURFACE WATER MANAGEMENT SYSTEM AND SUB-CATCHMENT BOUNDARIES (SEPTEMBER 2025)





**SCHEMATIC 1: EXISTING AND PROPOSED WATER MANAGEMENT SYSTEM SCHEMATIC**





A series of diversion drains capture runoff from upslope natural areas, conveying undisturbed area runoff to the downstream receiving environment (refer **Map 6**). Disturbed area runoff is captured and conveyed by collection drains to mine water management storages.

The MWD is the main water storage on-site and supplies makeup water requirements to the CHPP. Thickened fine reject slurry produced by the CHPP is pumped to the Fines Emplacement Area and water liberated from the settling of fine reject, together with Fines Emplacement Area rainfall runoff, are recovered via pumping to the MWD. The water management system allows water in all dams to ultimately report to the MWD. Inflows to the MWD also include water pumped from the Hunter River extracted via WALs during periods of reduced on-site water inventory. Outflows include water supply for the CHPP, construction, vehicle washdown and dust suppression.

The MPO sources water from the Hunter River via an approved water supply pipeline. Potable water for all facilities is trucked to site and stored in on-site storage tanks.

As stated in **Section 2.3.2**, licensed discharge from the MWD to the Hunter River would be undertaken in accordance with the HRSTS and EPL 20850. An interim water discharge pipeline has been constructed to enable discharge from the MWD to the Hunter River prior to the construction of a discharge dam (referred to as DW1). DW1 and its associated pipeline are approved for construction under the development consent for the Bengalla Continuation Project (SSD-5170), with Development Consent DA 92/97 and Development Consent SSD 10418 authorising the use of the discharge system.

Environment Dam ED2 is located downstream of the Fines Emplacement Area and serves as a sediment dam during construction of the Fines Emplacement Area embankment raises. Seepage from the Fines Emplacement Area is captured in a subsurface seepage collection system located at the toe of the Fines Emplacement Area embankment and returned to the Fines Emplacement Area (ATCW, 2018).

Effluent from site amenities is treated on-site via a STP. Treated effluent is directed to ED3 and subsequently to the mine water management system. A truckfill point at ED3 is used to supply a small portion of the dust suppression demand.

Groundwater inflow to South Pit and Central Pit is currently dewatered and directed to High Wall Dam 2 (HWD2). A truckfill point at HWD2 is used to supply water for haul road dust suppression with transfer from HWD2 to the MWD available during periods of high in-pit water inventory.

Environment Dam Mine Infrastructure Area (EDMIA) is a sediment dam that can supplement site water supply via pumping to the MWD during periods of low water inventory. The RLD2 and Train Load Out (TLO) Dam are located adjacent to the rail loop to capture potentially mine affected runoff from this area with water pumped back to ED3.

Sediment dams SD1, SD3, SD4, SD6 and SD7 were designed in accordance with Landcom (2004) and DECC (2008), with water pumped to the mine water management system for reuse.

The Stockpile Sediment Dam (Stockpile SD) is a small sediment dam that captures runoff from a soil stockpile area, with water pumped to the MWD for reuse.

**Table 13** lists the design criteria and capacity of existing water management system storages.



**TABLE 13: EXISTING WATER MANAGEMENT SYSTEM STORAGES**

Storage*	Classification	Design Criterion	Spill Level Capacity (ML)
ED2	Mine water storage	Managed to reduce spill risk	25.5
ED3	Mine water storage	1% AEP spill risk	302
EDMIA	Sediment dam	Nominal size – spills to ED3	17.1
CHPPSD	Mine water storage	Nominal size – spills to ED3	8.2
HWD2	Mine water storage	Nominal size – spills to Central Pit	219.4
MWD	Mine water storage	Allow for buffer to supply site demands	2,067
SD1	Sediment dam	Landcom (2004) & DECC (2008)	51.6
SD3	Sediment dam	Landcom (2004) & DECC (2008)	40.2
SD4	Sediment dam	Landcom (2004) & DECC (2008)	34.7
SD6	Sediment dam	Landcom (2004) & DECC (2008)	0.3
SD7	Sediment dam	Landcom (2004) & DECC (2008)	0.75
RLD2	Mine water storage	1% AEP spill risk	9.5
TLO dam	Mine water storage	Managed to reduce spill risk	1.5
Stockpile SD	Mine water storage	Managed to reduce spill risk	<0.1

\* In addition to these water storages, operational water is managed in the open cut pit(s) and the Fines Emplacement Area.

### 3.3 Proposed Operational Water Management System

The proposed operational water management system would comprise a combination of existing storages and additional storages as necessary to manage runoff from mine disturbed areas and divert undisturbed area runoff away from the open cut pit areas. The proposed operational water management system and sub-catchment boundaries at Year 2027, Year 2029 and Year 2031 are shown in **Map 7** to **Map 9**. The proposed water management system storages and inter-linkages are shown in **Schematic 1**.

As the mine development progresses, existing diversion drains would be realigned and additional diversion drains constructed to divert runoff from undisturbed areas offsite. Progressive rehabilitation of waste rock emplacement areas to the east of the open cut pit areas would be undertaken.

Additional sediment dams (SD5, SD8 and SD9) are proposed to be constructed at the eastern boundary of the MPO to manage runoff from the expanded open cut pit and waste rock emplacement areas. An additional sediment dam (SD12) is proposed to be constructed adjacent to the western haul road, immediately to the west of HWD2, to manage runoff during construction and operation of the haul road. A temporary sediment basin (TSB4) is proposed to be constructed in the latter stages of the open cut pit expansion to manage sediment runoff during the pre-stripping period. Collection drains would be constructed to convey runoff from upstream areas disturbed by mining to the sediment dams. Detailed design of sediment dams SD5, SD8 and SD9 has been undertaken, with the design capacities listed in **Section 3.3.1**. Sediment dams SD12 and TSB4 have been conceptually sized as detailed in **Section 3.3.1**.

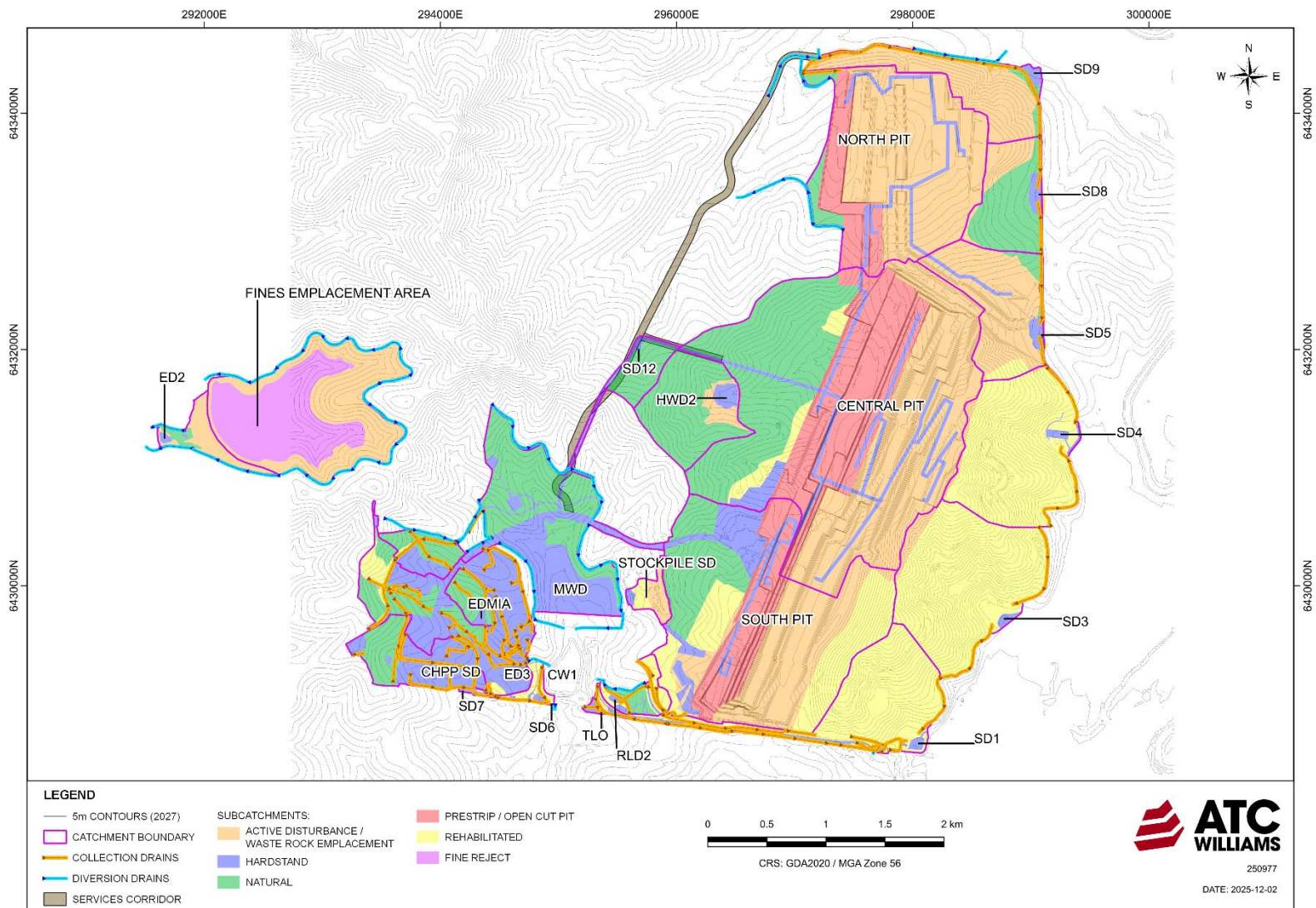
As the catchment area directed to SD1 and SD4 is expected to increase in size, enlargement of SD1 and SD4 would be required as detailed in **Section 3.3.1**.

An additional mine water dam (MWD2) is proposed to be commissioned early 2028 to provide for additional water storage and supply requirements.

The Fines Emplacement Area embankment would be raised in stages to provide additional storage capacity for emplacement of fine reject. Diversion drains and collection drains associated with the Fines Emplacement Area and ED2 would be subsequently realigned as the Fines Emplacement Area extent increases.

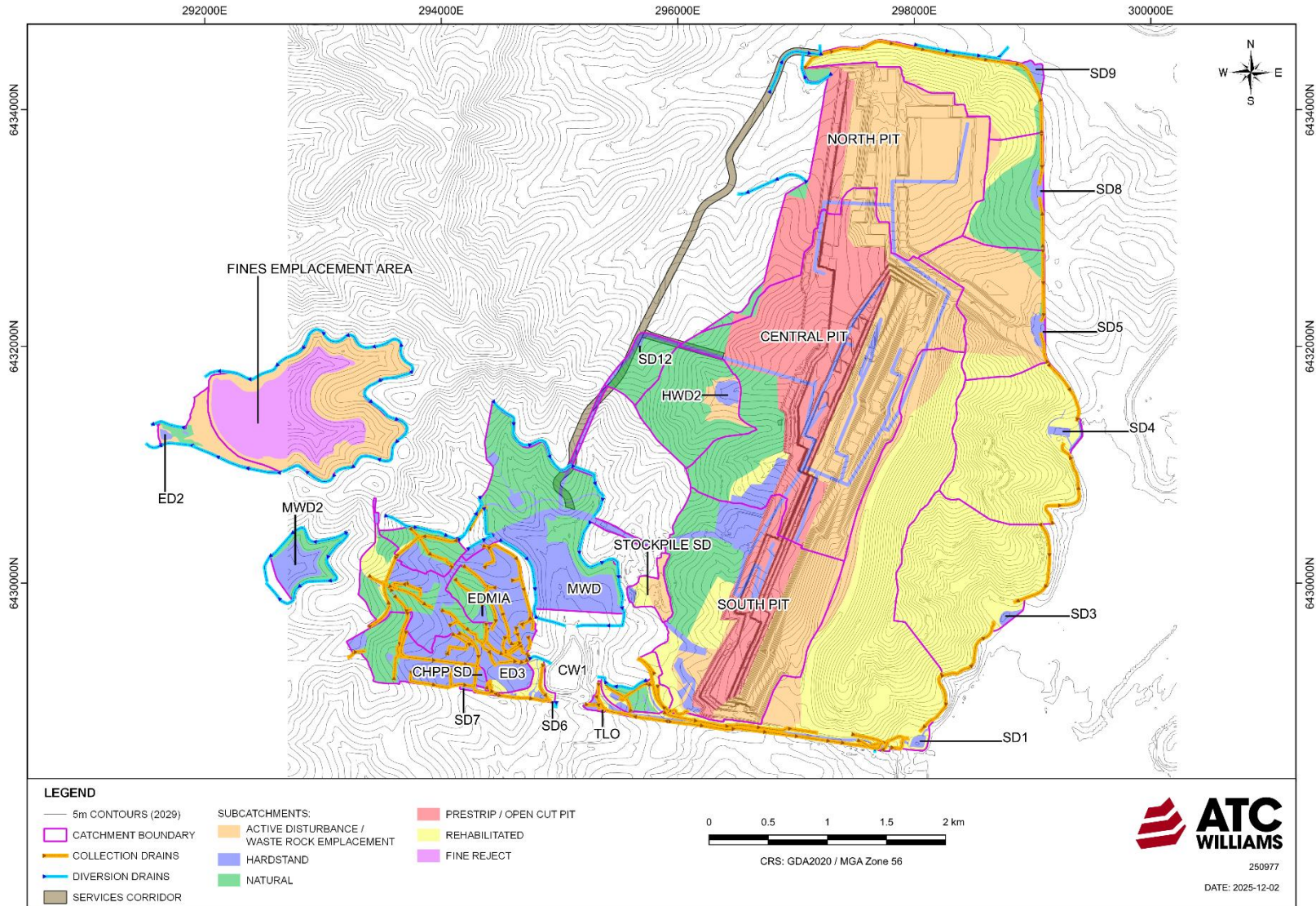


### MAP 7: YEAR 2027 PROPOSED WATER MANAGEMENT LAYOUT AND SUB-CATCHMENT BOUNDARIES



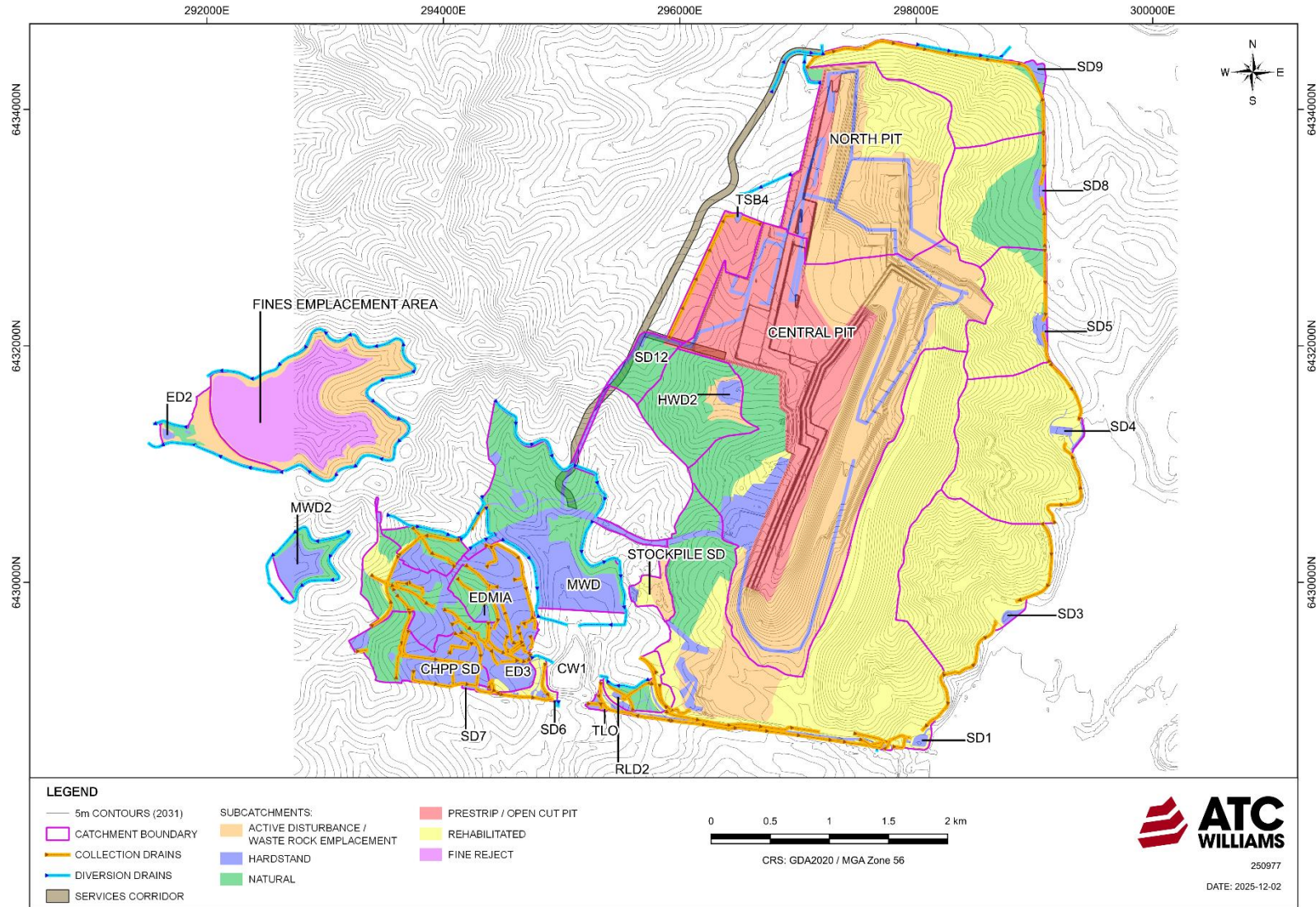


### MAP 8: YEAR 2029 PROPOSED WATER MANAGEMENT LAYOUT AND SUB-CATCHMENT BOUNDARIES





### MAP 9: YEAR 2031 PROPOSED WATER MANAGEMENT LAYOUT AND SUB-CATCHMENT BOUNDARIES





### 3.3.1 Sediment Dams

Sediment dams SD4 (enlargement), SD5, SD8 and SD9 are proposed to be commissioned in June 2026 with detailed design having been completed for these storages. The design capacity and pump rate for these storages are presented in **Table 14**.

The design capacity of SD4 (enlargement), SD5, SD8 and SD9 has been reviewed with consideration to the maximum catchment areas estimated to report to these storages during the life of the Modification. In addition, conceptual design of the proposed SD1 (enlargement), SD12 and TSB4 has been undertaken in accordance with the Landcom (2004) and DECC (2008) guidelines assuming the following design criteria:

- Type D or Type F sediment retention basin (10% or more of the soil materials are dispersive);
- sediment dams to be in place for 6-12 months (TSB4) or more than three years (SD1, SD4, SD5, SD8, SD9 and SD12);
- SD1, SD4, SD5, SD8, SD9 and SD12 - adequate settling zone capacity to capture runoff from a 90<sup>th</sup> percentile 5-day duration rainfall event (DECC, 2008) of 39.4 mm (average of Cessnock and Scone 5-day rainfall depths in Table 6.3a of Landcom, 2004);
- TSB4 - adequate settling zone capacity to capture runoff from an 80<sup>th</sup> percentile 5-day duration rainfall event (DECC, 2008) of 23.5 mm (average of Cessnock and Scone 5-day rainfall depths in Table 6.3a of Landcom, 2004);
- a volumetric runoff coefficient of 0.51 assuming soil hydrologic group C – Table F2 of Landcom (2004); and
- allowance for sediment storage zone capacity equal to 50% of the above calculated settling zone capacity.

A summary of estimated maximum catchment areas, recommended capacity and recommended pump rate of the sediment dams is provided in **Table 14**. The pump rate has been calculated based on the requirement that the sediment dams can be emptied within five days of filling, as recommended by Landcom (2004).

Note that as transfer would occur from SD3, SD4 and SD5 to SD1 and from SD8 to SD9 (refer **Schematic 1**), the recommended cumulative pump rate for SD1 and SD9 is presented in **Table 14**. Runoff captured in TSB4 would be pumped to the MWD via the Central Pit or North Pit, while runoff captured in SD12 would be pumped to HWD2.

As shown in **Table 14**, the design capacities and design pump rates of SD4 (enlargement), SD5, SD8 and SD9 are sufficient to manage sediment laden runoff from the maximum catchment area estimated to report to these storages over the life of the Modification.



