Environmental Management Plan Review 2016-2021

MMG Rosebery

November 2021
Prepared by MMG

Includes 2020-21 Annual Monitoring Review and Management Report and 5-yearly Monitoring System Reviews

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EXECUTIVE SUMMARY

This report addresses the requirements of the five-yearly Environmental Management Plan Review. It includes:

- The Annual Monitoring Reviews and Management Reports (AMRMR) for the period 1 July 2020 to 30 June 2021, which was prepared and reported in accordance with the requirements under Environmental Protection Notices (EPN) 7153/3 and 8815/2; and
- Progress against commitments in EPN 7153/3 and EPN 8815/2.
- All monitoring areas also had a 5-year review and recommendations were made to improve the monitoring performance.
- Focus is placed on new strategic policies implemented over the period, Closure Prefeasibility Study (PFS), compliance with global industry standard on tailings management (GISTM) and climate change emisssion reduction.
- Review of the Environmental Management Plan also highlights opportunities to update the monitoring and reporting system managed by EPN 7153/3.

Planning

- The MMG Operating Model, Safety, Security, Health and Environment (SSHE) Performance Standard, Risk Management Standard and the Social Performance Standard allow MMG Rosebery to deliver an internal SHEC management system which facilitates continuous improvement in the management of material environmental risks.
- Progress has been made against environmental objectives to further align with Global Standards for best practise environmental management. MMG have developed a Tailings Storage Facilities and water storage dam standard that aligns with the Global Industry Standard on Tailings Management.
- MMG are in the process of implementing a companywide Climate Change initiative with a goal of net zero by 2050. Progress against this will be reported annually and will be incorporated into the annual business planning processes.
- Annual business planning processes have confirmed the need of a new tailings storage facility to ensure the ongoing operations of Rosebery Mine. Investigations are underway for potential TSF sites and further studies will be commenced to understand the required capacity of the existing facilities up until TSF3 is commissioned.
- Environmental improvement activities in the reporting period have been implemented.

Implementation and Operation

- Upgrades and lifts are currently occurring at Bobadil and 2/5 Dam, additionally 2/5 Dam has begun Sub-Aerial deposition.
- MMG have submitted and EPA approvals are progressing for:
    - TFS3 – South Marionoak
    - Trial closure cover on Bobadil.

Closure

Focus is currently on Closure PFS, compliance with global tailings standard and Climate change and emission reduction, in line with the strategic planning development. MMG are investing in research projects with CRC Time, Flinders University, CSIRO and MRT to further understand industry wide data gaps.

Checking and Corrective Action

Air Quality was reviewed over the past five years' showed minimal exceedances of the trigger levels and no exceedances of the compliance limits of the EPN conditions. This indicates that the Rosebery Mine activities are a low environmental risk to air quality and that the current dust mitigation controls are appropriate.

Over the last five years, the DustTrak, HVAS and weather data reported a high data availability with some exceptions for the Carpark weather station location due to issues with the wind direction sensor in FY20. The Dust Deposition Gauge (DDG) reported a low to medium data availability. This is primarily due to the amount of rainfall at site causing the bottles to overflow and invalidating the sample.

Water management at MMG Rosebery has changed over the past five years. This is associated with increased stormwater collection and treatment, and the commissioning of the redeveloped 2/5 TSF. These actions have increased the volume of water reporting to the Effluent Treatment Plant (ETP) and discharged at Bobadil Outfall (BO).

Average annual flows at BO ranged between 0.27 to 0.28 m^3/s in the 2016-2017 through 2018-2019 monitoring years, and increased to 0.48 and 0.49 m^3/s in 2019-2020 and 2020 -2021, respectively. The collection of additional stormwater has increased the variability of the discharge as well as the volume.

Management at BO has remained consistent over the past 5-years, with MMG Rosebery maintaining pH levels in the TSF discharge generally above pH 7.5. Alkalinity in the TSF has also remained relatively consistent between 20 and 60 mg/L, with a few periods of very high alkalinity associated with high dosing at the ETP.

Total zinc concentrations which is the parameter of most concern in the BO discharge is generally ≤0.1 mg/L). Concentrations tend to increase during very high flow events in the winter, with the increase likely attributable to an increase in storm water inflows and associated decrease in retention time. In the 5-years of weekly monitoring there have been three occasions when total zinc exceeded the guideline value of 1 mg/L, all three events occurring during high flow events in the month of July.

On three occasions over the past five years, the weekly EC values have exceeded the EPN limit of 2000 mS/cm. These have generally coincided with periods of overdosing of lime at the ETP. Sulphate concentrations which are a major contributor to EC along with Ca and other ions has remained between 500 and 1000 mg/L, well below the EPN limit.

Corrective actions to improve monitoring of the site are detailed in Appendix B & C, expert reviews are summarised in Table 25. Corrective actions associated with non-compliance are initiated in the investigative process and documented as the actions are reported to EPA via exceedance reports and concluded with corrective actions.

Review

- Annual independent external audit against EPN requirements have been completed for the last 5 years with continual year-on-year improvements observed.
- Third party reviews of MMG Rosebery's activities and 2011-2015 monitoring data have highlighted opportunities for refinement of conditions in EPN 7153/3.

1 PURPOSE

This report was prepared in accordance with the requirement under Environmental Protection Notice (EPN) 7153/3 (issued 26 October 2011) for submission of a five-yearly Environmental Management Plan (EMP) Review for the period 1 July 2016 – 30 June 2021 (Table 1).

This report also assesses progress commitments for the 3 Level Waste Rock Dump (3LWRD) as outlined in EPN 8815/2 (issued 13 February 2015, Table 2) and includes the 5 yearly external monitoring audit (Appendix L) along with external monitoring program reviews commissioned by MMG (Appendix B and C).

Where applicable the reporting period refers to 1 July 2016 – 30 June 2021 and the reporting year 1 July 2020 – 30 June 2021 to coincide 2020-21 Annual Monitoring Review and Management Report (AMRMR) reporting period.

This report is publicly available upon request and hard copies will be provided. It is set to be available through MMG Rosebery's new community liaison office in Rosebery.

Table 1: Report coverage of EMP requirements (as outlined within EPN 7153/3)

EPN REQUIREMENT		REPORT SECTION
G6 1.1.1	Site and operational history, particularly where it relates to the environmental performance of the activity.	3
G6 1.1.2	Short, medium and long term strategic, management and planning issues, and production and process changes that are likely to impact on production efficiency, the quantities produced, and environmental performance of the activity.	4
G6 1.1.3	Information required under G7 (2) of EPN 7153/3	-
G7 2.1	An Executive Summary	Executive Summary
G7 2.2	A review of environmental aspects and impacts register against environmental controls and documentation.	4.2
G7 2.3	A review of activity compliance and annual external compliance audit against EPN requirements.	7.1
G7 2.4	Environmental planning, including objectives and targets relating to the review period and details of the forward environmental planning and forecasting process, including strategic issues for the activity, for but not limited to the management period.	4.3
G7 2.5	A review of environmental commitments and process changes (including annual tonnage) for, but not limited to, the management period.	4.4
G7 2.6	A review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations, including discharge and ambient monitoring points that illustrate significant trends.	Appendices C-E
E4-2	The water quality monitoring program must be reviewed in accordance with the requirements of Condition G7 (2.6) of this Notice. Implementation of the monitoring program and or any subsequently amended program, must be implemented for the 5-year review period, with a review of results, any identified impacts on the Pieman and Stitt River receiving environments and any further recommended amendments to the program to be included in the five yearly EMP reviews	Appendix B, F & G
A4-3*	An analysis of yearly climate is to be included in the Annual Monitoring Review and Management Report for each year	Appendix

A5-3*	Tabulated high volume air sampler, and dust and metal deposition results for the entire year, showing intermediate values as well as final monitoring results. Tabulated annual averages of the deposition increment above background, supported by deposition isopleths or graphs <of monthly results>. Summaries of all exceedances…, describing the results of any investigations undertaken and the mitigation measures that were adopted in response. Any supporting data analysis or description necessary to aid interpretation of the dataset.	Appendix C & H
E3*	Annual biological survey and ambient water quality monitoring programme of the Stitt River and Lake Pieman …. to document ongoing environmental conditions, increase the understanding of temporal, spatial and seasonal biological and chemical changes within the lake and progress the development of site specific toxicity guidelines for sulphate and zinc in Lake Pieman.	Appendix F & G
E5-1.2*	Monitor the level of groundwater contamination (mass load of pollutants) due to seepages from the Bobadil, No.2, No.5 and rehabilitated No.1 tailings storage facilities on the Stitt River and Lake Pieman. Monitoring results must be reported in the AMRMR	Appendix J
M4-3*	If the concentrations in effluent <from Bobadil Tailings Dam end-of-pipe discharge> of parameters <listed in EPN> do not comply with the levels specified….(Investigation Trigger Level) …then an investigation into the possible reason for the exceedance must be conducted and a report summarising the outcomes of all such investigations be submitted to the Director in MMG Rosebery's Annual Monitoring Review and Management Report.	Appendix I
N1-1.8*	Results of the continuous noise monitoring program and noise related complaints must be reported in the AMRMR.	Appendices D
WM1 2.4*	…any environmental or stability issue identified and associated with <all tailings dams>…further outlined to the Director in the AMRMR.	6.9
G7 2.7	Environmental performance, including incident management and community complaints and the corrective and preventative processes implemented.	6.8 and 5.2
G7 2.8	Any approvals or written notifications received in relation to this notice.	5.1
G7 2.9	A summary of any rehabilitation works carried out during the period and an estimate of current remediation liabilities.	5.3
G7 2.10 / WM3-2	An inventory of wastes disposed of on The Land during the previous 12 months, including details of the quantity of each waste and the location of its disposal.	5.4
G6 1.1.4	Any specific information required by the Director in writing.	No request received
G6 1.1.5	Any other environmentally relevant matters relating to the period of the EMP.	None
M3	Once every 5 years an external monitoring audit must be undertaken. The audit needs to assess compliance in relation to conditions M1 and M2 of this Notice and whether the current monitoring program is adequately measuring the discharge water quality from the land. The audit report must be incorporated into the next 5 yearly EMP Review	Appendix L and 29

*Condition does not directly refer to the EMP Review but included as supplementary information

Table 2: Report coverage of EPN 8815/2 requirements

EPN REQUIREMENT		REPORT SECTION
G4-4	Annual review of the surface and ground water monitoring program in accordance with Appendix B of the Detailed Design Report, including an assessment of surface and groundwater impacts from the 3 Level WRD.	6.2
M3 1.2	Results of 3 Level WRD surface and groundwater monitoring program.	6.2

2 ENDORSEMENT

"I hereby certify that to the best of my knowledge, the information within this Environmental Management Plan Review Report is true and correct."

Name: Steve Scott Signed: 

Position: MMG Rosebery - General Manager - Acting Date: 30.11.2021

3 OPERATIONAL HISTORY

EPN 7153/3, G6 1.1.1 Site and operational history, particularly where it relates to the environmental performance of the activity

EPN 7153/3, G7 2.5 A review of … process changes (including annual tonnage) for, but not limited to, the management period.

MMG Limited (MMG) acquired Rosebery in June 2009. MMG Rosebery is Australia's largest volcanic hosted metals (zinc, lead, copper, gold and silver) mine and its concentrator has been in continuous operation since 1936. As such, environmental performance at Rosebery is influenced by historical mining practices that preceded MMG's management of the operation.

The consolidated mining lease is 4,906 hectares, which includes the Rosebery mine, the decommissioned Hercules mine and more than 120 legacy abandoned mining tenements and features. The Rosebery mining operations are located within Mining Lease No. 28M/1993, approximately 300 kilometres north-west of Hobart and 125 kilometres south of Burnie.

Zinc, lead and copper concentrates and gold doré are produced at Rosebery using mechanised underground mining methods and crushing, grinding and flotation processes. Rosebery concentrates are transported by rail to the Port of Burnie where they are shipped in bulk carriers to smelters in Hobart and Port Pirie. Gold doré bars are sold to a refinery in Australia where they are refined into gold bullion.

MMG Rosebery production data is provided in Table 3. Waste rock and tailing tonnages are provided in Table 4 which details MMG Rosebery's environmental inventory across the review period.

Table 3: Rosebery production (2016-21)

	UNIT	2016-17	2017-18	2018-19	2019-20	2020-21
Ore Mined*	dry tonnes	962,555	1,002,991	1,023,375	992,076	1,038,213
Ore Milled**	dry tonnes	946,174	989,492	1,036,091	991,548	1,021,415
Gold in doré**	oz	13,256	23,918	20,371	18,035	24,595
Copper in concentrate**	dry tonnes	8,691	7,968	8,335	8,881	9,738
Lead in concentrate**	dry tonnes	41,902	50,138	40,309	38,432	42,927
Zinc in concentrate**	dry tonnes	141,373	138,077	142,806	143,822	132,524

*Data sourced from the MMG Reconciled EOM reports – for period 1 July to 30 June.

** Data sourced from MMG Quarterly Production Reports – for periods 1 July to 30 June.

Table 4: Environment inventory (2016-21)

PARAMETER	UNITS	2016-17	2017-18	2018-19	2019-20	2020-21
Waste rock generated	Thousand tonnes	344	319	338	315	403
Tailings generated	Thousand tonnes	754	793	845	800	836
Water inputs*	ML	4611	4633	5160	5370	5000
Water outputs*	ML	5003	4475	4639	5473	5366
Mining lease 28M/1993	Hectares	4906				
Total land disturbed	Hectares	286.91	287.37	287.37	309.77	312.27
Total land rehabilitated	Hectares	0				
Total greenhouse gas emissions (scope 1 and 2)**	Thousand tonnes CO_2-equivalent	33	34	41	36	39
Total energy use**	TJ	716	705	707	715	721
Total NO_x emissions***	Tonnes	113	101	95	108	98
Total SO_x emissions***	kg	103	96	93	70	72
Total PM_{10} emissions***	Tonnes	260	251	302	422	247

*Reported as per Minerals Council of Australia Water Accounting Framework. Does not include diverted water that is actively managed by MMG Rosebery but not used for any operational purpose.

** As per National Greenhouse and Energy Reporting

*** As per National Pollutant Inventory Reporting

Process changes and improvement projects that have influenced Rosebery's production and environmental performance in 2016-2021 are detailed in Table 5.

Table 5: Operational history and major environmental improvement projects (2016-2021)

ACTIVITY	MILESTONE	DETAILS
Processing plant	2021	Filter plant storm water drainage system (Cell 2) to reduce the risk of an uncontrolled release.
Closure	2018-20	Minor Legacy workings closure project. Total number of legacy sites/features identified, and location verified has expanded to 172, Risks to public safety and environment have been documented for them, and rehabilitation and/or heritage preservation works proposed.
	2019-ongoing	Closure prefeasibility study (PFS) – Findings to be incorporated into Rosebery Mine Closure Plan
Tailings storage	2016	Completed Stage 9B embankment lift at Bobadil TSF to provide storage capacity to allow continued production until 2017. Works include raising the northern portion of the facility to a crest of RL 199m using the upstream construction method and the construction of a new spillway that has been designed for closure.
	February 2016	Construction of the 2/5 Dam TSF site to replace Bobadil commenced.
	April 2018	2/5 Dam TSF commissioned. Tailings deposition to TSF commenced
	December 2019	Bobadil Polishing Ponds De-sludging works. Work commenced in Q1 2020 with a floating pontoon pumping sludge within Geo-tubes.
	2020 - Ongoing	Murchison highway mitigation works to reduce seepage water entering the Stitt River
	2021	2/5 Dam TSF second decant line commissioned
	2021	Bobadil TSF 10A Embankment raise complete and Trial Closure Cover is underway
	2021	2/5 Dam TSF Subaerial deposition infrastructure works

Subsequent sections outline the management approach for each environmental aspect and high-level findings from monitoring programs. Detailed environmental monitoring results and a description of annual environmental improvement programs are presented and discussed in MMG Rosebery's AMRMRs (MMG, 2017; 2018; 2019; 2020; 2021). Appendix B & C contain the 5-year assessments.

Data from current monitoring programs for water, air quality, noise and vibration are discussed in Section 6.

4 PLANNING

4.1 2021-2026 BUSINESS PLAN

EPN 7153/3, G6 1.1.2 Short, medium and long term strategic, management and planning issues, and production and process changes that are likely to impact on production efficiency, the quantities produced, and environmental performance of the activity.

EPN 7153/3, G7 2.4 Environmental planning, including objectives and targets relating to the review period and details of the forward environmental planning and forecasting process, including strategic issues for the activity, for but not limited to the management period.

The 2021 strategic business strategy was released in line with the review process. The following strategy was launched:

> "Continue to optimise operations, aggressively pursue orebody expansion through in-mine drilling programs to extend mine life and deliver a commercial outcome to self-fund construction of a new tailings facility. Leverage investment in tailings infrastructure to maximise asset value through a gated exploration program, aggressively pursue cost profile transformation and integration of technological advancements."

The Strategic Business Plan has a 5-year review based on the Integrated Business Planning process with the specific planning processes described in Figure 1 that results in the various budgets and the annual planning process. The Asset Business Plan (circled in Red) models the various asset budgets. Based on the Asset Business Plan all environmental projects and production rates are set. Forecasted production tonnages for 2021-2025 are presented in (Table 6).

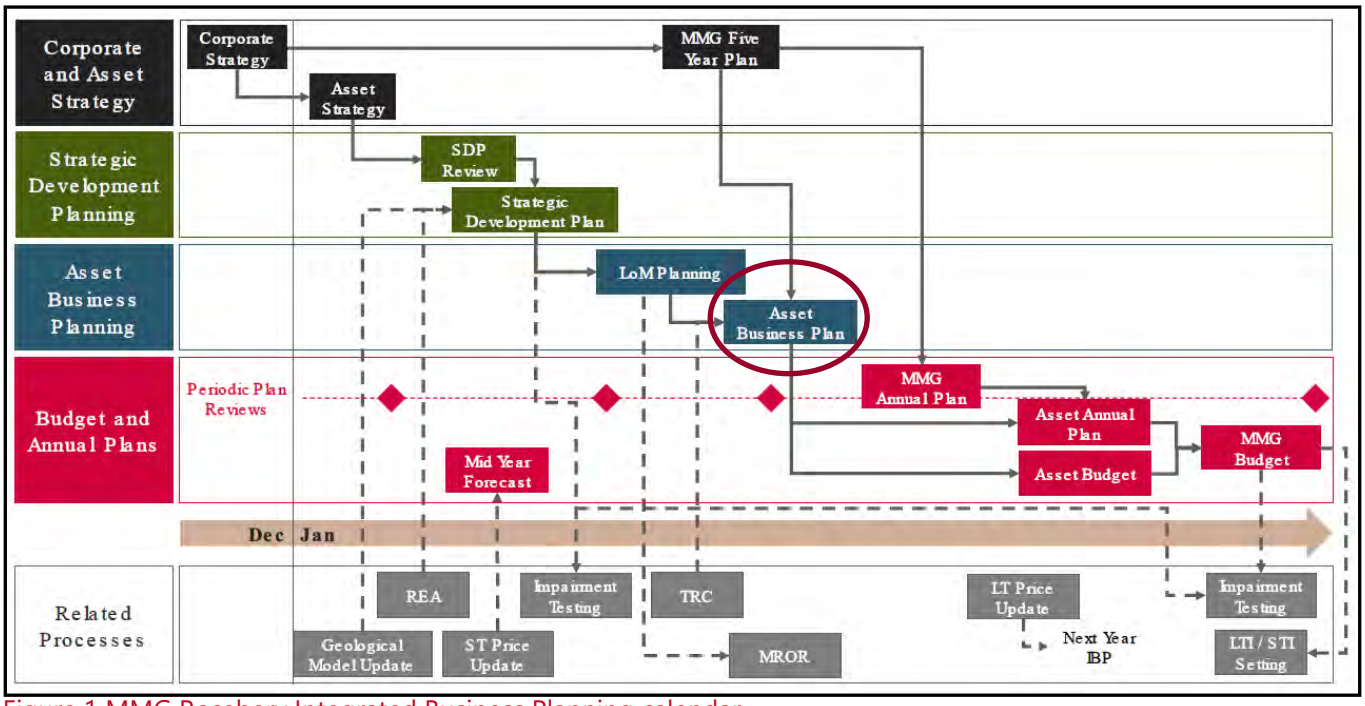

Figure 1 MMG Rosebery Integrated Business Planning calendar

Annual scenario planning enables flexible investment decisions. The Life of Asset (LoA) process provides consistent direction on long-term operational strategy.

LoA planning priorities are aligned to MMG's strategy drivers of growth, operations transformation, people and organisation and reputation. The planning process is grounded on annually updated resource and reserve estimates, human resources strategy and any social obligations. Outputs from the process include improvement plans and proposed capital projects. The LoA Plan also provides a primary basis for internal whole of life business valuation (net present value).

Table 6: Asset Business Plan Forecast Production Rates (2021-2025)

LOA ATTRIBUTE	DETAILS
Mining rate	2021: 1.001 Mt 2022: 1.001 Mt 2023: 1.007 Mt 2024: 0.999 Mt 2025 1.006 Mt
Plant throughput	2021: 1.026 Mt 2022: 1.001 Mt 2023: 1.007 Mt 2024: 0.999 Mt 2025 1.006 Mt
Key projects	TSF3 - Critical to LoM
Current estimate of life of mine	2028
Closure provisioning	$77M

Table 7: Environmental implications of Asset Business Plan

ENVIRONMENT	KEY TASKS
Environment permitting	Permitting requirements for TSF3 and additional permitting requirements for existing TSFs until TSF3 can be brought online
Energy and greenhouse	Implementation of climate change initiatives
Land and biodiversity	Closure/decommissioning/rehabilitation plans for Assay Creek, Bobadil and legacy Zeehan smelter site.
Water	Pieman water tank replacement. LV under carriage washbay Cell 2 Retention Pond 2/5 Dam Murchison Stormwater and seepage Site water balance model, updates and calibration aligned 58W Pump Station X Lens dewatering
Mineral waste management	South Marionoak TSF Water / Sludge Management. Oil Filler RMU U/G Replacement 2021 2/5 TSF further embankment raises Bobadil Capacity Extension Stage 11
Air. noise and vibration	Fixed Rock Breaker replacement 2020 19B Booster Fan Upgrade 33P Booster replacement, PSF3 Acoustic Dampening 40Y Booster fans 2/5 TSF Sub aerial deposition Stage 1 & Stage 2 Mine Fleet Water cart 2021 Rosebery Mine - Secondary fans 2021-2024
Closure studies	Life of Mine Rehab 2021-2024

Key forward environmental planning projects include continual improvement stormwater network maintenance, the construction of a subterranean drain along the Murchison highway, ongoing remediation of minor legacy workings project and improved dust management onsite. MMG Rosebery is also well underway with the closure PFS for both the Rosebery operation and Hercules legacy site to support the updating of the Mine Closure Plan. MMG is separately seeking approvals for a new tailings' storage facility at South Marionoak to enable continued operation of the Rosebery mine until mine closure.

Table 8: Planned capital investment (2021-2025)

PROPOSED INVESTMENT (MAJOR OR MINOR APPROVALS)*	PROPOSED TIMING	PURPOSE	STATUS OF APPROVALS
New TSF3 (South Marionoak)	Construction commenced ASAP completed by 2024.	To allow the operation to continue once Bobadil and 2/5 Dam TSFs reach capacity.	Awaiting Approval
2/5 TSF stage 2 and stage 3, Subaerial.	Dependent on delivery of TSF3	To provide interim tailings storage while TSF3 is pursued	Approvals occurring as required
Ventilation Upgrades	2021-2025	Upgrade of underground ventilation	Approvals occurring as required
LoM Closure and Rehabilitation	2021-2025	Define closure	Approvals occurring as required

* The scope and implementation of these proposed projects may be subject to change at annual review.

MMG's strategic planning also incorporates a series of environmental objectives which are outlined in Table 9.

In October 2021 MMG along with International Council on Mining & Metals' (ICMM) peers announced it would take proactive measures to limit global warming. This announcement included:

- Commitment to net zero Scope 1 and 2 emissions;
- Protect communities and natural habitats from global warming impacts;
- Mobilise financing for carbon reduction initiatives and technologies; and
- Work together to drive action between governments, business and civil society.

As part of this commitment MMG has identified the potential for Rosebery to become a world leading net zero emitter through fleet electrification and Tasmanian hydro power. This is in the conceptual phase with a potential pilot study set for 2023.

Table 9: Environmental objectives

OBJECTIVE	TARGET	TIMEFRAME	STATUS
Climate Change Strategy	Net zero Scope 1 and 2 emissions	by 2050 (interim 2030 targets to be set)	Development and implementation of whole-of-company climate resilience strategy, covering energy mix, technologies, efficiency and mitigation measures, is due for completion in 2022. This will be used to determine interim 2030 targets and support the 2050 goal.
Compliance with Global Industry Standard on Tailings Management	Compliance	2022	Engineering and Project management are applying the standards to all existing and new facilities.
Closure Objectives	Various	2022	Closure PFS is currently underway and several Preliminary Site Assessments (PSI) have been conducted. These are NEPM based Risk Assessments that manage risk.
Maintain good community relations	Develop feedback mechanisms to ensure concerns are addressed	2021	Reduction in community complaints for the reporting period. Improved engagement planned for the 2021-22 reporting period.
Compliance with environmental license and regulatory requirements	Year-on-year improvements on independent audits	2021	Compliance tracked on a weekly basis and reported to senior management on a monthly basis. Second line of defence (independent audit) has been deferred due to Covid-19 related travel restrictions.

4.2 ENVIRONMENTAL RISK REVIEW

EPN 7153/3, G7 2.2 A review of environmental aspects and impacts register against environmental controls and documentation.