**TABLE 14: CONCEPTUAL DESIGN OF PROPOSED SEDIMENT DAMS**

Sediment Dam:	SD1 (enlargement)	SD4 (enlargement)	SD5	SD8	SD9	SD12	TSB4
Planned / Recommended Commissioning Date	Jan 2028	Jun 2026	Jun 2026	Jun 2026	Jun 2026	Jun 2026	Jan 2030
Estimated Maximum Catchment Area (ha)	366	139	84	81	84	18.7	31.4
Settling Zone Volume (ML)	73	28	17	16	17	3.8	3.8
Sediment Zone Volume (ML)	37	14	8.4	8.1	8.4	1.9	1.9
Minimum Recommended Capacity (ML)	110	42	25	24	25	5.6	5.6
Minimum Recommended Pump Rate (L/s)	500	80	39	37	77	10	10
Design Capacity (ML)*	N/A	49	26	37	30	N/A	N/A
Design Pump Rate (L/s)*	N/A	80	80	80	120	N/A	N/A

Note: ha = hectares, L/s = litres per second, ML = megalitres.

\* Source: ATCW (2024).

### 3.3.2 Water Demand

The site water demands for the modified MPO comprise haul road dust suppression, stockpile dust suppression, vehicle washdown, construction and CHPP make-up requirements. The estimated water demands during the life of the modified MPO are detailed in **Section 4.2**.

### 3.3.3 Water Supply

Water would be supplied for site purposes from a number of sources during the life of the modified MPO, including (as available):

- open cut pit dewatering;
- internal runoff collection from the mine water management system;
- return water from the Fines Emplacement Area; and
- Hunter River supply.

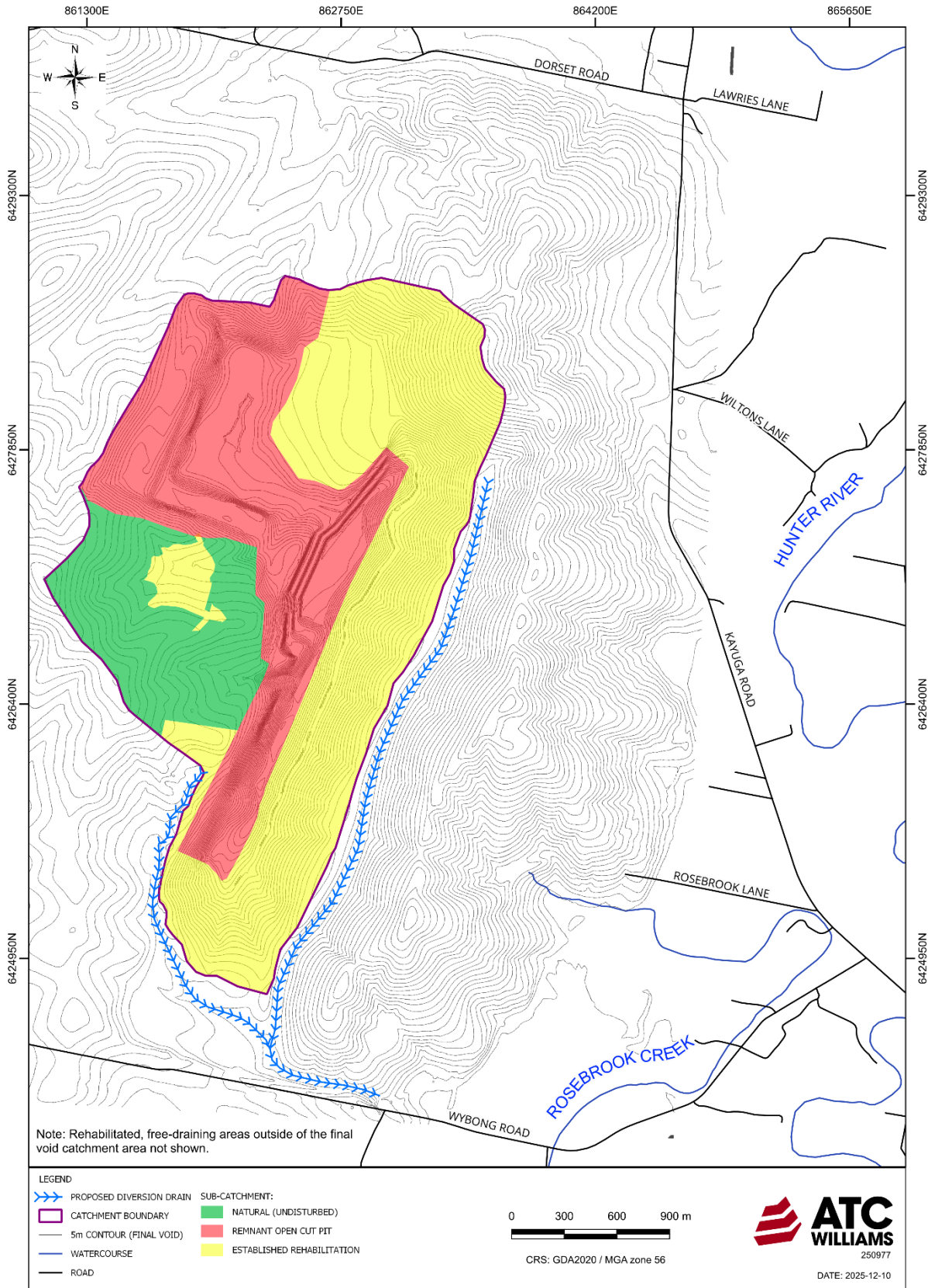
In addition, in order to reduce make-up water demand from the Hunter River over the life of the modified MPO, MACH may also source water from other external sources, such as excess mine water from the adjoining mines (i.e. Dartbrook and Bengalla Mines). Should this water sharing be undertaken, it would be subject to MACH and other relevant parties obtaining all necessary secondary approvals.

## 3.4 Proposed Final Landform

The proposed final void landform is illustrated in **Map 10**. Post-mining, all mining areas, except for the western pit face, would be regraded to a stable landform and revegetated. Permanent diversion drains would be constructed adjacent to the final void catchment to convey runoff from upstream areas away from the final void and divert runoff to existing surface water drainages.



# MAP 10: FINAL VOID WATER MANAGEMENT LAYOUT AND SUB-CATCHMENT BOUNDARIES





## 4 OPERATIONAL WATER AND SALT BALANCE MODELLING

### 4.1 Model Description

The operational water and salt balance model has been developed to simulate the storages and linkages shown in **Schematic 1**. The model has been developed using the GoldSim® simulation package. The model simulates the volume of water and salt mass held in and transferred between all simulated water storages. For each storage the model simulates:

$$\text{Change in Storage} = \text{Inflow} - \text{Outflow}$$

Where:

*Inflow* includes rainfall runoff, groundwater inflow (to the open cut pits), fine reject reclaim water (for the Fines Emplacement Area), water sourced from the Hunter River (for the MWDs) and all pumped inflows from other storages.

*Outflow* includes evaporation, spill, all pumped outflows to other storages or to a demand sink (e.g. haul road dust suppression) and controlled discharge via the HRSTS.

The model operates on an 8-hourly time step. Model simulations begin on 1 September 2025 and finish on 31 December 2032 (7.3 years). The model simulates 129 “realizations” derived using the historical daily climatic record from 1892 to 2020. The realizations were formed by ‘moving’ along the historical record one year at a time with the first realization comprising the first 7.3 years in the record, the second advancing by one year in the record, the third advancing by two years and so on. The start and end of the historical record is ‘linked’ so that additional realizations which included years from both the beginning and end of the historical record were combined to generate additional climatic realizations. Using this methodology 129, 7.3 year realizations of daily rainfall and evaporation were formulated for use in the model simulations.

The historical climate period adopted in the water balance model aligns with the Hunter River Integrated Quantity-Quality Model (IQQM) simulations which have been undertaken using climatic data from 1892 to 2020 to simulate available water determinations (AWDs) in the Hunter Valley as well as other key water supply parameters (refer **Section 4.2.6**). Although the period of climatic data from 2021 to 2024 is not simulated in the water balance model, due to the need to align with the IQQM simulations, the period of climatic data from 1892 to 2020 comprises a wide range of climatic events including high, low and median rainfall periods.

The results from all realizations are used to estimate the probability of key salt and water balance predictions.

### 4.2 Model Data and Assumptions

A summary of the data and key assumptions underpinning the model are provided in the sub-sections that follow.

#### 4.2.1 Rainfall Runoff Simulation and Catchment Areas

Rainfall runoff in the water balance model is simulated using the Australian Water Balance Model (AWBM) (Boughton, 2004). The AWBM is a nationally-recognised catchment-scale water balance model that estimates catchment yield (flow) from rainfall and evaporation.

AWBM simulation of flow from six different sub-catchment types was undertaken, namely: undisturbed (natural) areas, hardstand (for example, roads and infrastructure areas), prestrip and open cut pit, active disturbance (waste rock emplacement and other exposed areas), rehabilitated areas and fine rejects (i.e. Fines Emplacement Area). AWBM simulation of flow from each of the sub-catchment types was undertaken. Model AWBM parameters are summarised in **Table 15** below, adopted from literature based guideline values or experience with similar projects. Evaporation pan factors for rainfall runoff modelling were set to 1 for fine reject and hardstand areas and 0.85 for all other sub-catchment types based on experience with similar projects.

The fine reject sub-catchment was split into two sub-areas; wet beach (20% of the area) and dry beach (80% of the area) to allow for the different runoff rates expected.



**TABLE 15: MODEL AWBM PARAMETERS**

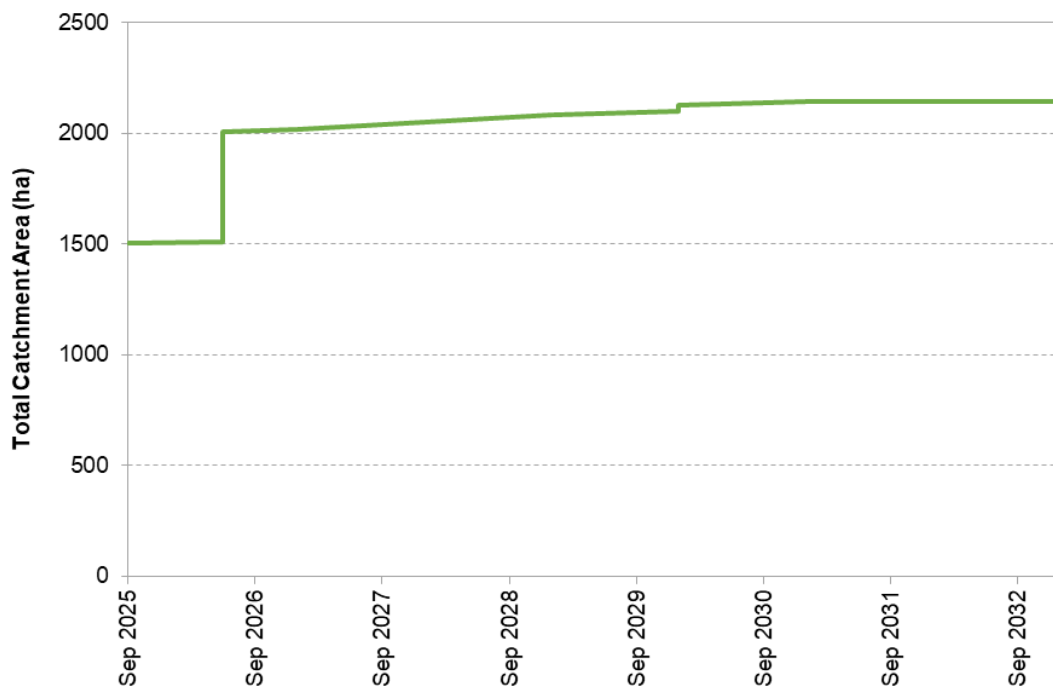
Parameter	Sub-catchment Type					
	Natural (Undisturbed)	Hardstand / Haul Roads	Open Cut Pit	Active Disturbance	Rehabilitated	Fine Rejects
C <sub>1</sub> (mm)	7.5	2	5	15	7.5	0
C <sub>2</sub> (mm)	76.2	10	70	50	76.2	5
C <sub>3</sub> (mm)	152.4	30	90	110	152.4	-
A <sub>1</sub>	0.134	0.333	0.2	0.1	0.134	0.2
A <sub>2</sub>	0.433	0.334	0.6	0.3	0.433	0.8
A <sub>3</sub>	0.433	0.333	0.2	0.6	0.433	-
K <sub>s</sub> (d <sup>-1</sup> )	0.2	0	0.1	0.5	0.3	0
BFI	0.22	0	0	0	0.22	0
K <sub>b</sub> (d <sup>-1</sup> )	0.861	-	-	-	0.861	-

For water surface areas, rainfall was assumed to add directly to the storage volume with no losses except for evaporation from the water surface.

Each modelled storage catchment area was divided into sub-catchment areas corresponding with the sub-catchment types in **Table 15**. Catchment and sub-catchment areas for the modelled storages were calculated from the current and proposed future plans (refer **Map 6** to **Map 9**).

**Graph 12** presents the estimated total catchment area reporting to the water management system over the life of the modified MPO. The catchment area was calculated in the model by linearly interpolating between the values derived from the current and proposed future plans. The total estimated catchment area was approximately 1500 ha as of September 2025 and is estimated to increase to approximately 2150 ha over the life of the modified MPO.

**GRAPH 12: MODELLED TOTAL CATCHMENT AREA VERSUS TIME**





#### 4.2.2 Evaporation from Storage Surfaces

Storage volumes simulated by the model are used to calculate storage surface area (i.e. water area) based on storage level-volume-area relationships for each water storage. Level-volume-area relationships were derived from as-built survey or estimated from design information supplied by MACH. For proposed sediment dams, level-volume-area relationships were estimated for the required storage capacity (refer **Table 14**).

The following pan factors were assumed in the estimation of evaporation from various water storage areas (as a multiplier on daily pan evaporation):

- Fines Emplacement Area - 1.1; due to the darker reject surface;
- Open Cut Pits - 0.8; due to shading effects and lower wind speed at depth; and
- All other storages - monthly values varying from 0.84 to 0.95 on the basis of values in McMahon et al. (2013) for Scone.

#### 4.2.3 CHPP Demand and Fine Reject Disposal

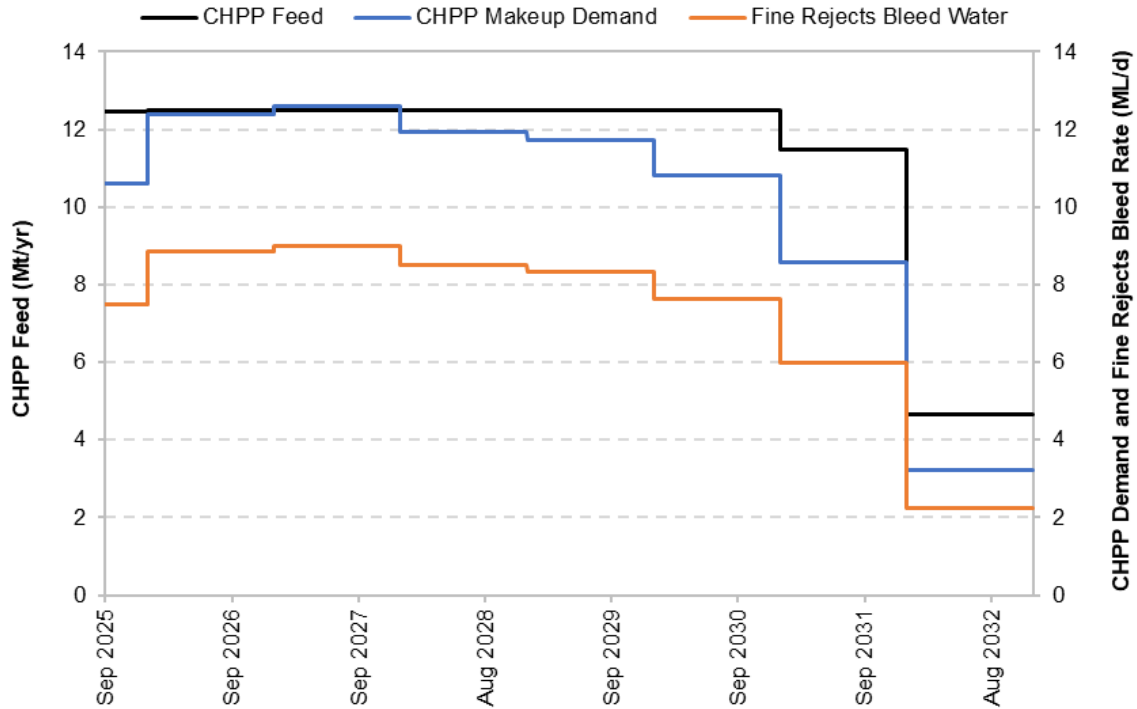
Relevant information pertaining to the CHPP demand and fine reject disposal was supplied by MACH. The CHPP demand was calculated based on the forecast tonnages of ROM feed, product coal and the following data:

- Coarse reject yield: 70% of total reject.
- Fine reject yield: 30% of total reject.
- ROM coal moisture: 9%.
- Product moisture: 11%.
- Coarse reject moisture: 17%.
- Thickened fine reject underflow solids content: 25%.

Fine reject was modelled as settling in the Fines Emplacement Area to 60% solids content, which is consistent with the in-situ testing of fine rejects undertaken by MACH. **Graph 13** shows the daily resulting calculated fine reject bleed rate (i.e. water reporting to the surface as the fine rejects settle).



**GRAPH 13: MODELLED CHPP FEED, WATER DEMAND AND FINE REJECT RECLAIM**



#### 4.2.4 Other Water Demands

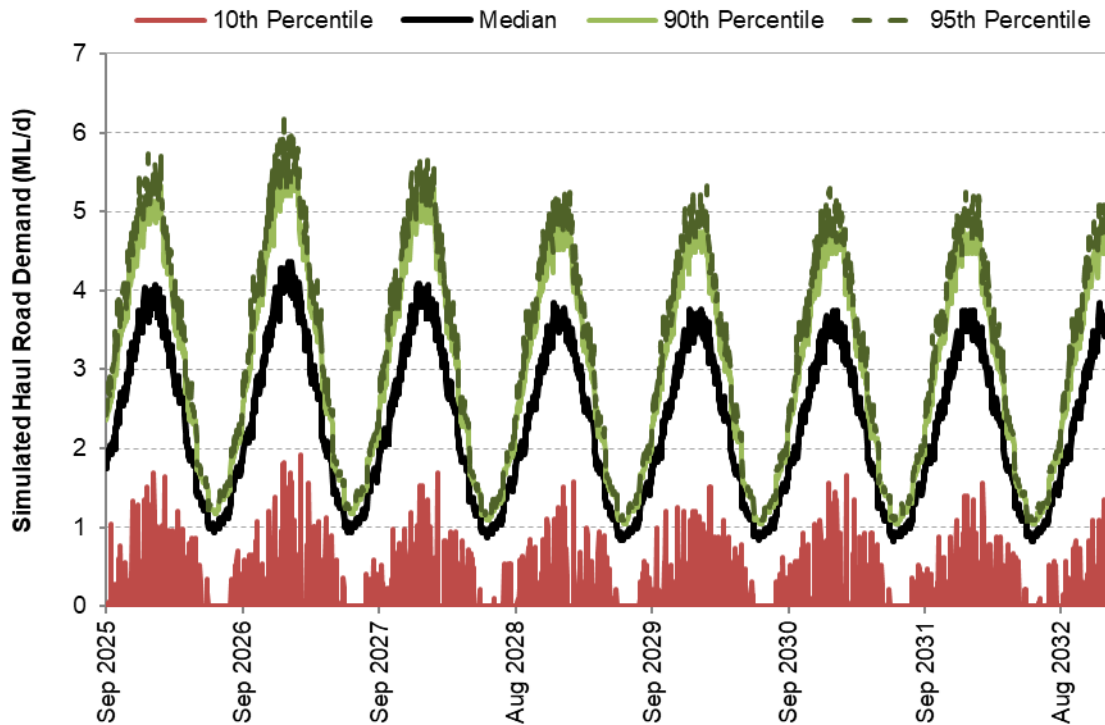
Haul road dust suppression demand was calculated based on the haul road lengths derived from current and proposed future plans (refer **Section 3**). Daily demand was calculated based on the following assumptions:

- 30 m average watering width for the primary haul road between the CHPP and the open cut pits;
- 25 m average watering width for the in-pit and waste rock emplacement haul roads;
- 80% of the total length of the in-pit and waste rock emplacement haul roads would be active and require watering at any one time;
- evaporation factor of 1.1 (as a multiplier on the excess of pan evaporation over rainfall) to allow for the darker, trafficked haul road surfaces; and
- on days where rainfall exceeded evaporation, zero demand was simulated.

The water truck fleet would be increased as necessary over the life of the modified MPO in order to meet haul road dust suppression demand requirements. The simulated haul road dust suppression demand is illustrated in **Graph 14**. Calculated haul road dust suppression demand averaged approximately 2 ML/day for the simulation period.



**GRAPH 14: SIMULATED HAUL ROAD DEMAND**



Other modelled site demands comprised:

- Vehicle washdown demand of 43.5 megalitres per year (ML/year) from 2025 to 2031, declining to 36.5 ML/year in 2032 to reflect a reduced truck fleet.
- Stockpile dust suppression estimated as the rainfall deficit on each day (pan evaporation minus rainfall) and an estimated stockpile area of 197,000 square metres (m<sup>2</sup>).
- Water demand for construction of proposed water storages estimated based on-site records.

Water demand for construction of MWD2, SD1 (enlargement), SD4 (enlargement), SD5, SD8, SD9 and SD12 was estimated based on-site records of water usage for construction of similar capacity storages. The modelled assumptions relevant to construction water demand are documented in **Table 16**.

**TABLE 16: CONSTRUCTION WATER DEMAND ASSUMPTIONS**

Proposed Storage	Modelled Storage Capacity (ML)	Estimated Construction Water Demand (m <sup>3</sup> )	Modelled Construction Duration	Modelled Commissioning Date
MWD2	1,000	16,930	10 months	January 2028
SD1 (enlargement)	110	2,320	6 months	January 2030
SD4 (enlargement)	49	550	6 months	June 2026
SD5	28	1,140	6 months	June 2026
SD8	37	1,500	6 months	June 2026
SD9	30	1,180	6 months	June 2026
SD12	5.7	225	3 months	June 2026
TSB4	5.7	225	3 months	January 2030

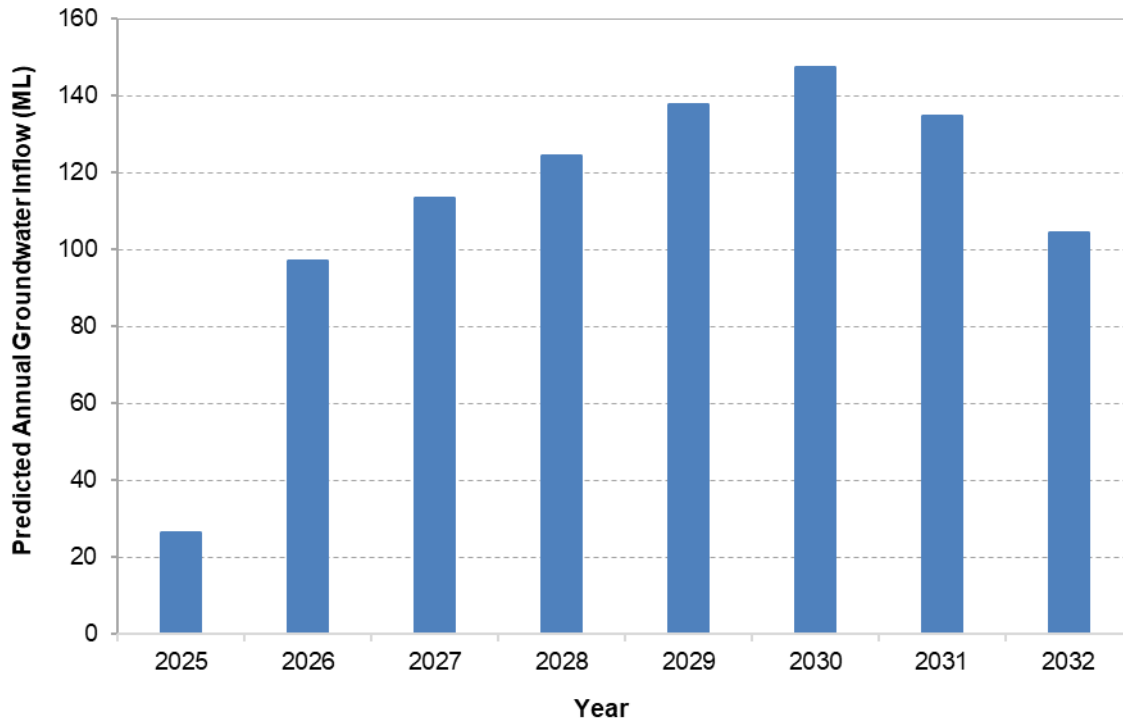
m<sup>3</sup> = cubic metres.



#### 4.2.5 Groundwater Inflow

The predicted annual groundwater inflow to the open cut pits is shown in **Graph 15** for the life of the modified MPO (AGE, 2025). Note that the 2025 groundwater inflow volume shown in **Graph 15** is for a 4-month period from September to December 2025.

**GRAPH 15: PREDICTED ANNUAL TOTAL OPEN CUT GROUNDWATER INFLOW**



As shown in **Graph 15**, the total annual groundwater inflow volume is predicted to peak in 2030 at 148 ML.

The groundwater inflow rates were apportioned to each modelled open cut pit based on the estimated coal seam strike length. The strike length, presented in **Table 17**, was estimated for each open cut pit based on the current and proposed future plans for the MPO.

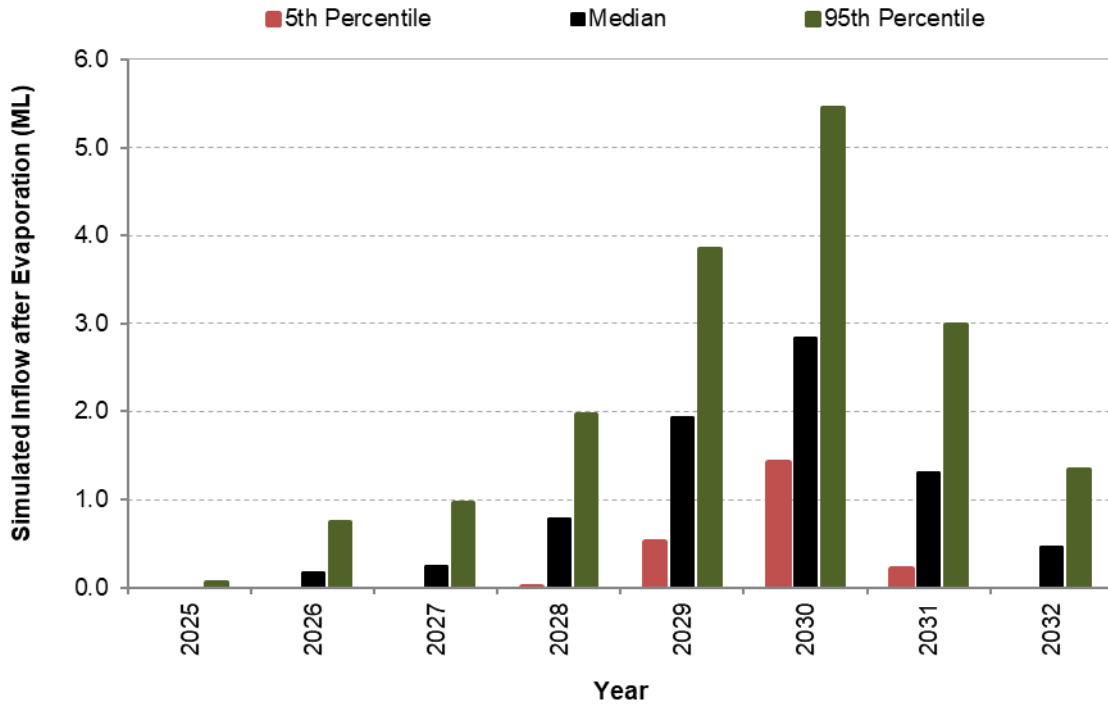
**TABLE 17: ESTIMATED OPEN CUT PIT STRIKE LENGTHS**

Year	South Pit Strike Length (km)	Central Pit Strike Length (km)	North Pit Strike Length (km)	Total Strike Length (km)
2025	1.6	1.5	0.0	1
2027	1.3	2.2	0.8	4.3
2029	1.3	2.5	1.4	5.1
2030	0.7	2.5	1.4	4.6
2032	0.0	2.6	1.6	4.2

The groundwater inflow rates were reduced in the model to allow for evaporation from the exposed coal seam (recognising that the coal seam is the principal aquifer). Calculations allowed for average coal seam thickness of 55.9 m (AGE, 2025) and strike length versus time multiplied by a pan factor for the open cut of 0.8. The simulated total annual groundwater inflow rate net of evaporation is shown in **Graph 16**. Note that the 2025 simulated inflow volume after evaporation shown in **Graph 16** is for a 4-month period from September to December 2025.



**GRAPH 16: GROUNDWATER INFLOW AFTER EVAPORATION**



#### 4.2.6 Hunter River Supply

The Hunter River IQQM is used by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) to forecast allowable extractions or AWDs through the water year (July to June), in accordance and in conjunction with the *Water Sharing Plan for the Hunter Regulated River Water Source 2016*. IQQM simulations were undertaken by DCCEEW using climatic data from 1892 to 2020 (the same period of data as used in the water balance model) to generate predictions of general security WAL AWDs, periods of off-allocation flow and the volume of water stored in Glenbawn Dam and Glennies Creek Dam (the two Hunter River major regulating storages), used in the estimation of AWD for High Security (HS) WALs.

A total of 961 ML/year Hunter River HS WALs and 2,947 ML/year Hunter River General Security (GS) WALs were modelled for the MPO (refer **Section 2.3.1**). The total volume of Hunter River water supplied to the MPO in the portion of the water year prior to simulation commencement (July 2025 to September 2025) was input to the model.

A pumping rate of 160 L/s was used to simulate extractions from the Hunter River. Sourcing of water from the Hunter River was only simulated when certain 'trigger' volumes in the MWDs occurred (refer **Section 4.2.9**). Carry over of GS WALs has been included per clause 53(6)(b) of the *Water Sharing Plan for the Hunter Regulated River Water Source 2016* although no carry over was assumed for financial year 2025.

#### 4.2.7 Licensed HRSTS Discharge

In the event of an excess volume of water stored in the MWD, governed by 'trigger' volumes in the MWD (refer **Section 4.2.9**), water would be transferred from the MWD to the Hunter River during river discharge periods in accordance with the HRSTS.

Discharge from the MWD to the Hunter River was simulated as occurring via the approved interim discharge pipeline prior to commissioning of DW1 (assumed January 2027). The discharge pipeline was modelled with a maximum capacity of 750 L/s (maximum design flow rate).

From January 2027, discharge from the MWD to the Hunter River was simulated as occurring via DW1. DW1 was modelled with an estimated catchment area of 15 ha and a capacity of 363 ML, consistent with previous approvals modelling. Discharge from DW1 to the Hunter River was simulated at a maximum discharge rate of 125 ML/day.



Simulating periods available for licensed discharge involved firstly developing a relationship between river flow rate and river registers for declared “high” flow events. This was carried out using historical river registers sourced online, correlated against recorded Hunter River daily flows. This correlation was extended to “flood” flow events in the Hunter River (during which no daily discharge restriction applies). Hunter River flow rates at Denman were simulated by the IQQM for the same period of historical climate data as used in the water balance model and these flows used with the above correlation relationship to simulate river registers. A total of 70 HRSTS credits were simulated, with the rate of discharge dependent on the modelled salinity of the MWD (refer **Section 4.3.6**).

#### 4.2.8 Storage Capacity and Initial Stored Water Volumes

The modelled storage capacity of the existing and proposed water storages was as detailed in **Section 3.2** and **Section 3.3.1**. It is understood that construction of MWD2 is proposed to commence in 2027 with commissioning in early 2028. A storage capacity of 1,000 ML was adopted.

Initial stored water volumes, as listed in **Table 18**, were input to the model. Where available, the stored water volumes were obtained from September 2025 site records. Where site records were unavailable, the initial stored water volumes were nominally set with consideration to the normal operating volumes of the site storages.

**TABLE 18: MODELLED INITIAL STORED WATER VOLUMES**

Storage	Initial Stored Water Volume (ML)
<i>Site Records</i>	
MWD	1264.3
ED2	8.2
ED3	143.6
HWD2	158.7
SD1	2.7
SD3	0.52
SD4	0.2
South Pit	125
Central Pit	34
<i>Assumed</i>	
CHPP SD	3.6
EDMIA	9
Fines Emplacement Area	25
TLO Dam	1.9
RLD2	8.3
SD6	0.12
SD7	0.39

#### 4.2.9 Pumping Rates and Triggers

Simulated pumped transfer rates between storages and the triggers which dictate when pumps are activated and deactivated are summarised in **Table 19**. Triggers were adjusted based on iterative simulations to achieve desired water management outcomes.



**TABLE 19: MODELLED PUMP RATES AND TRIGGERS**

Source	Destination	Pump Rate (L/s)	Condition 1 - To Start Pump	Condition 2 - To Start Pump	Condition 3 - To Stop Pump
ED2	FEA <sup>(1)</sup>	80	ED2 > 9.9 ML	FEA < FSL <sup>(2)</sup>	ED2 < 9 ML
ED3	MWD	100	ED3 > 44 ML	MWD < 1,987 ML	ED3 < 40 ML
EDMIA	MWD	75	EDMIA > 6.6 ML	MWD < 1,656 ML	EDMIA < 6 ML
HWD2	MWD	200	HWD2 > 175 ML	MWD < 1,656 ML	HWD2 < 120 ML or MWD > 1,676 ML
MWD	MWD2 (when operational)	165	MWD > 1,676 ML	MWD2 < 920 ML	MWD < 1,676 ML or MWD > 940 ML
MWD	Hunter River (pre DW1)	750 (limit)	MWD > 1,797 ML	River discharge period	MWD < 1,797 ML
MWD	DW1		MWD > 1,797 ML	DW1 < 182 ML	MWD < 1,797 ML or DW1 > 182 ML
MWD	HWD2	120	MWD > 506 ML	HWD2 < 120 ML	MWD < 506 ML or HWD2 > 175 ML
			MWD > 1,856 ML	-	MWD < 1,856 ML
MWD2	MWD	120	MWD2 > 190 ML	MWD < 1,636 ML	MWD2 < 100 ML or MWD > 1,636 ML
DW1	Hunter River	1,447	DW1 > 0.8 ML and MWD > 1,797 ML	River discharge period	MWD < 1,797 ML or DW1 < 0.5 ML or cessation of river discharge period
DW1	MWD	40	DW1 > 182 ML	MWD < 1,636 ML	MWD > 1,656 ML or DW1 < 0.5 ML
Hunter River	MWD	160	MWD < 1,425 ML	Allocation available	MWD > 1,656 ML
South Pit	HWD2	100	Pit Sump > 12 ML	HWD2 < 175 ML	Pit Sump < 10 ML
		300	Pit Sump > 100 ML		Pit Sump < 50 ML
Central Pit	HWD2	100	Pit Sump > 12 ML	HWD2 < 175 ML	Pit Sump < 10 ML
		300	Pit Sump > 20 ML		Pit Sump < 10 ML
North Pit	HWD2	100	Pit Sump > 12 ML	HWD2 < 175 ML	Pit Sump < 10 ML
		300	Pit Sump > 20 ML		Pit Sump < 10 ML



**TABLE 19 (CONT.): MODELLED PUMP RATES AND TRIGGERS**

Source	Destination	Pump Rate (L/s)	Condition 1 - To Start Pump	Condition 2 - To Start Pump	Condition 3 - To Stop Pump
RLD2	MWD	100	RLD2 > 0.14 ML	MWD < 1,967 ML	RLD2 < 0.04 ML or MWD > 1,987 ML
TLO	MWD	50	TLO > 1 ML	MWD < 1,987 ML	TLO < 0.6 ML or MWD > 1,987 ML
SD1	MWD	250	SD1 > 18 ML	MWD < 1,856 ML	SD1 < 17 ML or MWD > 1,856 ML
SD1 (enlarged)	MWD	500 <sup>(3)</sup>	SD1 > 41 ML	MWD < 1,856 ML	SD1 < 39 ML or MWD > 1,856 ML
SD3	SD1	100	SD3 > 14 ML	SD1 < 40 ML	SD3 < 13 ML or SD1 > 40 ML
SD4	SD1	70	SD4 > 13 ML	SD1 < 40 ML	SD4 < 12 ML or SD1 > 40 ML
SD4 (enlarged)	SD1	80 <sup>(4)</sup>	SD4 > 17 ML	SD1 < 40 ML	SD4 < 16 ML or SD1 > 40 ML
SD5	SD1	80	SD5 > 7.7 ML	SD1 < 40 ML	SD5 < 6.7 ML or SD1 > 40 ML
SD6	ED3	125	SD6 > 0.09 ML	ED3 < 211 ML	SD6 < 0.05 ML or ED3 > 211 ML
SD7	ED3	50	SD7 > 0.25 ML	ED3 < 211 ML	SD7 < 0.14 ML or ED3 > 211 ML
SD8	SD9	80	SD8 > 6.7 ML	SD9 < 18 ML	SD8 < 5.7 ML or SD9 > 18 ML
SD9	HWD2	120	SD9 > 8.2 ML	HWD2 < 175 ML	SD9 < 7.2 ML or HWD2 > 175 ML
SD12	HWD2	10	SD12 > 2.9 ML	HWD2 < 175 ML	SD12 < 1.9 ML or HWD2 > 175 ML
FEA	MWD	100	FEA > 125 ML	MWD < 1,807 ML	FEA < 25 ML or MWD > 1,807 ML
			FEA > FSL	MWD < 1,987 ML	FEA < FSL or MWD > 1,987 ML

Notes:

1. FEA = Fines Emplacement Area.
2. FSL = Full Supply Level = spill level minus 1 m.
3. Recommended upgraded pump rate – refer **Table 14**.
4. Design upgraded pump rate – refer **Table 14**.

#### 4.2.10 Salinity Estimates

Catchment runoff salinity (EC values) were estimated from surface water monitoring data for the Hunter River, local surface water monitoring sites, existing site water storages, the Fines Emplacement Area and the existing open cut pit/s (refer **Section 2.6** and **Section 2.7**). An EC to TDS conversion factor of 0.64 mg/L was adopted (Abrol et al., 1988). Contemporary EC monitoring data was used to estimate sub-catchment runoff EC (to maintain consistency with the current catchment and site water management characteristics), whereas **Section 2.7** presents summaries of the full record of water quality data.

Following initial model simulation, simulated salinity concentrations of site water storages were reviewed against monitored EC records. Where required, the salinity inputs were modified to improve the match of modelled to monitored EC of the site water storages. The adopted inflow salinities are provided in **Table 20**.



**TABLE 20: MODELLED INFLOW SALINITY**

Component		EC (µS/cm)	Basis
Hunter River supply		493	Median field EC of the Hunter River at monitoring site W15
Groundwater		4,965	Estimated based on the median field EC of the open cut pits
Sub-catchment Runoff	Undisturbed	236	Estimated based on field EC records for monitoring site W9 and W14
	Hardstand – Roads	640	Estimated from the EC records for water storages accounting for the area of hardstand sub-catchment
	Hardstand – CHPP and MIA	2,000	Estimated from the EC records for the CHPP SD accounting for the area of hardstand sub-catchment
	Open Cut Pit	7,000	Estimated through comparison of modelled to monitored EC for the open cut pits
	Waste Rock Emplacement / Active Disturbance	1,200	Estimated from the EC records for water storages accounting for the area of active waste rock / disturbance sub-catchment
	Rehabilitated Areas	420	Estimated from the EC records for SD1, SD3 and SD4 accounting for the area of rehabilitated sub-catchment
	Fines Emplacement Area	2,500	Median field EC of the Fines Emplacement Area

It is noted that the median weighted average EC value of overburden and interburden samples tested by RGS (2021) was 459 µS/cm, with a 95<sup>th</sup> percentile weighted average EC value of 843 µS/cm. As such, the 1,200 µS/cm modelled inflow salinity for waste rock emplacement runoff, presented in **Table 20**, is considered conservative.

#### 4.2.11 Initial Electrical Conductivity Estimates

Initial EC was based on values recorded in late August 2025 as part of the MPO water monitoring programme, just prior to the commencement of the model simulation period (**Table 21**).

**TABLE 21: MODELLED INITIAL STORAGE SALINITY**

Storage	Initial Stored Water EC (µS/cm)
ED2	3,500
ED3	1,675
EDMIA	545
CHPPSD	2,210
HWD2	4,380
MWD	2,070
SD1	412
SD3	501
SD4	605
Fines Emplacement Area	2,250
South Pit	2,310
Central Pit	3,960



## 4.3 Operational Water and Salt Balance Model Results

### 4.3.1 Probabilistic Results

Probabilistic outputs for key model results are presented in the following sections. The probabilistic outputs present the range of predicted outcomes based on all modelled realizations. For example, there is a predicted 90% probability that the total water volume would fall in between the 5<sup>th</sup>/95<sup>th</sup> percentile volume plots. It is important to note that the plots do not represent a single climatic realization – the probability plots are compiled from all 129 realizations - e.g. the median volume plot does not represent model forecast volume for median climatic conditions. The percentile plots indicate ranges within which the predicted volumes could vary, within these risk or confidence limits/levels.