The annual risk profile review for Rosebery's material risks was performed in Q1 2021. Risk analysis of material risks and design of critical controls continues as part of the risk management process.

A desktop review of Bobadil TSF and the newly constructed 2/5 Dam TSF was undertaken by MMG's Dam Review Board in May 2021 as a site visit wasn't available due to COVID-19 travel restrictions. MMG Rosebery are planning to reschedule the onsite review once travel restrictions ease.

MMG Rosebery maintains an Environmental risk register; the register was reviewed in 2021. MMG Rosebery are continuing to improve environmental controls to reduce potential impact. Within the reporting period seepage mitigation works were completed to reduce the likelihood of overtopping events at the seepage collection system along the Murchison highway. In addition, MMG are planning to further investigate dust mitigation technologies for the 2/5 Dam TSF in the summer of 2021/22.

Closure planning has continued in 2021, as part of the risk assessment process several Preliminary Site Investigations (PSI) were conducted. This process is different to the Aspects and impact assessment process where each part of the process is risk assessed. The PSI process examines the site for potential contamination and uses a source pathway receptor system based on NEPM health / environment impact criteria.

MMG is currently conducting detailed closure planning scientific investigations to inform the development of a Closure Pre-Feasibility Study (PFS) for both the Rosebery and Hercules mines. The Hercules Mine has been in care and maintenance for an extended period of time.

A series of biophysical investigations are currently underway and are expected to conclude in 2022 for Hercules and 2023 for Rosebery, culminating in the development of a preferred closure option for each site. These closure options will be further developed in feasibility studies in future years.

The completion of the current closure PFS studies will also coincide with an update to the Rosebery Mine Closure Plan that will be submitted to the Tasmanian EPA for review. MMG has sought approval from the Tasmanian EPA to extend the submission date next Mine Closure Plan. The use of Preliminary Site Investigations allows a structured risk assessment to be completed with NEPM trigger values.

As part of the business planning process, resourcing for future strategic environmental work programmes is also reviewed.

4.3 ENVIRONMENTAL COMMITMENTS REVIEW

EPN 7153/3, G7 2.5 A review of environmental commitments … for, but not limited to, the management period.

Key environmental commitments and their current status are outlined in Table 10.

Table 10: Environmental commitments review 2016-2021

COMMITMENT	DUE	CURRENT STATUS
Installation of seepage control works around 2/5 Dam as documented in EPN 9359/1	Pre-construction operation of 2/5 Tailings Dam Storage Facility	Refer to Section 3.1.1.
Submission of decommissioning plan for Bobadil TSF.	31 October 2015	The Bobadil TSF Closure Plan was submitted on 30 June 2016. MMG have subsequently investigated an additional embankment raise (Stage 10) and closure cover trial has been approved and awaiting completion.
Construction of the 3 Level WRD in accordance with EPN 8815/2 and submission of periodic construction audit reports.	Within 30 days of audit date	Stage 2 lift 1 of the 3 Level WRD is under construction. No waste rock is currently being disposed of on the surface. Two construction audits were conducted over the reporting period with audit reports provided to the EPA.
Installation of suitable dust suppression system to control ground level dust (Dust Mitigation Plan, submitted June 2015).	December 2020 (Approval date)	A review of the Dust Mitigation plan was completed as a part of the 2/5 dam TSF subaerial conversion submission and subsequently approved in December 2020. The review identified the current dust suppression systems onsite are sufficient to control ground level dust.
Submission of a Closure Plan for 3 Level WRD.	31 October 2018 (Submission date)	Submitted by the due date, awaiting EPA response.

Refer to section 7.1 for details of the external compliance audit against commitments in EPN 7153/3.

5 IMPLEMENTATION AND OPERATION

5.1 APPROVALS AND NOTIFICATIONS

EPN 7153/3, G7 2.8 Any approvals or written notifications received in relation to this notice.

An update to the progress of Environmental Approvals within the reporting year are highlighted in Table 11.

Table 11: Environmental approval update for the reporting year (2020-21)

ACTIVITY	APPROVAL REFERENCE	APPROVAL DATE	DETAILS
South Marionoak TSF	-	Awaiting Approval	Notice of Intent (NOI) and EPBC referral submitted for the proposal. EIS guidelines issued in August 2021. Preparation of EIS is underway
2/5 Dam TSF Stage 2 subaerial conversion	-	Awaiting Approval	Notice of Intent (NOI) submitted and EIS guidelines issued in August 2021
2/5 Dam TSF Stage 2 BAMP and amended WQMP	PCE 9084	July 2021	2/5 Dam Stage 2 construction works required an amended Borrow Area Management Plan (BAMP) to be submitted prior to works commencing. The amended BAMP was approved in July 2021. A review of the water quality monitoring plan was also amended and subsequently approved by EPA.
Bobadil Borrow Area UC Material	EPN 10504/1	June 2021	Approval to blend UC material from blast 7 with NAF for the usage of construction material at the Bobadil stage 10 embankment raise
Bobadil Borrow Area UC Material	EPN 10504/1	May 2021	Approval to blend UC material from blast 6 with NAF for the usage of construction material at the Bobadil stage 10 embankment raise
Monitoring Audit – Appointment of independent Consultant	EPN 7153/3 and PCE 9084	March 2021	Approval for the appointment of an independent consultant for the 5-yearly monitoring audit. In addition, approval was granted to submit the monitoring audit report with the 5-yearly Environmental Management Plan review.
Bobadil Borrow Area UC Material	EPN 10504/1	February 2021	Approval to blend UC material from blast 2 and 3 with NAF for the usage of construction material at the Bobadil stage 10 embankment raise
Geo-Tube Trial at Bobadil TSF extension	EPN 7153/3	January 2021	Approval was granted to extend the Geotube trial to include a total of 36 geo-tubes
2/5 Dam TSF Subaerial Tailings Deposition	PCE 9084	December 2020	Piping, spigots and sprinklers installed. Subaerial deposition commenced in some areas.
2/5 Dam Borrow Area Vegetation Clearance	PCE 9084	December 2020	A pre-clearance survey was completed for the 2/5 dam TSF borrow area and subsequently approved by EPA in December 2020
Dust Mitigation Plan Review	EPN 7153	December 2020	An external review of MMG Rosebery air quality network was completed in February 2020. The outputs of the review were utilised to update the sites Dust Mitigation Plan. Approval was granted by EPA in December 2020.

Bobadil TSF BAMP	EPN 10504-1	November 2020	Bobadil TSF embankment raise Borrow Area Management Plan approval was granted in November 2020
Bobadil TSF	EPN 10504-1	October 2020	Stage 10A embankment raise is complete, 10b is underway and scheduled to be completed Q4 2021. The trial closure cover at the Bobadil TSF is underway.
2/5 Dam TSF Investigative monitoring program	PCE 9084	October 2020	An external review of water chemistry was completed that recommended reducing the monitoring frequency for the Murchison highway seepage investigation. The key findings were provided to the EPA and approval was granted to reduce the monitoring program in October 2020.
Decommissioning of monitoring bores	EPN 7153/3	September 2020	Approval was granted by EPA to decommission a number of groundwater monitoring wells around the Rosebery mine.
Extension for annual calibration of HVAS	EPN 7153/3 and PCE 9084	September 2020	Extension to undertake annual high-volume air sampler service and calibration due to Covid-19 travel restrictions
Extension of Annual External Compliance Audit	EPN 7153/3 and PCE 9084	September 2020	Extension to undertake external compliance audit due to Covid-19 travel restrictions
Geo-Tube Trial at Bobadil TSF	EPN 7153	July 2020	MMG gained approval to trial Geo-tubes to manage ongoing sediment deposition as a result of ongoing accumulation of metal hydroxides since the permanent cessation of tailings deposition at the Bobadil TSF. This work was completed over the reporting period.
Non-Mineral Waste Management Procedure review	EPN 7153	Awaiting Approval	A review of the Rosebery Mine Waste Management Procedure was completed during the reporting period. In accordance with Condition WM4 the procedure when revised should be submitted to the Director of the EPA for approval. The Procedure was submitted to EPA in July 2020.

5.2 COMMUNITY FEEDBACK

EPN 7153/3, G7 2.7 Environmental performance, including … community complaints and the corrective and preventative processes implemented.

EPN 7153/3, N1 – 1.8 … and noise related complaints must be reported…

For the July 2016-June 2021 period, 20 instances of community feedback were recorded, none of which were classified as significant based on MMG's risk ranking procedure (Figure 2 and Table 12). This was a decrease from 44 instances for the 2011-16 period. Where applicable complaints were discussed with the community members concerned and issues raised were immediately addressed by MMG Rosebery to stop any disturbance and minimise the risk of its reoccurrence.

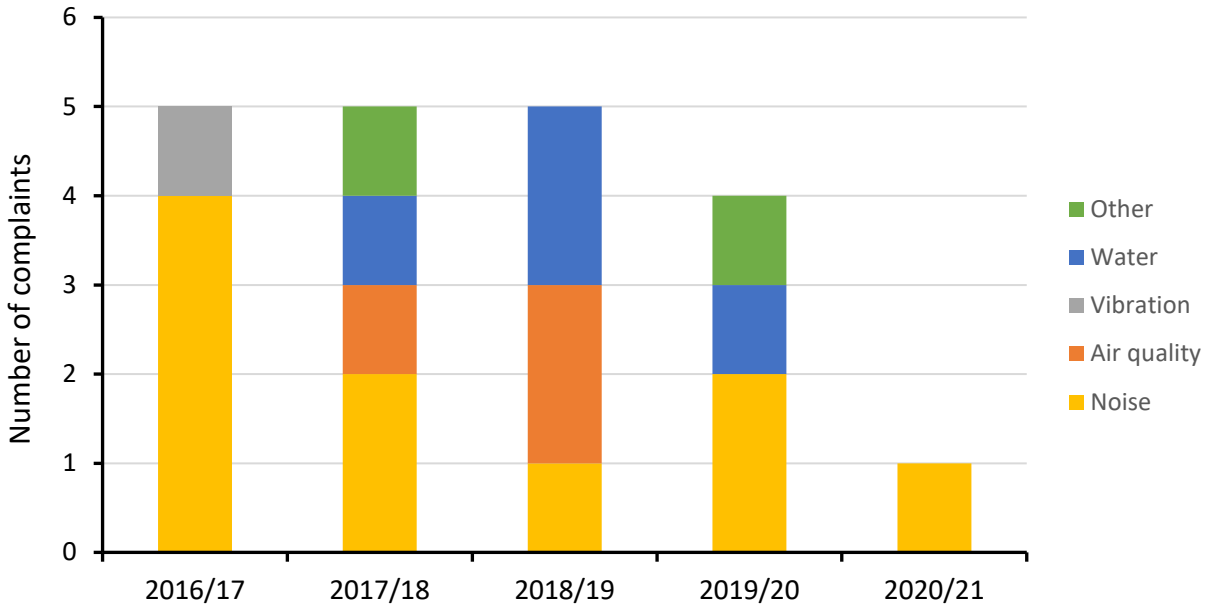

Figure 2 Community complaints by year and category (July 2016-June 2021)

Table 12: Community complaints received in the reporting period (2016-21)

CATEGORY	DATE	DETAILS
Noise	15/07/2016	Community member reported noise nuisance from rock breaking activities at 2/5 Dam. The community member also expressed concern about the noise levels during the day since they worked night shifts. MMG Rosebery offered the community member alternative accommodation during the day. The community member did not request any further action from MMG Rosebery.
Noise	06/09/2016	Community member reported noise nuisance which was coming from a ventilation fan. MMG Rosebery investigated and discovered that the noise attenuating cover for the fan had been removed for maintenance at the time of the complaint. The community member did not request any further action from MMG Rosebery.
Noise	02/02/2017	Community member reported noise nuisance from daytime grouting and drilling operations at the 2/5 Dam Project. The community member was working night shift at the time. MMG Rosebery provided a timeframe for completion of drilling
Noise & Vibration	28/02/2017	Community member made an indirect complaint via a local radio station concerning continuous noise and vibration resulting property damage. MMG Rosebery visited the complainant and concluded that the property damage was independent of operational activity.

Noise	4/7/2017	Community member contacted MMG as the train was idling causing noise nuisance. MMG contacted the train operator to stop the train from idling. To stop reoccurrence processing department held a meeting with Tasrail.
Traffic	8/11/2017	Community member contacted MMG as the screening wall was believed to be obstructing the view of oncoming traffic
Dust	Feb-18	Community member contacted MMG as dust at 4 level was visible. MMG sent a water truck to 4 level to suppress the dust.
Noise	2/02/2018	A community member contacted MMG due to excessive noise from what was believed to be an MMG residence within the Rosebery Township. Upon investigation the property did not belong to MMG rentals.
Water	4/02/2018	A community member identified a number of dead fish within the lower reaches of the Stitt river. The investigation determined the fish deaths were not a result of mine operations.
Noise	9/02/2018	A community member contacted MMG due to concerns of what was believed to be a blast event. Upon investigation the tremor was a result of a seismic event.
Water	14/08/2018	MMG Rosebery received a phone call from Tasmanian EPA indicating community member sighted an uncontrolled release from the Rosebery facility entering Rosebery creek. MMG Environment staff investigated and provided a response to the EPA. It was determined there was not an uncontrolled release.
Noise	28/10/2018	MMG Rosebery were contacted by a community member as the train at the Filter plant was idling causing environmental nuisance. The Mill Supervisor was contacted to inform the train to cease idling. Tasrail were made aware of issue.
Dust	19/11/2018	MMG Rosebery received 6 complaints, 1 from Tasmanian EPA and the other 5 from community members in relation to dust pick-up from the Bobadil TSF. In response to the complaint's additional spigots at the TSF were opened to increase the wetted area, and reduce dust being generated.
Dust	13/12/2018	MMG Rosebery received 5 complaints, 3 from Tasmanian EPA and the other 2 from community members in relation to dust pick-up from the Bobadil TSF. In response to the complaints additional water was sent to Bobadil to increase the wetted area. As well as this MMG Rosebery developed a plan to install a sprinkler system to maximise the wetted area. This project was completed in February 2019.
Water	Unknown (2018-19 reporting period)	MMG Rosebery received advice from Tasmanian EPA that a number of community members have complained to the department in response to the Murchison Highway groundwater discharge. MMG Rosebery are continuing to work with Tasmanian EPA to develop and implement a long-term mitigation strategy for this issue.
Water	17/08/2019	A phone call was received by EPA Tasmania informing MMG of ongoing community concern regarding overtopping events at the Murchison highway seepage collection system. MMG responded to EPA with an update to the mitigation works plan.
Noise	03/12/2019	A community member informed MMG Rosebery of nuisance noise from the ROM, 3L and/or 4L areas. Upon initial investigation the likely cause was excessive use of the mobile and pedestal rock breakers.
Noise	04/02/2020	Ongoing Noise complaint (original complaint 03/12/2020). Upon receiving the complaint MMG staff engaged an external Noise specialist to better understand the noise source and provide short, mid and long-term abatement measures. Immediate actions included; weekly meetings with the complainant, reduced use of the mobile rock breaker and

		reduced hours of operation of the pedestal rock breaker between the hours of 0700 and 2100. Long term abatement measures are still progressing through the design phases.
People	04/02/2020	A community member contacted MMG Rosebery staff for advice on identifying a geological formation. The community member found the staff member rude and ignorant. Senior management responded to the complainant.
Noise	13/3/2021	Effluent Treatment Plant pump failure resulting in nuisance noise. Corrective actions included; replacing pump, a review of the current maintenance scheduling and a stocking a spare pump onsite to limit breakdown time.

5.3 REHABILITATION AND CLOSURE

EPN 7153/3, G7 2.9 A summary of any rehabilitation works carried out during the period and an estimate of current remediation liabilities.

5.3.1 Closure liability

The estimate of current remediation liabilities for MMG Rosebery is AUD$77 million, based on the current Closure Management Plan. This is the current rehabilitation bond.

5.3.2 Mine Closure Stakeholder Engagement Update

MMG's overarching goal for successful mine closure is outlined in a closure planning framework that involves:

- Establishing a closure vision that takes into consideration the end land uses and land users;
- Setting objectives that support the vision;
- Developing completion criteria that will be used by both MMG and stakeholders to determine that the objectives have been met and that the site is suitable for relinquishment; and
- Putting in place work programs to rehabilitate the site to meet the objectives.

This framework is supported by an administrative process (relinquishment pathway) that will ensure all parties are satisfied that requirements are met. In 2020 MMG commenced negotiations with government regulators including Tasmanian EPA, MRT and DPIPWE- Dam Safety to formalise a relinquishment pathway and set of closure objectives. These are currently under review by these stakeholders.

Previous stakeholder interviews KPMG Banarra (most recently in 2019) have identified the need for and importance of understanding the socio-economic impact of future mine closure on the Rosebery town and, more broadly, the West Coast Region and the state.

In 2021 MMG completed the first of a series of planned mine closure planning workshops with potential future land users and the local community facilitated by the University of Queensland's Sustainable Minerals Institute. The feedback from this engagement was captured via the Town Transition Tool (TTT), a diagnostic tool that offers a structured process to share knowledge and data collected by MMG and other stakeholders about the town or local community. The tool also assists to identify the gaps in knowledge that need to be filled to complete the current picture.

MMG is committed to filling these knowledge gaps and carrying out a detailed mine closure social impact assessment study that will identify the existing and potential impacts of the mine closure, the proposed measures for mitigation, the significance of residual and cumulative impacts and the concerns of external stakeholders affected, including regulators, interested public and the communities.

MMG is also planning further closure visioning workshops in early 2022 in collaboration with the West Coast Council. These engagement aims to build upon the TTT workshop to establish a collaborative post closure vision for Rosebery and the local government area, consistent with MMG's closure planning framework.

5.3.3 Closure Plan Update

MMG is currently conducting detailed closure planning scientific investigations to inform the development of a Closure PFS for both the Rosebery and Hercules mines. The Hercules Mine has been in care and maintenance for an extended period of time, and the Rosebery Mine is currently expected to cease operations between 2025 and 2029.

A series of biophysical investigations are currently underway and are expected to conclude in 2022 for Hercules and 2023 for Rosebery, culminating in the development of a preferred closure option for each site. These closure options will be further developed in feasibility studies in future years.

The completion of the current closure PFS studies will also coincide with an update to the Rosebery Mine Closure Plan that will be submitted to the Tasmanian EPA for review. MMG has sought approval from the Tasmanian EPA to extend the submission date next Mine Closure Plan. A response to this request is pending.

5.3.4 Progressive rehabilitation

There was limited progressive rehabilitation of disturbed land areas completed during the reporting period because, being an underground mine, the disturbance area is largely limited to operational areas that continue to be used or are planned to be used in the future and are therefore not available for rehabilitation.

Monitoring of revegetation success at the Hercules site was carried out in 2021 by LMRS according to the Hercules Assessment Index for Rehabilitation (HAIR score), which considers pH, total nitrogen, total phosphorus, percentage live vegetation cover and an exotic versus native vegetation ratio. LMRS concluded that the lack of active treatment over the last eight years has reduced the rate of improvement at the site. MMG do not propose to undertake further soil treatments at the site until the completion the Hercules Closure PFS study which may recommend further earthworks at the site.

The Bobadil TSF is an area that is in the process of progressive rehabilitation through the field scale trial closure cover. MMG developed a Conceptual Closure Plan (CCP) for Bobadil in 2013 and carried out consultation with the EPA at this time regarding potential closure designs. The CCP outlined several data gaps including geotechnical and geochemical characterisation of tailings and capping materials. An extensive works program was undertaken in to address these data gaps and several further closure cover design concepts were shared with the EPA.

In 2020, MMG finalised a comprehensive closure pre-feasibility study which proposed field scale trials of two soil cover variants. These trials have now been established as part of the Stage 10 embankment raise and instrumentation has been installed to monitor the biophysical performance of the cover over the next 3-5 years. The learnings from this cover trial will also inform future cover designs for Bobadil, 2/5 Dam and other future tailings facilities and mine waste landforms.

5.3.5 Closure Research Project Update

In 2020 MMG joined the Cooperative Research Centre for Transformations in Mining Economies (CRC TiME) which brings together over 70 leading mining and mining service companies, regional development organisations, State and Commonwealth governments and research partners. This unique coalition brings scale and coordinated investment into innovative research that addresses the complex challenges underpinning mine closure and relinquishment.

MMG is currently a major sponsor of the $10M project, "Improved Prediction, Remediation and Closure of Acid and Neutral Metalliferous Drainage (AMD/NMD) Sites by Examination of Mine Waste Behaviour at the Meso-scale". The objective of this project is to develop improved prediction and remediation of acid/neutral and metalliferous drainage (AMD and NMD) from mine wastes. CRC TiME provides the framework by which to do this by enabling the investigation of mine wastes from across a range of climatic zones and evolutionary stages of weathering and closure planning.

In 2021, MMG finalised a comprehensive 6-year study into the geochemical risk of Bobadil tailings waste in collaboration with RGS Consulting. The findings of the study indicated that Bobadil tailings may have a much longer AMD lag phase than originally estimated. In order to further understand this finding, MMG entered into a research partnership with Flinders University and have commenced a kinetic testing program utilising contemporary Rosebery tailings whilst simulating several different environmental conditions & treatments. This project also aligns with MMG's commitment to implementation of the GISTM.

5.4 WASTE DISPOSAL

EPN 7153/3, G7 2.10 An inventory of wastes disposed of on The Land during the previous 12 months, including details of the quantities of each waste and the location of its disposal.

5.4.1 Waste rock and tailings

Waste rock and tailings production is summarised in Table 13. The mineral waste mined to develop declines and access the ore body is primarily used to backfill underground mine stopes and voids. All waste rock that cannot be stored underground is sent to the surface and placed in the 3 Level waste rock dump, managed in accordance with EPN 8815/2. MMG Rosebery is currently at a waste rock deficit as such waste rock has not been carted to surface since February 2017.

From 2016- April 2018, the Bobadil TSF was used as the sole location for tailings deposition. Since April 2018, tailings have primarily been deposited at the 2/5 Dam TSF with intermittent deposition at Bobadil TSF depending on operational strategies. This has been aided by the 2021 completion of the Bobadil Stage 10A embankment raise. In the 2020-21 reporting year, 786,227 tonnes of tailings were deposited at 2/5 Dam TSF and 49,998 tonnes at the Bobadil TSF.

Table 13: Waste rock and tailings production tonnes

	2016-17	2017-18	2018-19	2019- 20	2020-21
Waste rock mined	344,023	318,748	338,489	313,357	403,055
- Waste rock to underground	328,013	318,748	338,489	313,357	403,055
- Waste rock to Assay Creek WRD	0	0	0	0	0
- Waste rock to 4 Level area	0	0	0	0	0
- Waste rock to 3 Level WRD	16,010	0	0	1300*	0
Dry tailings	754,206	793,307	844,638	800,414	836,224

*1300 tonnes of core cuttings were disposed of at the 3L WRD

5.4.2 Onsite landfill

MMG Rosebery's Non-mineral Waste Management Procedure addresses critical controls for non-mineral waste facility design, non-mineral waste characterisation, inventory, tracking and handling, onsite landfill management and inspections and training.

In accordance with EPN 7153/3, Condition WM3, Bobadil Landfill (located adjacent to the TSF) is used for the disposal of lead contaminated inert materials including used filter cloths (usually buried underground), poly pipe and other plastics, timber, rubber (but not tyres) and non-recyclable metal.

Bins are inspected for unauthorised materials prior to emptying and, on a monthly basis, the waste in the landfill is spread out by an excavator and any unauthorised materials are segregated and removed. After inspection by the Waste Management Contractor Supervisor the waste is then covered with soil. An internal permitting system is used to manage non-routine disposal requirements and access to the landfill is controlled.

The amount of waste disposed at Bobadil landfill, as determined by load cells fitted to the bin collection vehicles, is presented in Table 14.

Table 14: Bobadil landfill tonnages (2016-21)

	2016-17	2017-18	2018-19	2019- 20	2020-21
Onsite Landfill disposal (tonnes)	334	232	220	235	299

6 CHECKING AND CORRECTIVE ACTION

6.1 ENVIRONMENTAL MONITORING AUDIT

EPN 7153/3, M3 Once every 5 years an external monitoring audit must be undertaken. The audit needs to assess compliance in relation to conditions M1 and M2 of this Notice and whether the current monitoring program is adequately measuring the discharge water quality from the land. The audit report must be incorporated into the next 5 yearly EMP Review

PCE 9084, M5 A monitoring audit must be undertaken by a suitably qualified independent consultant engaged by the responsible person. Conducted at the same time as any other monitoring audit conducted under the requirements of Permit No.1904. The audit must assess compliance since commencement of the discharge of tailings into the TSF with condition M1 of this permit and compliance with any monitoring Plan approved under a condition of this permit. A report on the results of the audit must be submitted to the Director no later than three months after commencement of the audit unless otherwise specified in writing by the Director.

MMG engaged *Environmental Initiatives (Tas)* to conduct the 5-yearly external monitoring audit, performed between April 20-23, 2021 (Appendix K)

The audit identified good conformance with Australian Standards and other industry guidelines with respect to the collection of surface and groundwater samples. There were some areas where improvements could be incorporated to strengthen internal quality control. High volume air sampling was also found to be well managed. Contract field staff who are engaged by MMG Rosebery to collect environmental samples had a good theoretical knowledge of the sampling methodology and techniques required.

A number of non-conformances were identified particularly in relation to the existing installation of depositional dust gauges, noise monitoring installations and the current location of the blast vibration/overpressure monitoring station.

This report contains a number of recommended actions and improvement opportunities in relation to the collection of environmental monitoring samples and data at the MMG Rosebery operation.

6.2 METEROLOGICAL MONITORING

EPN 7153/3, A4-3 Analysis of yearly climate.