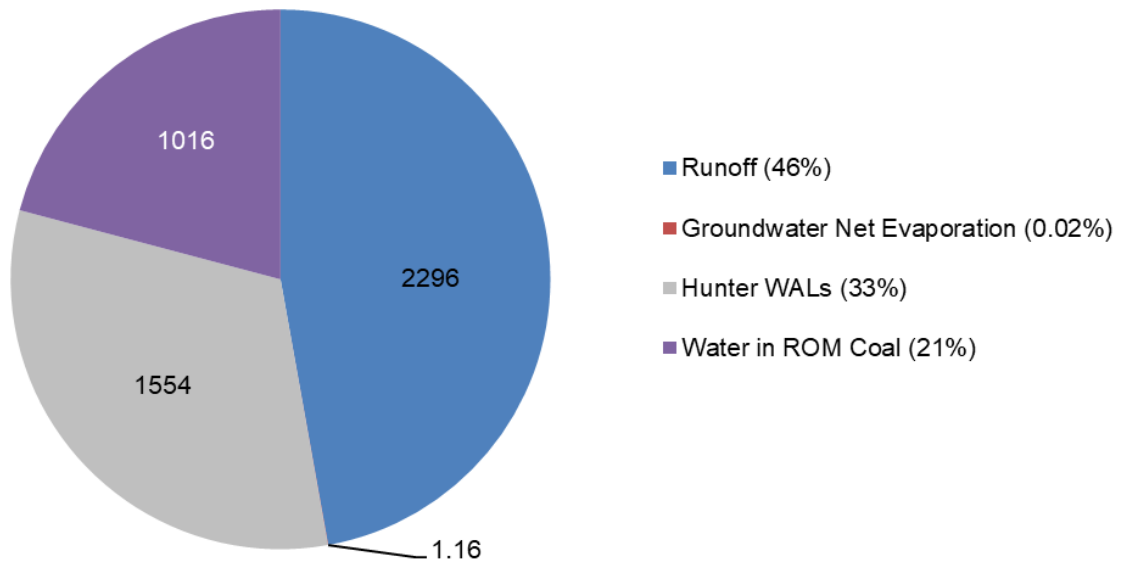
### 4.3.2 Overall Site Water Balance

Model predicted average inflows and outflows, averaged over all 129 realizations and the simulation period, are shown in **Graph 17**, rainfall runoff provides the largest input of average modelled system inflow, accounting for 46% of total inflows, followed by licensed extraction (via WALs) at 33%. Average outflows are dominated by evaporation (30%).

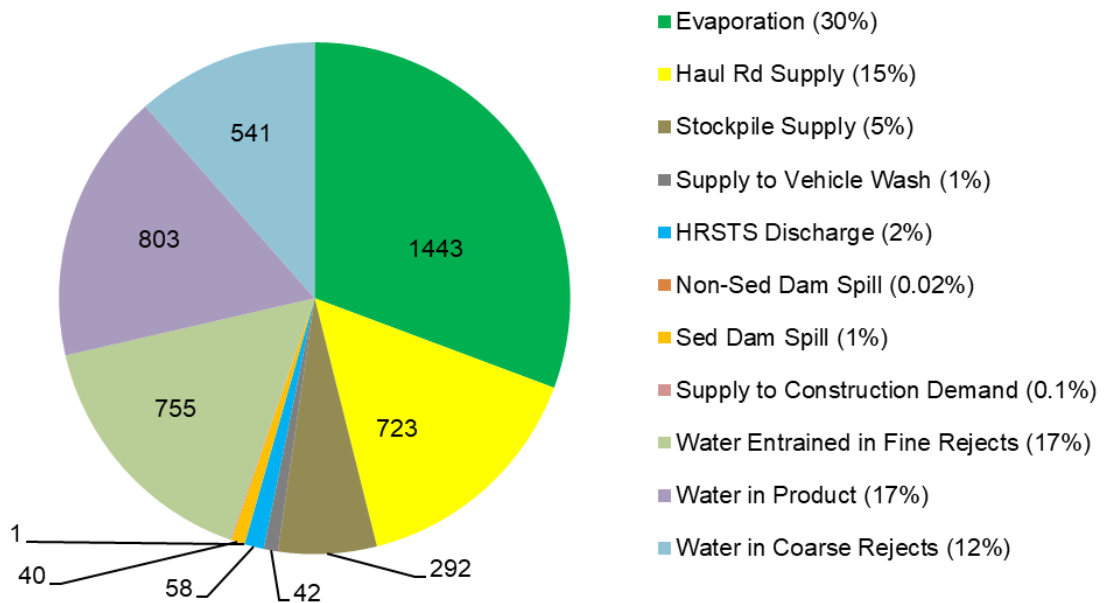


### GRAPH 17: AVERAGE (MEAN) MODELLED SYSTEM INFLOWS AND OUTFLOWS

#### Average Inflows (ML/year)



#### Average Outflows (ML/year)

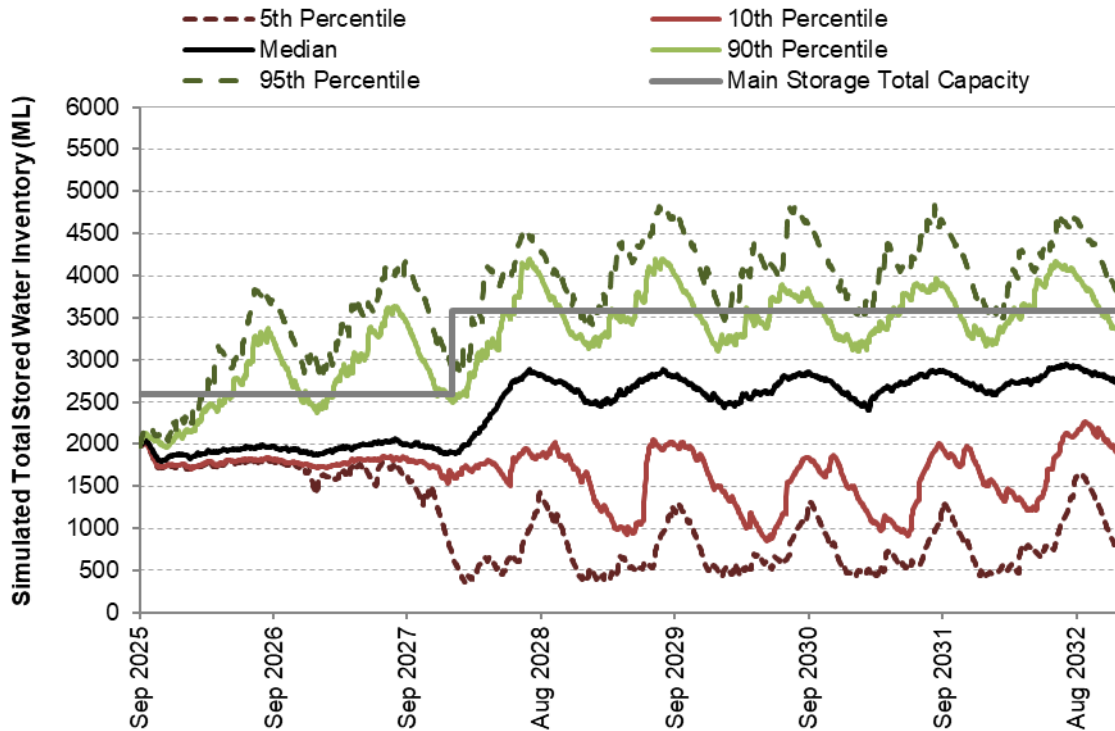




### 4.3.3 Stored Water Volumes

The predicted total stored water inventory for the MPO (incorporating the Modification) is shown in **Graph 18** as probability plots over the simulation period. The total storage capacity of the main site water storages – MWD, MWD2, HWD2 and ED3 – is also shown for comparative purposes.

**GRAPH 18: SIMULATED TOTAL STORED WATER VOLUME**

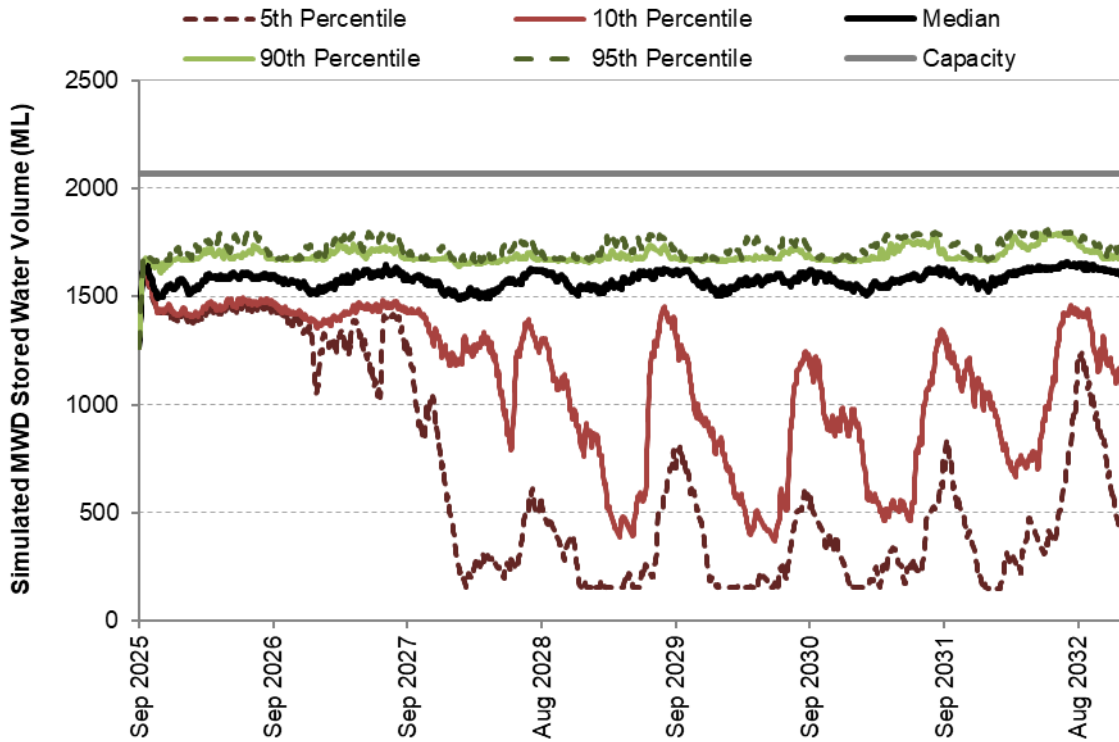


The model results plotted in **Graph 18** indicate that the median total stored water volume is predicted to fluctuate around 2,000 ML until early 2028. Following commissioning of MWD2 in early 2028, additional storage capacity would be available at the MPO to facilitate further transfer from the Hunter River and subsequently improve supply reliability. Based on the median model results, the total stored water volume would remain below the main storage total capacity for the life of the modified MPO. The total stored water volume based on the 90<sup>th</sup> and 95<sup>th</sup> percentile model results is predicted to exceed the main storage total capacity at times. During these periods, excess water would be temporarily stored in inactive parts of the open cut pits until capacity in HWD2, MWD or MWD2 became available.

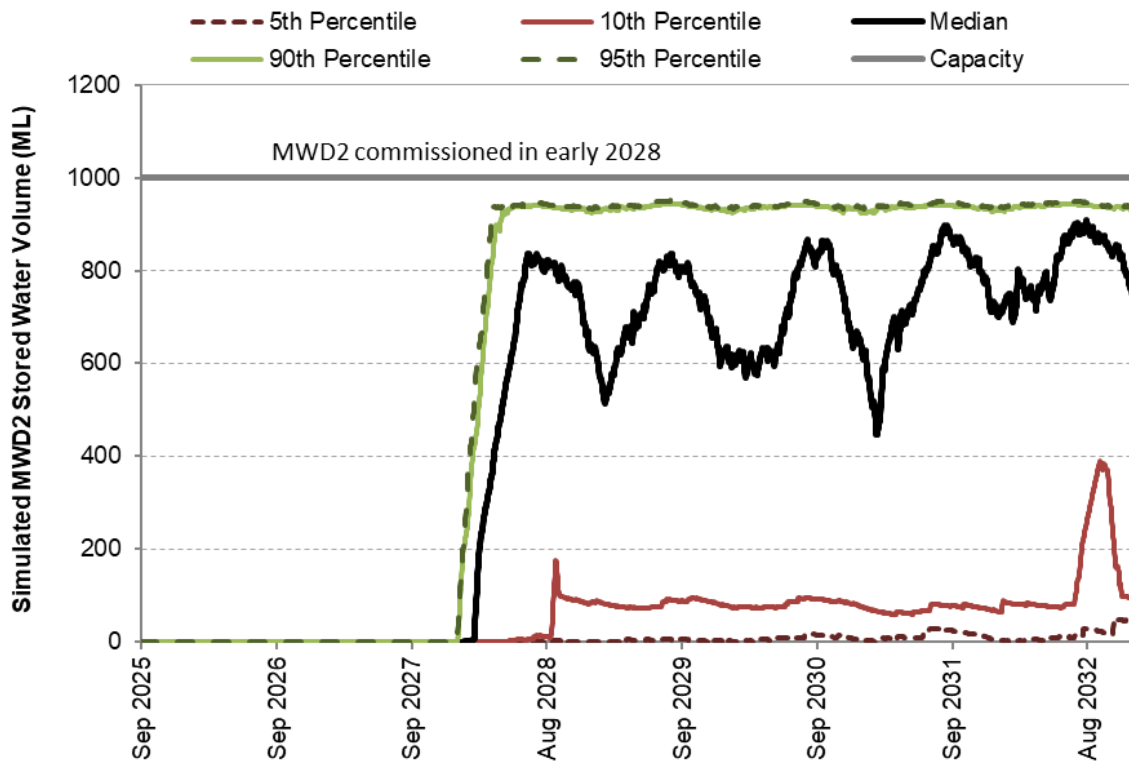
**Graph 19** and **Graph 20** provide probability plots of the simulated volume of the MWD and MWD2.



**GRAPH 19: SIMULATED STORED WATER VOLUME IN MWD**



**GRAPH 20: SIMULATED STORED WATER VOLUME IN MWD2**



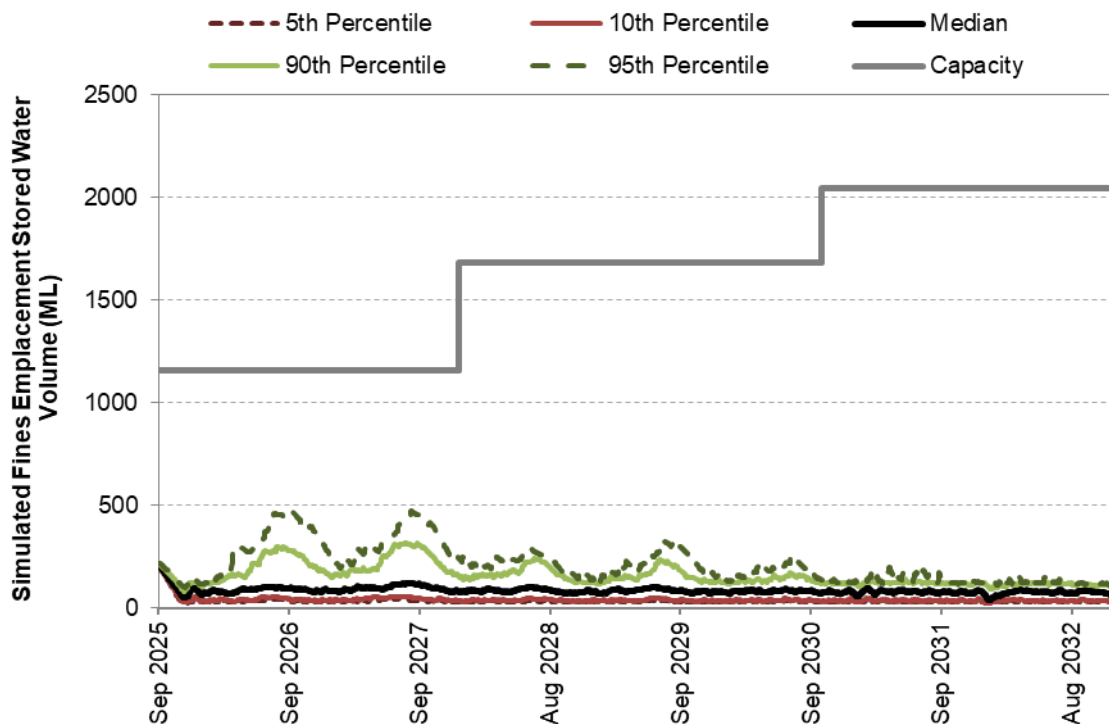


Based on the median, 90<sup>th</sup> percentile and 95<sup>th</sup> percentile model results presented in **Graph 19**, the MWD would be maintained at a relatively high water storage volume for the period of operation with the aim of maintaining supply reliability. Based on model results, the total stored water volume in the MWD is not predicted to exceed the storage capacity (i.e. no storage spills are predicted).

MWD2 would be managed to provide sufficient storage capacity for transfer from the MWD when discharge to the Hunter River is unable to be undertaken. Based on the median model results presented in **Graph 20**, MWD2 stored water volume would vary between approximately 450 ML and 940 ML following commissioning. The total stored water volume in MWD2 is not predicted to exceed the storage capacity (i.e. no storage spills are predicted).

**Graph 21** provides probability plots of the simulated water volume of the Fines Emplacement Area. The estimated decant pond capacity to the spillway level is also presented on **Graph 21**. The decant pond capacity has been estimated based on the design capacity of the Fines Emplacement Area over the life of the modified MPO and the forecast cumulative fine reject tonnes to be deposited in the Fines Emplacement Area over the life of the modified MPO (refer **Section 4.2.3**). The capacity shown in **Graph 21** reflects the capacity estimated to be available immediately prior to each embankment raise (i.e. a conservatively low estimate of capacity).

**GRAPH 21: SIMULATED WATER VOLUME IN THE FINES EMPLACEMENT AREA**



The results presented in **Graph 21** illustrate that the water volume of the Fines Emplacement Area based on the median model results would be maintained at around 100 ML for the life of the modified MPO. The 95<sup>th</sup> percentile model results indicate that the water volume may increase to a maximum of 500 ML. However, the water volume is not predicted to exceed the modelled available decant pond capacity, with no overflow predicted from the Fines Emplacement Area.

An excessive volume of water stored in the open cut pits has the potential to disrupt mining. The risk of mining disruption has been assessed by comparing the number of days over the simulation period in which more than 200 ML is predicted to be held in the North Pit and more than 400 ML in each of the South Pit and Central Pit (volumes as advised by MACH).

**Table 22** presents the model predictions for the 5<sup>th</sup> percentile, median and 95<sup>th</sup> percentile distributions of the percentage of days over the full simulation period in which more than 200 ML is predicted to be held in the North Pit and more than 400 ML in each of the South Pit and Central Pit.



**TABLE 22: PREDICTED PERCENTAGE OF PIT INUNDATION DAYS**

Pit	Percentage of Days over the Simulation Period		
	5 <sup>th</sup> Percentile Result	Median Result	95 <sup>th</sup> Percentile Result
South Pit	0.0%	0.0%	7.1%
Central Pit	0.0%	3.1%	20.4%
North Pit	0.0%	4.1%	22.0%

Based on the model results presented in **Table 22** there is a 5% chance (95<sup>th</sup> percentile) that in excess of 200 ML would be stored in the North Pit more than 22% of the time over the life of the modified MPO. There is a 50% probability (median) chance that there would be in excess of 200 ML stored in the North Pit more than 4.1% of the time over the life of the modified MPO.

As stated previously, the MPO (incorporating the Modification) would include three distinct mining areas within the North Pit, Central Pit and South Pit which would provide flexibility to store water to mitigate the impact to mining activities. Water would be able to be transferred from the North Pit to the Central Pit or South Pit as required.

#### 4.3.4 Water Supply Reliability

Predicted average supply reliability is expressed as total water supplied divided by total demand (i.e. a volumetric reliability) over the simulation period. Average supply reliability over all climatic realizations, as well as the lowest single realization reliability (representing a simulated 'worst case' 7.3 year period), for CHPP supply, haul road dust suppression, stockpile dust suppression, vehicle wash and construction demand are summarised in **Table 23**.

**TABLE 23: MODELLED WATER SUPPLY RELIABILITY**

Demand	Average Volumetric Supply Reliability	
	Average	Lowest
CHPP	99.1%	86.8%
Haul Road Dust Suppression	97.3%	67.8%
Stockpile Dust Suppression	98.5%	79.9%
Vehicle Wash	99.0%	85.1%
Construction	99.5%	82.4%

An average 99.1% CHPP supply reliability is equivalent to 25 days of lost operation over the 7.3 year simulation period, while the 86.8% lowest reliability equates to 354 days of lost operation over that period.

Low supply reliability was predicted during periods in which predicted Hunter River AWDs were significantly reduced. While MACH holds sufficient WALs to account for the predicted water demand over the life of the modified MPO, in extended periods of below average rainfall when Hunter River AWDs are reduced, impact to water supply reliability may occur. During these periods, MACH would implement mitigation and management measures which may include:

- ROM coal bypass or decreased production to reduce the CHPP water demand.
- Adaptive use of supplementary measures, such as chemical dust suppressants during low rainfall periods. It is estimated that a 40 – 50% reduction in haul road dust suppression water requirements may be achieved through implementation of chemical suppressants during low rainfall periods (Katestone Environmental, 2011).