The meteorological monitoring results for the reporting period are summarised in Appendix C (Air Quality and Meteorological Monitoring Program – Five Year Review - ERM, 2021).

6.3 WATER MONITORING – 3 LEVEL WASTE ROCK DUMP (EPN 8815/2)

EPN 8815/2, G4-4 Annual review of the surface and ground water monitoring program in accordance with Appendix B of the Detailed Design Report, including an assessment of surface and groundwater impacts from the 3 Level WRD.

EPN 8815/2, M3 1.2 Results of 3 Level WRD surface and groundwater monitoring program.

During the 2020 – 2021 monitoring year, no additional waste rock was added to the 3LWRD.

Below are the Surface Water and Ground Water monitoring program reviews for 3LWRD. These are conducted each year and reported in the Annual Review.

The 2020/2021 report conclusions are presented in Tables 15 & 16 below, *(Technical Advice of Water 2021).* Appendix B covers the summary of the past 5 years of data and recommendations of the monitoring program.

Table 15: Summary of surface water monitoring results for 3 Level WRD in 2020-2021.

REQUIREMENT	FINDINGS
Monitoring Frequency and Parameters	Surface water monitoring is required to be completed on a quarterly basis as the 2015 EPN specifies monthly monitoring for 3-years, followed by quarterly thereafter. Monitoring was completed as required at all sites for all parameters when water was present.
Compliance with EPN – Assessment of surface water impacts from the 3 Level WRD	The EPN requires an assessment of surface water impacts associated with 3 Level WRD. Surface water impacts beyond the immediate area of the WRD are minimal as all surface runoff from the 3 Level WRD is collected at the 4 Level settlement pond and directed to the ETP for treatment and discharge via the Bobadil TSF. There were no discharges from the settlement pond to Rosebery Creek during the 2020-2021 monitoring year. pH and zinc results from OC3, OC4 and OC5 are consistent with previous results with OC3 located at the toe of the WRD having the lowest pH and highest zinc values (Figure 3, Figure 4). In 2020-2021 zinc in OC3 has ranged from 66 mg/L to 128 mg/L with the quarterly results reversing what had been an apparent decreasing trend. At OC4 and OC5 total zinc ranged up to 11 and 3 mg/L. OC5 continues to have the highest pH values and generally the lowest zinc concentrations consistent with this site being the clean water diversion. Three of the four results collected at the site had total zinc of <1 mg/L. There is no clear relationship between 5-day rainfall totals and zinc concentration at OC3, with low rainfall associated with both high and low concentrations. However, higher rainfall in winter does tend to be associated with higher zinc concentrations, and could reflect higher saturation levels in the dump in winter leading to the flushing out of oxidation products that accumulated over the summer (Figure 5). Average zinc and sulphate concentrations in Rosebery Creek are consistent with historic results, and increase with distance downstream, reflecting diffuse inputs rather than surface discharge from the WRD or open cut as all runoff is collected and directed for treatment (Figure 6, Figure 7). The results show substantial increases between RC1 and RC1820, reflecting inputs from the 3L WRD and open cut area and other diffuse sources, and between RC1820 and RC2, due to additional diffuse inputs.

	The increase in zinc between the sites upstream and downstream of the 3L WRD area is shown in more detail in (Figure 8). Concentrations at RC2 are about 100-fold higher than RC1. RC1 shows relatively uniform zinc concentrations since 2014, whereas RC2 shows episodic elevated zinc values, although none were recorded in 2020-2021. Other metals at the site recorded concentrations within the range of previous monitoring (Figure 9).
Significant trends - longer period	All surface runoff from the 3L WRD continues to be collected and directed to the ETP for treatment. The increase in zinc and sulphate in Rosebery Creek is attributable to diffuse sources entering the waterway. There continues to be a large increase in zinc at RC1820 as compared to RC1 (10-fold) but only a small increase in sulphate (<10 mg/L) suggesting the zinc may be derived from sources other than sulphide oxidation.

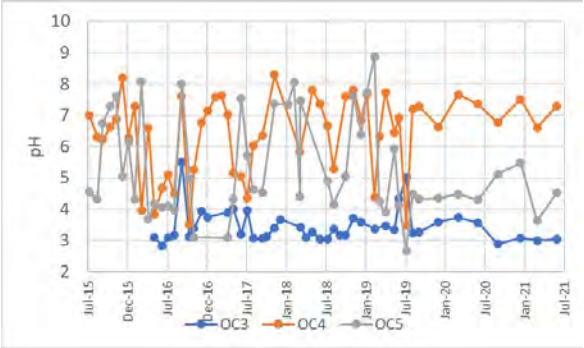

Figure 3 Time-series of pH in OC sites June 2015 – June 2021.

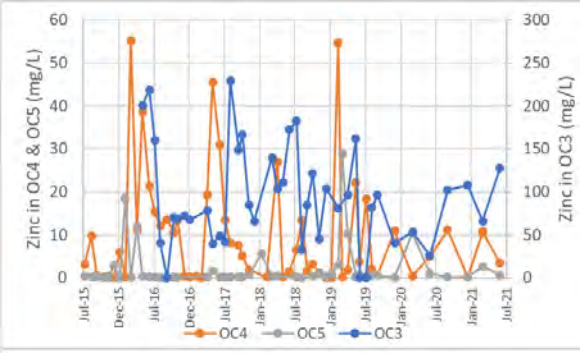

Figure 4 Time-series of total zinc in OC sites June 2015 – June 2021.

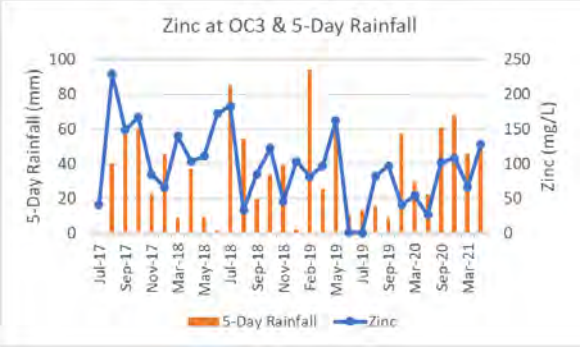

Figure 5 Comparison of total zinc concentrations in OC3 and rainfall total for 4 days prior to sampling and sampling day from Jul 2017 to Jun 2020.

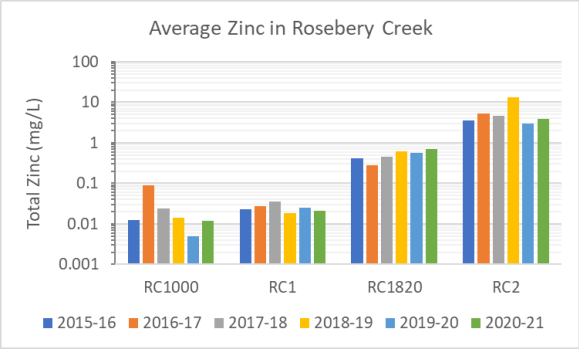

Figure 6 Average total zinc concentrations in Rosebery Creek in 2015 – 2021 monitoring years

Note: RC1000=background, RC1=upstream of WRD and open cut, RC1820 downstream of 3L WRD and open cut, RC2=upstream of confluence with Stitt River below all mine inputs.

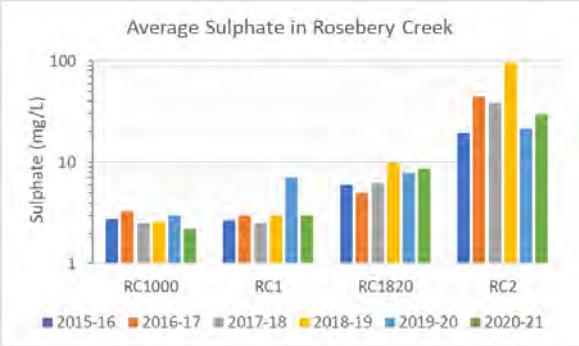

Figure 7 Average sulphate concentrations in Rosebery Creek In 2015 – 2021 monitoring years.

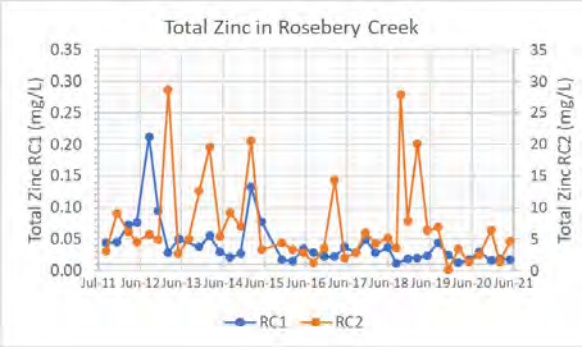

Figure 8 Comparison of total zinc concentrations at RC1 and RC2 from July 2011 to June 2021.

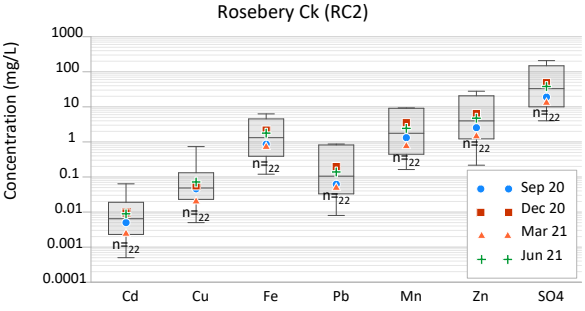

Figure 9 Total metals and sulphate at RC2 in 2019-2020 compared to results from Jan 2015 – Jun 20.

Table 16: Summary of groundwater monitoring results at 3 Level WRD 2020-2021

REQUIREMENT	FINDINGS
Monitoring Frequency and Parameters	Groundwater sampling at the 3 Level WRD was completed on a six-monthly basis as required. Parameters were determined as required. GB25D is no longer monitored as it was difficult to sample and the EPA approved removal of the site from the monitoring schedule in September 2020. Additional parameters are reported for the ground water bores that are not listed in the EPN.
Compliance with EPN – Assessment of groundwater impacts from the 3 Level WRD	The EPN requires an assessment of groundwater impacts associated with 3 Level WRD. The relative position of the groundwater bores is shown in Figure 10. Monitoring results were within the range of previous results for pH, zinc, sulphate (Figure 11 - 17) and other metals. The results were generally similar in each bore for each monitoring period except in bore GB27 where total zinc in April 2021 was 1,920 mg/L, considerably higher than record in October (1,120 mg/L) and equivalent to the highest concentration recorded at the site. Bores near the top of the valley (GB21-GB25) continue to have higher pH and lower zinc and sulphate concentrations as compared to bores located downslope of the WRD and open cut; The bores at the base of the WRD (GB27, GB36, GB44, GB46) are characterised by low pH and elevated zinc and sulphate concentrations (Figure 6-10 to Figure 6-14). Bore GB27, located within the PAF material in the WRD has consistently recorded the highest concentrations with lead, manganese and zinc levels of almost 1-2 g/L and sulphate concentrations of ~10 g/L (Figure 11 – 17), and the lowest pH values. Water levels in the bores at sites upslope of the WRD (GB21, GB22, GB23) showed decreases between Oct/Nov and Apr/May of between 0.8 m and 1.1 m. Lower on the slope water level in GB24 and GB27 increased by 0.9 m and 0.2 m between the two sampling dates, respectively. At the base of the WRD bores GB36 and GB44 increased by <0.2 m. The largest change occurred in GB46 which increased by 1.24 m between Oct 2020 and April 2021. The water level results are consistent with regional groundwater in elevated areas decreasing over the summer months. The increase in level in the lower bores may reflect the higher than average rainfall which occurred in March and April 2021.
 Figure 10. Vertically exaggerated view of 3L WRD showing approximate relative position of groundwater bores.	
Significant trends - longer period	Bores GB23 continues to record elevated zinc (11-14 mg/L) and sulphate (103-126 mg/L) concentrations even though it is located well above the open cut and WRD. Identifying the source of this groundwater would be useful for understanding diffuse inputs to Rosebery Creek.

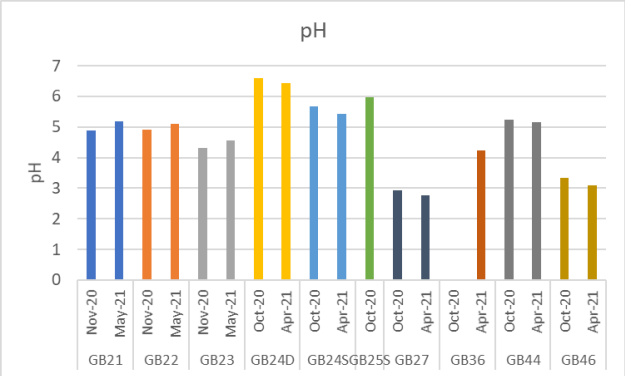

Figure 11. pH in groundwater at 3 Level WRD in 2020-2021. Colours indicate different groundwater bores as labelled on the x-axis.

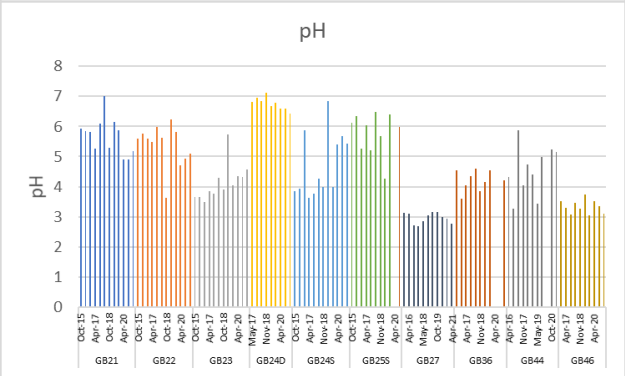

Figure 12. pH in groundwater bores since 2015. Colours indicate different groundwater bores as labelled on the x-axis.

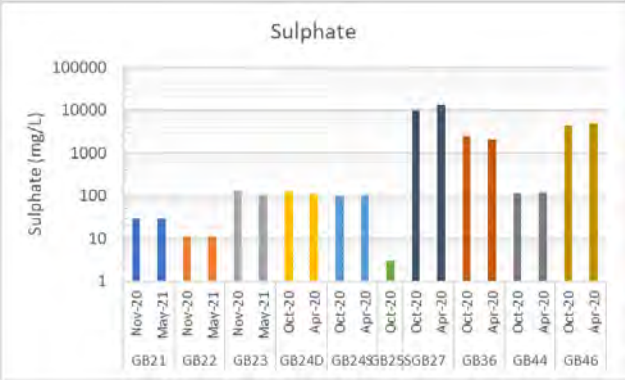

Figure 13. Sulphate in groundwater at 3 Level WRD in 2020-2021. Colours indicate different groundwater bores as labelled on the x-axis.

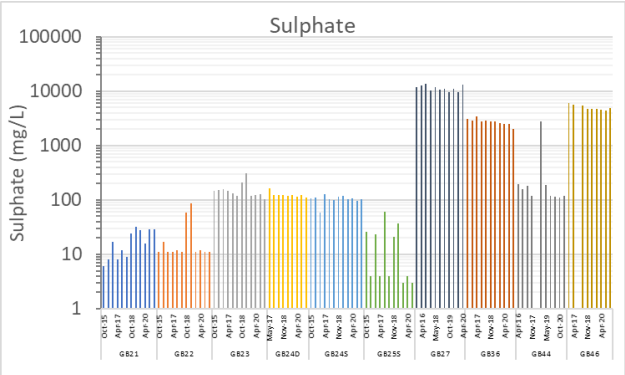

Figure 14. Sulphate in groundwater since 2015. Colours indicate different groundwater bores as labelled on the x-axis.

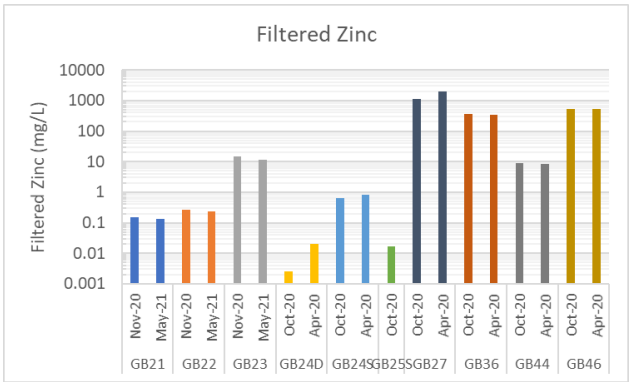

Figure 15. Dissolved zinc in groundwater at 3 Level WRD in 2020-2021. Colours indicate different groundwater bores as labelled on the x-axis.

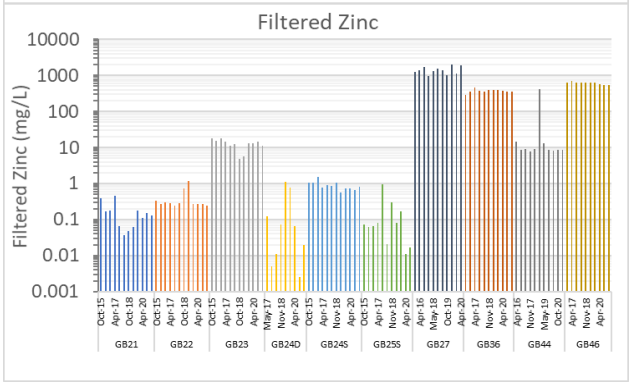

Figure 16. Dissolved zinc in groundwater since 2015. Colours indicate different groundwater bores as labelled on the x-axis.

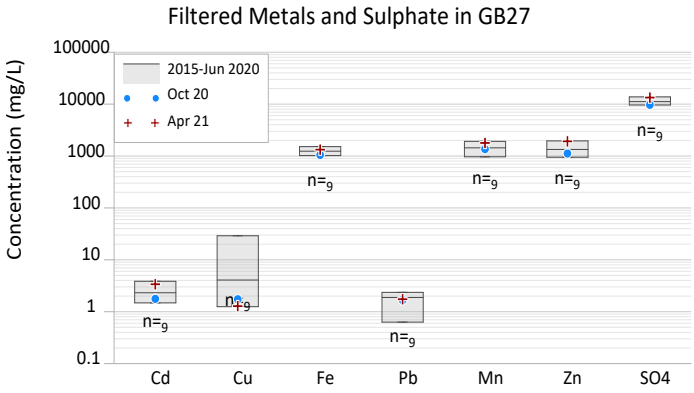

Figure 17. Filtered metals in GB27 Oct 2015 to Jun 2020. Box encompasses the 5th to 95th percentile vales. Data points show values in October 2021and April 2021.

6.4 WATER MONITORING – ROSEBERY (EPN 7153/3)

EPN 7153/3, G7 2.6 A review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations, including discharge and ambient monitoring points that illustrate significant trends.

EPN 7153/3, M4-4 If the concentrations in effluent <from Bobadil Tailings Dam end-of-pipe discharge> of parameters <listed in EPN> do not comply with the levels specified. (Investigation Trigger Level) then an investigation… must be conducted and a report summarising the outcomes of all such investigations be submitted …. in MMG Rosebery's Annual Monitoring Review and Management Report.

EPN 7153/3, E3 Annual ambient water quality monitoring programme… to document ongoing environmental conditions, increase the understanding of temporal, spatial and seasonal … chemical changes within the lake and progress the development of site specific toxicity guidelines for sulphate and zinc in Lake Pieman.

Water quality monitoring results for the reporting period have been submitted to the Director on a quarterly basis and include all water monitoring data required under EPN 7153/3.

MMG engaged Technical Advice on Water (TAoW) to undertake a review of the water quality monitoring data for the period July 2016-June 2021. The report is attached as Appendix B (TAoW, 2021).

A full review was conducted with recommendations outlined in 46.

6.5 BIOLOGICAL MONITORING

6.5.1 Lake Pieman

EPN 7153/3, E3 Annual biological survey … to document ongoing environmental conditions, increase the understanding of temporal, spatial and seasonal biological …changes within the lake…

Routine biological monitoring program is conducted by Freshwater Biomonitoring (FBM) (Appendix E) to assess the ecological status of the area in Lake Pieman influenced by the discharge from the Bobadil polishing pond. The findings are summarised in Table 17. Monitoring locations are shown in Figure 2.

Annual biological survey and ambient water quality monitoring programme of the Stitt River and Lake Pieman. The survey documents ongoing environmental conditions and increases the understanding of temporal, spatial and seasonal biological and chemical changes within the lake. The survey also allows for the development of site-specific toxicity guidelines for sulphate and zinc in Lake Pieman. Biological sampling is seasonal, and the 2021 data has not been collected to date.

Table 17: Biological monitoring of Lake Pieman – key findings 2020

EPN REQUIREMENT	FINDINGS OF MONITORING PROGRAM*
Status of environmental conditions	Chlorophyll-a levels were very low in Lake Pieman in the spring 2020 sampling, with a similarly low mean mg Chlorophyll-a per site to that recorded in 2019. The most likely cause of low levels in 2020 was the impact of the 1 m drop in Lake levels in the days prior to sampling. Benthic algal growth in Lake Pieman is limited to well lit, shallow shore zones (generally to around 0.5 - 2 m depth). As a result, the drop of 1 m in Lake levels prior to sampling is likely to have resulted in the exposure of previously more deeply inundated Lake-edge habitat with more attenuated algae growth.
Status of understanding of temporal, spatial and seasonal biological changes	The macroinvertebrate fauna collected from the Lake Pieman shoreline in spring 2020 was also characterized by generally low diversity and abundance. As was the case for algae, this low diversity and abundance of macroinvertebrates is likely to reflect the impact of constant variation in Lake levels (specifically a 1 m drop in Lake level in the days prior to sampling).

	Within the context of this low diversity and abundance of macroinvertebrates, the near-surface shoreline and snag fauna of Lake Pieman showed no apparent benthic algal response to the inflow of the Bobadil discharge

*Freshwater Biomonitoring (2020)

Quality Assurance and Quality Control

The Biological Assessment process is not NATA Certified, QA/QC is not inherently in the system. There is a certification process that the samplers and ID personnel obtain. This includes a review process that is in the scope of work. Once certified additional samples are collected and are reviewed by a second certified person as a QA/QC system. The AUSRIVAS procedures cover the QA/QC process.

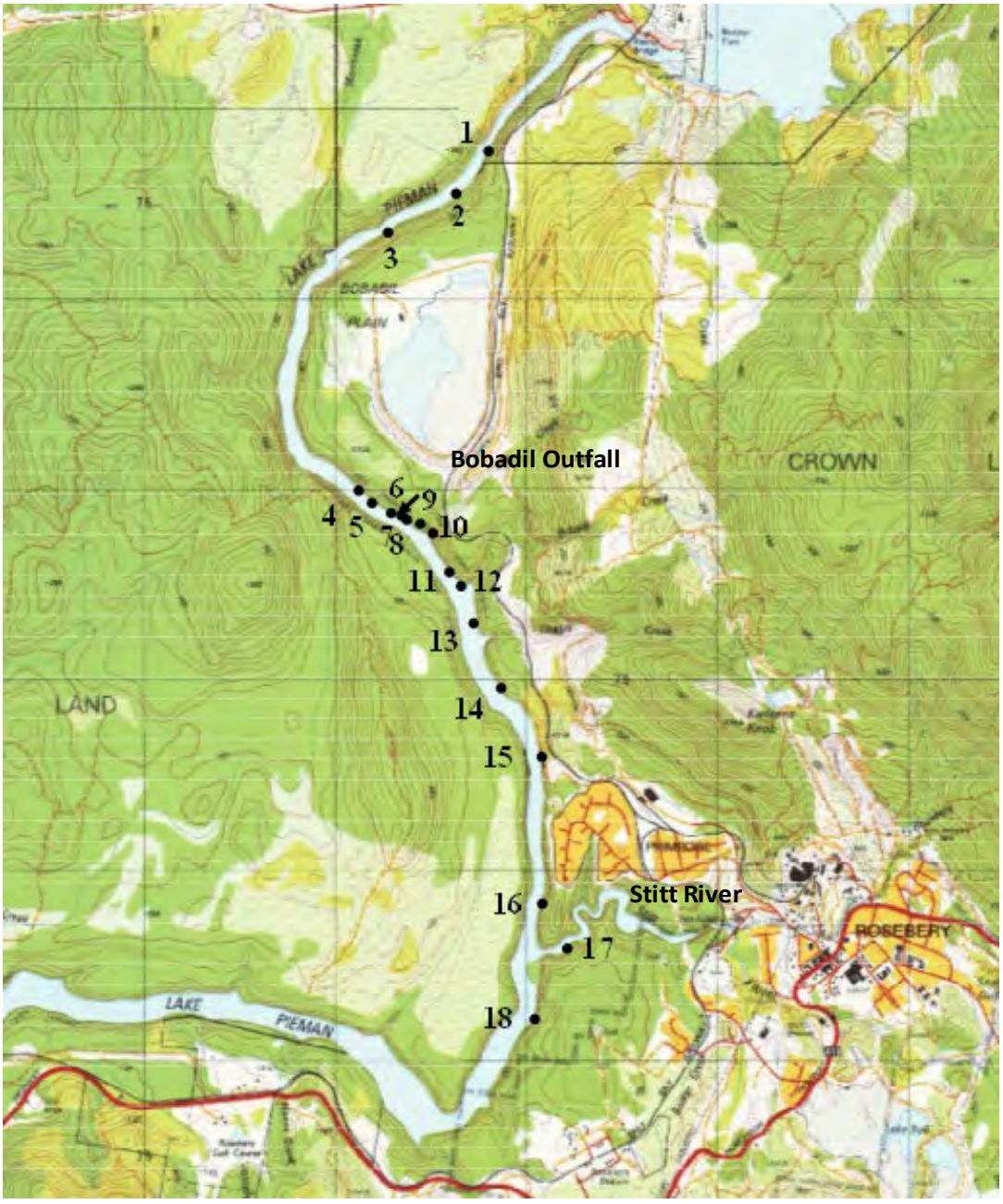

Figure 18 Lake Pieman biological monitoring sites

6.5.2 Ring and Stitt Rivers

EPN 7153/3, E3 Annual biological survey… of the Stitt River … to document ongoing environmental conditions, increase the understanding of temporal, spatial and seasonal biological …changes …

Routine six-monthly biological monitoring of the Ring and Stitt rivers was undertaken by Freshwater Biomonitoring (Appendix F) during the reporting period. Monitoring locations are shown in Figure 19 and Figure 20. The findings of the 2020-21 reporting year are summarised in Table 18 and Table 19.