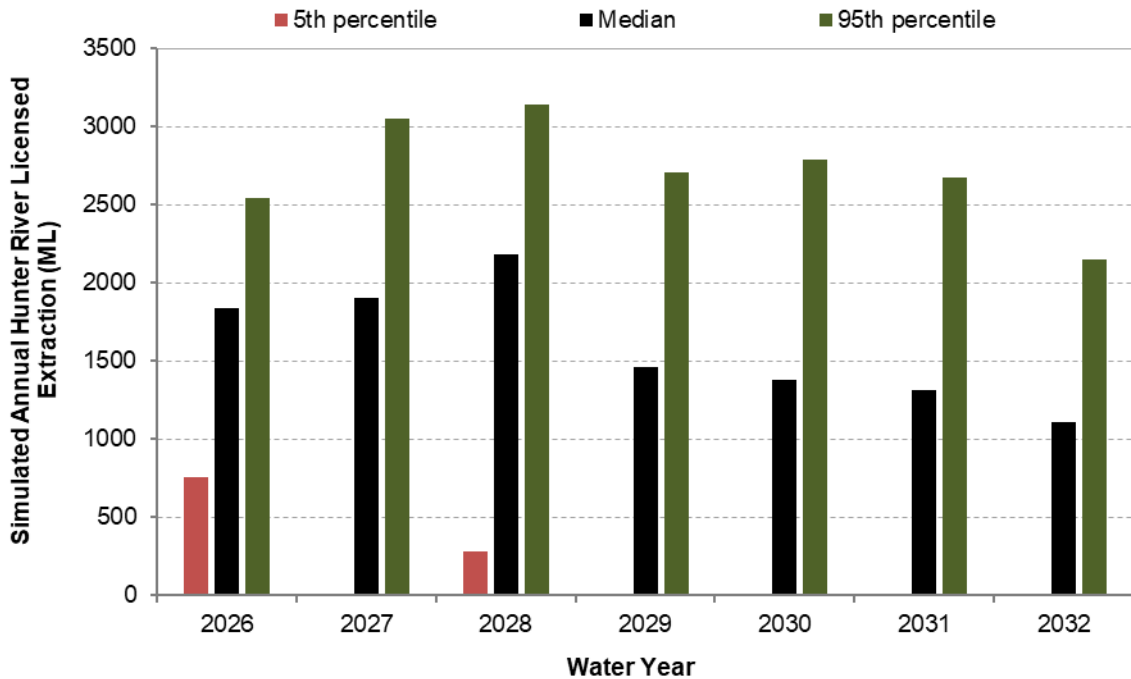


- Acquisition of additional high security water allocation licences or allocation assignment where available.

#### 4.3.5 Hunter River Licensed Extraction

A plot of the predicted annual licensed extraction volume from the Hunter River via WALs for the simulation period at different probabilities is shown in **Graph 22**. It is noted that the predicted licensed extraction volume in 2026 (water year<sup>6</sup>) is for the period from commencement of the model simulation (September 2025) to end June 2026.

**GRAPH 22: ANNUAL HUNTER RIVER LICENSED EXTRACTION VOLUME**



The model results provided in **Graph 22** indicate that the volume of water sourced from the Hunter River would be lower than the total licence volume in all years. Based on the 95<sup>th</sup> percentile model results, a maximum of 3,145 ML would be required to be sourced from the Hunter River in 2028 (water year). This is less than the total 3,908 ML General Security and High Security WALs held by MACH.

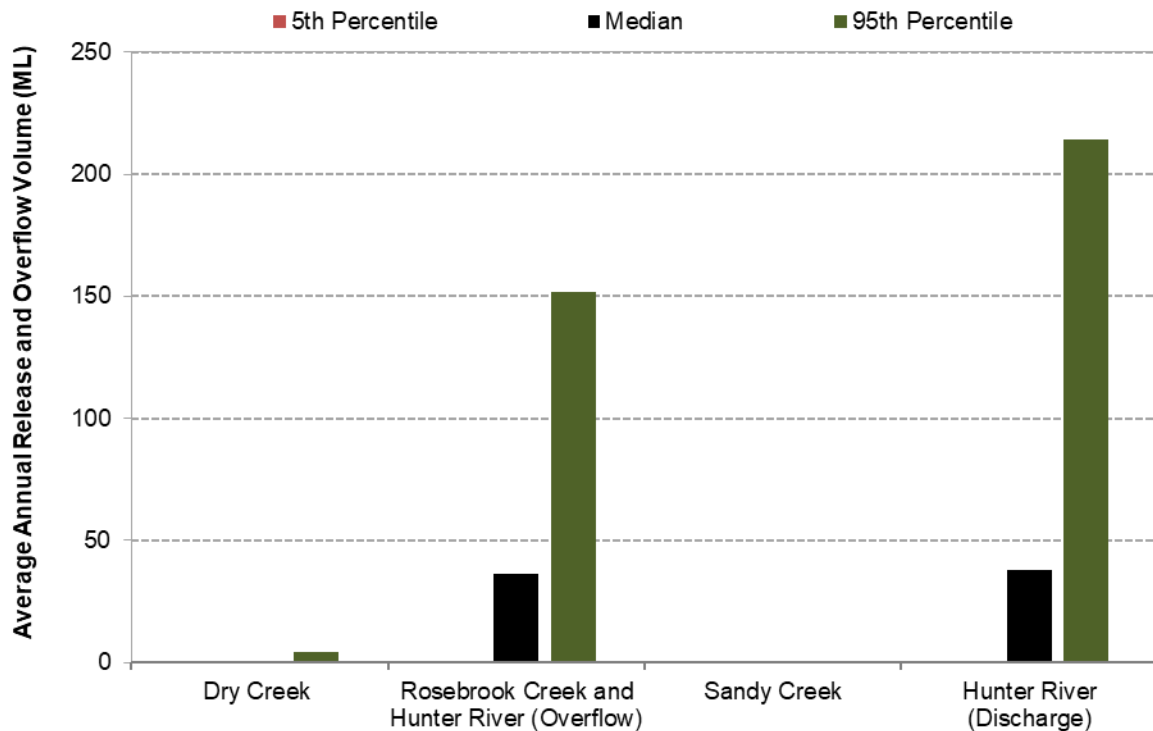
#### 4.3.6 External Discharge and Overflow

External discharge and overflow were simulated as occurring in accordance with the design criteria (refer **Table 19**) and the HRSTS discharge criteria (refer **Section 4.2.7**). **Graph 23** presents the simulated average annual discharge and overflow to the Hunter River, Dry Creek, Sandy Creek and Rosebrook Creek.

<sup>6</sup> The water year constitutes July to June; consistent with the DCCEEW forecast allowable extractions or AWDs.



**GRAPH 23: ANNUAL DISCHARGE AND OVERFLOW VOLUME**



**Graph 23** illustrates that, on average, an annual volume of 36 ML is predicted to overflow to Rosebrook Creek and the Hunter River from sediment dams SD1, SD3, SD4, SD5, SD9, SD9 and SD12 based on the median model results and 151 ML based on the 95<sup>th</sup> percentile model results. On average, an annual volume of 4 ML is predicted to overflow to Dry Creek from SD6, SD7, TLO Dam, RLD2 and ED3 based on the 95<sup>th</sup> percentile model results. The average annual Hunter River discharge volume is predicted at 38 ML based on the median model results and 214 ML based on the 95<sup>th</sup> percentile model results.

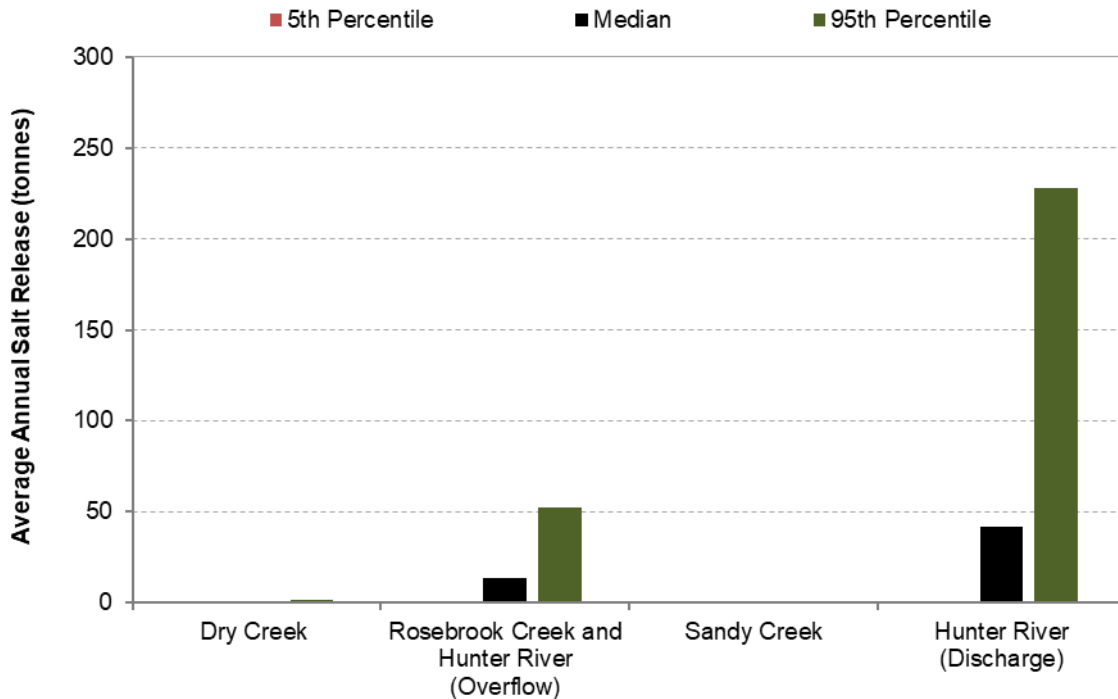
For specific storages, the model predicted overflow is summarised as follows:

- No spills were predicted from the Fines Emplacement Area, ED2, DW1, MWD or MWD2.
- A low risk of overflow from ED3 to Dry Creek was predicted based on all model results. The percentage of annual overflow days from ED3 to Dry Creek was estimated at 0.9% based on all model realizations, which is less than the 1% AEP spill risk design criterion (i.e. in any simulated year ED3 has a predicted overflow risk equal to 0.9%).
- A low risk of overflow from RLD2 to Dry Creek was predicted based on all model results. The percentage of annual overflow days from the RLD2 to Dry Creek was estimated at 0.2% based on all model realizations (i.e. in any simulated year the TLO Dam has a predicted overflow risk equal to 0.2%).
- A low risk of overflow from the TLO Dam to Dry Creek was predicted based on all model results. The percentage of annual overflow days from the TLO Dam to Dry Creek was estimated at 0.5% based on all model realizations (i.e. in any simulated year the TLO Dam has a predicted overflow risk equal to 0.5%).

**Graph 24** presents the simulated average annual salt mass in discharge and overflow to the Hunter River, Dry Creek, Sandy Creek and Rosebrook Creek.



**GRAPH 24: ANNUAL DISCHARGE AND OVERFLOW SALT MASS**



**Graph 24** illustrates that, on average, an annual mass of 14 tonnes of salt is predicted to overflow to Rosebrook Creek and the Hunter River from sediment dams SD1, SD3, SD4, SD5, SD8, SD9 and SD12 based on the median model results and 53 tonnes based on the 95<sup>th</sup> percentile model results. On average, an annual mass of 2 tonnes is predicted to overflow to Dry Creek from SD6, SD7, TLO Dam, RLD2 and ED3 based on the 95<sup>th</sup> percentile model results. The average annual Hunter River discharge salt mass under the HRSTS requirements is predicted at 42 tonnes based on the median model results and 228 tonnes based on the 95<sup>th</sup> percentile model results.

Based on the predicted total overflow volume, the average EC of overflow to Rosebrook Creek and the Hunter River from sediment dams SD1, SD3, SD4, SD5, SD8, SD9 and SD12 is predicted at 603  $\mu\text{S}/\text{cm}$  based on the median model results. This EC value is within the range of baseline EC values recorded for local and regional surface water systems (refer **Section 2.6**). It is noted that the predicted EC of 603  $\mu\text{S}/\text{cm}$ , based on the median model results, is higher than the EC values recorded during overflow events from the sediment dams. Based on the EC values presented in **Section 2.7.3**, the average EC of all overflow events from SD1 and SD4 was 327  $\mu\text{S}/\text{cm}$ , with a maximum EC value of 420  $\mu\text{S}/\text{cm}$  recorded. As such, the model predictions are considered conservative.

Based on the predicted total overflow volume, the average EC of overflow from SD6, SD7, TLO Dam, RLD2 and ED3 to Dry Creek is predicted at 663  $\mu\text{S}/\text{cm}$  based on the 95<sup>th</sup> percentile model results. As stated above, overflow to Dry Creek was predicted infrequently, with an annual volume of 4 ML, on average, predicted to overflow to Dry Creek from SD6, SD7, TLO Dam, RLD2 and ED3 based on the 95<sup>th</sup> percentile model results. During these periods, flow in Dry Creek is likely to be highly diluted by incident rainfall and therefore EC reporting to the Hunter River from Dry Creek is likely to be highly diluted.

The average EC of discharge to the Hunter River is predicted at 1,726  $\mu\text{S}/\text{cm}$  based on the median model results. As described in **Section 4.2.7**, water discharged to the Hunter River was simulated based on 70 HRSTS credits, the modelled salinity of the MWD and the simulated flow in the Hunter River.



## 5 FINAL VOID WATER AND SALT BALANCE MODELLING

### 5.1 Model Description

A daily timestep, final void water and salt balance model has been developed using the GoldSim® simulation package. The model simulates the volume and salinity of the final void water body by simulating the inflows, outflows and resultant volume of water and salt mass:

$$\text{Change in Storage} = \text{Inflow} - \text{Outflow}$$

Where:

*Inflow* includes direct rainfall, runoff and groundwater inflow.

*Outflow* includes evaporation.

### 5.2 Key Data and Assumptions

The model simulates inflow from remnant final void catchment rainfall runoff (including direct rainfall), groundwater inflow from bedrock as well as outflow due to evaporation on a daily basis. Key model input data include the following:

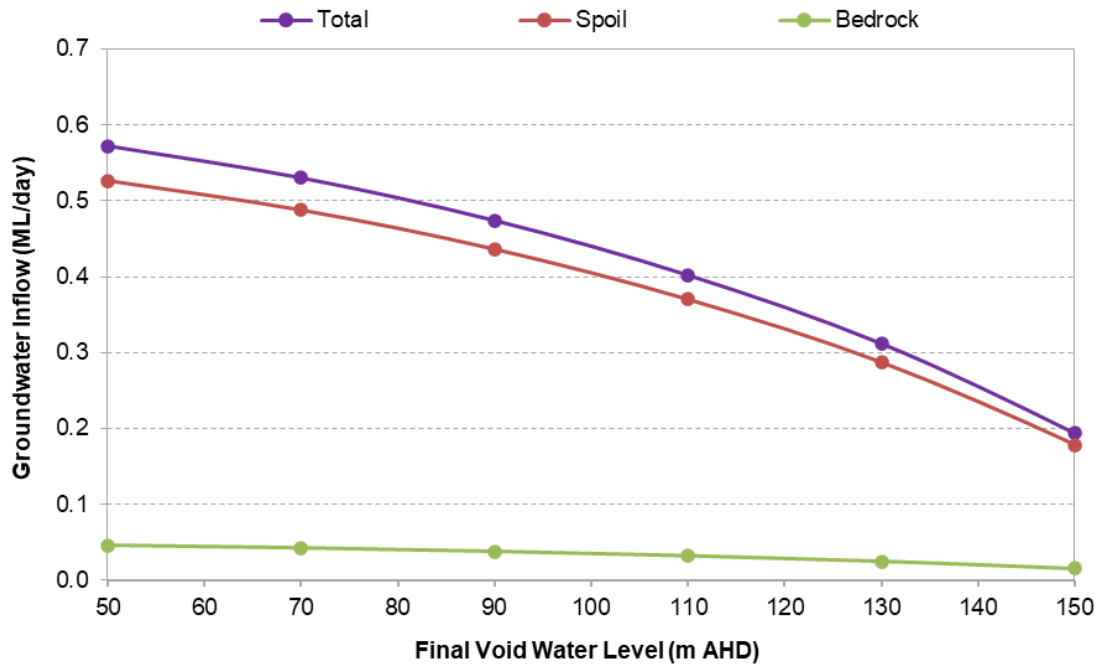
- A catchment area of 615.6 ha comprising 297.4 ha of rehabilitated sub-catchment, 97.7 ha of natural undisturbed sub-catchment and 220.5 ha of remnant open cut pit sub-catchment (refer **Section 3.4**).
- A 136-year rainfall data set (1889 to 2024) obtained from SILO Point Data and a 136-year evaporation data set for the same period (refer **Section 4.2.1**). The data set was repeated several times over to generate an extended period of climate data for final void simulation – to ensure equilibrium water levels were reached during the simulation period.
- A constant pan factor of 0.8 was assumed for calculation of evaporation from the final void until the water level reached 10 m below the spill point (if this occurs) at which point monthly pan factors taken from McMahon et al. (2013) were used – refer **Section 4.2.2**. The lower pan factor used for lower final void levels reflects lower evaporation likely at depth as a result of shading effects.
- Surface rainfall runoff was estimated using the AWBM applied to the final void sub-catchments, in a manner similar to the operational water balance model (refer **Section 4.2.1**). Direct rainfall was simulated on the contained water surface.
- Catchment runoff salinity (EC) values were estimated from water quality monitoring data as listed in **Table 20**.
- A groundwater inflow EC of 4,695 µS/cm was adopted for bedrock inflow based on the median EC records for the open cut pits (**Table 20**).
- A groundwater inflow EC of 900 µS/cm was adopted for spoil (seepage) inflow based on RGS (2021).
- The rate of evaporation was adjusted based on the simulated final void water salinity (per Morton et al., 1985).

In simulating pit lake salinity, the model assumes conservation of mass and fully mixed conditions.

Groundwater inflow to the final void is expected to occur from the in-pit spoil and bedrock. Predicted rates of groundwater inflow versus water level in the final void were provided by AGE (2025) as shown in **Graph 25**. Note that this includes estimates of seepage from in-pit spoil and therefore sub-surface seepage from the catchment AWBM ('baseflow' in the AWBM) was not included as inflow to the final void.



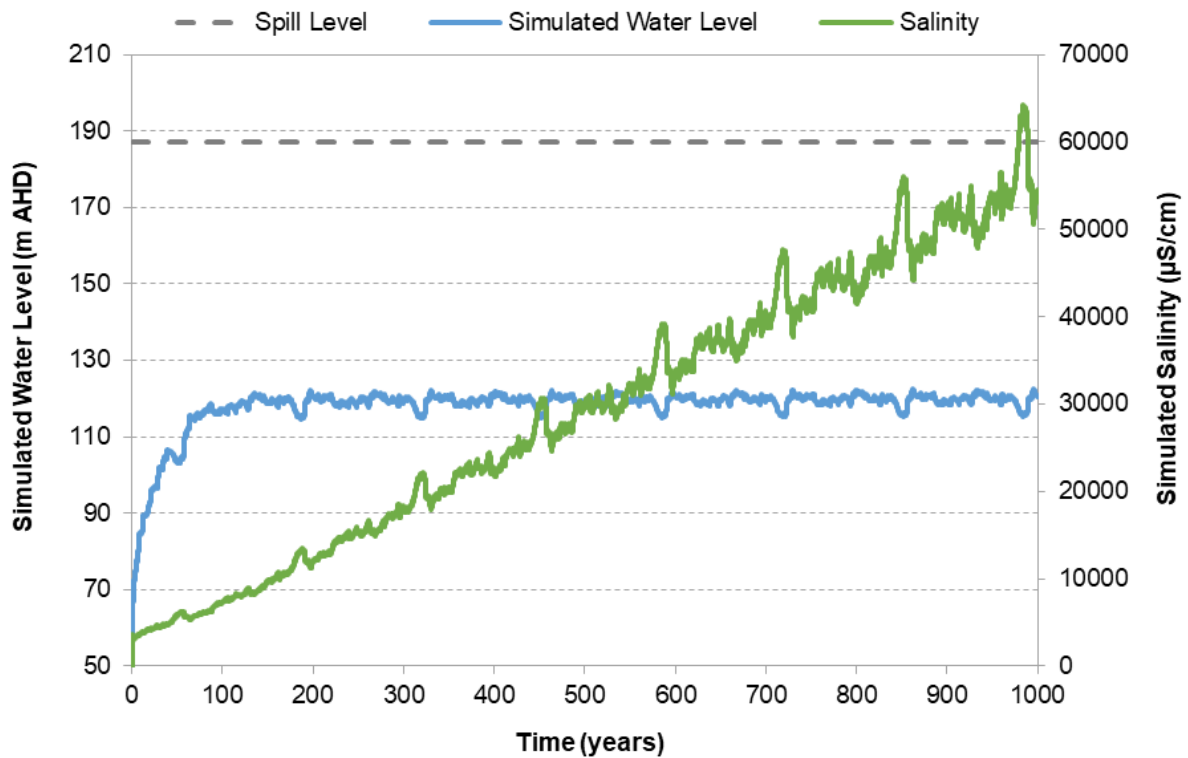
**GRAPH 25: PREDICTED FINAL VOID GROUNDWATER INFLOW RATES**



### 5.3 Simulated Future Performance

Model-predicted final void water levels and EC values are shown on **Graph 26**.