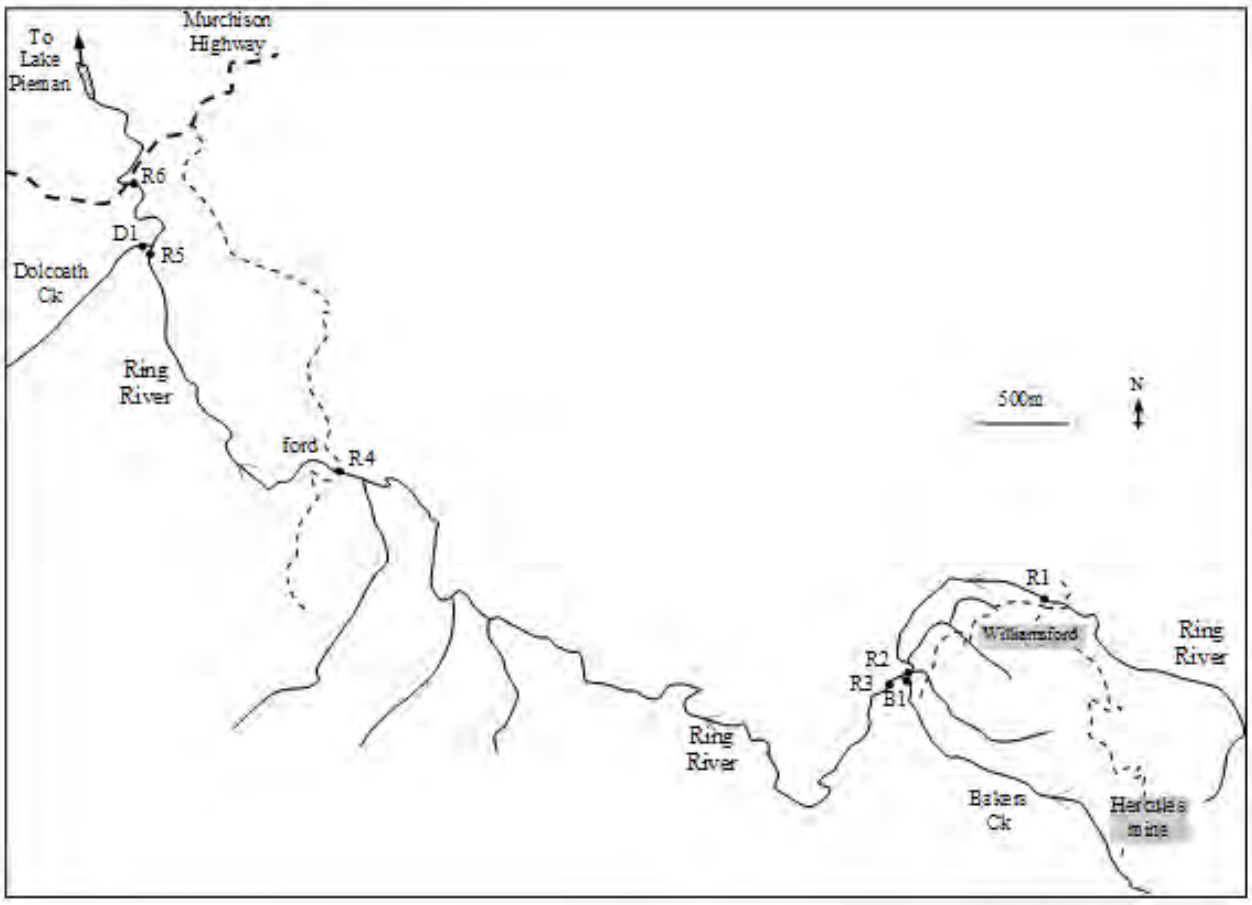

Figure 19 Ring River biological monitoring sites

Table 18: 2020-21 Biological monitoring of Ring River – key findings

EPN REQUIREMENT	FINDINGS OF MONITORING PROGRAM*
Status of environmental conditions	The Ring River remains in a degraded condition. Diversity and abundance remain severely depressed downstream of Williamsford, with an associated decline in the Observed/Expected (O/E) scores (an index of macroinvertebrate health) and total macroinvertebrate health moving downstream.
Status of understanding of temporal, spatial and seasonal biological changes	The TRCI macroinvertebrate assessment rated all Ring River sites downstream of Williamsford as being in Poor or Very Poor condition due to low abundance and the absence to a number of expected families. The primary reason for poor condition of river fauna communities in the Ring continues to be pollution from the Hercules mine area via Bakers Creek.

* Freshwater Biomonitoring (2020)

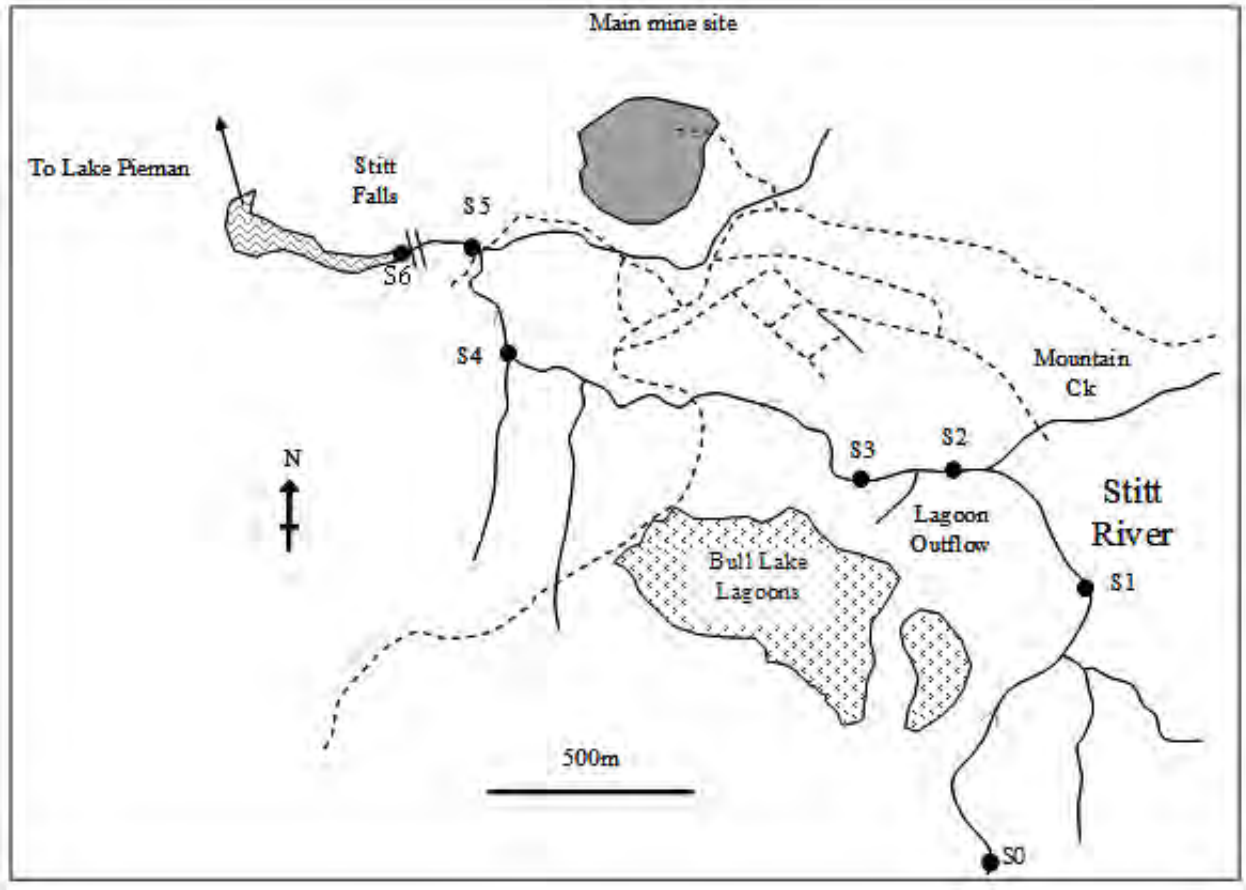

Figure 20 Stitt River biological monitoring sites

Table 19: Biological monitoring of Stitt River – key findings 2020

EPN REQUIREMENT	FINDINGS OF MONITORING PROGRAM*
Status of environmental conditions	Overall, the Stitt River is in a substantially better ecological condition than the Ring River. The surveys also suggest some additional improvement in the condition of the lower Stitt River over the past 12 months.
Status of understanding of temporal, spatial and seasonal biological changes	More recent survey results in spring 2018/autumn 2019 and spring 2019/autumn 2020 have recorded a steady improvement in the condition of the lower Stitt River. The results from the present spring 2020/autumn 2021 survey suggest relatively clean-water conditions again prevail in the Stitt River, with a range of clean-water macroinvertebrate taxa present at all sites in the Stitt River including in the lower reaches. The presence of a breeding population of brown trout throughout the Stitt River in autumn 2021 indicates that the relatively healthy macroinvertebrate fauna of the river now also supports a breeding population of brown trout, although numbers of trout captured continues to be depressed in the lower reaches of the Stitt River.

*Freshwater Biomonitoring (2020)

6.5.3 Quality Assurance and Quality Control

The Biological Assessment process is not NATA Certified, QA/QC is not inherently in the system. There is a certification process that the samplers and ID personnel obtain. This includes a review process that is in the scope of work. Once certified additional samples are collected and are reviewed by a second certified person as a QA/QC system. The AUSRIVAS procedures cover the QA/QC process.

6.6 DUST MONITORING

EPN 7153/3, G7 2.6 A review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations…that illustrate significant trends.

EPN 7153/3, A5-3 Tabulated high volume air sampler, and dust and metal deposition results for the entire year, showing intermediate values as well as final monitoring results. Tabulated annual averages of the deposition increment above background, supported by deposition isopleths or graphs <of monthly results>. Summaries of all exceedences…, describing the results of any investigations undertaken and the mitigation measures that were adopted in response. Any supporting data analysis or description necessary to aid interpretation of the dataset.

ERM was commissioned to analyse the results of MMG Rosebery's dust deposition and ambient air monitoring programs. Their key findings and detailed monitoring results are presented as Appendix C (Air Quality and Meteorological Monitoring Program – Five Year Review ERM 2021). Annual air quality review was also carried out by ERM (Appendix G).

A review of the past five years of data showed minimal exceedances of the trigger levels and no exceedances of the compliance limits of the permit conditions. This indicates that the Rosebery Mine activities are a low environmental risk to air quality and that the current dust mitigation controls are appropriate.

Over the last five years, the DustTrak, HVAS and weather data reported a high data availability with some exceptions for the carpark weather station location due to issues with the wind direction sensor in FY20. The DDG reported a low to medium data availability. This is primarily due to the amount of rainfall at site causing the bottles to overflow and invalidating the sample.

Recommendations for changes to the monitoring are covered in Table 23.

6.6.1 High Volume Air Sampling (HVAS) 2021

There were no exceedances reported of the trigger levels or compliance limits for all HVAS locations. The 5-year review is covered in Appendix C (ERM 2021).

6.6.2 Dust Deposition 2021

No exceedances of the compliance limit were reported for any deposition gauges at or beyond the site boundary for FY17 - FY21.

In FY 21 there were reported exceedances of the trigger levels for monthly dust and monthly deposited dust above background at AD21 and AD22. An investigation into the exceedance of the dust deposition trigger level at AD21 and AD22 were expected due to dust from highly localised emissions from the nearby resurfacing roadworks.

Over the 5-year period the majority of the trigger level exceedances of the DDGs are recorded at BG3. This location is furthest from site and is the designated background deposition monitoring gauge.

A 5-year review of all data is conducted in Appendix C (ERM 2021).

6.6.3 Quality Assurance and Quality Control

All of the dust deposition and HVAS samples are processed through a NATA Laboratory with a fully certified QA/QC process. The Dust Track units are NATA calibrated and EPA have introduced a local wood smoke correction factor.

6.7 NOISE AND VIBRATION MONITORING

EPN 7153/3, G7 2.6 A review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations…that illustrate significant trends.

EPN 7153/3, N1 – 1.8 Results of the continuous noise monitoring program and noise related complaints must be reported…

MMG engaged Tarkarri Engineering to conduct an annual review of noise, ground vibration and air blast overpressure data collected over the 2020-21 reporting year at MMG's Rosebery mine. (Appendix D)

Average LAeq,15min levels recorded by five fixed noise monitoring stations were commensurate with last year except for Murchison Station which averaged 3 dB lower levels during the evening and night periods.

Exceedances of air blast overpressure limits set for blasting under EPN 7153/3 occurred on a few occasions during scheduled blasting times, however, these are not a breach of the EPN conditions as blasting occurred at depths of 1 km underground with levels likely controlled by gusty weather conditions and or precipitation. Ground vibration data showed high ambient (i.e. outside of blasting times) levels through the year with times when blasts occurred showing no signal over and above ambient. Given this, the meter having passed NATA calibration and blasting occurring at distances greater than 1 km underground, breaches of the sites EPN ground vibration limits are considered to have not occurred.

6.7.1 Quality Assurance and Quality Control

Data availability was generally greater than 98 % except for Mt Black where a number of USB and data conversion errors occurred.

After filtering out adverse weather conditions and meter overloads, between 66 and 71 % of possible intervals were available for analysis, up from 58 to 67 % available from the previous year's data.

6.7.2 Noise

The environmental noise monitoring data typically showed annual averages for the LAeq, LA90 and LA10 15-minute levels at monitoring positions N1, N2, N3, N4 and N5 similar to those measured in the previous year except for Murchison Station which was on average 3 dB lower during the evening and night.

6.7.3 Vibration and Overpressure

Exceedances of air blast overpressure limits set for blasting under EPN 7153/3 occurred on 3 occasions during scheduled blasting times, however, these are not breaches of the EPN conditions as blasting occurred at depths of approximately 1 km underground with levels likely controlled by gusty weather conditions and or precipitation.

6.8 INCIDENT MANAGEMENT

G7 7153/3, 2.7 Environmental performance, including incident management …. and the corrective and preventative processes implemented.

During the period July 2020-June 2021, MMG Rosebery recorded nine environmental incidents other than those concerning compliance with EPN limits (Table 20). All events are reported in Table 20.

None of the nine incidents were classified as significant based on the MMG Risk Management Rating. One of the incidents was related to overtopping event at the Murchison highway seepage collection sump, one was in relation to new seepage at Bobadil TSF, one relating to a burst water feed line, two were in relation to lost or missed sample events, one in relation to residual flocculant trigger level breaches and the last three were in relation to minor hydrocarbon spills that were contained. All incidents were entered within MMG's Incident Event Management (IEM) system and preventative actions were developed and implemented to reduce the likelihood of re-occurrence.

Table 20: Number of environmental incidents 2020-2021

	INCIDENTS IN PREVIOUS REPORTING YEAR	INCIDENTS IN CURRENT REPORTING YEAR
Total number of environmental incidents	16	9
Total number of significant* environmental incidents	0	0

*Based on classifications in the Risk Management Rating associated with MMG's Risk Management Standard.

6.9 TAILINGS DAM MANAGEMENT

WM1 7153/3, 2.4 …any environmental or stability issue identified and associated with <all tailings dams>…further outlined to the Director in the Annual Monitoring Review and Management Report…

MMG Rosebery has two active tailings storage facilities (TSF) and one new facility in early stages of feasibility study, all requiring to be in conformance with the regulatory guidelines (ANCOLD). As MMG is in the process to be in full compliance with the Global Industry Standard in Tailings Management (GISTM) by August 2023, this is part of MMG commitment as being a signatory to the ICMM. There are no issues or actions outstanding in terms of stability. No environmental issues were notified to the Director in the reporting period.

The Bobadil and 2/5 Dam TSF's undergo monthly on-site surveillance by ATC Williams. Independent Comprehensive Surveillance Audits scheduled for 2021 and will be submitted to EPA and the Water Management branch of DPIPWE upon finalisation of the reports.

6.10 RECORDS MANAGEMENT AND RETENTION

Water quality, dust deposition and ambient air monitoring data from routine monitoring programs are managed using an environmental database (Esdat). All consultant reports/reviews are stored on MMG's document management system.

MMG's Retention and Disposal Schedule (RDS) applies to all MMG information held in electronic format in any MMG authorised information system or network drive and in physical format (hard copy). Under the RDS, all MMG Rosebery environmental business information is retained at least for the life of the mining lease.

6.10.1 Meteorological data

MMG have three weather stations that use a 3GModem and a cloud-based website. This platform provides a live service, providing users all of your weather data from each of the connected weather stations. This data is available on a Webpage accessed via the internet on any browser from a computer or mobile device and alerts are sent automatically if sensors are faulty.

6.10.2 Noise and vibration data

Recording, reporting processes and accountabilities are described in MMG Rosebery Environmental Recording and Reporting Work Quality Requirement.

7 REVIEW

7.1 EPN COMPLIANCE

G7 7153/3, 2.3 A review of activity compliance and annual external compliance audit against EPN requirements.

An external compliance audit against EPN requirements was completed in 2020 (Hammerschmid, 2020). Due to Covid-19 travel restrictions the 2021 audit was deferred and is scheduled for December 2021.

The key overall findings from this Environmental Protection Notice (EPN) Compliance Audit of MMG Rosebery in December 2020 identified that:

- As observed during the previous annual EPN audits the level of statutory compliance against MMG Rosebery's current EPN (No. 7153/3) remains high
- During the 2020 audit and the eight former EPN audits, there was no evidence of any "significant" environmental impact/harm occurring or being demonstrated as a result of the operation's current (not historical) activities (Note: "significant" defined as "resulting in long-term, widespread, irreversible environmental harm with substantial impairment of ecosystem function")
- No "major" non-compliances, one (1) minor non-compliance and one (1) partial non-compliance were identified during this December 2020 audit
- A total of seven (7) conditions of the EPN were considered to be non-applicable as of December 2020. These continue to apply to final rehabilitation and decommissioning related conditions.

Table 21: Status of actions to address the minor EPN non-compliance identified in recent external audit

ITEM	NATURE OF MINOR NON-COMPLIANCE	STATUS OF CORRECTIVE ACTIONS
1	BO - Isolated exceedances in effluent discharge limits defined in the EPN 7153/3 occurred in 2019/20. Parameters such as Zn, TPH and pH exceeded.	Immediate check samples were taken. Corrective action was to dredge the polishing ponds and associated drains to removed sediment.

Table 22: Status of actions to address the potential EPN non-compliance identified in recent external audit

ITEM	NATURE OF POTENTIAL NON-COMPLIANCE	STATUS OF CORRECTIVE ACTIONS
1	The MMG Public complaints register (Borealis) did not have a field to note if the Director – EPA has been Notified.	The MMG Public complaints register (Borealis) has been updated to have a field to note if the Director – EPA has been Notified.

Compliance with EPN limits (eg for water discharge, dust deposition etc) is assessed separately and is reported in relevant sections of this report.

7.2 PROPOSED EPN AMENDMENTS

Third party reviews of MMG Rosebery's air and water data for the period 2016-2021 have highlighted opportunities for refinement of conditions in EPN 7153/3 – these are summarised in Table 23.

Table 23: EPN refinement recommendations

EPN CONDITION	MONITORING POINTS	RECOMMENDATION	SUPPORTING EVIDENCE
A3-3 (Table 12 of Attachment 2,)	AD1.1	Remove location.	This station can be removed due to the lower data capture at this site (58% during FY17-FY21). This site is located within the site boundary. An annual trend of deposition data for this site is well known and established.
A3-4 (Table 12 of Attachment 2)	AD5	Remove location.	This station can be removed due to the low data capture at this site (52% during FY17-FY21). This site is located within the site boundary. An annual trend of deposition data for this site is well known and established.
A3-4 (Table 12 of Attachment 2)	AD23	Remove location.	This station can be removed due to the low data capture at this site (less than 50% during FY17-FY21) and the duplicate nearby DDG locations. This station is classified in the EPN as an 'additional site', sufficient data for annual trends have been collected for this location to justify its removal.
A3-4 (Table 12 of Attachment 2)	AD25	Remove location.	This station can be removed due to the low data capture at this site (less than 50% during FY17-FY21). This station is classified in the EPN as an 'additional site', sufficient data for annual trends have been collected for this location. This site is located within the site boundary however, if continuing annual trend of deposition within the site boundary is desired than this location can be retained.
A3-4 (Table 12 of Attachment 2)	AD11	Remove location.	This station can be removed due to the lowest data capture across the network (less than 50% during FY17-FY21) and the duplicate nearby DDG locations. This station is classified in the EPN as an additional site, sufficient annual trends have been collected for this location. This station has never exceeded the trigger or compliance levels
A3-4 (Table 12 of Attachment 2)	AD21	Remove location.	This station can be removed due to the lower data capture at this site (53% during FY17-FY21) and the duplicate nearby DDG locations. This station is classified in the EPN as an 'additional site', sufficient data for annual trends have been collected for this location to justify its removal.
A3-4 (Table 12 of Attachment 2)	AD22	Remove or relocate location. However, this station could be moved to be co-located with the Alec Street HVAS and DustTrak monitors.	This station can be removed due to the lower data capture at this site (53% during FY17-FY21) and the duplicate nearby DDG locations. This station is classified in the EPN as an 'additional site', sufficient data for annual trends have been collected for this location to justify its removal
A3-4 (Table 12 of Attachment 2)	BG3	New location for the background DDG recommended.	The location of this station is not suitable as historically, higher deposition rates have been reported at this location. A background dust deposition site can be useful for estimating the deposition above background as per the requirements of the EPN/PCE. Currently the minimum dust deposition rate is used for calculating the background value due to the issues with this current location. A new location for the background DDG is recommended with the BG3 location removed.
E4-1 (Table 3, Table 5 of Attachment 2)	BO	Reduce monitoring parameter requirements	Changes due to sewage no longer being discharged into 2/5 TSF: Remove TP from monitoring requirements. TP was relevant when sewage entered the system, but is not relevant to the

			mining activities and has high false negative due to interference with a milling reagent, which contains P but is not biologically available. Remove Total coliforms (6-monthly) and Thermotolerant Coliforms (monthly & 6-monthly) from monitoring requirements. The parameters were relevant when sewage was entering system but not relevant to mining activities. All sewage from MMG Rosebery enters municipal sewage system. Remove ammonia from the monitoring schedule. Ammonia was relevant to the discharge of sewage but not mining at MMG. Long term (5-yr) 95th percentile values are <1 mg/L. Remove Total CN from the monitoring schedule as it has been problematic due to interferences, and WAD CN provides a better indication of CN in the discharge. Recommended changes to remove EPN inconsistencies and align requirements with implemented monitoring strategy Remove Temperature from the parameters requiring continuous monitoring and change to weekly Remove TN from monthly monitoring requirement and retain as weekly, as it is relevant to N inputs from the ore and explosives. Increase the TN 90th percentile trigger value from 5.5 to 8.0 mg/L or remove a 95th percentile trigger. The 5-year 95th percentile value for TN is 7.5 mg/L. Nutrients pose a low risk in the receiving environment due to dark water, high currents and rapid mixing, the 95th trigger was not based on an understanding of the system, and there is no potential to reduce concentrations in the discharge. Remove Toxicological testing as an annual EPN requirement. The toxicological investigations were a one-off investigation and not intended as a regulatory requirement. Recommendations based on long-term monitoring results Change Hg monitoring from monthly to quarterly, or 6-monthly. In over 5-years there have been no detections of Hg at the LoR of 0.0001 mg/L. Change Fluoride monitoring from weekly to monthly or quarterly. In the last 5-years the highest value has been 1.8 mg/L and 95th percentile is 1.5 mg/L. There are no ANZG (2018) freshwater guidelines for Fluoride. Ecotox literature (Camargo and Alonso, 2017) suggests that safe levels for sensitive riverine snails ranges from 2.4 to 3.7 mg/L (e.g. infinite exposure). Based on this, and the rapid mixing in Lake Pieman, fluoride poses a low risk to the receiving environment, and does not provide any insights into the performance of the operation.
E4-1 (Table 5 of Attachment 2)	BI, BF	Reduce monitoring parameter requirements	Remove F from the monitoring schedule. Highest values at BF and BI in 5 years have been 1.7 mg/L and 2.3 mg/L, respectively. Not considered an environmental risk, and captured at BO. Reduce parameters at BF to pH, EC, TSS and SO4. The variability of solids at the site makes interpretation of total metal results difficult. Include provision in EPN to eliminate monitoring at BF when all tailings discharge to the TSF cease. Comparing BI and BO will provide information about behaviour of the TSF.
E4-1 (Table 5 of Attachment 2)	Bobadil Seeps (BD1 – BD5)	Review seepage monitoring plan	Review seepage from the TSF and develop a seepage monitoring plan that can be altered or amended via agreement with the Director of the EPA. Several of the seeps

			listed in the EPN do not regularly flow, and other known seeps are not being captured in the monitoring. V-notch weirs should be installed on all seeps being monitored
E4-1 (Table 11 of Attachment 2)	Bobadil Groundwater (GB4-GB9)	Reduce monitoring parameter requirements and develop new groundwater monitoring plan	A new groundwater monitoring plan should be developed that reflects the present understanding of groundwater movement in the area, and supports long-term closure monitoring. The plan should be linked to the EPN that it can be revised with the approval of the EPA Director to allow flexibility into the future. Recommended changes based on the long-term results include: Remove BTEX from the monitoring schedule or reduce the frequency to annual. BTEX has been below the LoR in all wells on all dates in the last 5 years. Remove TP from the monitoring schedule or reduce frequency to annual. TP concentrations have been <1 mg/L in all wells in the last 5 years. Remove total mercury from the monitoring schedule or reduce frequency to annual total mercury has been below the LoR of 0.0001 mg/L in all wells on all dates in the last 5 years.
Table 3 of 2/5 Dam TSF Water Quality Monitoring Plan (2021)	DW01	Reduce monitoring parameter requirements	Remove TP from the parameter list, as it is not relevant to mining activities and milling reagents interfere with the analysis. Due to this interference all results have low reliability.
Table 3 of 2/5 Dam TSF Water Quality Monitoring Plan (2021)	SP01 SP02	Remove monitoring sites	Sites are no longer relevant. Prior to redevelopment of 2/5 Dam the sites were used to inform operational effectiveness.
Table 3 of 2/5 Dam TSF Water Quality Monitoring Plan (2021)	SCD01 SCD02	Review monitoring frequency	Monthly monitoring should be maintained as TSF transitions to sub-aerial deposition. Results should be reviewed after 3 years and monitoring frequency could be reduced to quarterly if results show low variability
Table 3 of 2/5 Dam TSF Water Quality Monitoring Plan (2021)	SCP01	Review monitoring frequency	Monthly monitoring should be maintained as TSF transitions to sub-aerial deposition. Results should be reviewed after 3 years and monitoring frequency could be reduced to quarterly if results show low variability. Field flow requirement should be altered to recording of pump hours.
Table 3 of 2/5 Dam TSF Water Quality Monitoring Plan (2021)	MHS2 MHS3	Reduce monitoring frequency	Reduce monitoring frequency to quarterly unless discharging to Stitt River, in which case monitor daily.
E4-1 (Table 7 of Attachment 2) & Table 3 of 2/5 Dam TSF Water Quality Monitoring Plan (2021)	WL8	Reduce monitoring parameter requirements	Remove F from the monitoring schedule. All results except 1-outlier in 2017 have been ≤0.3 mg/L, with 29the 95th percentile value being below the LoR of 0.130 mg/L. Reduce monitoring frequency of K, Na, Mg, and Cl to quarterly. There are 5+ years of results showing the background concentration of these parameters. Reduce the monitoring frequency of As and Ni from monthly to quarterly as these are consistently below or near the LoR.

Table 3 of 2/5 Dam TSF Water Quality Monitoring Plan (2021) for PCE 9084	SR02 SR03	Develop flow model	No recommendations to the monitoring regime. Development of a flow model linking flow at monitoring sites to WL8 is recommended for quantifying diffuse inputs
Table 3 of 2/5 Dam TSF Water Quality Monitoring Plan (2021)	CWDD01	Increase monitoring parameter requirements	Add As, Cd and Ni to parameter list to be consistent with monitoring at SR02 and SR03.
Table 3 of 2/5 Dam TSF Water Quality Monitoring Plan (2021) for PCE 9084	SD	Increase monitoring parameter requirements	Add acidity to the parameter list to be monitored in the event of a discharge event.
E4-1 (Table 9 of Attachment 2)	AC1 AC2 FPC1 FPC2 PC1	Remove locations	These sites should be removed from the EPN monitoring schedule as they do not reflect stormwater that is leaving the site. A revised stormwater monitoring plan should be developed that includes monitoring of any overflows from the Filter Plant stormwater ponds, and includes any additional sources of stormwater leaving the site.
E4-1 (Table 9 of Attachment 2)	RC1 RC2 FPC3 PC2	Retain locations	Rosebery Creek is a major conduit of diffuse inputs from the site (and surrounding area) to the Stitt River and Lake Pieman and monitoring should be maintained in future stormwater monitoring plans. Sites PC2 and FPC3 predominantly monitor runoff from the residential area and roads, but may contain some runoff from the MMG site. They are the most downstream sites in their respective catchments, so should be retained in future stormwater monitoring plan. Flow should be measured or estimated at RC1, FPC3 and PC2 during stormwater sampling to allow quantification of loads at the sites.
Table 10 of Attachment 2	Underground Monitoring	Underground (17L, 8L, NED, Head of Race)	Monitoring at NED should be reviewed following completion of the Closure study with the potential to eliminate the site or reduce monitoring to quarterly.
E4-1 (Table 8 of Attachment 2)	RR@Bridge RR u/s BC 7LComp WSP RAH	Reduce monitoring parameter requirements	Remove fluoride from the monitoring schedule. All results have been <2mg/L at 7L and <1mg/L in BC2 and RR u/s BC over past 5 years. Concentrations at RAH are at or near LoR of 0.1 mg/L showing very low concentrations in the lower river entering Lake Pieman. Remove Ca and Mg from the monitoring schedule. There is a long record for these parameters and there is good correlation with zinc and sulphate. WSP and 7L Comp sites monitor the same stream in 2 places with no inflows in between. One of these sites could be removed from the monitoring schedule.
E4-1 (Table 6 of Attachment 2)	PBS2 – PBS6	Reduce monitoring parameter requirements	Remove fluorine from the monitoring schedule as all results are <1 mg/L and are not useful as an indicator of mining inputs. Remove Cl from the monitoring schedule as it reflects rainfall and is not a good indicator of mining input (Ca and SO4 are good indicators)

8 ACRONYMS

ACRONYM	DEFINITION
AMRMR	Annual Monitoring Review and Management Report
EPA	Environmental Protection Authority
EPN	Environmental Protection Notice
ETP	Effluent Treatment Plant
PFS	Prefeasibility Study
HVAS	High Volume Air Sampling
PM_{10}	Fraction of total particles suspended in the air, having diameters less than 10µm.
QA/QC	Quality assurance / quality control
SHEC	Safety, Health, Environment and Community
TSF	Tailings Storage Facility
TSP	Total suspended particles – the term given to the fraction of total particles suspended in the air having diameters generally less than 50µm.
WRD	Waste rock dump

APPENDIX A: SAMPLING LOCATION MAPS

1:7,500 (at A3)

0 200 400

metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid Of Australia, Zone 55

N W E S

LEGEND

- Groundwater Monitoring Point
- Surface Water Monitoring Point
- Underground Workings
- Regional Road
- Regional Waterway

Annual Monitoring Review

Date | 26 SEPT 2014

Rosebery Mill & Town Area Water Monitoring Locations

Figure A.1

S:\Environmental\Rosebery\Routine\ROE-R013_External Reporting and Communication\EPA\Annual Reporting\GIS\002_MMG Site Sampling Locations__Fig1_Site_V02.WOR

MMG Aerial Image 2014 Created by: MuellerG

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APPENDIX B: MMG FIVE YEAR WATER QUALITY REVIEW (TECHNICAL ADVICE ON WATER, 2021)

MMG Five Year Water Quality Review

Report to MMG Rosebery

V1.1

26 October 2021

L. Koehnken

Technical Advice on Water

DOCUMENT TYPE:	Report	
TITLE:	MMG Five Year Water Quality Review	
VERSION:	V1.1	
CLIENT:	MMG Rosebery	
PREPARED BY:	Lois Koehnken	V1.1 26 Oct 2021 V1 15 Oct 2021 Draft 11 Oct 2021
DISTRIBUTED TO:	Adam Pandelis, MMG SHEC Bowen Wagenknecht, MMG SHEC	V1 15 Oct 2021 Electronic; .doc, .pdf Draft: 11 Oct 2021 Electronic .doc

Contents

1 Introduction

MMG Rosebery is required to complete a five-year review of the water quality monitoring program and results, with the following components required under the EPN:

- Summary commentary on any identified impacts on the Pieman and Stitt Rivers based on the analysis completed in the Annual Review (condition E4-2);
- Provide recommendations for refining the monitoring program (condition E4-2);
- Advise on the suitability of the monitoring program to adequately measure discharge water quality from MMG Rosebery's operations (condition M3); and,
- Provide independent assurance that MMG Rosebery's sampling and analysis regime, records management and quarterly reporting meet the requirements of condition M3.

This report addresses these requirements based on the monitoring data collected by MMG Rosebery as required under EPN 7153/3, which includes monitoring schedules for the MMG Rosebery site and the decommissioned Hercules mine site. A detailed analysis of results from all monitoring sites is provided in the Annual Review Reports. This summary focusses on the results related to discharges entering the receiving environment.

2 Impacts of discharge from MMG Rosebery on the Receiving Environment

MMG Rosebery has one active licenced discharge point BO (Bobadil Outfall) from the Bobadil Tailings Storage Facility (TSF) with the discharge entering Lake Pieman. All process water, underground mine water, tailings decant from the 2/5 TSF and a substantial portion of stormwater from the site are directed to the Effluent Treatment Plant (ETP) for lime dosing and discharged to the Bobadil TSF. The EPN contains criteria for direct discharge to the Stitt River from the 2/5 TSF, but MMG does not discharge from this TSF to the environment under normal operations.

Diffuse emissions from MMG Rosebery's operations enter Lake Pieman directly, or via the Stitt River. Non-MMG Rosebery related diffuse and point source emissions also enter these water ways, and are associated with the discharge of treated wastewater, stormwater runoff, leaching of historic (non-MMG Rosebery) acid forming rock and fill material and other historic mine sites.

Diffuse emissions from the decommissioned Hercules site enter the Ring River as it flows through the mine site and eventually enter Lake Pieman, downstream of BO and the Stitt River. Additional diffuse sources enter the Ring River from historic and active mine sites downstream of the Hercules site.

The following sections summarise the trends in these discharges to the receiving environment between 2016 and 2021 and provide an indication of the impact of these discharges on the receiving environment.

2.1 Discharge at BO

Water management at MMG Rosebery has changed over the past five years, associated with increased stormwater collection and treatment, and the commissioning of the redeveloped 2/5 TSF. Both of these actions have increased the volume of water reporting to the ETP and discharged at BO. Average annual flows at BO ranged between 0.27 to 0.28 m^3/s in the 2016-2017 through 2018-2019 monitoring years, and increased to 0.48 and 0.49 m^3/s in 2019-2020 and 2020 -2021, respectively. The collection of additional stormwater has increased the variability of the discharge as well as the volume.

Management at BO has remained consistent over the past 5-years, with MMG Rosebery maintaining pH levels in the TSF discharge generally above pH 7.5 (Figure 2-1). Alkalinity in the TSF has also remained relatively consistent between 20 and 60 mg/L, with a few periods of very high alkalinity associated with high dosing at the ETP.

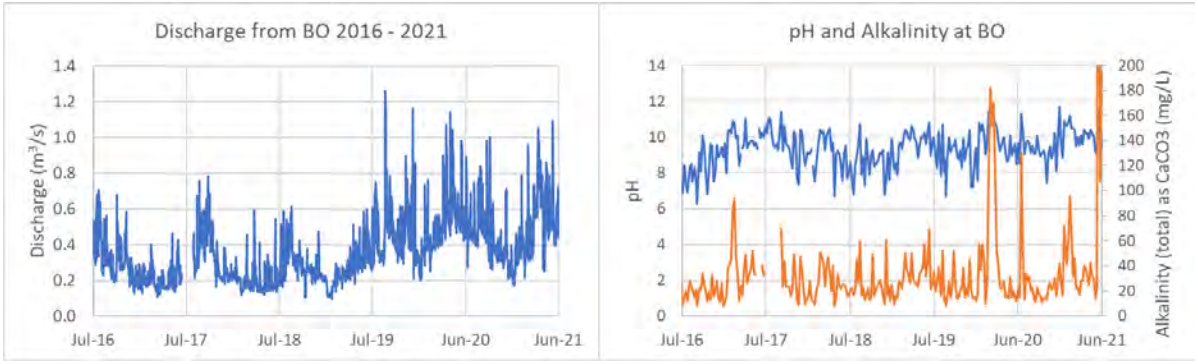

Figure 2-1. (left) Average daily discharge at BO based on continuous (15-minute) measurement. (right) Time-series of pH and alkalinity at BO July 2016 to June 2021 based on weekly monitoring.

Total zinc concentrations, which is the parameter of most concern in the BO discharge, is generally ≤0.1 mg/L (Figure 2-2). Concentrations tend to increase during very high flow events in the winter, with the increase likely attributable to an increase in storm water inflows, and associated decrease in retention time. In the 5-years of weekly monitoring, there have been three occasions when total zinc exceeded the guideline value of 1 mg/L, with all three events occurring during high flow events in the month of July.

On three occasions over the past five years, the weekly EC values have exceeded the EPN limit of 2000 µS/cm. These have generally coincided with periods of over dosing of lime at the ETP. Sulphate concentrations, which are a major contributor to EC along with Ca and other ions, has remained between 500 and 1000 mg/L, well below the EPN limit.

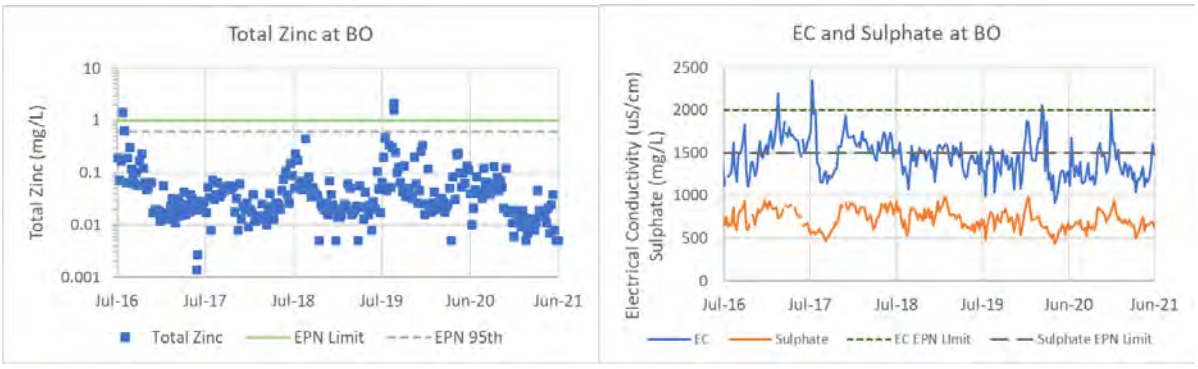

Figure 2-2 (left) Time-series of total zinc at BO based on weekly monitoring. The EPN limit of 1 mg/L and 95th percentile investigative trigger level are indicated; (right) time-series of EC and sulphate at BO with respective EPN limits.

Average daily total zinc loads (Figure 2-3) show that higher loads are discharged during the wet winter periods. Elevated loads occurred in most months in 2019-2020, and are attributable to multiple factors, including: a reduction in tailings input to Bobadil TSF associated with commissioning of the 2/5 TSF, an increase in water discharge due to the higher volumes of water used to transport tailings to the 2/5 TSF which is subsequently discharged via Bobadil; and dredging of the polishing pond. During the 2019-2020 year there were two zinc EPN exceedances. In 2020-2021 there were no zinc

exceedances and the zinc loads are within the range recorded prior to 2019, demonstrating that the increase in flow rates has not increased the zinc loads in the discharge. The median average daily load discharged at BO is 0.8 kg/day. The monitoring is adequate to quantify emissions to the receiving environment.

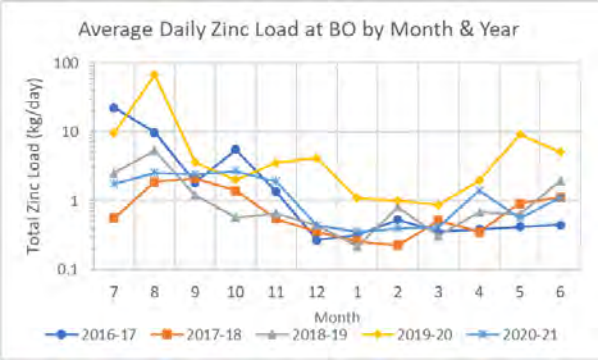

Figure 2-3. Average daily total zinc load (kg/day) in BO discharge by month (1 = Jan, 12 = Dec) and year based on weekly monitoring results.

2.2 Diffuse inputs to Stitt River from Rosebery Creek

Rosebery Creek drains a large area of the MMG Rosebery mine site, along with residential and municipal areas. The creek joins the Stitt River upstream of Stitt Falls, and the Stitt enters the backwater of Lake Pieman within another 200 m downstream. Estimated zinc loads based on the quarterly stormwater results and flow in the creek range from ~2 kg/day to ~112 kg/day, with a median value of 14 kg/day.

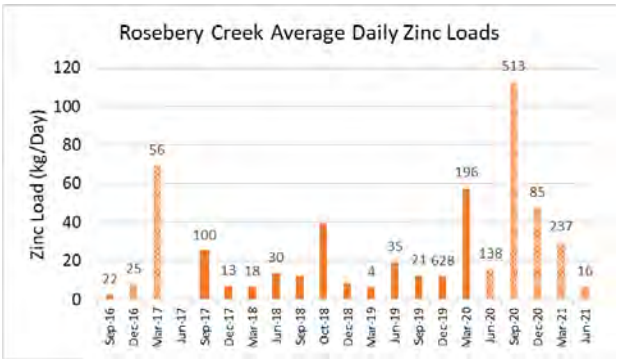

Figure 2-4. Daily zinc loads in Rosebery Creek based on quarterly storm water monitoring. Stippled bars indicate that flow measurements in Rosebery Creek are not available, and flow was estimated based on a correlation with flow in the Stitt River. Number labels indicate flow rate on sampling day.

2.3 Diffuse inputs into the Stitt River upstream of Rosebery Creek

The redevelopment and commissioning of the 2/5 TSF during the past 5-years has resulted in an increase in surface water monitoring in the Stitt River. Monitoring locations include the clean water diversion upstream of the TSF, and the Stitt River upstream and downstream of the TSF. More recently, sites have been added upstream of the confluence with Rosebery Creek, and upstream of Lake Pieman. The results show a progressive increase in total zinc with distance down the Stitt River, with a notable increase at SR02 and another at U/S Pie due to the inflow from Rosebery Creek. Diffuse inputs to the Stitt have decreased since 2019 due to the collection and treatment of seeps emanating along the Murchison Highway toe of the TSF. The monitoring results are adequate to demonstrate the cumulative impact of diffuse discharges on the Stitt River.

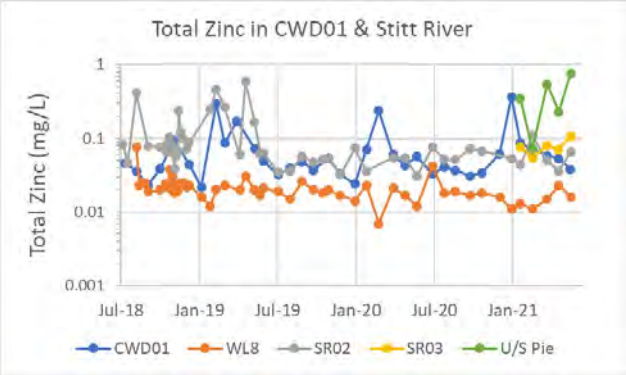

Figure 2-5. Time-series of total zinc concentrations in monitoring sites in the Stitt River. CWD01 =Clean Water diversion drain, WL8=Stitt upstream of TSF, SR02 and SR03 are downstream of the TSF and U/S Pie is downstream of the confluence with Rosebery Creek.

2.4 Diffuse inputs to Lake Pieman

Historically, additional stormwater generated near the Filter Plant area entered the Stitt River via Filter Plant and Primrose Creek. The development of a stormwater collection and transfer system has largely eliminated contaminated runoff from the filter plant area, and intercepted and reduced runoff from neighbouring areas as well. Storm water monitoring of Filter Plant and Primrose Creek continues, although most of the runoff is associated with the surrounding residential area and roads rather than from the site. The monitoring results are adequate to capture the quality of the water entering Lake Pieman in the flooded arm of the Stitt River. No flow results are available for the creeks so contaminant loads cannot be determined.

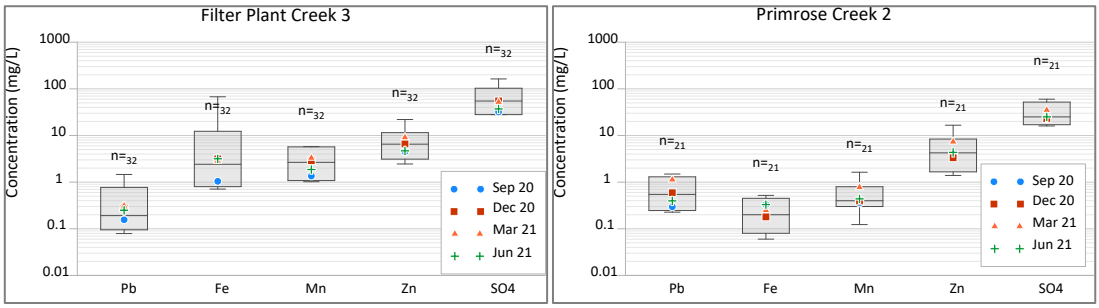

Figure 2-6. Box and whisker plots of storm water monitoring in lower Filter Plant Creek (FPC3) and Primrose Creek (PC2), upstream of where it enters the Stitt River arm of Lake Pieman. Box encompasses the 5th to 95th percentile monitoring results collected between Jan 2015 and Jun 2020, and the monitoring results collected from Jul 2020 to Jun 2021 are shown as data points.

2.5 Impact of MMG Rosebery discharge on Lake Pieman

MMG Rosebery complete quarterly monitoring in Lake Pieman, with 5 sites distributed between upstream of the BO discharge point, to downstream of the Stitt River. Water quality in Lake Pieman is strongly influenced by the operation of the Bastyan Power station located about 4 km upstream of BO. Under typical operations, discharge from the station is either 0 m^3/s (off) or about 140 m^3/s when operating. This flow provides between 160- to 500-fold mixing of the BO discharge (range = 0.3 – 0.8 m^3/s). Periods with no flow are typically limited to a few hours, and overall the station tends to discharge about two-thirds of the time. The concentrations of zinc and other parameters tend to be low when the power station is operating, and increase during periods of prolonged power station shutdown (e.g. several days of shut down). Figure 2-7 shows the surface zinc concentrations from

2014 to present. Periods with elevated values at all locations reflect power station shut downs. During normal operation, zinc concentrations tend to increase at PBS5, reflecting the inflow of the Stitt River.

Total zinc concentrations in Lake Pieman exceed the ANZG (2018) 95th percentile guideline of 0.008 mg/L, but are frequently within the 90th percentile level of 0.015 mg/L. Site specific toxicity testing using Lake Pieman water and a resident macroinvertebrate *Ceriodaphnia* provided a No Observable Effects Level (NOEC) of 0.239 mg/L. Applying a 10-fold safety factor to this value suggests that zinc levels of 0.020 to 0.025 mg/L should provide a high level of protection for the artificial lake environment. Zinc levels at mid-depth in the bottom water of the lake tend to show similar trends as surface waters. The results suggest that discharges from MMG Rosebery pose a low risk during periods of power station operation, or intermittent operation. Slightly higher risks are posed during periods of infrequent extended shut-downs.

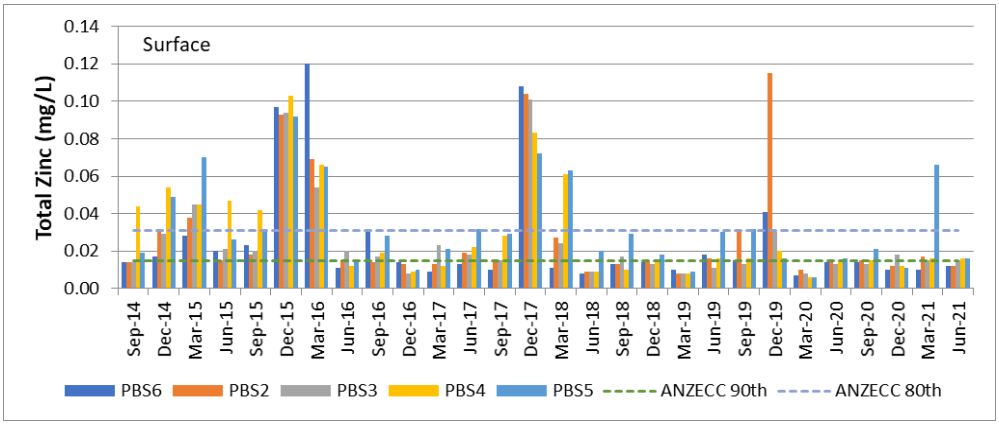

Figure 2-7. (top) Total zinc concentrations in the surface waters of Lake Pieman. Results for each date are shown in a downstream direction (e.g. PBS6 is upstream of BO, PBS5 is downstream of the confluence with the Stitt River).

2.6 Diffuse inputs to the Ring River

The decommissioned Hercules mine site discharges acidic, metal rich drainage into the upper Ring River, and Baker Creek, a tributary of the Ring. Monitoring discharge at the sites is difficult and, up until recent flow infrastructure upgrades, there have been gaps in the data, and some erroneous results. The 2020-21 results are considered to be of good quality, and have been used to estimate daily zinc fluxes from the Hercules site (Figure 2-8). Zinc loads of over about 600 kg/day are estimated for Baker Creek with an additional 90 kg/day entering from the Ring.

Figure 2-8 summarises the total zinc concentrations recorded at three monitoring sites located on the upper Ring River and Baker Creek (RR@Br RRusBC and BC2) and a site upstream of the confluence with Lake Pieman (RAH). The results show that the inflow from Hercules and other sources in the catchment has a net impact of increasing the concentration of zinc from an average of 0.8 mg/L at the Ring at Bridge site to 2.8 mg/L at the Ring at Murchison Highway site. The monitoring results provide a good indication of water quality discharges from Hercules and how concentrations change in the lower catchment.