**GRAPH 26: PREDICTED FINAL VOID WATER LEVEL AND EC**





As shown on **Graph 26**, the final void water level is predicted to reach a peak equilibrium level of approximately 120 m AHD which is more than 67 m below the spill level (i.e. the final void is contained). Equilibrium levels would be reached slowly over a period of more than 300 years. Note that, given the water level and groundwater flux relationship provided, groundwater outflow was not simulated to occur – i.e. the final void would remain a groundwater sink (AGE, 2025). Final void salinity levels would increase slowly as a result of evapo-concentration.

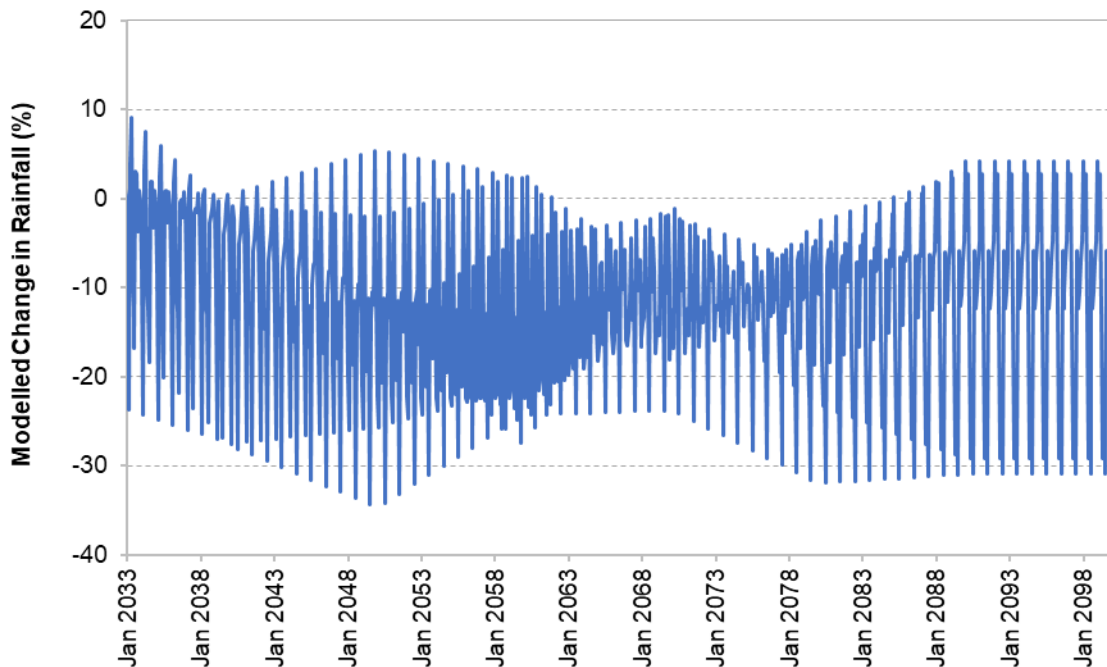
#### 5.4 Implications of Climate Change on Final Void Water Level

The NSW Government provides regional climate projections through the NSW and ACT Regional Climate Model (NARClIM) project. NARClIM computes local-scale climate projections based on information provided by 10 selected global climate models. Regional climate models are then applied to dynamically downscale the global climate models (NSW Government, 2025).

Climate projections are available at 4 kilometre (km) resolution thereby capturing the influence of local topography on atmospheric processes that influence climatic conditions. Projections of changes in rainfall and evaporation at 4 km resolution are available for two emissions scenarios: low emissions (SSP1-2.6) and high emissions (SSP3-7.0). Under the high emissions scenario (SSP3-7.0), average temperature is projected to increase by 2.0°C by 2050 and 4.0°C by 2090 relative to the 1990-2009 baseline (NSW Government, 2025).

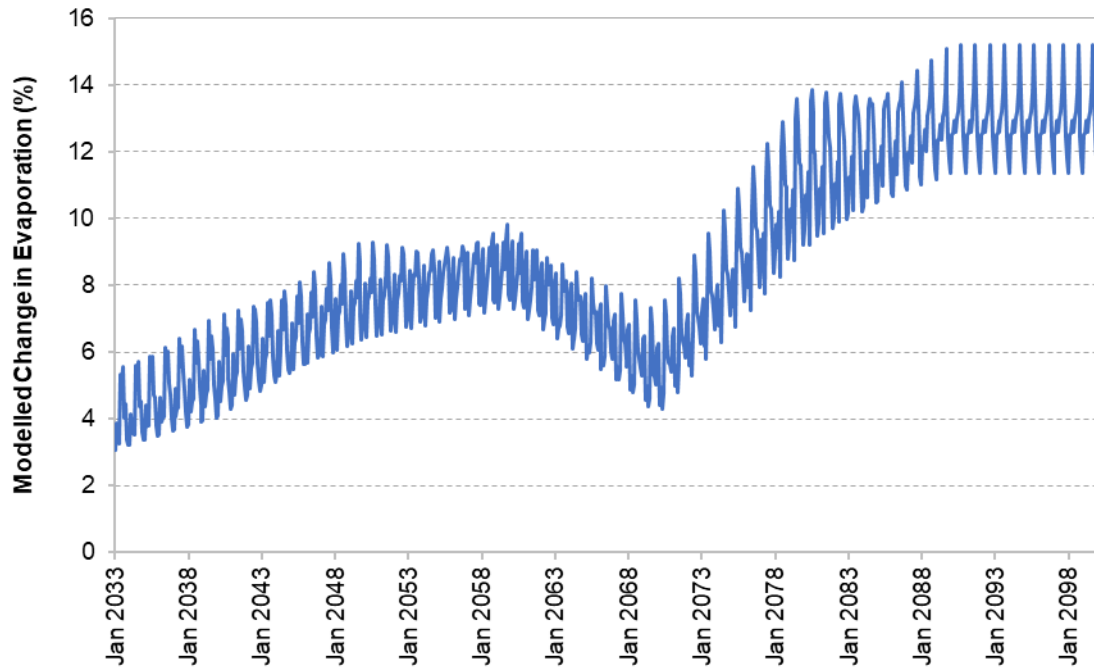
For this assessment, the SSP3-7.0 emissions scenario has been adopted. The modelled percentage change in monthly rainfall and evaporation from 2033 to 2099 is presented in **Graph 27** and **Graph 28** respectively. The values presented are an average of all 10 global climate model predictions. It is noted that the predicted percentage change for each year is relative to 2009, where zero change was projected at 2009. As climate change projections are unavailable post 2099, the 2099 projections were adopted for the remainder of the final void water and salt balance simulation.

**GRAPH 27: MODELLED CHANGE IN RAINFALL**



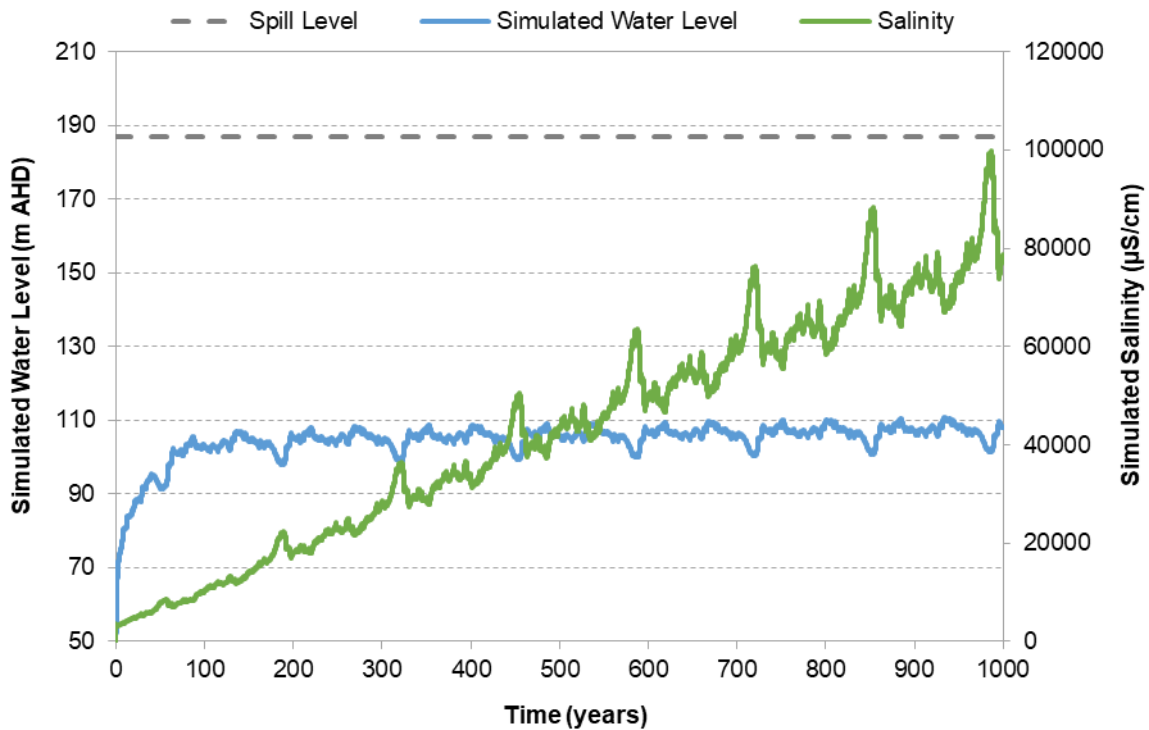


**GRAPH 28: MODELLED CHANGE IN EVAPORATION**



The model-predicted final void water level considering climate change effects is shown on **Graph 29**.

**GRAPH 29: PREDICTED FINAL VOID WATER LEVEL AND EC – CLIMATE CHANGE SCENARIO**





With consideration of potential climate change effects, the final void water level is predicted to reach a peak equilibrium level of approximately 110 m AHD which is approximately 77 m below the spill level (i.e. the final void is contained). Given the water level and groundwater flux relationship provided, groundwater outflow was not simulated to occur – i.e. the final void would remain a groundwater sink.

As a lower equilibrium water level of the final void is predicted with climate change effects (high emissions scenario – SSP3-7.0), and accordingly lower stored water volume, the salinity of the final void is predicted to be greater than that without climate change effects (refer **Graph 29**).



## 6 POTENTIAL SURFACE WATER IMPACTS

The potential impacts of the MPO (incorporating the Modification) on local and regional surface water resources comprise:

- Changes to flows in local creeks and the Hunter River due to the progressive extension and subsequent capture and re-use of drainage from active mine catchment areas and the post-mining final landform.
- Changes to groundwater-derived baseflow in local creeks and the Hunter River.
- Potential for export of contaminants (principally sediments and soluble salts) in mine catchment area runoff, controlled discharge and overflow from containment storages (principally sediments, soluble salts, oils and greases).
- Potential cumulative impacts to downstream water users associated with licensed extraction and discharge.

### 6.1 Catchment Yield and Flow Impacts

#### 6.1.1 Catchment Area Reduction and Catchment Yield Effects

During active mining operations, the mine water management system would continue to capture runoff from areas that would have previously flowed to the receiving waters. The potential effects on total flow in the surface water catchments have been assessed on the basis of the reduction in catchment area associated with the MPO (incorporating the Modification). **Table 24** lists the total area of land excised by the MPO water management system over the life of the modified MPO from the catchments of the Hunter River at Muswellbrook Bridge, Sandy Creek at Wybong Road, Rosebrook Creek at the Hunter River and Dry Creek at the Hunter River.

**TABLE 24: TOTAL AREA EXCISED BY MODIFIED MPO FROM SURFACE WATER CATCHMENTS**

Watercourse:	Hunter River at Muswellbrook Bridge		Sandy Creek at Wybong Road		Rosebrook Creek at Hunter River		Dry Creek at Hunter River*	
Pre-mining Catchment Area (km <sup>2</sup> )	4,220		47		19		17	
Year	Excised Area (km <sup>2</sup> )	Percentage of Catchment Area	Excised Area (km <sup>2</sup> )	Percentage of Catchment Area	Excised Area (km <sup>2</sup> )	Percentage of Catchment Area	Excised Area (km <sup>2</sup> )	Percentage of Catchment Area
September 2025	0	0.00%	1.41	3.0%	10.64	55.8%	3	17.8%
2027	3.3	0.08%	1.41	3.0%	12.06	63.3%	3.27	19.3%
2029	3.76	0.09%	1.74	3.7%	12.06	63.2%	3.27	19.3%
2031	4.38	0.10%	1.74	3.7%	12.06	63.2%	3.27	19.3%
Final Landform	1.38	0.03%	0	0%	4.78	25.1%	0	0%

\* Bengalla Mine excluded from total catchment area.



A summary of the maximum area excised by the MPO from the catchment of Sandy Creek at Wybong Road and the total maximum area excised by the MPO from the Hunter River at the Dry Creek confluence is provided in **Table 25**. These areas are compared to the maximum area excised by:

- the originally approved MPO, as described in the original water management study prepared for the MPO (PPK Environment & Infrastructure [PPK], 1997) (Original 1997 Environmental Impact Statement [EIS]); and
- the currently approved MPO at December 2026, as listed in **Table 25**.

**TABLE 25: COMPARISON OF MAXIMUM AREA EXCISED FROM KEY SURFACE WATER CATCHMENTS FOR APPROVED MPO AND MODIFIED MPO**

Watercourse:	Sandy Creek at Wybong Road	Hunter River at Dry Creek Confluence
Catchment area (km <sup>2</sup> )	47	4,384
Development Scenario	Maximum Catchment Excised (km <sup>2</sup> )	
Approved MPO (Original 1997 EIS)*	4.3	20.1
Approved MPO at December 2026	1.41	18.6
Modified MPO at December 2032	1.74	19.1

\* Source: PPK (1997).

The maximum area excised by the modified MPO from the Hunter River at Muswellbrook Bridge catchment is estimated at 4.38 km<sup>2</sup>, equating to 0.10% of the total catchment area of the Hunter River at Muswellbrook Bridge (refer **Table 24**). The maximum area excised by the modified MPO from the Hunter River at Muswellbrook Bridge is considered negligible and unlikely to result in impacts to streamflow in the Hunter River.

In comparison to the approved MPO at December 2026, the modified MPO would result in an incremental increase of 0.5 km<sup>2</sup> in the maximum catchment area excised from the Hunter River at the Dry Creek confluence (refer **Table 24**). However, the maximum catchment area excised from the Hunter River at the Dry Creek confluence due to the modified MPO is estimated at less than that originally approved for the MPO (Original 1997 EIS).

The maximum area excised by the modified MPO from the Sandy Creek catchment is estimated at 1.74 km<sup>2</sup> in 2031, equating to 3.7% of the total catchment area of Sandy Creek at Wybong Road. However, it is noted that the incremental increase associated with the Modification, in comparison to the approved MPO at December 2026, is 0.33 km<sup>2</sup> only. The maximum area estimated to be excised by the approved MPO at December 2026 and modified MPO is less than the predicted maximum area excised by the original approved MPO, which included two separate staged Fines Emplacement Areas in the Sandy Creek catchment. The preferred Fines Emplacement Area is a single storage with staged, downstream lifts which reduces the area excised in the water management system relative to the original approved MPO. The establishment of MWD2 post-2026, results in an increase in the area excised from the Sandy Creek catchment relative to the approved MPO at December 2026.

The maximum area excised by the modified MPO from the Rosebrook Creek catchment is estimated at 12.06 km<sup>2</sup>, equating to 63% of the total catchment area of Rosebrook Creek, while the maximum area excised by the MPO from the Dry Creek catchment is estimated at 3.27 km<sup>2</sup>, equating to 19% of the total catchment area of Dry Creek. The Modification would result in no incremental change to the catchment of Dry Creek or Rosebrook Creek relative to the approved MPO at December 2026.

As discussed in **Section 2.5.1**, the local surface water drainage systems within and adjacent to the MPO are predominately ephemeral. A maximum 63% reduction in average total flow volume in Rosebrook Creek is likely based on the reduction in catchment area associated with the approved and modified MPO. This reduction in total flow volume would be significant during high rainfall periods and discernible from natural flow variability. However, the reduction in flow would occur as part of the approved MPO rather than the modified MPO.



As discussed in **Section 2.5.1**, the Dry Creek catchment has been heavily modified by the Bengalla Mine Dry Creek Project and is no longer a natural surface water system. A maximum 19% reduction in average total flow volume in Dry Creek is likely based on the reduction in catchment area associated with the approved and modified MPO. However, the reduction in flow would occur as part of the approved MPO rather than the modified MPO. In addition, the reduction in total flow volume is not considered material given the heavily modified nature of Dry Creek downstream of the MPO.

Post-closure, the total area excised from the Hunter River catchment is estimated at 6.2 km<sup>2</sup>. This comprises a 25% reduction of the Rosebrook Creek catchment and a 0.03% reduction of the Hunter River at Muswellbrook Bridge catchment (**Table 24**). This is less than that proposed to be excised by the original approved final landform for the MPO of 20.3 km<sup>2</sup>, presented in the 1997 EIS (refer to Figure G6 of PPK [1997], reproduced in **Map 11**).

### 6.1.2 Baseflow Effects

Changes in groundwater-derived baseflow have been predicted by AGE (2025) for the Hunter Regulated River, Muswellbrook and Dart Brook Water Sources and associated water licensing requirements are summarised in **Table 26** in comparison with the share components currently held by MACH for the MPO.

**TABLE 26: MAXIMUM PREDICTED BASEFLOW REDUCTION DURING OPERATIONS AND POST-CLOSURE**

Water Sharing Plan	Water Source	Current MACH Share Components (Units)	During Mining Predicted Baseflow Reduction (ML/year)	Post-Closure Predicted Baseflow Reduction (ML/year)
Hunter Regulated River Water Source, 2016	Hunter Regulated River (Management Zone 1A)	961 (High Security) 2,947 (General Security)	27.5	41.8
Hunter Unregulated and Alluvial Water Sources, 2022	Muswellbrook Water Source (Sandy Creek)	41	0.4 <sup>^</sup>	2.3 <sup>^</sup>
	Dart Brook	20	1.2 <sup>^</sup>	6.3 <sup>^</sup>

<sup>^</sup> Includes indirect take from alluvial systems associated with these water sources.