Downstream of the Murchison Highway monitoring site, additional discharges enter the river from the active Bluestone tin mine site. Monitoring of Lake Pieman downstream of the confluence with the Ring River is not included in the MMG Rosebery monitoring schedule so the overall impacts of these emissions on the lake cannot be evaluated.

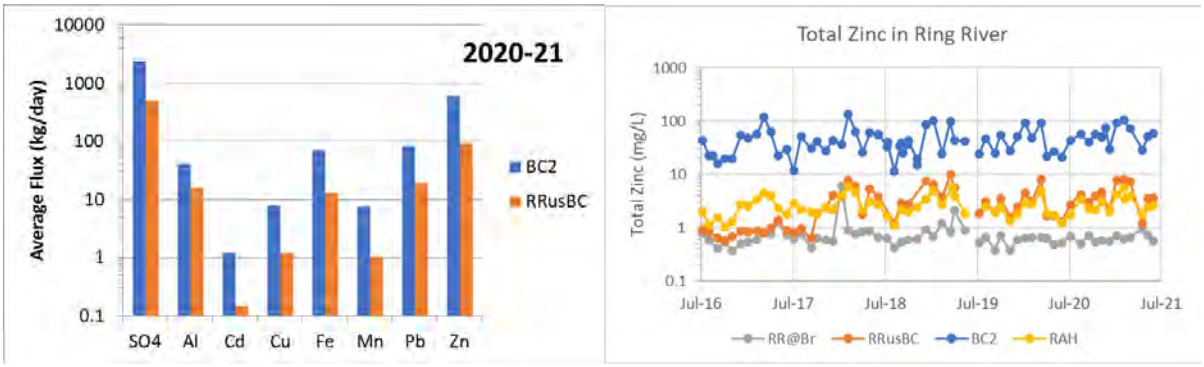

Figure 2-8. (left) Average zinc loads discharged from the Hercules site in 2020-21 (right) Total zinc concentrations at monitoring sites in the Ring River. From upstream to downstream the sites are: Ring River at Bridge, Ring River upstream Baker Ck, Baker Creek upstream of Ring River and Ring River at Murchison Highway.

3 Recommendations for refining monitoring

The monitoring requirements for MMG Rosebery are set out in EPN 7153/3, which was issued in 2011, with the monitoring providing a decade of results. Operations at MMG Rosebery have changed during this period, including improvements to stormwater capture and treatment, cessation of sewage discharge to the 2/5 TSF, redevelopment of the 2/5 TSF, several lifts of the Bobadil TSF, and cessation of continuous tailings discharge at Bobadil. The combination of these factors has resulted in some of the scheduled monitoring becoming obsolete and / or not providing useful information about the environmental performance of the operation. This section outlines recommendations for how monitoring at MMG Rosebery could be adjusted recognising the long data history for the site, and the present water management strategy.

3.1 Monitoring at Bobadil TSF

The Bobadil Outfall (BO) site is the licenced discharge point for the operation and it is anticipated that discharge will continue to enter Lake Pieman via BO for the foreseeable future, however the inputs to the TSF are likely to change and may reduce. A revised EPN should have provisions that allow for flexibility in future monitoring to reflect these potential changes.

Table 1. Recommended changes to monitoring sites associated with the Bobadil TSF

Site(s)	Recommendations
BO	Changes due to sewage no longer being discharged into 2/5 TSF: • Remove TP from monitoring requirements. TP was relevant when sewage entered the system, but is not relevant to the mining activities and has high false negative due to interference with a milling reagent, which contains P but is not biologically available. • Remove Total coliforms (6-monthly) and Thermotolerant Coliforms (monthly & 6-monthly) from monitoring requirements. The parameters were relevant when sewage was entering system but not relevant to mining activities. All sewage from MMG Rosebery enters municipal sewage system. • Remove ammonia from the monitoring schedule. Ammonia was relevant to the discharge of sewage but not mining at MMG. Long term (5-yr) 95th percentile values are <1 mg/L. • Remove Total CN from the monitoring schedule as it has been problematic due to interferences, and WAD CN provides a better indication of CN in the discharge.

Site(s)	Recommendations
	Recommended changes to remove EPN inconsistencies and align requirements with implemented monitoring strategy • Remove Temperature from the parameters requiring continuous monitoring and change to weekly • Remove TN from monthly monitoring requirement and retain as weekly, as it is relevant to N inputs from the ore and explosives. • Increase the TN 95th percentile trigger value from 5.5 to 8.0 mg/L or remove a 95th percentile trigger. The 5-year 95th percentile value for TN is 7.5 mg/L. Nutrients pose a low risk in the receiving environment due to dark water, high currents and rapid mixing, the 95th trigger was not based on an understanding of the system, and there is no potential to reduce concentrations in the discharge. • Remove Toxicological testing as an annual EPN requirement. The toxicological investigations were a one-off investigation and not intended as a regulatory requirement. Recommendations based on long-term monitoring results • Change Hg monitoring from monthly to quarterly, or 6-monthly. In over 5-years there have been no detections of Hg at the LoR of 0.0001 mg/L. • Change Fluoride monitoring from weekly to monthly or quarterly. In the last 5-years the highest value has been 1.8 mg/L and 95th percentile is 1.5 mg/L. There are no ANZG (2018) freshwater guidelines for Fluoride. Ecotox literature (Camargo and Alonso, 2017) suggests that safe levels for sensitive riverine snails ranges from 2.4 to 3.7 mg/L (e.g. infinite exposure). Based on this, and the rapid mixing in Lake Pieman, fluoride poses a low risk to the receiving environment, and does not provide any insights into the performance of the operation.
BI, BF	• Remove F from the monitoring schedule. Highest values at BF and BI in 5 years have been 1.7 mg/L and 2.3 mg/L, respectively. Not considered an environmental risk, and captured at BO. • Reduce parameters at BF to pH, EC, TSS and SO4. The variability of solids at the site makes interpretation of total metal results difficult. • Include provision in EPN to eliminate monitoring at BF when all tailings discharge to the TSF cease. Comparing BI and BO will provide information about behaviour of the TSF.
Bobadil Seeps (BD1 – BD5)	• Review seepage from the TSF and develop a seepage monitoring plan that can be altered or amended via agreement with the Director of the EPA. Several of the seeps listed in the EPN do not regularly flow, and other known seeps are not being captured in the monitoring. • V-notch weirs should be installed on all seeps being monitored
Bobadil Groundwater (GB4-GB9)	• A new groundwater monitoring plan should be developed that reflects the present understanding of groundwater movement in the area, and supports long-term closure monitoring. • The plan should be linked to the EPN that it can be revised with the approval of the EPA Director to allow flexibility into the future. Recommended changes based on the long-term results include: • Remove BTEX from the monitoring schedule or reduce the frequency to annual. BTEX has been below the LoR in all wells on all dates in the last 5 years. • Remove TP from the monitoring schedule or reduce frequency to annual. TP concentrations have been <1 mg/L in all wells in the last 5 years.

Site(s)	Recommendations
	• Remove total mercury from the monitoring schedule or reduce frequency to annual total mercury has been below the LoR of 0.0001 mg/L in all wells on all dates in the last 5 years.

3.2 2/5 Monitoring

In July 2021, the EPA approved implementation of a revised water quality monitoring strategy for the 2/5 Dam. The revised plan reflects the current management of the TSF and includes surface water monitoring upstream, near and downstream of the TSF. The following modifications to the updated plan are recommended based on the recent annual review.

Table 2. Summary of recommendations to monitoring sites associated with the 2/5 TSF.

Site	Recommendation
DW01	• Remove TP from the parameter list, as it is not relevant to mining activities and milling reagents interfere with the analysis. Due to this interference all results have low reliability.
2/5 Collection ponds (SP01, SP02)	• Sites were relevant to construction. Remove from the monitoring schedule unless relevant to future lifts.
2/5 Seeps (SCD01, SCD02)	• Monthly monitoring should be maintained as TSF transitions to sub-aerial deposition. Continuous recording EC should be implemented on SCD01 or on the discharge from SCP01 back to the TSF with the aim of establishing a relationship between EC and zinc so a continuous record can be obtained. Results should be reviewed after 12 months and if a reliable EC and zinc relationship can be established monitoring frequency could be reduced to quarterly.
2/5 Seep Collection Pond (SCP01)	• Monthly monitoring should be maintained as TSF transitions to sub-aerial deposition. Results should be reviewed after 3 years and monitoring frequency could be reduced to quarterly if results show low variability. • Field flow requirement should be altered to recording of pump hours.
Murchison Highway Seeps (MHS2, MHS3)	• Reduce monitoring frequency to quarterly at MHS2 unless discharging to Stitt River, in which case monitor daily. • The MHS3 seep reflects local groundwater flowing through fill at the Stitt Park. It is recommended that this site be considered a stormwater site rather than a 2/5 Seepage site and monitored quarterly with the other stormwater sites.
Stitt River (WL8)	• Remove F from the monitoring schedule. All results except 1-outlier in 2017 have been ≤0.3 mg/L, with the 95th percentile value being below the LoR of 0.1 mg/L. • Reduce monitoring frequency of K, Na, Mg, and Cl to quarterly. There are 5+ years of results showing the background concentration of these parameters. • Reduce the monitoring frequency of As and Ni from monthly to quarterly as these are consistently below or near the LoR.
Stitt River downstream of TSF (SR02, SR03)	• No recommendations to the monitoring regime. • Development of a flow model linking flow at monitoring sites to WL8 is recommended for quantifying diffuse inputs
Stitt River upstream of TSF (CWDD01)	• Add As, Cd and Ni to parameter list to be consistent with monitoring at SR02 and SR03.

Site	Recommendation
Discharge to Stitt (SD)	• Add acidity to the parameter list to be monitored in the event of a discharge event.
2/5 Groundwater	• No changes recommended.

3.3 Stormwater monitoring

Over the past years, MMG has substantially increased the interception and storage capacity of the stormwater system on site. The existing stormwater monitoring schedule largely monitors sources that are intercepted and treated. Monitoring of stormwater is recommended to be altered as follows:

Table 3. Summary of recommendations to stormwater monitoring.

Site(s)	Recommendation
Stormwater Monitoring (AC1, AC2, FPC1, FPC2, PC1)	• These sites should be removed from the EPN monitoring schedule as they do not reflect stormwater that is leaving the site. • A revised stormwater monitoring plan should be developed that includes monitoring of any overflows from the Filter Plant stormwater ponds, and includes any additional sources of stormwater leaving the site.
Stormwater Monitoring (RC1, RC2, FPC3, PC2)	• Rosebery Creek is a major conduit of diffuse inputs from the site (and surrounding area) to the Stitt River and Lake Pieman and monitoring should be maintained in future stormwater monitoring plans. • Sites PC2 and FPC3 predominantly monitor runoff from the residential area and roads, but may contain some runoff from the MMG site. They are the most downstream sites in their respective catchments, so should be retained in future stormwater monitoring plan. • Flow should be measured or estimated at RC1, FPC3 and PC2 during stormwater sampling to allow quantification of loads at the sites.

3.4 Underground monitoring

All water monitored at the underground sites is directed to the ETP for treatment, and therefore has no direct impact on the environment. The following modifications to monitoring are recommended.

Table 4. Summary of recommendations to underground monitoring.

Site(s)	Recommendations
Underground (17L, 8L, NED, Head of Race)	• Monitoring at NED should be reviewed following completion of the Closure study with the potential to eliminate the site or reduce monitoring to quarterly. All of the flow at this site is captured at 17L.

3.5 Hercules monitoring

The continuous recording probes at the long-term monitoring sites at Hercules have recently been upgraded, and are providing reliable results. The following minor changes are recommended for monitoring at Hercules.

Table 5. Summary of recommendations to monitoring at the decommissioned Hercules site.

Site(s)	Recommendations
Hercules (BC2, RR@Bridge, RRusBC, 7LComp, WSP, RAH)	• Remove fluoride from the monitoring schedule. All results have been <2mg/L at 7L and <1mg/L in BC2 and RRusBC2 over past 5 years. Concentrations at RAH are at or near LoR of 0.1 mg/L showing very low concentrations in the lower river. • Remove Ca and Mg from the monitoring schedule. There is a long record for these parameters and there is good correlation with zinc and sulphate. • WSP and 7L Comp sites monitor the same stream in 2 places with no inflows in between. One of these sites could be removed from the monitoring schedule. It is recommended that 7L be maintained (contingent on safe access) due to it being closer to the mine.

3.6 Lake Pieman Monitoring

Monitoring in Lake Pieman continues to provide a good understanding of how the point source and diffuse discharges from MMG Rosebery disperse within the managed lake environment. The following minor adjustments to monitoring are recommended.

Table 6. Summary of recommendations for monitoring in Lake Pieman.

Site(s)	Recommendation
Lake Pieman (PBS2 – PBS6)	• Remove fluorine from the monitoring schedule as all results are <<1 mg/L and are not useful as an indicator of mining inputs. • Remove Cl from the monitoring schedule as it reflects rainfall and is not a good indicator of mining input (Ca and SO4 are good indicators)

4 Suitability of monitoring to measure discharge from site (M3)

Section M3 of the EPN requires an external audit to assess whether the current monitoring program is adequately measuring the discharge water quality from the site. Table 7 assesses this objective for each discharge from the site. Where applicable, recommendations are included that would improve the overall usefulness of the information with respect to understanding and quantifying water discharges from the site. The adequacy of the monitoring compared to the objective is colour coded as shown below.

	The EPN monitoring regime provides good to excellent information about discharges from the site– No changes recommended
	The EPN monitoring regime provides adequate to good information about discharges from the site – The value of monitoring results could be enhanced with some modifications, generally related to measuring or deriving flow rates
	The EPN monitoring regime provides some information about discharges from the site, but could be improved by updating the monitoring regime to reflect current operations. This rating applies to groundwater and seepage at BO which have altered since the EPN was issued in 2011.

Table 7. Suitability of monitoring to document and understand water discharges from the MMG Rosebery site on the receiving environment.

Discharge Source	Is the monitoring information suitable to measure and interpret the discharge from the site?	How could the monitoring be changed to improve the understanding of discharge from the MMG site?
Discharges from Bobadil TSF		
Bobadil Discharge	The present monitoring provides an excellent understanding of flow & WQ leaving the site, with the information suitable to track trends and calculate loads.	No changes recommended other than those listed in previous section.
Bobadil groundwater	EPN groundwater sites provide poor coverage, one site has been lost and some of the bores are problematic to monitor.	There are many groundwater bores at the Bobadil TSF that could provide an improved understanding of diffuse discharges. A new diffuse emissions monitoring plan for Bobadil that includes groundwater should be developed and linked to the EPN with the plan reviewed every 3 to 5 years.
Bobadil seepage	The EPN sites provide a poor understanding of seepage due to several no longer flowing, or only flowing intermittently due to changes associated with development of the TSF.	MMG has a good understanding of the location of seeps from the Bobadil TSF, and many are routinely monitored. A diffuse emissions monitoring plan for Bobadil that includes seepage should be developed and linked to the EPN with the plan reviewed every 3 to 5 years.
Diffuse emissions from MMG Rosebery		
Stormwater from MMG Rosebery	With the exception of Rosebery Creek, limited stormwater is discharged from the site. The existing monitoring accurately captures Rosebery Creek and provides an indication of stormwater quality (but not quantity) in lower Primrose and Filter Plant Creeks, which enter the Stitt River	A review of stormwater discharge from the site should be completed, and if required, new stormwater monitoring sites should be established. Measuring or estimating flow rates during monitoring at PC2 and FPC3 would allow quantification of these diffuse inputs.
Rosebery Creek	The present monitoring provides a good understanding of water quality changes downstream in the creek, and flow allows the calculation of loads entering the Stitt River.	A relationship between flow in the Stitt River at WL8 and Rosebery Creek at RC2 could be derived to safe guard against damage to the flow station in Rosebery Creek limiting the use of the water quality results.

Discharges from 2/5 TSF		
Stitt River upstream of Rosebery Creek	Monitoring of the Stitt at SR02 and SR03 provides a qualitative understanding of the diffuse inputs from the 2/5 TSF to the creek. The lack of flow information at SR02 or SR03 prevents quantification of the diffuse loads entering from the area.	A simple hydrologic model could be developed allowing flow at WL8 to be extrapolated to SR02 and SR03 to allow estimation of loads.
Stitt River upstream Lake Pieman	This site provides good water information about the quality of water entering Lake Pieman but the lack of flow data prevents the calculation of loads.	A hydrologic model could be developed allowing flow at the Stitt River upstream of Lake Pieman to be estimated based on flow at WL8 and flow in Rosebery Creek to allow quantification of loads.
2/5 TSF Groundwater	The recently adopted groundwater monitoring regime at the 2/5 TSF provides a good understanding of groundwater conditions upstream and downstream of the site.	No changes to monitoring recommended.
2/5 TSF Seeps	Only one seep is known to enter the Stitt River directly, with all others collected and treated. The impact on water quality from this emission is captured at site SR02. All other known seeps are collected and directed to the ETP for treatment.	No change required
Discharges from Hercules		
Ring River	Monitoring of the Ring at the Ring@Br, BC2, RRusBC and RAH sites provides a good understanding of water quality trends down the river. Flow monitoring at RRusBC and BC2 allows quantification of the mass emission from the site.	The recent re-establishment of the flow site in the lower Ring River has increased the value of monitoring results, as it allows quantification of loads entering Lake Pieman, and the establishment of contaminant balances within the river catchment. It is recommended that the flow site in the lower Ring River be maintained for at least 1-2 years to allow quantification of inputs over different seasons and rainfall patterns.

5 Monitoring audit

The five-year review is required to include an audit of monitoring and reporting procedures at MMG Rosebery. A five-yearly monitoring audit was completed in April 2021 (Environmental Initiatives, 2021). The following sections address the audit requirements as described in Section M1 to M3 of the EPN.

5.1 M1: Dealing with samples obtained for monitoring

The five sub-criteria under section M1 of the EPN address sample collection, transportation and analysis. MMG Rosebery has demonstrated compliance with these requirements as summarised below.

Table 8. Compliance of MMG with monitoring requirements as listed under Section M1 of the EPN.

Requirement	Evidence of Compliance
1.1 samples must be tested in a NATA lab	• All water quality samples are analysed by ALS Melbourne, which is a NATA registered laboratory. Each laboratory results report displays NATA registration and certification information.
1.2 Measurements must be made and samples collected in accordance with Australian Standards	• Field measurements are collected by trained contractors or MMG staff. Meters are calibrated prior to sampling, with a record of the calibration maintained by MMG SHEC. The MMG site maintains several sets of water quality probes providing backup and allowing cross-probe comparison. Field monitoring techniques are routinely audited by an external party, with the most recent audit completed in April 2021 by Environmental Initiatives, Pty Ltd and reported in May 2021. • ALS analyses the water samples using NATA registered procedures, which are listed on the Certificate of Analysis (COA) along with the results. The COA also contains detailed QA/QC results from the laboratory. • MMG collects and submits sample duplicates at a rate of 1 in 20, with the sites selected at random. The Annual Review includes a comparison of the Compliance and Duplicate samples for a metal, general parameter and a nutrient.
1.3 Noise measurements must be taken in accordance with the Tasmanian Noise Measurement Procedure Manual	• An external company, Tarkarri Engineering, completes annual monitoring data reviews for MMG addressing requirements G7, N1, B1 and B2 of the EPN. The reviews consistently state that the noise monitoring stations are in general accordance Tasmanian Noise Measurement Procedures Manual, with all data collected using a NATA calibrated logger. • The NATA certified calibration certificates are included in the annual review • A minor difference between noise monitoring at MMG Rosebery and the Tasmanian procedures related to the height of microphones has been identified.
1.4 Results of samples and details of methods must be retained for at least three years after the collection date	• MMG Rosebery and ESD maintain records of field instrument calibration for more than 3 years, and calibration techniques are routinely audited. The most recent audit was completed in April 2021 by Environmental Initiatives, Pty Ltd. • Copies of sample submission forms are provided by the contractor completing the sampling, and retained by MMG for more than 3 years. Copies of all Chain of Custody forms are provided with the analytical results by ALS. This is verified by an annual external audit, with the most recent one completed in 2021 by Environmental Initiatives, Pty Ltd. • All laboratory documents provided by ALS (COA, Quality Control Report, QA/QC Compliance Assessment, copies of Chain of Custody) are stored electronically by MMG Rosebery for periods in excess of 3 years. This was documented in the most recent monitoring audit (Environmental Initiatives, 2021) • The electronic results are uploaded directly in the MMG ESDAT database, minimising data entry errors
1.5 Samples and measurements must be obtained and	• At MMG Rosebery, compliance monitoring is contracted to Environmental Service & Design (ESD), an established Tasmanian based environmental consulting company. The company states that personnel

Requirement	Evidence of Compliance
transported by a person with appropriate training and expertise	are trained and comply with all Quality Assurance and NATA requirements and field equipment is calibrated to Quality Assurance stipulations. • If required, MMG Rosebery SHEC staff are also qualified to collect, transport and submit environmental samples. • All sampling containers are provided by the NATA registered laboratory, ensuring sample bottle preparation is appropriate for the samples collected.

5.2 M2: Reporting of monitoring results

MMG Rosebery is required to submit monitoring results related to the discharge from BO, any discharge from the 2/5 TSF into the Stitt River, and all routine monitoring as described in the EPN monitoring schedule (Tables 5 – 11) on a quarterly basis and submitted no later than 30 days after the end of the monitoring period.

MMG have demonstrated compliance with this criteria by suppling copies of emails sent to the EPA with the required quarterly monitoring results attached.

References

ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

Camargo, J.A. and Alonso, A. 2017. Ecological assessment of the impact of fluoride (F^-) and turbidity on the freshwater snail Physella acuta in a polluted river receiving and industrial effluent

Environmental Initiatives, 2021. MMG Rosebery Environmental Monitoring Audit, Prepared for 1710, Report #: MMG Rosebery Operation.

Tarkarri Engineering, 2021. MMG Limited Rosebery mine Environmental noise, ground vibration and air blast overpressure annual monitoring data review 2020-2021. Report No 5577_ACVIB_R. September 2021.

APPENDIX C: AIR QUALITY AND METEOROLOGICAL MONITORING PROGRAM – FIVE YEAR REVIEW (ERM, 2021)

Air Quality and Meteorological Monitoring Program – Five Year Review

Rosebery Mine

26 October 2021

Project No.: 0516238

The business of sustainability

ERM

Document details	
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26 October 2021

Air Quality and Meteorological Monitoring Program – Five Year Review

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EXECUTIVE SUMMARY

MMG's Rosebery Mine is an underground polymetallic base metal mine located in the township of Rosebery, Tasmania. MMG Rosebery has an obligation under its Environmental Protection Notice's (EPN 7153/3) to complete a five yearly Environmental Management Plan (EMP) review of its meteorological, dust deposition and ambient air quality monitoring programs (EPN 7153/3 condition G6).

A review of the past five years of data showed minimal exceedances of the trigger levels and no exceedances of the compliance limits of the EPN and PCE conditions. This indicates that the Rosebery Mine activities are a low environmental risk to air quality and that the current dust mitigation controls are appropriate.

Over the last five years, the DustTrak, HVAS and weather data reported a high data availability with some exceptions for the Carpark weather station location due to issues with the wind direction sensor in FY20. The DDG reported a low to medium data availability. This is primarily due to the amount of rainfall at site causing the bottles to overflow and invalidating the sample.

It is recommended that the weather station locations and AD2.1, AD3, Giblin Street monitoring locations for DustTrak, HVAS and DDG are retained. The Alec Street location can be removed if a reduction of the number of HVAS monitoring locations is required. It is recommended that AD1.1, AD5, AD11, AD21, AD22, AD23, AD25 and BG3 be removed from the monitoring network. This is due to a combination of the low valid data capture and a number of the locations being considered 'additional sites' within the EPN. This will allow for consolidation of the air quality network.

It is recommended Rosebery mine continue its current mitigation management and mitigation measures with three yearly reviews of the inspection and mitigation levels for the DustTrak data alerts. This will ensure the performance of these alerts is still adequate for dust mitigation. The calibration factors of the DustTraks should be reviewed annually.

Reviews of newly available technologies should be completed as they become available to understand if they will allow for improvements in the dust mitigation measures from site.

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1. INTRODUCTION

MMG Limited's (MMG) Rosebery Mine is an underground polymetallic base metal mine located in the township of Rosebery, Tasmania. MMG has an obligation under its Environmental Protection Notice's (EPN 7153/3) to complete a five yearly Environmental Management Plan (EMP) review of its meteorological, dust deposition and ambient air quality monitoring programs (EPN 7153/3 Condition G6).

ERM has completed the annual air quality review and meteorological review for the past three years for MMG's Rosebery Mine. The purpose of this report is to complete the five yearly Environmental Management Plan (EMP) review based on data collected at site (air quality and weather) and provide any recommendations for Rosebery Mine's monitoring program.

1.1 EPN and PCE Requirements

MMG is required to comply with the conditions detailed in EPN 7153/3 and PCE 9084. Within these documents, the following compliance limits and triggers apply for the high volume air sampling (HVAS), as presented in Table 1.1, and dust deposition gauges (DDG), as presented in Table 1.2.

As per paragraph 2 in section A3 of EPN 7153/3, monthly deposition measurements must be adjusted to account for the background deposition rate. For each sampling month, the background is defined as the minimum of the measured dust deposition rates.

Table 1.1: HVAS compliance limits and trigger levels

Parameter	Compliance Limit	Trigger Levels
Total Suspended Particles (TSP)	0.090 mg/m^3 Annual average	0.150 mg/m^3 24 hour average
Particulate Matter sub 10 micron (PM_{10})	0.150 mg/m^3 24 hour average	0.050 mg/m^3 24 hour average
Lead (as TSP)	0.0015 mg/m^3 90 day average	0.0087 mg/m^3 24 hour average
Cadmium (as PM_{10})	-	0.000003 mg/m^3 24 hour average [a]
Zinc (as PM_{10})	-	0.015 mg/m^3 24 hour average [a]

a. 24 hour average was not specified within the EPN and PCE documents but was applied to be consistent with the other trigger level averaging periods

Table 1.2: Dust deposition gauge compliance limits and trigger levels

Parameter	Compliance Limit	Trigger Levels
Deposited dust	2.0 g/m^2/month as an annual average increase above background at/or beyond the site boundary.	2.0 g/m^2/month as an increase above background at/or beyond the site boundary (monthly trigger level).
Deposited dust	4.0 g/m^2/month as an annual average at/or beyond the site boundary.	4.0 g/m^2/month as total deposition experiences at/or beyond the site boundary (monthly trigger level).

1.2 Scope of work

The scope of this report includes the 5-yearly EMP review is required as per EPN 7153/3 G6:

- A summary of current air quality and meteorological locations and EPN and PCE requirements.
- A review of air quality and meteorological monitoring data for the past five years including data capture, quality and any significant spatial or temporal trends.
- Summary of the compliance against the EPN and PCE conditions over the reporting periods and a review of the dust management performance.
- Commentary on the suitability of current meteorological and air quality monitoring locations.
- Recommendations including any revisions to the current monitoring program.

2. MONITORING LOCATIONS

Rosebery Mine currently operates a monitoring network that consists of eleven DDGs and eight HVAS (four TSP[1] and four PM_{10}[2], one each at four sites). Co-located at each HVAS monitoring site is a real-time DustTrak monitor. Three real-time weather stations are installed within and surrounding the operational boundary of the mine.

The real-time DustTrak and weather data are displayed within the Environmental Department office. Automatically generated emails are sent to relevant employees when an inspection or mitigation level is triggered or meteorological conditions are conducive to dust generation events.

As dictated within EPN 7153/3 and PCE 9084, the locations and ID's for the air quality monitoring sites are presented in Figure 2.1. The DDGs within the site boundary are AD1.1, AD2, AD5, AD23 and AD25. The EPN and PCE trigger levels and compliance are presented in Table 1.1 and Table 1.2. A summary of the monitoring locations and weather stations is presented in Table 2.1 and Figure 2.1.

Within the EPN, the DDG locations are referred to as 'core sites' or 'additional sites'. As per EPN 7153/3 condition A3-4:

> *Measurement at the 'additional sites' (BG3, AD11, AD22, AD23 and AD25) are to continue until such a time as an annual pattern can be established and a full 12-month dataset is compiled. This data is to be analysed in a report to the Director, containing recommendations and a request for approval to remove specific 'additional sites' from the monitoring network. Monthly monitoring must continue at all of the 'additional sites' until the Director provides approval to remove the individual sites*

These 'additional sites' have been collecting data for over nine years which is sufficient to establish annual patterns.

Table 2.1: Monitoring locations

Monitoring Site ID	Monitoring Location Description	Location (WGS 84 Zone 55S)	
		Easting (km)	Northing (km)
HVAS (EPN) with co-located DustTrak			
AD2.1	Former PMR Training Centre on Arthur Street	378.63	5,374.00
AD3	15 Beech Street (near the Filter Plant)	377.71	5,374.49
Giblin St	Giblin Street	378.63	5,373.18
Alec St	Alec Street	378.97	5,373.41
DDG (EPN within the site boundary)			
AD1.1	Mine Office Building on Hospital Road – core site	378.81	5,374.19
AD2	Former PMR Training Centre on Mill Road – core site	378.66	5,373.91
AD5	Breaker Station/Crusher – core site	378.65	5,374.23
AD23	Filter Plant Carpark – background site	377.78	5,374.51
AD25	Passing Bay on Filter Plant Road – background site	378.27	5,374.21
DDG (EPN at/or beyond the site boundary)			
AD3	15 Beech Drive (near the HVAS) – core site	377.70	5,374.49
AD4	Near Rosebery Station – core site	378.61	5,373.18
AD11	Front yard of 1 Howard Street – background site	377.90	5,374.38

[1] Total suspended particulates

[2] Particulate matter with an aerodynamic diameter less than 10 µm

Monitoring Site ID	Monitoring Location Description	Location (WGS 84 Zone 55S)	
		Easting (km)	Northing (km)
AD21	Backyard in 9 Murchison St – background site	379.07	5,373.89
AD22	Frontyard of 21 Dalmeny St – background site	379.29	5,373.60
BG3	Rosebery Golf Course – background site	375.59	5,372.78
Weather Stations			
2/5 Dam	2/5 Tailings Storage Facility (TSF)	378.50	5,372.63
Carpark	Carpark of Rosebery Mine	378.75	5,374.01
Bobadil	Bobadil TSF	376.83	5,376.25

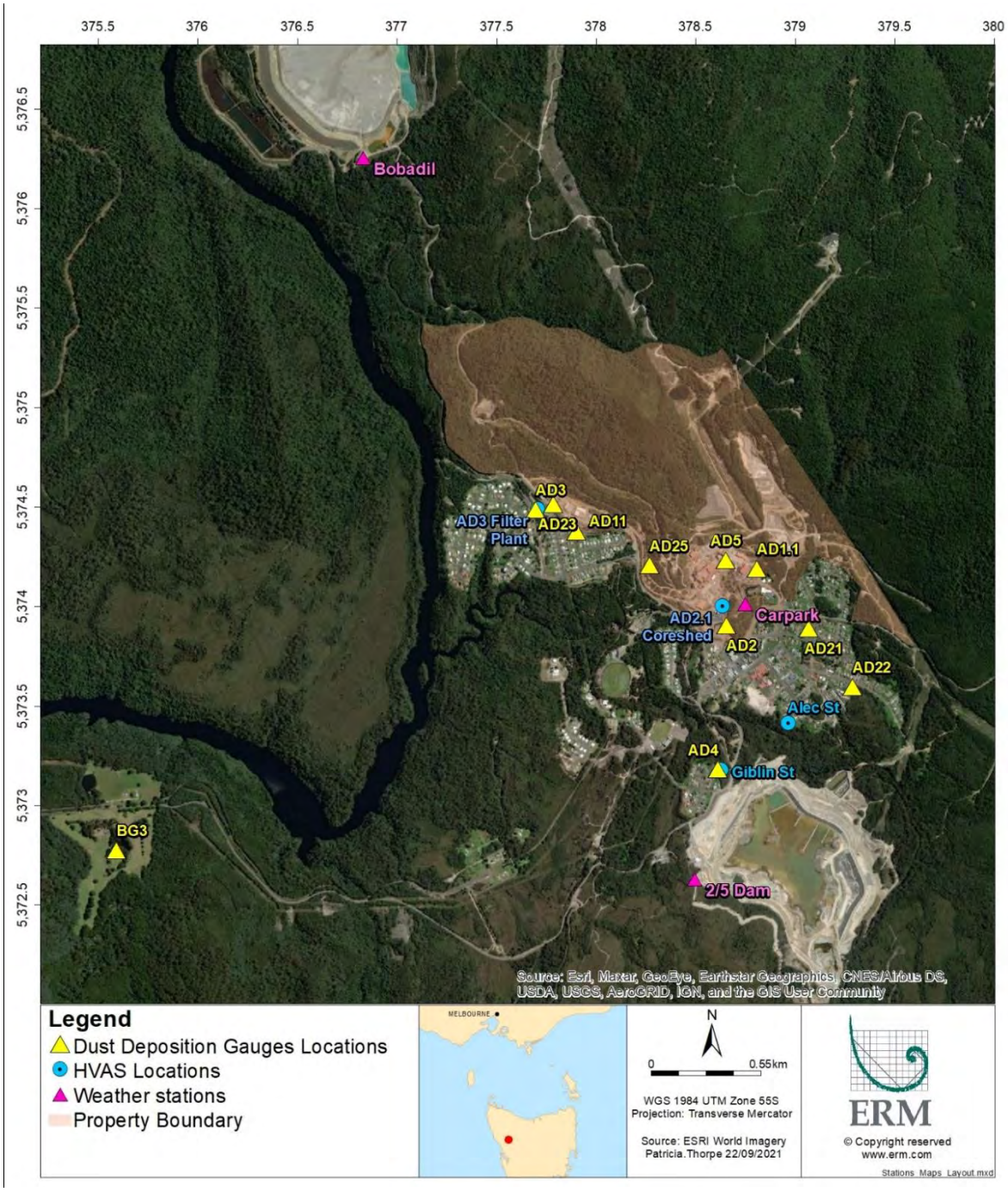


Figure 2.1: Monitoring locations

3. AIR QUALITY AND METEOROLOGICAL DATA REVIEW

The Rosebery Mine annual air quality data reviews from FY17 to FY21 were used in the analysis for the five year review. The analysis included a review of the data availability, comparison to EPN and PCE requirements, summary of real-time DustTrak data and summary of meteorological data.

3.1 Data Availability

A summary of the FY17 to FY21 average data capture for the monitoring network for the past five years is presented in Table 3.2 and Table 3.3. The data availability has been colour coded based on the percent capture, as shown below in Table 3.1. Data availability on an individual year basis is presented in Appendix A.

Overall the DustTrak, HVAS and weather data has high availability with the exception of the wind speed and direction of the Carpark weather station. This is due to a faulty wind direction sensor in FY20. Due to COVID-19 travel restrictions, this sensor was only replaced in July 2020.

The DDG has low to medium availability. This is primarily impacted by the amount of rainfall received at the site causing the monthly sample to be considered invalid due to bottle overflow. It is recommended that at least six months of data is required for a valid annual average (50% or greater data capture).

Table 3.1: Data availability colour key

Data Availability		
High ≥80%	Medium 50 – 80%	Low ≤50%

Table 3.2: Data availability for monitoring sites for past five years

Monitoring Site ID	Data Availability (%)			
	DustTrak [a]	PM_{10} HVAS and Metals [b]	TSP HVAS and Metals [b]	Dust Deposition Gauge [c]
AD1.1	-	-	-	58%
AD2.1/AD2/Core Shed	88% [d]	99%	94%	55%
AD3/Filter Plant	83% [d]	100%	97%	52%
AD4/Giblin St	76% [d]	100%	100%	78%
AD5	-	-	-	52%
AD11	-	-	-	47%
AD21	-	-	-	53%
AD22	-	-	-	53%
AD23	-	-	-	48%
AD25	-	-	-	47%
BG3	-	-	-	52%
Alec St	89%	100%	95%	-

a. Data availability based on 15 minute data for DustTrak
b. Data availability based on 1 in 6 day sampling for HVAS
c. Data availability based on 5 years monthly sampling for DDG
d. DustTrak installed at these locations in FY19

Table 3.3: Data availability for weather stations for past 5 years

Sampling Location	Data availability (%)			
	Rainfall	Air temperature	Relative humidity	Wind Speed and Direction
2/5 Dam	96%	96%	81%	80%
Bobadil	100%	100%	98%	96%
Carpark	100%	100%	100%	65%

3.2 Comparison to EPN and PCE Conditions

The DDG and HVAS monitoring data for the FY17 to FY21 period were compared against the EPN and PCE trigger and compliance conditions as discussed in Section 1.1. These results are summarised in Table 3.4 and Table 3.5. The number of exceedances of the EPN and PCE conditions are presented in brackets.

The site has complied with the compliance limits for the HVAS and DDGs in the five year period.

The majority of the trigger level exceedances of the DDGs are recorded at BG3. This location is furthest from site and is the designated background deposition monitoring gauge.

Exceedances of the PM_{10} trigger levels corresponded to one exceedance day at all four locations due to smoke haze event which was confirmed by visual observations from site staff and the EPA Tasmania BLANkET monitoring.

There have been three exceedances of the cadmium trigger levels over the five year period. Rosebery Mine does not have a high cadmium dust concentration source. As the exceedances of the 24 hour cadmium trigger level do not correspond with exceedances of the 24 hour PM_{10} trigger levels, it is unlikely that the cadmium originated from the mines activities. The cause of the exceedance is much more likely to be a source with high cadmium concentrations.

Table 3.4: DDG Compliance against EPN condition A3 and PCE condition A5

Period	Trigger Level		Compliance Level	
	Monthly Deposited Dust above background	Monthly Total Deposited Dust	Annual Average Deposited Dust above background	Annual Average Total Deposited Dust
FY17	✗ (2)	✗ (1)	✓	✓
FY18	✗ (1)	✗ (1)	✓	✓
FY19	✗ (1)	✗ (1)	✓	✓
FY20	✓	✓	✓	✓
FY21	✗ (3)	✗ (1)	✓	✓

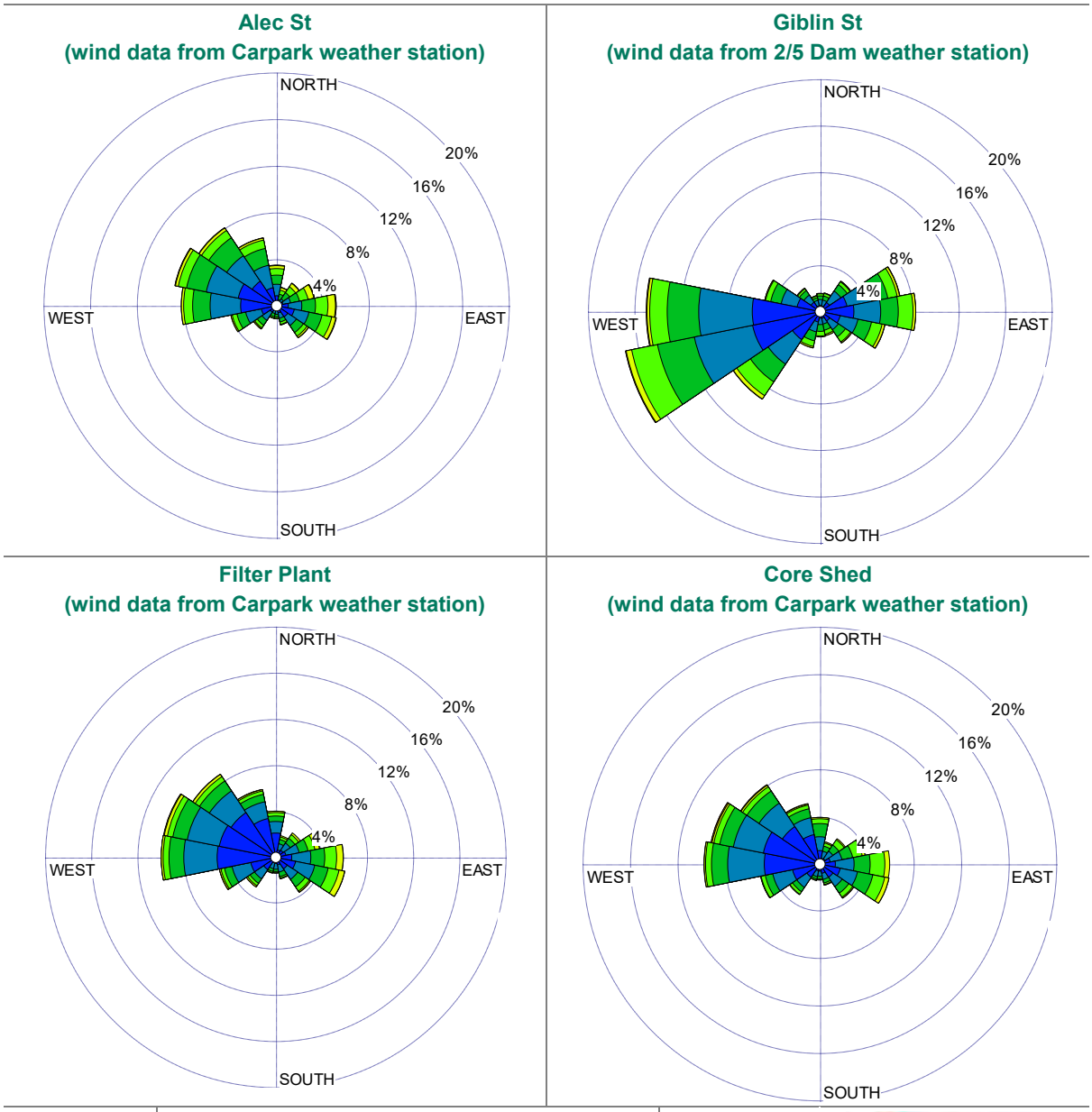
Table 3.5: HVAS Compliance against EPN condition A2 and PCE condition A4

Period	Trigger Level					Compliance Level		
	24 hour average					Annual Average	24 hour average	90 day average
	TSP	PM_{10}	Lead (as TSP)	Cadmium (as PM_{10})	Zinc (as PM_{10})	TSP	PM_{10}	Lead (as TSP)
FY17	✓	✓	✓	✗(1)	✓	✓	✓	✓
FY18	✓	✓	✓	✗(1)	✓	✓	✓	✓

Period	Trigger Level					Compliance Level		
	24 hour average					Annual Average	24 hour average	90 day average
	TSP	PM_{10}	Lead (as TSP)	Cadmium (as PM_{10})	Zinc (as PM_{10})	TSP	PM_{10}	Lead (as TSP)
FY19	✓	✓	✓	✗(1)	✓	✓	✓	✓
FY20	✓	✗(4)	✓	✓	✓	✓	✓	✓
FY21	✓	✓	✓	✓	✓	✓	✓	✓

3.3 DustTrak Data

Pollution roses for the DustTrak sites are show in Figure 3.1. A pollution rose shows the wind direction on the angular axis, pollution frequency on the axil axis and pollution concentrations based on colour. The wind data was taken from the Carpark weather station for the Alec St, Core Shed and Filter Plant sites with the 2/5 Dam used for the Giblin St site.



Site	Average DustTrak Concentration (µg/m^3)
Alec St	15.5
Giblin St	12.1
Filter Plant	11.7
Core Shed	11.2

Figure 3.1: Pollution roses of DustTrak concentration

The DustTrak data is used for operational mitigation practices with the application of inspection and mitigation levels as shown in Table 3.6. There are no requirements stipulated within the EPN or PCE for compliance reporting for the DustTrak monitoring, this falls within the Dust Mitigation Plan for the site. In late 2020, with the assistance of EPA Tasmania, site specific calibration factors were applied to the DustTraks to reduce the amount of alerts for inspection and mitigation levels due smoke haze from nearby residence. Since their implementation, the number of alerts recorded by the DustTrak have decreased. It is recommended that the calibration factors are validated yearly to assess their appropriateness.

There have been no exceedances of the compliance limits at the HVAS locations, which indicates that the DustTrak data is helpful for real-time dust management.

Table 3.6: Real-time dust trigger levels in dust mitigation plan

Averaging period	Inspection Level (µg/m^3)	Mitigation Level (µg/m^3)
15 minute	300	500
60 minute	200	350

Source: (ERM, 2020c)

3.4 Meteorological Data

Presented in Figure 3.2 is the annual rainfall at each meteorological station. There is a larger amount of precipitation measured at the Rosebery Carpark. The wind roses for each station are presented in Figure 3.3. The wind roses indicate that the wind speeds at the site are low with a high frequency of calm conditions. The low wind speeds are likely due to the surrounding hill terrain. The differences in predominate wind directions at the different stations are most likely a consequence of the hill terrain, with a dominant westerly flow in the region modified by the hills. There is minimal variations in the wind roses between years as presented in Appendix A. Wind roses for FY17 are impacted due to limited data availability in the latter half of 2016 and first half of 2017 while FY20 wind data was highly impacted by the broken wind sensor.

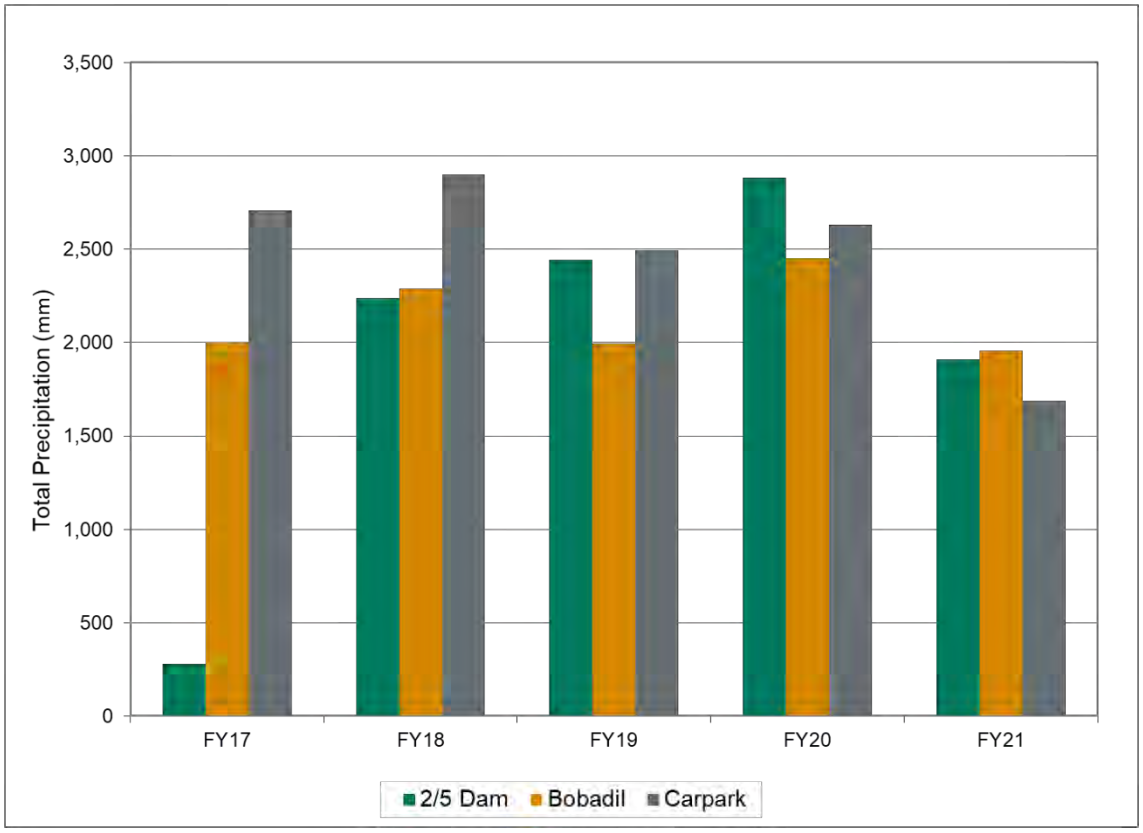
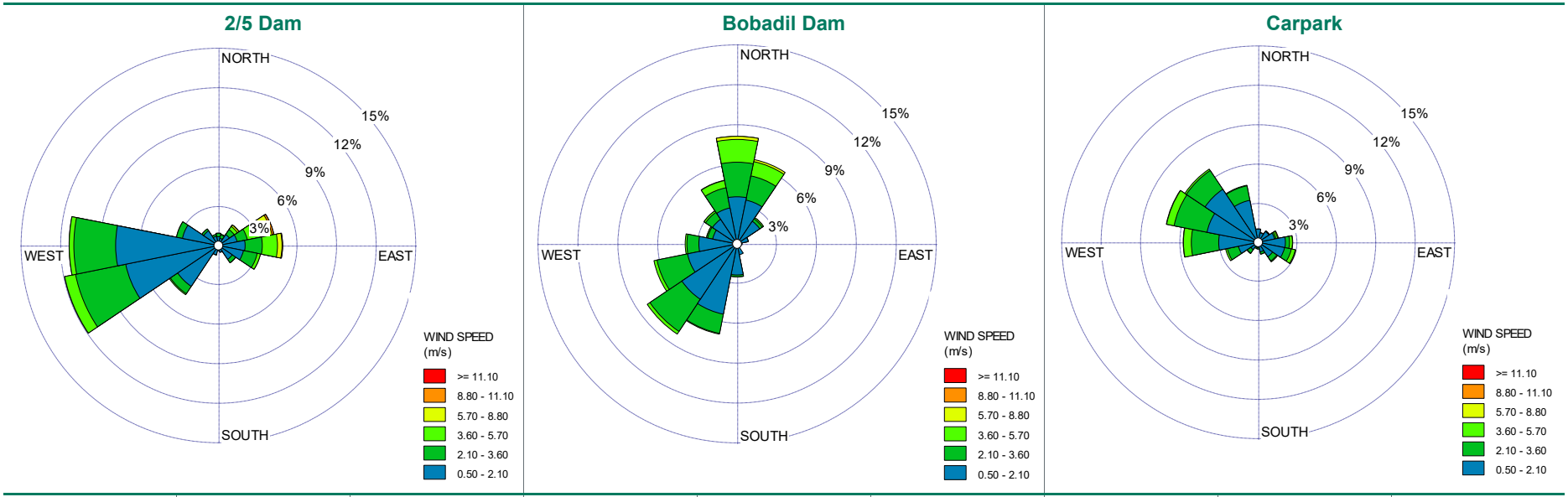


Figure 3.2: Total precipitation



Average wind speed (m/s)	Calms (%)	Data Availability (%)	Average wind speed (m/s)	Calms (%)	Data Availability (%)	Average wind speed (m/s)	Calms (%)	Data Availability (%)
1.3	27	80	1.1	38	96	1.1	22	65

Figure 3.3: Wind roses for last 5 years of monitoring

4. RECOMMENDATIONS

No exceedances of the compliance limits of the EPN and PCE requirements were reported in the FY17-FY21 years which indicates that MMG's Rosebery Mine is a low environmental risk to air quality and that the current dust mitigation controls are appropriate.