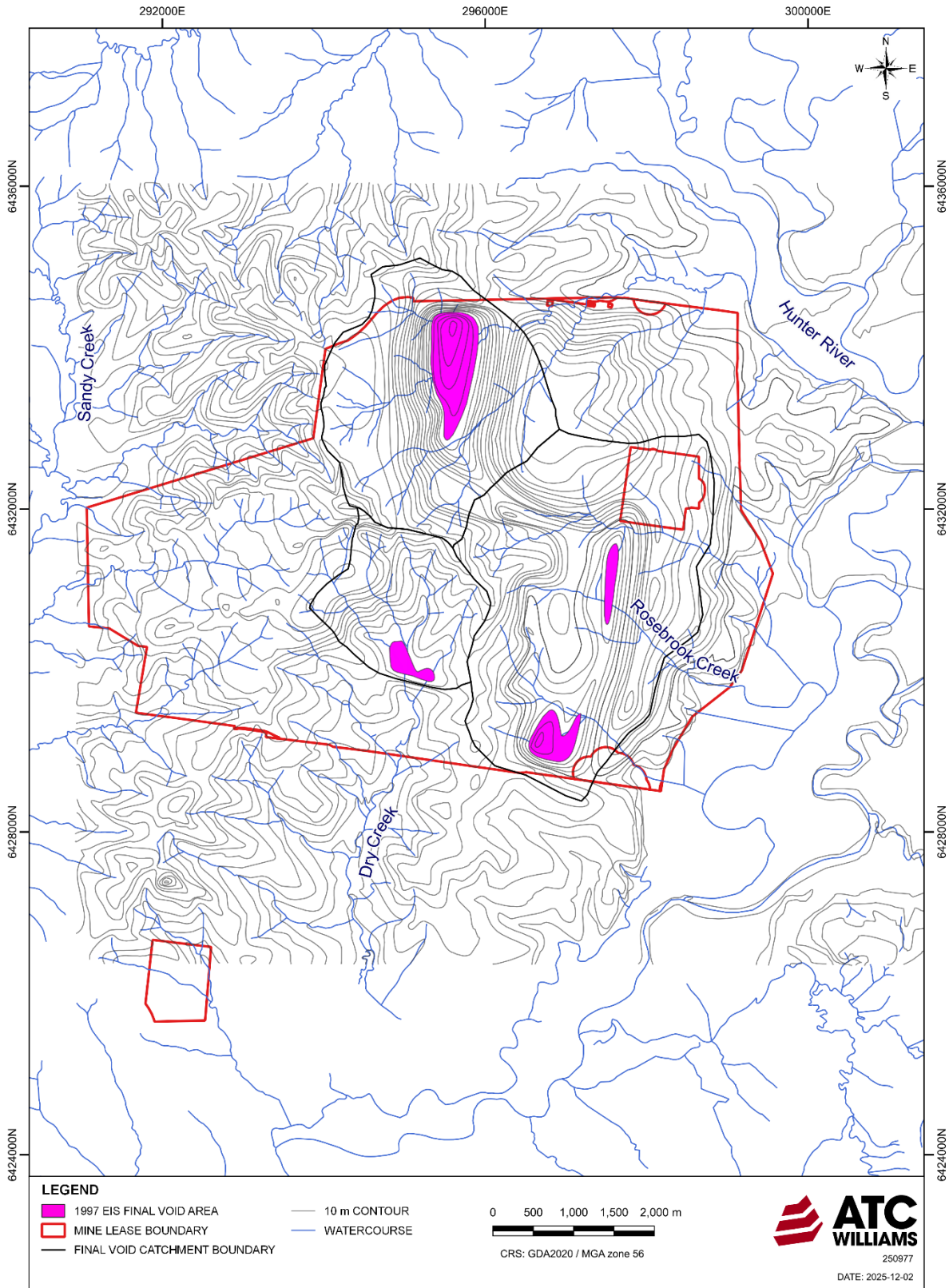
**Table 26** shows that a maximum of 27.5 ML/year baseflow reduction is predicted during mining for the Hunter Regulated River Water Source and a maximum total of 1.6 ML/year for Sandy Creek and Dart Brook (including indirect take from alluvial systems associated with these water sources).

The maximum predicted reduction in baseflow from the Hunter River and its tributaries during mining (29.1 ML/year) (i.e. the Hunter Regulated River Water Source and Hunter Unregulated and Alluvial Water Sources) amounts to approximately 0.02% of the 163,195 ML median annual total flow<sup>7</sup> in the Hunter River at Muswellbrook (GS 210002) (refer **Section 6.1.1**). Post-closure, the total predicted baseflow reduction from the Hunter Regulated River Water Source and Hunter Unregulated and Alluvial Water Sources (50.4 ML/year) amounts to approximately 0.03% of the 163,195 ML median annual total flow in the Hunter River at Muswellbrook (GS 210002). These forecast baseflow reductions represent a very small and indiscernible impact to flow in the Hunter River at Muswellbrook during operations and post-closure.

<sup>7</sup> Calculated for the period 2000-2024.



**MAP 11: ORIGINAL APPROVED FINAL LANDFORM (REPRODUCED FROM FIGURE G6 OF ORIGINAL 1997 EIS)**



N:\Synergy\Projects\1211\21164\_1607 MR Pleasant MACH Energy\28 MOD 7 SWA\GIS\Baseline\_MRPleasant\_StagePlans\_Report Figures.gxz



## 6.2 Water Quality Impacts

MACH has approval for discharge from the MPO to the Hunter River under the HRSTS. Additionally, Development Consent DA 92/97 permits discharge from sediment dams in accordance with the relevant design criteria.

A Geochemistry Assessment previously prepared for the MPO (RGS, 2020) identified that most of the overburden and interburden materials likely to be mined at the MPO are expected to be classified as non-acid forming (NAF) with leachate from these materials likely to be slightly to moderately saline and have low concentrations of soluble metals/metalloids. Overall, the assessment concluded that dissolved metal/metalloid concentrations in surface runoff and seepage from most NAF mining waste materials at the MPO are unlikely to present a significant risk to surface and groundwater resources (RGS, 2020). Material classified as potentially acid forming (PAF) is managed, and would continue to be managed, in accordance with the Water Management Plan for the MPO in order to reduce the potential for further weathering and oxidation of these materials.

### 6.2.1 Storage Overflow

The design of the proposed sediment dams has been undertaken in accordance with the Landcom (2004) and DECC (2008) guidelines. These guidelines provide for sediment dams to overflow (or discharge) when rainfall exceeds the design capacity of the dams. Up to late 2025, one overflow event has occurred from sediment dam SD1, two overflow events have occurred from sediment dams SD6 and SD7 and three overflow events from sediment dam SD4 as detailed in **Section 2.7.3**.

Overflow from sediment dams is predicted by the operational water balance model to occur during high rainfall events only. During these periods, the concentration of environmentally significant constituents in the sediment dams is likely to be low as inflow from catchment surface runoff will predominate over baseflow (seepage). This is supported by the Groundwater Assessment (AGE, 2025), which states that the majority of seepage from the waste rock emplacement area would report to the MPO and Bengalla Mine open cut pits.

To assess the potential influence of overflow from sediment dams SD1, SD3, SD4, SD5, SD8, SD9 and SD12 on the water quality of the Hunter River, the following was undertaken:

1. The median and maximum concentration of key constituents were calculated from the water quality records for sediment dams SD1, SD3 and SD4 to provide an indication of the potential water quality of sediment dam overflow.
2. The median and maximum concentration of key constituents in the Hunter River at monitoring site W17 were calculated to provide an indication of the potential water quality of the Hunter River in the vicinity of potential overflow from SD1, SD3, SD4, SD5, SD8, SD9 and SD12.
3. The predicted median and 95<sup>th</sup> percentile daily overflow rates from the sediment dams were calculated from operational water balance model results (refer **Section 4.3.6**) for the 7.3 year simulation period and all 129 realizations.
4. The predicted flow rates at the Hunter River at Muswellbrook on the overflow days that equated to the median and 95<sup>th</sup> percentile overflow rates were identified from the operational water balance model results.
5. Mass balance equations were conducted for two scenarios as follows:
  - a. Median conditions:
    - median predicted overflow rate;
    - Hunter River at Muswellbrook flow rate at the time of overflow;
    - estimated median overflow water quality; and
    - median Hunter River at W17 water quality.
  - b. 95<sup>th</sup> percentile conditions:
    - 95<sup>th</sup> percentile predicted overflow rate;
    - Hunter River at Muswellbrook flow rate at the time of overflow;



- estimated maximum overflow water quality; and
- maximum Hunter River at W17 water quality.

It is noted that the quality of stored water in the sediment dams may not represent the water quality of overflow from the sediment dams during high rainfall periods (e.g. when overflows are designed to occur). Based on the EC values presented in **Section 2.7.3**, the average EC of all overflow events from SD1 and SD4 was 327  $\mu\text{S}/\text{cm}$ , with a maximum EC value of 420  $\mu\text{S}/\text{cm}$  recorded. As shown in **Table 28**, the median EC of SD1, SD3 and SD4 based on monitoring records of stored water was 637  $\mu\text{S}/\text{cm}$  with a maximum EC value of 1,988  $\mu\text{S}/\text{cm}$ . As such, it is considered that the water quality assessment detailed below is conservative.

The estimated water quality in the Hunter River at monitoring site W17 following predicted overflow from the MPO to the Hunter River via SD1, SD3, SD4, SD5, SD8, SD9 and SD12 is given in **Table 27**. Note that only constituents with a surface water quality trigger level or ANZG (2018) default guideline value have been assessed. Additionally, only constituents which were recorded above the limit of detection in the sediment dams have been assessed. Further, the assessment assumed conservation of mass of constituents and fully mixed conditions.

The assessment in **Table 27** indicates the following:

1. Under median conditions, the increase in median values of constituents in the Hunter River at W17 is estimated at less than 1% as a result of predicted overflow from the MPO sediment dams SD1, SD3, SD4, SD5, SD8, SD9 and SD12.
2. Based on the 95<sup>th</sup> percentile conditions, the increase in constituents in the Hunter River at W17 is estimated at less than 1% as a result of predicted overflow from the MPO sediment dams SD1, SD3, SD4, SD5, SD8, SD9 and SD12.
3. The maximum values of total lead, total nickel, total manganese, total arsenic and total boron in the Hunter River at W17 are not expected to exceed the ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems).
4. Although the median and maximum total copper and total aluminium concentrations in the Hunter River at W17 following sediment dam overflow are estimated to exceed the ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems), it is noted that the median and maximum concentrations of these constituents exceed the ANZG (2018) default guideline value under baseline conditions.
5. Although the maximum total chromium and total zinc concentrations in the Hunter River at W17 following sediment dam overflow are estimated to exceed the ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems), it is noted that the maximum concentrations of total chromium and total zinc exceed the ANZG (2018) default guideline value under baseline conditions.

The above assessment was also conducted to assess the influence of overflow from SD6, SD7, TLO Dam, RLD2 and ED3 on the water quality of the Hunter River at W15 (refer **Section 4.3**). It is noted that few water quality records are available for SD6, SD7, TLO Dam and RLD2. As such, water quality records for ED3 have been adopted in the assessment.

The assessment presented below is considered conservative with respect to the potential influence of EC in overflow from SD6 and SD7 on the water quality of the Hunter River at W15. Based on the EC values presented in **Section 2.7.3**, the average EC of all overflow events from SD6 and SD7 was 248  $\mu\text{S}/\text{cm}$ , with a maximum EC value of 371  $\mu\text{S}/\text{cm}$  recorded.

The estimated water quality in the Hunter River at W15 following predicted overflow from the MPO to the Hunter River via SD6, SD7, TLO Dam, RLD2 and ED3 is given in **Table 28**.

The assessment in **Table 28** indicates that, for both the median and 95<sup>th</sup> percentile conditions, less than 1% increase in median and maximum constituent values in the Hunter River at monitoring site W15 is predicted as result of overflow from the MPO via SD6, SD7, TLO Dam, RLD2 and ED3.



**TABLE 27: ESTIMATED HUNTER RIVER WATER QUALITY WITH OVERFLOW – ROSEBROOK CREEK AND HUNTER RIVER**

Location	Value	Monitored Water Quality											
		EC (µS/cm)	TSS (mg/L)	Total Copper (mg/L)	Total Lead (mg/L)	Total Zinc (mg/L)	Total Nickel (mg/L)	Total Manganese (mg/L)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Aluminium (mg/L)	Total Boron (mg/L)	
SD1, SD3 and SD4	Median	637	49	0.005	0.001	0.006	0.003	0.035	0.001	0.002	1.7	0.05	
	Maximum	1,988	1,340	0.018	0.007	0.033	0.014	0.306	0.005	0.01	15.9	0.13	
Hunter River at W17	Median	618	26	0.002	0.001	0.005	0.001	0.094	0.001	0.001	0.8	0.05	
	Maximum	1,120	3,260	0.005	0.002	0.014	0.005	0.146	0.002	0.011	4.6	0.05	
Model Result		Predicted Flow Rate (ML/day)											
		Overflow		Hunter River at Muswellbrook (GS210002)									
Median		28		2,688									
95 <sup>th</sup> Percentile		100		10,836									
Location	Value	Estimated Hunter River Water Quality with Overflow											
		EC (µS/cm)	TSS (mg/L)	Total Copper (mg/L)	Total Lead (mg/L)	Total Zinc (mg/L)	Total Nickel (mg/L)	Total Manganese (mg/L)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Aluminium (mg/L)	Total Boron (mg/L)	
Hunter River at W17	Median	618	26	0.002	0.001	0.005	0.001	0.094	0.001	0.001	0.8	0.05	
	Maximum	1,121	3,257	0.005	0.002	0.014	0.005	0.146	0.002	0.011	4.7	0.05	
	Value	Estimated Percent Increase with Overflow											
	Median	<1%	<1%	<1%	<1%	<1%	<1%	<1%	0%	<1%	<1%	<1%	<1%
	Maximum	<1%	0%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	0%	<1%	<1%
Trigger level / DGV <sup>^</sup>		650 <sup>+</sup>	85 <sup>+</sup>	0.0014 <sup>^</sup>	0.0034 <sup>^</sup>	0.008 <sup>^</sup>	0.011 <sup>^</sup>	1.9 <sup>^</sup>	0.024 <sup>^</sup>	0.001 <sup>^</sup>	0.055 <sup>^</sup>	0.94 <sup>^</sup>	

<sup>^</sup> DGV = default guideline value - ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems)

<sup>+</sup> Hunter River at W17 trigger level



**TABLE 28: ESTIMATED HUNTER RIVER WATER QUALITY WITH OVERFLOW – DRY CREEK AND HUNTER RIVER**

Location	Value	Monitored Water Quality										
		EC (µS/cm)	TSS (mg/L)	Total Copper (mg/L)	Total Lead (mg/L)	Total Zinc (mg/L)	Total Nickel (mg/L)	Total Manganese (mg/L)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Aluminium (mg/L)	Total Boron (mg/L)
ED3	Median	1,641	9	0.001	0.001	0.005	0.003	0.02	0.001	0.001	0.11	0.08
	Maximum	3,640	307	0.004	0.001	0.01	0.006	0.08	0.003	0.002	1.84	0.13
Hunter River at W15	Median	493	24	0.001	0.001	0.005	0.001	0.05	0.001	0.001	0.62	0.05
	Maximum	1,146	3,550	0.007	0.001	0.015	0.003	0.09	0.002	0.002	3.06	0.05
Model Result		Predicted Flow Rate (ML/day)										
		Overflow		Hunter River at Muswellbrook (GS210002)								
Median		0.24		2,574								
95 <sup>th</sup> Percentile		16.8		86,192								
Location	Value	Estimated Hunter River Water Quality with Overflow										
		EC (µS/cm)	TSS (mg/L)	Total Copper (mg/L)	Total Lead (mg/L)	Total Zinc (mg/L)	Total Nickel (mg/L)	Total Manganese (mg/L)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Aluminium (mg/L)	Total Boron (mg/L)
Hunter River at W15	Median	493	23	0.001	0.001	0.005	0.001	0.05	0.001	0.001	0.61	0.05
	Maximum	1,146	3,549	0.007	0.001	0.015	0.003	0.09	0.002	0.002	3.06	0.05
	Value	Estimated Percent Increase with Overflow										
	Median	<1%	0%	<1%	<1%	<1%	<1%	0%	<1%	<1%	0%	<1%
	Maximum	<1%	0%	0%	<1%	0%	<1%	0%	<1%	<1%	0%	<1%
Trigger level / DGV <sup>^</sup>		460 <sup>+</sup>	23 <sup>+</sup>	0.0014 <sup>^</sup>	0.0034 <sup>^</sup>	0.008 <sup>^</sup>	0.011 <sup>^</sup>	1.9 <sup>^</sup>	0.024 <sup>^</sup>	0.001 <sup>^</sup>	0.055 <sup>^</sup>	0.94 <sup>^</sup>

<sup>^</sup> DGV = default guideline value - ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems)  
<sup>+</sup> Hunter River at W15 trigger level



## 6.2.2 Hunter River Discharge

Controlled discharge from the MWD and DW1 via the HRSTS should comprise a very small component of the flow in the Hunter River (as governed by the discharge rules of the HRSTS) and dilution would be substantial. The average annual Hunter River discharge volume is predicted at 38 ML based on the median model results. This compares with a median annual flow recorded in the Hunter River at Muswellbrook (GS 210002) of approximately<sup>8</sup> 163,195 ML, meaning the forecast median discharge represents approximately 0.02% of the recorded median annual river flow.

An average annual discharge volume of 214 ML is predicted based on the 95<sup>th</sup> percentile model results. This compares with a 95<sup>th</sup> percentile annual flow recorded in the Hunter River at Muswellbrook (GS 210002) of approximately<sup>9</sup> 575,979 ML, meaning the forecast 95<sup>th</sup> percentile discharge represents approximately 0.04% of the recorded 95<sup>th</sup> percentile annual river flow.

It is recognised that the above assessment does not account for the fact that controlled discharge is only predicted to occur at intermittent periods. As such, simulated controlled daily discharge volumes were used to calculate the percentage of flow in the Hunter River at Muswellbrook that these forecast discharges would represent for each discharge day – i.e. the forecast discharge dilution. A modelled mine life realization corresponding to the median overall total controlled discharge volume was selected for illustrative purposes. For each simulated day, the controlled discharge volume was compared with the flow rate for the Hunter River at Muswellbrook. Discharge was found to occur on 0.4% of days in total over the 7.3 year simulation. On average, the controlled discharge volumes equated to 0.8% of river flow on those (rare) discharge days.

To assess the influence of discharge from the MWD and DW1 on the water quality of the Hunter River, the following was undertaken:

1. The median and maximum concentration of key constituents were calculated from the water quality records for MWD to provide an indication of potential discharge water quality.
2. The median and maximum concentration of key constituents in the Hunter River at monitoring site W15 were calculated to provide an indication of the potential water quality of the Hunter River in the vicinity of discharge from the MWD.
3. The predicted median and 95<sup>th</sup> percentile daily discharge rates from the MWD and DW1 were calculated from operational water balance model (refer **Section 4.3.6**) results for the 7.3 year simulation period and all 129 realizations.
4. The predicted flow rates at the Hunter River at Muswellbrook on the discharge days that equated to the median and 95<sup>th</sup> percentile discharge rates were identified from the operational water balance model results.
5. Mass balance equations were conducted for two scenarios as follows:
  - a. Median conditions:
    - median predicted discharge rate;
    - Hunter River at Muswellbrook flow rate at the time of discharge;
    - Estimated median discharge water quality; and
    - Median Hunter River at W15 water quality.
  - b. 95<sup>th</sup> percentile conditions:
    - 95<sup>th</sup> percentile predicted discharge rate;
    - Hunter River at Muswellbrook flow rate at the time of discharge;
    - estimated maximum discharge water quality; and
    - maximum Hunter River at W15 water quality.

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<sup>8</sup> Calculated for the period 2000-2024.



The estimated water quality in the Hunter River at monitoring site W15 following predicted discharge from the MPO to the Hunter River via the MWD or DW1 is given in **Table 29**. Note that only constituents with a surface water quality trigger level or ANZG (2018) default guideline value have been assessed. Additionally, only constituents which were recorded above the limit of detection in the MWD have been assessed. Further, the assessment assumed conservation of mass of constituents and fully mixed conditions.

The assessment in **Table 29** indicates the following:

1. Under median conditions, the maximum increase in the median values of assessed constituents in the Hunter River at W15 was estimated to be 4.3% (i.e. total nickel) as a result of discharge from the MWD or DW1 to the Hunter River, with other constituents estimated to increase by less than 1.9%.
2. Although a 4.3% increase in total nickel in the Hunter River at W15 is estimated as a result of discharge from the MWD or DW1 to the Hunter River under median conditions, the ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) would not be exceeded.
3. Under 95<sup>th</sup> percentile conditions, the maximum values of constituents in the Hunter River at W15 are estimated to increase by up to 7% as a result of discharge from the MWD or DW1 to the Hunter River.
4. Although total nickel is estimated to increase by up to 7% as a result of discharge from the MWD to the Hunter River, the ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems) would not be exceeded.
5. The ANZG (2018) default guideline values for total lead, total nickel, total manganese, total arsenic and total boron would not be exceeded.
6. Although the median and maximum EC values in the Hunter River at W15 may exceed the site-specific trigger level due to discharge from MWD or DW1, it is noted that the median and maximum EC values in the Hunter River at W15 exceed the site-specific trigger level under baseline conditions.
7. Although the maximum total aluminium, total copper, total chromium and total zinc concentrations in the Hunter River at W15 may exceed the ANZG (2018) default guideline value due to discharge from the MWD or DW1, it is noted that the maximum concentrations of these constituents in the Hunter River at W15 exceed the ANZG (2018) default guideline value under baseline conditions.



**TABLE 29: ESTIMATED HUNTER RIVER WATER QUALITY WITH CONTROLLED DISCHARGE**

Location	Value	Monitored Water Quality												
		EC (µS/cm)	TSS (mg/L)	Total Copper (mg/L)	Total Lead (mg/L)	Total Zinc (mg/L)	Total Nickel (mg/L)	Total Manganese (mg/L)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Aluminium (mg/L)	Total Boron (mg/L)		
MWD	Median	2,040	5	0.001	0.001	0.005	0.008	0.039	0.001	0.001	0.05	0.07		
	Maximum	3,630	36	0.003	0.001	0.081	0.026	0.462	0.003	0.001	0.3	0.12		
Hunter River at W15	Median	493	24	0.001	0.001	0.005	0.001	0.046	0.001	0.001	0.62	0.05		
	Maximum	1,146	3,550	0.007	0.001	0.015	0.003	0.09	0.002	0.002	3.06	0.05		
Model Result		Predicted Flow Rate (ML/day)												
		Controlled Discharge		Hunter River at Muswellbrook (GS210002)										
Median		28		4,409										
95 <sup>th</sup> Percentile		100		10,836										
Location	Value	Estimated Hunter River Water Quality with Controlled Discharge												
		EC (µS/cm)	TSS (mg/L)	Total Copper (mg/L)	Total Lead (mg/L)	Total Zinc (mg/L)	Total Nickel (mg/L)	Total Manganese (mg/L)	Total Arsenic (mg/L)	Total Chromium (mg/L)	Total Aluminium (mg/L)	Total Boron (mg/L)		
Hunter River at W15	Median	502	23	0.001	0.001	0.005	0.001	0.046	0.001	0.001	0.61	0.05		
	Maximum	1,169	3,518	0.007	0.001	0.016	0.0032	0.093	0.002	0.002	3.03	0.05		
	Value	Estimated Percent Increase with Controlled Discharge												
	Median	1.9%	0%	0%	0%	0%	4.3%	0%	0%	0%	0%	0%	<1%	
	Maximum	2.0%	0%	0%	<1%	4.0%	7.0%	3.8%	<1%	0%	0%	0%	1.3%	
Trigger level / DGV <sup>^</sup>		460 <sup>+</sup>	23 <sup>+</sup>	0.0014 <sup>^</sup>	0.0034 <sup>^</sup>	0.008 <sup>^</sup>	0.011 <sup>^</sup>	1.9 <sup>^</sup>	0.024 <sup>^</sup>	0.001 <sup>^</sup>	0.055 <sup>^</sup>	0.94 <sup>^</sup>		

<sup>^</sup> DGV = default guideline value - ANZG (2018) default guideline value for aquatic ecosystems (95% level of species protection for slightly to moderately disturbed ecosystems)

<sup>+</sup> Hunter River at W15 trigger level



## 6.3 Potential Cumulative Impacts

### 6.3.1 Overview of Cumulative Impacts

Cumulative impacts have been described in a mining context by Franks, et al (2010) as:

*“...arise from compounding activities of a single operation or multiple mining and processing operations, as well as the aggregation and interaction of mining impacts with other past, current and future activities that may not be related to mining.”*

In the context of surface water resources potentially impacted by the MPO there has been significant past development in the upstream, immediate and downstream catchment areas which, if taken from European settlement, include widespread agricultural development and urbanisation. There has also been significant development of the surface water resources themselves - including regulation and extraction of water from local and regional surface water resources. The effects of past development are inevitably incorporated into the baseline data and descriptions of surface water resources developed for the MPO which are based on contemporary monitoring.

### 6.3.2 Local Cumulative Impacts

The Mangoola Coal area is partially located in the Sandy Creek catchment downstream of the MPO. The maximum area of the Sandy Creek catchment to be excised by Mangoola Coal was estimated at 2.88 km<sup>2</sup> in 2021 which equates to approximately 2.1% of the total catchment area of Sandy Creek (WRM, 2013).

As shown in **Table 24**, the maximum area of the Sandy Creek catchment to be excised by the modified MPO is 1.7 km<sup>2</sup>. This, combined with the maximum reduction of Sandy Creek catchment area as a result of the Mangoola Coal development, would see a cumulative maximum reduction of 4.6 km<sup>2</sup> equating to approximately 3.2% of the total catchment area of Sandy Creek to the confluence with the Hunter River. A 3.2% reduction in the total catchment area of Sandy Creek is considered small and unlikely to significantly affect flow in Sandy Creek.

As stated in **Section 4.3.6**, negligible overflow from the MPO to Sandy Creek is predicted to occur. As such, it is highly unlikely that the MPO will contribute to any significant impacts to the water quality of Sandy Creek.

The Dry Creek catchment has been heavily modified by the Dry Creek Project for the Bengalla Mine and is no longer a natural surface water system. While a moderate reduction in the catchment yield of Dry Creek is predicted based on the reduction in catchment area associated with the approved and modified MPO (maximum 19.3% reduction in **Table 24**), the reduction in total flow volume is not considered material given the heavily modified nature of Dry Creek downstream of the MPO.

### 6.3.3 Regional Cumulative Impacts

The MPO is situated adjacent to the Bengalla Mine and in the vicinity of the Muswellbrook Coal Mine, Dartbrook Mine, Mount Arthur Coal Mine and Mangoola Coal. These mines operate in a highly regulated water system with licensing of water take undertaken in accordance with the *Water Management Act 2000* and discharge of water undertaken in accordance with the HRSTS, the relevant Development Consent and the EPL for each site. With the implementation of the various controls under these regulatory systems, the cumulative impacts on downstream water users associated with the proposed modified MPO are expected to be negligible.



## 7 MONITORING, MITIGATION AND MANAGEMENT

### 7.1 Operational Monitoring and Management

Surface water monitoring and management at the MPO will continue to be undertaken in accordance with the Water Management Plan. The Water Management Plan will be updated to include the modified MPO water management system following approval.

The current surface water monitoring program for the MPO will continue to be undertaken and the outcomes assessed in accordance with the trigger action response protocols detailed in the Water Management Plan. In conjunction with the current surface water monitoring program, it is recommended that additional monitoring is undertaken at the relevant time during the life of the MPO as summarised in **Table 30**.

**TABLE 30: RECOMMENDED SURFACE WATER MONITORING**

Monitoring Sites/Locations	Parameters	Frequency	Recommendation
Hunter River discharge pipeline	Volume discharged	Daily when discharging	Continue monitoring
	pH, EC and TSS	Continuous EC, daily pH and TSS monitoring during discharge	
ED2, ED3, SD1, SD3, SD4, SD5, SD6, SD7, SD8, SD9, SD12, RLD2, TLO Dam, MWD, MWD2 and Fines Emplacement Area	pH, EC, TSS, TDS and occurrence and duration of spillway flow	Daily during discharge and for five days after	Continue or commence monitoring
SD5, SD8, SD9 and SD12	Suite 1 <sup>^</sup>	Monthly	Commence upon commissioning
	Suite 2 <sup>^</sup>	Minimum annually	
	Suite 3 <sup>^</sup>	Minimum annually	
	Water level	Minimum monthly	Installation of level gauge board upon construction
Erosion and sediment control structures	Integrity/function, water level and sediment build up	Monthly and immediately following rainfall events with more than 20 mm in 24 hours*	Continue existing and add proposed additional sediment controls

<sup>^</sup> Refer **Section 2.4**.

\* In accordance with the MPO Erosion and Sediment Control Plan contained in the Water Management Plan (MACH, 2025).

The results from the monitoring program will continue to be maintained in a database for review and assessment and used to assist in the management of the quality and quantity of surface water within and around the MPO. Monitoring results and any specialist interpretations of trends observed in the monitoring data will be reported annually in the Annual Review.

It is recommended that the site water balance model and numerical groundwater model are updated and verified on a regular basis to maintain the models as reliable tools for assessing the effectiveness of the site water management system. Periodic forecast water balance modelling will inform near term water supply reliability for the MPO and the need to plan for contingency measures such as the use of dust suppressants in low rainfall periods.



## 7.2 Post-Mining Monitoring and Management

Water quality monitoring should continue for two years following cessation of operations, with monitoring data reviewed at annual intervals (as part of the annual review process) over this period. Reviews should involve assessment against long-term performance objectives that are derived from baseline conditions or a justifiable departure from these, with due allowance for climatic variations. If objectives are not substantially met within the two-year period, management measures should be revised and the monitoring period extended.

## 7.3 Potential Contingency Measures

Potential contingency measures in the event of unforeseen impacts or impacts in excess of those predicted would include:

- conducting additional monitoring (e.g. increase in monitoring frequency or additional sampling locations) to confirm impacts and inform the proposed contingency measures;
- refinements to the water management system design such as additional containment dams, drains, increases to storage or pumping capacity, installation of new structures as required to address the identified issue or repairs / maintenance of existing structures;
- remediation of any sources of elevated environmentally significant water quality constituents that have the potential to degrade the water quality of environmental receptors to beyond levels experienced to date;
- provision of compensatory water supply to affected landholders; and/or
- acquisition of additional water allocation licence shares.



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## APPENDICES



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## APPENDIX A – WATER QUALITY SUMMARY TABLES



## APPENDIX A1 – WATER QUALITY SUMMARY FOR THE HUNTER RIVER AND MUSCLE CREEK

Parameter (mg/L unless otherwise stated)	Default Guideline Value	W1				W2				W3			
		No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum
Total Aluminium	0.055	7	0.13	0.32	8.48	11	0.10	0.3	0.49	13	0.02	0.41	6.39
Total Arsenic	0.024	13	<0.001	<0.001	0.002	17	<0.001	<0.001	<0.001	19	<0.001	<0.001	0.002
Total Barium	-	13	<0.01	0.014	0.06	17	<0.01	0.014	0.02	19	<0.01	0.016	0.055
Total Boron	0.94	7	<0.05	<0.05	0.06	11	<0.05	<0.05	<0.05	13	<0.05	<0.05	0.07
Total Cadmium	0.0002	13	<0.0001	<0.0001	0.0002	17	<0.0001	<0.0001	0.0002	19	<0.0001	<0.0001	<0.0002
Total Chromium	0.001	12	<0.001	<0.001	0.012	12	<0.001	<0.001	<0.001	16	<0.001	<0.001	0.007
Total Copper	0.0014	13	<0.001	<0.001	0.012	17	<0.001	<0.001	0.003	19	<0.001	<0.001	0.008
Total Iron	-	12	0.005	0.43	10.40	12	0.007	0.19	0.56	15	0.012	0.41	7.34
Total Lead	0.0034	13	<0.001	<0.001	0.003	17	<0.001	<0.001	0.01	18	<0.001	<0.001	0.003
Total Lithium	-	13	<0.001	0.005	0.01	17	<0.001	0.002	0.01	19	<0.001	0.002	0.01
Total Manganese	1.9	13	<0.001	0.031	0.35	17	<0.001	0.031	0.062	19	<0.001	0.04	0.304
Total Mercury	0.0006	7	<0.0001	<0.0001	0.0001	11	<0.0001	<0.0001	<0.0001	13	<0.0001	<0.0001	<0.0001
Total Nickel	0.011	13	<0.001	<0.001	0.01	17	<0.001	<0.001	0.002	19	<0.001	<0.001	0.01
Total Selenium	0.011	13	<0.001	<0.001	0.01	17	<0.001	0.01	0.01	19	<0.001	0.01	0.01
Total Silver	0.00005	5	<0.001	<0.001	0.01	5	<0.001	<0.001	0.005	8	<0.001	<0.001	0.005
Total Strontium	-	13	0.21	0.24	0.36	17	0.23	0.27	0.44	19	0.23	0.27	0.51
Total Zinc	0.008	13	<0.005	<0.005	0.19	17	<0.005	<0.005	0.014	19	<0.005	<0.005	0.026



Parameter (mg/L unless otherwise stated)	Default Guideline Value	W4				W6A				W15			
		No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum
Total Aluminium	0.055	13	0.08	0.15	2.65	9	0.1	0.4	13.1	8	0.29	0.62	3.06
Total Arsenic	0.024	19	<0.001	0.002	0.003	14	<0.001	<0.001	0.003	14	<0.001	<0.001	0.002
Total Barium	-	19	0.035	0.053	0.09	14	<0.01	0.017	0.079	14	0.012	0.019	0.034
Total Boron	0.94	13	<0.05	0.09	0.14	9	<0.05	<0.05	<0.05	8	<0.05	<0.05	<0.05
Total Cadmium	0.0002	19	<0.0001	<0.0001	0.0002	14	<0.0001	<0.0001	0.0002	14	<0.0001	<0.0001	0.0002
Total Chromium	0.001	15	<0.001	<0.001	0.002	14	<0.001	<0.001	0.018	14	<0.001	<0.001	0.002
Total Copper	0.0014	19	<0.001	<0.001	0.03	14	<0.001	<0.001	0.015	14	<0.001	<0.001	0.007
Total Iron	-	15	0.006	0.28	3.3	14	0.007	0.425	15.5	14	0.016	0.62	3.2
Total Lead	0.0034	19	<0.001	<0.001	0.002	14	<0.001	<0.001	0.004	14	<0.001	<0.001	<0.001
Total Lithium	-	19	0.003	0.01	0.017	14	<0.001	0.005	0.01	14	<0.001	0.004	0.01
Total Manganese	1.9	19	0.002	0.14	0.27	14	<0.001	0.038	0.465	14	<0.001	0.046	0.09
Total Mercury	0.0006	13	<0.0001	<0.0001	0.0001	9	<0.0001	<0.0001	<0.0001	9	<0.0001	<0.0001	<0.0001
Total Nickel	0.011	19	<0.001	<0.001	0.004	14	<0.001	<0.001	0.019	14	<0.001	<0.001	0.003
Total Selenium	0.011	19	<0.001	0.01	0.01	14	<0.001	0.006	0.01	14	<0.001	0.01	0.006
Total Silver	0.00005	8	<0.001	<0.001	0.005	8	<0.001	<0.001	0.005	8	<0.001	<0.001	0.005
Total Strontium	-	19	0.1	0.81	1.44	14	0.23	0.26	0.46	14	0.21	0.29	0.46
Total Zinc	0.008	19	<0.005	0.007	0.037	14	<0.005	<0.005	0.036	14	<0.005	<0.005	0.015



Parameter (mg/L unless otherwise stated)	Default Guideline Value	W17			
		No. of Samples	Minimum	Median	Maximum
Total Aluminium	0.055	9	0.28	0.80	4.64
Total Arsenic	0.024	9	<0.001	<0.001	0.002
Total Barium	-	9	0.019	0.022	0.038
Total Boron	0.94	9	<0.05	<0.05	<0.05
Total Cadmium	0.0002	9	<0.0001	<0.0001	0.0002
Total Chromium	0.001	9	<0.001	<0.001	0.011
Total Copper	0.0014	9	<0.001	0.002	0.005
Total Iron	-	9	0.53	1.00	6.5
Total Lead	0.0034	9	<0.001	<0.001	0.002
Total Lithium	-	9	<0.001	<0.001	0.01
Total Manganese	1.9	9	0.041	0.094	0.146
Total Mercury	0.0006	8	<0.0001	<0.0001	<0.0001
Total Nickel	0.011	9	<0.001	<0.001	0.005
Total Selenium	0.011	9	<0.01	<0.01	<0.01
Total Silver	0.00005	8	<0.001	<0.001	0.005
Total Strontium	-	9	0.19	0.35	0.56
Total Zinc	0.008	8	<0.005	<0.005	0.014



## APPENDIX A2 – WATER QUALITY SUMMARY FOR SANDY CREEK

Parameter (mg/L unless otherwise stated)	Default Guideline Value	W11				W12				W16			
		No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum
Total Aluminium	0.055	4	<0.01		0.22	9	<0.01	0.05	6.16	5	0.11	2.45	87.7
Total Arsenic	0.024	9	<0.001	<0.001	0.004	15	<0.001	<0.001	0.006	5	<0.001	0.002	0.006
Total Barium	-	9	0.1	0.19	0.34	15	0.09	0.22	0.37	5	0.048	0.23	0.437
Total Boron	0.94	4	0.06		0.11	9	<0.05	0.18	0.28	5	<0.05	0.06	0.16
Total Cadmium	0.0002	9	<0.0001	<0.0001	0.0002	15	<0.0001	<0.0001	0.0002	4	<0.0001	-	0.0002
Total Chromium	0.001	9	<0.001	<0.001	<0.001	15	<0.001	<0.001	0.007	4	<0.001	-	0.134
Total Copper	0.0014	9	<0.001	<0.001	0.003	15	<0.001	<0.001	0.006	5	0.002	0.004	0.056
Total Iron	-	10	0.14	0.42	0.71	15	0.012	0.17	6.1	5	0.28	2.08	84.6
Total Lead	0.0034	9	<0.001	<0.001	<0.001	15	<0.001	<0.001	0.004	4	<0.001	-	0.038
Total Lithium	-	9	0.011	0.024	0.037	15	0.004	0.01	0.016	5	0.002	0.03	0.054
Total Manganese	1.9	9	0.075	0.18	1.1	15	<0.001	0.22	1.65	5	0.06	0.139	1.3
Total Mercury	0.0006	4	<0.0001	-	<0.0001	9	<0.0001	<0.0001	<0.0001	4	<0.0001	-	<0.0001
Total Nickel	0.011	9	<0.001	0.002	0.003	15	<0.001	0.002	0.014	5	0.005	0.008	0.15
Total Selenium	0.011	9	<0.001	<0.001	0.01	15	<0.001	<0.001	0.01	5	<0.001	0.01	0.01
Total Silver	0.00005	3	<0.001		0.005	8	<0.001	<0.001	<0.005	4	<0.001	-	0.005
Total Strontium	-	9	2	2.8	3.6	15	0.188	1.52	2.16	5	0.106	0.242	1.5
Total Zinc	0.008	9	<0.005	<0.005	0.017	15	<0.005	<0.005	0.016	5	0.005	0.012	0.179



Parameter (mg/L unless otherwise stated)	Default Guideline Value	W13			
		No. of Samples	Minimum	Median	Maximum
Total Aluminium	0.055	2	0.76		5.23
Total Arsenic	0.024	3	<0.001		0.002
Total Barium	-	3	0.02		0.27
Total Boron	0.94	2	<0.05		0.21
Total Cadmium	0.0002	3	<0.0001		0.0002
Total Chromium	0.001	3	0.002		0.006
Total Copper	0.0014	3	0.003		0.004
Total Iron	-	3	1.4		4.29
Total Lead	0.0034	3	<0.001		0.002
Total Lithium	-	3	0.004		0.006
Total Manganese	1.9	3	0.009		0.2
Total Mercury	0.0006	2	<0.0001	-	<0.0001
Total Nickel	0.011	3	0.006		0.017
Total Selenium	0.011	3	<0.001		0.01
Total Silver	0.00005	2	<0.001	-	0.005
Total Strontium	-	3	0.045		1.4
Total Zinc	0.008	3	<0.005		0.014



## APPENDIX A3 – WATER QUALITY SUMMARY FOR UNNAMED TRIBUTARIES OF THE HUNTER RIVER

Parameter (mg/L unless otherwise stated)	Default Guideline Value	W5				W9			
		No. of Samples	Minimum	Median	Maximum	No. of Samples	Minimum	Median	Maximum
Total Aluminium	0.055	1	3.2	-	3.2	1	5.01	-	5.01
Total Arsenic	0.024	1	<0.001	-	<0.001	1	<0.001	-	<0.001
Total Barium	-	1	0.033	-	0.033	1	0.06	-	0.06
Total Boron	0.94	1	<0.05	-	<0.05	1	<0.05	-	<0.05
Total Cadmium	0.0002	1	<0.0001	-	<0.0001	1	<0.0001	-	<0.0001
Total Chromium	0.001	1	<0.001	-	<0.001	1	0.005	-	0.005
Total Copper	0.0014	1	0.002	-	0.002	1	0.004	-	0.004
Total Iron	-	1	3.02	-	3.02	1	4.4	-	4.4
Total Lead	0.0034	1	<0.001	-	<0.001	1	0.002	-	0.002
Total Lithium	-	1	<0.001	-	<0.001	1	0.003	-	0.003
Total Manganese	1.9	1	0.027	-	0.027	1	0.063	-	0.063
Total Mercury	0.0006	1	<0.0001	-	<0.0001	1	<0.0001	-	<0.0001
Total Nickel	0.011	1	0.003	-	0.003	1	0.008	-	0.008
Total Selenium	0.011	1	<0.01	-	<0.01	1	<0.01	-	<0.01
Total Silver	0.00005	1	<0.001	-	0.001	1	<0.001	-	<0.001
Total Strontium	-	1	0.043	-	0.043	1	0.173	-	0.173
Total Zinc	0.008	1	<0.01	-	<0.01	1	0.023	-	0.023



Parameter (mg/L unless otherwise stated)	Default Guideline Value	W14			
		No. of Samples	Minimum	Median	Maximum
Total Aluminium	0.055	1	1.21	-	1.21
Total Arsenic	0.024	1	0.008	-	0.008
Total Barium	-	1	0.029	-	0.029
Total Boron	0.94	1	<0.05	-	<0.05
Total Cadmium	0.0002	1	<0.0001	-	<0.0001
Total Chromium	0.001	1	0.002	-	0.002
Total Copper	0.0014	1	0.007	-	0.007
Total Iron	-	1	3.12	-	3.12
Total Lead	0.0034	1	<0.001	-	<0.001
Total Lithium	-	1	<0.001	-	<0.001
Total Manganese	1.9	1	0.25	-	0.25
Total Mercury	0.0006	1	<0.0001	-	<0.0001
Total Nickel	0.011	1	0.009	-	0.009
Total Selenium	0.011	1	<0.01	-	<0.01
Total Silver	0.00005	1	<0.001	-	<0.001
Total Strontium	-	1	0.17	-	0.17
Total Zinc	0.008	1	0.058	-	0.058