Based on the analysis of this review, it is recommended that the air quality monitoring network is consolidated for practicality. Due to the low environmental risk and the typical annual rainfall, a consolidated air quality network will provide more practical monitoring obligations for the same understanding of the mine's dust impacts. The monitoring network recommendations and justification are summarised in Table 4.1.

It is recommended that the AD2.1, AD3, Giblin Street and weather station locations are retained.

Alec Street station can be removed if a reduction of the number of HVAS monitoring locations is required. It is recommended that AD11, AD21, AD22 and BG3 be removed from the monitoring network due to a combination of low valid data capture and the locations being considered 'additional sites' within the EPN. If continuation of monitoring within the site boundary is no longer required, AD1.1, AD5, AD23 and AD25 can be also be removed from the monitoring network. These sites also have low valid data capture with AD23 and AD25 considered 'additional sites'.

The dust mitigation plan and the inspection and mitigation levels for the DustTrak data alerts are recommended to be reviewed every three years to understand if they are sufficient to assist with the continued control of dust from site. Additionally, the review of the DustTrak calibration factors should be reviewed annually, in consultation with the Tasmania EPA, to ensure they are performing well with only removing alerts due to smoke from wood-fire heaters rather than dust from the mine.

Regular reviews (every three to five years) of new technologies should be considered to ensure the mine is using the best, most relevant technology. These reviews may include the advancements in real-time dust monitoring techniques, such as low-cost sensors, LIDAR (Light Detection and Ranging) or other methods to allow for improved dust management.

Table 4.1: Recommendations for monitoring locations

Monitoring Location	Recommendation	Justification
HVAS (EPN) with co-located DustTrak		
AD2.1	Retain location.	This station allows for understanding the dust impacts at the property boundary. This station allows for additional analysis with the DDG co-located at this location, if required.
AD3	Retain location.	This station allows for understanding the dust impacts at the property boundary. This station allows for additional analysis with the DDG co-located at this location, if required.
Giblin St	Retain location.	This station allows for understanding of the dust impacts from the mine and 2/5 Dam on the location community. This station allows for additional analysis with the DDG co-located at this location, if required.
Alec St	Retain location.However, if a reduction in the number of HVAS and DustTraks is desired, remove location.	This station allows for an understanding of dust impacts on the community, however, the nearby Giblin Street station can also provide this information.
DDG (EPN within the site boundary)		
AD1.1	Remove location.	This station can be removed due to the lower data capture at this site (58% during FY17-FY21). This site is located within the site boundary. If an annual trend of deposition within the site boundary is desired than this location should be retained.
AD2	Retain location.	This station should remain as typically data availability has been adequate. This station is classified in the EPN as a core site and is co-located with the HVAS and DustTraks. It can provide an indication of deposition impacts at the site boundary.
AD5	Remove location.	This station can be removed due to the low data capture at this site (52% during FY17-FY21). This site is located within the site boundary. If an annual trend of deposition within the site boundary is desired than this location can be retained.
AD23	Remove location.	This station can be removed due to the low data capture at this site (less than 50% during FY17-FY21) and the duplicate nearby DDG locations. This station is classified in the EPN as an ‘additional site’, sufficient data for annual trends have been collected for this location to justify its removal.
AD25	Remove location.	This station can be removed due to the low data capture at this site (less than 50% during FY17-FY21). This station is classified in the EPN as an ‘additional site’, sufficient data for annual trends have been collected for this location. This site is located within the site boundary however, if continuing annual trend of deposition within the site boundary is desired than this location can be retained.
DDG (EPN at/or beyond the site boundary)		

Monitoring Location	Recommendation	Justification
AD3	Retain location.	This station should remain as typically data availability has been adequate. This station is classified in the EPN as a core site and is co-located with the HVAS and DustTraks. It can provide an indication of deposition impacts at the site boundary.
AD4	Retain location.	This station should remain as typically data availability has been adequate. This station is classified in the EPN as a core site and is co-located with the HVAS and DustTraks. It can provide an indication of deposition impacts due to activities at the 2/5 Dam.
AD11	Remove location.	This station can be removed due to the lowest data capture across the network (less than 50% during FY17-FY21) and the duplicate nearby DDG locations. This station is classified in the EPN as an additional site, sufficient annual trends have been collected for this location. This station has never exceeded the trigger or compliance levels
AD21	Remove location.	This station can be removed due to the lower data capture at this site (53% during FY17-FY21) and the duplicate nearby DDG locations. This station is classified in the EPN as an 'additional site', sufficient data for annual trends have been collected for this location to justify its removal.
AD22	Remove location. However, this station could be moved to be co-located with the Alec Street HVAS and DustTrak monitors.	This station can be removed due to the lower data capture at this site (53% during FY17-FY21) and the duplicate nearby DDG locations. This station is classified in the EPN as an 'additional site', sufficient data for annual trends have been collected for this location to justify its removal.
BG3	New location for the background DDG is recommended.	The location of this station is not suitable as historically, higher deposition rates have been reported at this location. A background dust deposition site can be useful for estimating the deposition above background as per the requirements of the EPN/PCE. Currently the minimum dust deposition rate is used for calculating the background value due to the issues with this current location. A new location for the background DDG is recommended with the BG3 location removed.
Weather Stations		
2/5 Dam	Retain location.	This station provides for weather data nearby the tailings facility and can allow for understanding meteorological conditions conductive to dust issues and assist with dust mitigation. Having a network of weather station allows for understanding of the weather pattern changes due to terrain variations.
Carpark	Retain location.	This station provides for weather data at site and provides an understanding of the weather patterns changes due to terrain variations.
Bobadil	Retain location.	This station provides for weather data nearby the tailings facility and can allow for understanding meteorological conditions conductive to dust issues and assist with dust mitigation. Having a network of weather station allows for understanding of the weather pattern changes due to terrain variations.

5. REFERENCES

ERM. (2019a). *Annual Air Quality Review - Rosebery Mine.* ERM Australia Pacific Pty Ltd.
ERM. (2019b). *Annual Meteorological Review - Rosebery Mine.* ERM Australia Pacific Pty Ltd.
ERM. (2020a). *Annual Air Quality Review - FY20 - Rosebery Mine.* ERM Australia Pacific Pty Ltd.
ERM. (2020b). *Annual Meteorological Review - FY20 - Rosebery Mine.* ERM Australia Pacific Pty Ltd.
ERM. (2020c). *Dust Mitigation Plan Review - Rosebery Mine.* ERM Australia Pacific Pty Ltd.
ERM. (2021a). *Annual Air Quality Review - FY21 - Rosebery Mine.* ERM Australia Pacific Pty Ltd.
ERM. (2021b). *Annual Meteorological Review - FY21 - Rosebery Mine.* ERM Australia Pacific Pty Ltd.
GHD. (2017a). *MMG Rosebery - MMG Air Quality Monitoring Data - Annual Report Dust Deposition and Ambient Air Quality Review.* GHD.
GHD. (2017b). *MMG Australia Limited - MMG Rosebery 2016/17 dust report - Meteorological data review.* GHD.
GHD. (2018a). *MMG Rosebery - MMG Air Quality Monitoring Data - Annual Report - Dust Deposition and Ambient Air Quality Review.* GHD.
GHD. (2018b). *MMG Australia Limited - Rosebery Air Quality Monitoring Data Review 2017/2018 - Meteorological Data Review.* GHD.

Appendix A ADDITIONAL PLOTS AND TABLES

Table 5.1: Data availability for DustTrak and HVAS data

Year	Data availability (%)		
	DustTrak (15 minute)	PM_{10} HVAS and Metals (one 24hr average every 6 days)	TSP HVAS and Metals (one 24hr average every 6 days)
Alec st			
FY17	99%	100%	77%
FY18	97%	100%	100%
FY19	93%	100%	100%
FY20	85%	100%	97%
FY21	72%	100%	100%
Giblin St			
FY17	0% [a]	100%	100%
FY18	0% [a]	100%	100%
FY19	94%	100%	100%
FY20	80%	100%	100%
FY21	53%	100%	100%
Filter Plant			
FY17	0% [a]	100%	100%
FY18	0% [a]	100%	100%
FY19	81%	100%	85%
FY20	80%	100%	98%
FY21	87%	100%	100%
Core Shed			
FY17	0% [a]	97%	71%
FY18	0% [a]	100%	100%
FY19	86%	100%	100%
FY20	80%	100%	97%
FY21	97%	100%	100%

a. No data available

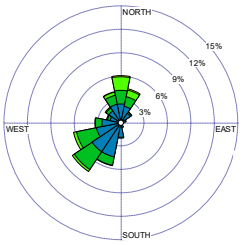
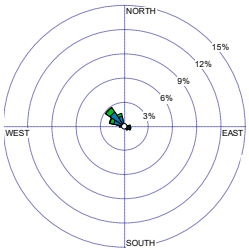
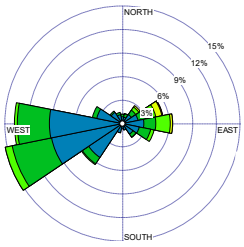
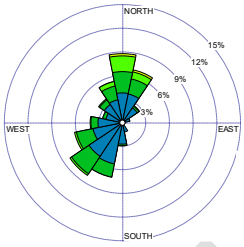
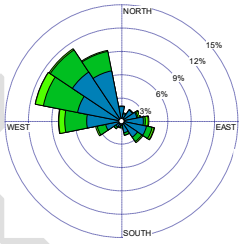
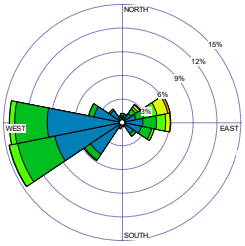
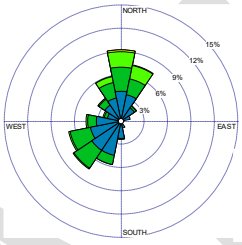
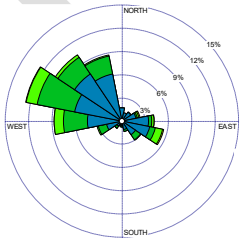
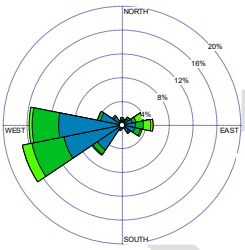
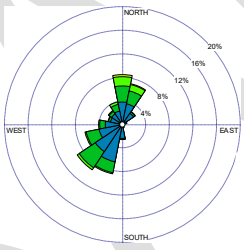
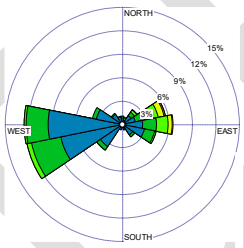
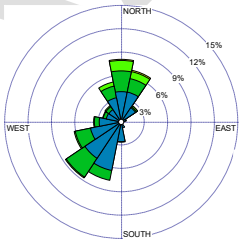
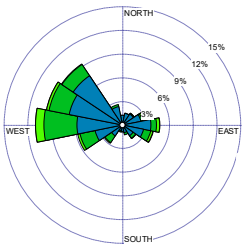
Table 5.2: Number of valid samples for DDG

Year	Data Availability (Monthly Sampling)										
	AD 1.1	AD 2	AD 3	AD 4	AD 5	AD 11	AD 21	AD22	AD23	AD25	BG3
FY17	83%	83%	75%	100%	83%	67%	83%	83%	67%	75%	83%
FY18	42%	33%	33%	100%	33%	33%	33%	33%	33%	33%	42%
FY19	67%	67%	67%	100%	67%	58%	58%	58%	58%	58%	58%
FY20	33%	33%	33%	33%	33%	33%	33%	33%	33%	33%	25%
FY21	67%	58%	50%	58%	42%	42%	58%	58%	50%	33%	50%

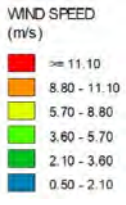
Table 5.3: Data availability for weather stations

Year	Data availability			
	Rainfall	Air temperature	Relative humidity	Wind Speed/Direction
2/5 Dam				
FY17	78%	78%	3.0%	3.1%
FY18	100%	100%	100%	100%
FY19	100%	100%	100%	100%
FY20	100%	100%	100%	100%
FY21	100%	100%	100%	98%
Bobadil				
FY17	100%	100%	100%	81%
FY18	100%	100%	100%	100%
FY19	100%	100%	100%	100%
FY20	100%	100%	91%	100%
FY21	100%	100%	100%	100%
Car Park				
FY17	100%	100%	100%	32%
FY18	100%	100%	100%	100%
FY19	99%	99%	99%	99%
FY20	100%	100%	100%	0% [a]
FY21	100%	100%	100%	92% [a]

a. An error with the wind directions sensor at the Carpark monitoring station caused the FY20 data to be considered invalid. The wind sensor was replaced during the FY21 annual calibrations when COVID-19 travel restrictions were eased.

	2/5 Dam	Bobadil Dam	Carpark
FY17	No data available		
FY18			
FY19			
FY20			No data available
FY21			

Year	Average Wind Speed (m/s)			Calm Winds (%)		
	2/5 Dam	Bobadil	Carpark	2/5 Dam	Bobadil	Carpark
FY17	-	1.1	0.6	-	33%	28%
FY18	1.3	1.1	1.1	31%	38%	33%
FY19	1.4	1.1	1.2	35%	39%	33%
FY20	1.3	1.1	- [a]	33%	39%	- [a]
FY21	1.1	1.0	1.1	39%	41%	30%



a. An error with the wind directions sensor at the Carpark monitoring station caused the FY20 data to be considered invalid. The wind sensor was replaced during the FY21 annual calibrations when COVID-19 travel restrictions were eased.

Figure 5.1: Annual wind roses

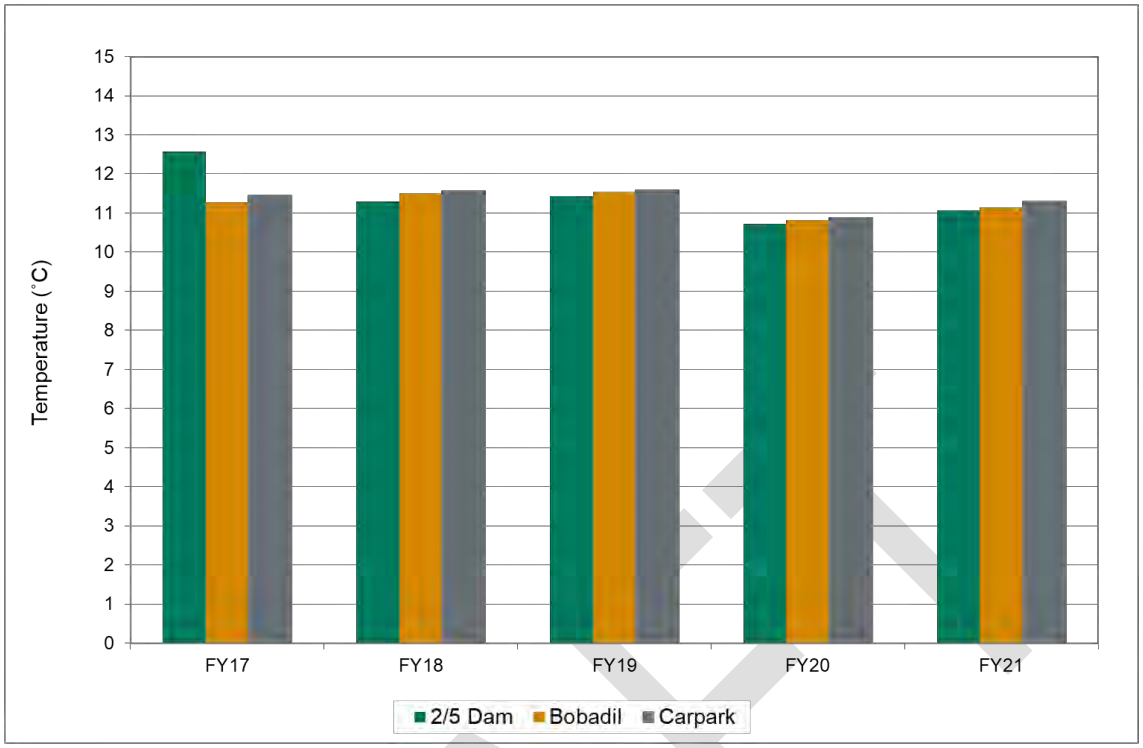


Figure 5.2: Average temperature for FY17-FY21

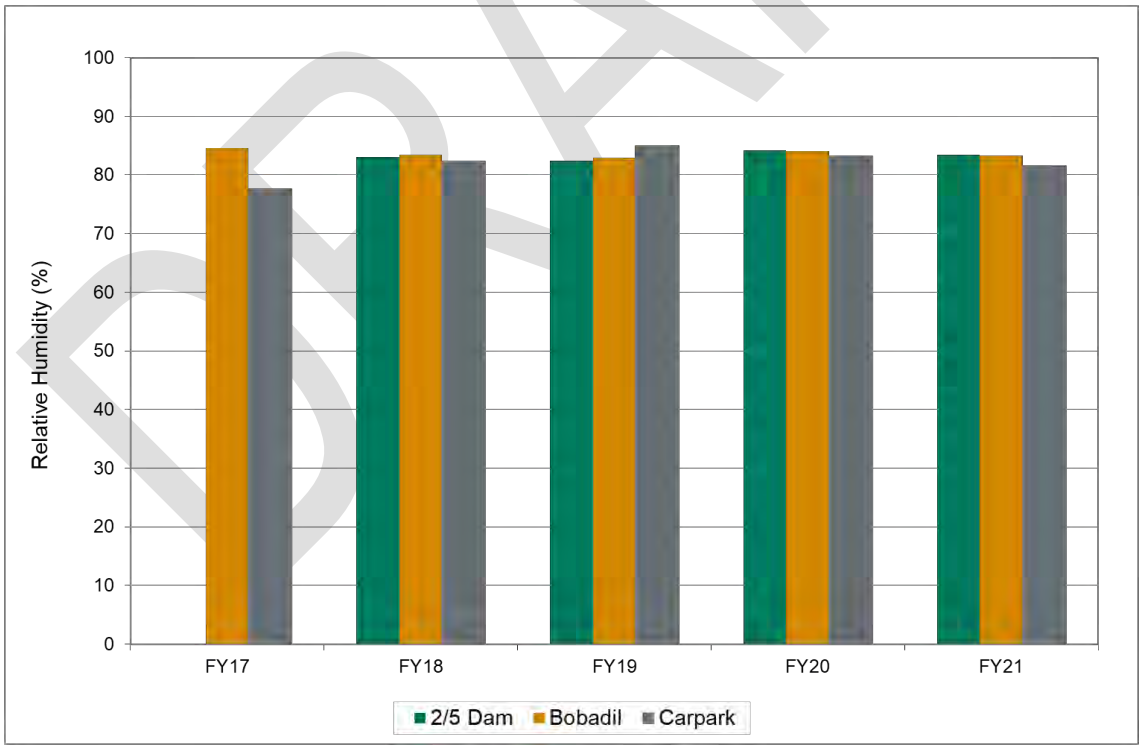


Figure 5.3: Average relative humidity for FY17-FY21

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APPENDIX D: ANNUAL NOISE AND VIBRATION REVIEW (TARKARRI 2021)

MMG Limited

Rosebery mine Environmental noise, ground vibration and air blast overpressure annual monitoring data review 2020-2021

Report No. 5577_ACVIB_R

TARKARRI ENGINEERING PTY LTD
PO Box 506
Kings Meadows TAS 7249
September 2021

Tarkarri Engineering

Air Quality • Acoustics • Environment • Vibration

DOCUMENT CONTROL

MMG LIMITED
ROSEBERY MINE
ENVIRONMENTAL NOISE, GROUND VIBRATION AND AIR BLAST OVERPRESSURE ANNUAL MONITORING DATA REVIEW
2020-2021

Report No.
5577_ACVIB_R
Prepared for
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Reviewed	Alex McLeod Director / Principal Consultant	Date: 2 September 2021

Revision History

Revision No.	Date Issued	Reason/Comments
0	23/8/21	Initial draft issue

Distribution

Copy No._____	Revision No.	Location
1	0	Project/Client File
2	0	Client
3	0	Tarkarri Engineering Library

Keywords environmental noise, dBA, L_{Aeq}, ambient, background (L_{A90}), GV, ABO

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References

[1] Tasmanian Department of Primary Industries, Water and Environment (July 2004) Noise Measurement Procedures Manual.

[2] 5272_ACVIB_R_MMG - Rosebery mine environmental noise, ground vibration and air blast overpressure annual monitoring data review 2018-2019_R1.

Executive Summary

Tarkarri Engineering was commissioned to conduct an annual review of noise, ground vibration and air blast overpressure data collected over the 2020-21 financial year at MMG's Rosebery mine.

Average $L_{Aeq,15min}$ levels recorded by five fixed noise monitoring stations were commensurate with last year except for Murchison Station which averaged 3 dB lower levels during the evening and night periods.

Exceedances of air blast overpressure limits set for blasting under EPN 7153/3 occurred on a few occasions during scheduled blasting times, however, these are not breaches of the EPN conditions as blasting occurred at depths of 1 km underground with levels likely controlled by gusty weather conditions and or precipitation. Ground vibration data showed high ambient (i.e. outside of blasting times) levels through the year with times when blasts occurred showing no signal over and above ambient. Given this, the meter having passed NATA calibration and blasting occurring at distances greater than 1 km underground, breaches of the sites EPN ground vibration limits are considered to have not occurred.

The noise levels reviewed show that there remains no indication of performance changes in environmental noise emission levels or blasting generated by Rosebery mine.

1 Introduction

MMG Limited commissioned Tarkarri Engineering to undertake an annual review of continuous environmental noise monitoring and of ground vibration (GV) and air blast overpressure (ABO) monitoring of blasting at their Rosebery mine. The review is a requirement under Environmental Protection Notice (EPN), no 7153/3, condition G7 for the mine.

The relevant sections of the mines EPN are provided below:-

G7 Annual Monitoring Review and Management Report

1 Unless otherwise specified in writing by the Director, an Annual Monitoring Review and Management Report, covering a 12 month review period from 1 July of the preceding year to 30 June of the following year, must be submitted to the Director by 30 November 2011 and every subsequent year by September 30 thereafter. The Annual Monitoring Review and Management Report must be made publicly available by the person responsible for the activity.

2 The Annual Monitoring Review and Management Report must be compiled for the activity using the ISO 14001 Environmental Management System (EMS) Framework to demonstrate continual improvement and compliance with legal requirements (including this Notice) and must include, but not be limited to:

2.6 a review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations, including discharge and ambient monitoring points that illustrate significant trends. Include a review of the accuracy of the sampling procedures, sampling schedule, sample locations and test methods applied;

Noise Control

N1 Continuous Noise Monitoring

1 Unless otherwise approved in writing by the Director:

1.1 noise emissions from the activity must be monitored applying the MMG Rosebery Mine continuous monitoring program at the locations specified in Table 13 of Attachment 2 and locations shown on Attachment 7, based on equivalent continuous (Leq) and L10 and L90 A-weighted sound pressure levels measured over a period of 15 minutes or an alternative time interval specified by the Director;

1.2 noise level measurements must be taken in the presence of ambient noise normally existent in the area;

1.3 measured noise levels are to be adjusted for tonality and impulsiveness in accordance with the *Tasmanian Noise Measurement Procedures Manual 2004*, or any future revision of this manual, issued by the Director;

1.4 all methods of measurement must be in accordance with the *Tasmanian Noise Measurement Procedures Manual 2004*;

1.5 noise from the activity must not cause an environmental nuisance, at any domestic residence or commercial activity in other ownership;

1.6 an indicator of whether environmental noise nuisance has occurred will be based on the record of any noise complaints received by MMG Rosebery Mine; and

1.7 If a noise complaint is received, the person responsible must:

1.7.1 address the complaint including the use of appropriate dispute resolution if required; or if necessary; and

1.7.2 implement noise abatement measures so that nuisance noise emissions from the activity do not result in ongoing environmental nuisance occurring

1.8 Results of the continuous noise monitoring program and noise related complaints must be reported in the Annual Monitoring Review and Management Report.

Blasting

B1 Blasting Control

Ground vibration due to blasting must not result in environmental nuisance occurring at any domestic residence or commercial activity in other occupation or ownership. Ground vibration management must be controlled by the combination of monitoring, at the location shown on Attachment 7 and for the parameters specified in Table 13 of Attachment 2.

B2 Blasting - noise and vibration limits

1 Blasting on The Land must be carried out in accordance with blasting best practice environmental management (BPEM) principles, and must be carried out such that, when measured at the curtilage of any residence (or other noise sensitive premises) in other occupation or ownership, airblast overpressure and ground vibration comply with the following:

- **1.1** for 95% of blasts, airblast overpressure must not exceed 115dB (Lin Peak);
- **1.2** airblast overpressure must not exceed 120dB (Lin Peak);
- **1.3** for 95% of blasts ground vibration must not exceed 5mm/sec peak particle velocity; and
- **1.4** ground vibration must not exceed 10mm/sec peak particle velocity.

2 All measurements of airblast overpressure and peak particle velocity must be carried out in accordance with the methods set down in *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration*, Australian and New Zealand Environment Council, September 1990.

ATTACHMENT 2 (9 OF 9)

NOISE & VIBRATION MONITORING SCHEDULE

Table 13 Noise and vibration monitoring

Location	Description	Continuous Measurement
N1	Police house	Noise: LAeq, LA10, LA90
N2	Cohen Street	Noise: LAeq, LA10, LA90
N3	Clemons Street	Noise: LAeq, LA10, LA90
V1	Hospital	Peak Particle Vibration: mm/sec

This technical memo presents the results of the annual review for the period 1 July 2019 to 30 June 2020.

2 Site description

The MMG Rosebery mine is located on the lower south-west slope of Mount Black. The township of Rosebery borders the mine's above ground ore processing and train loading facilities to the south, south-west and west. Tailings storage facilities for the mine are located approx. 1.7 km north-west of the Rosebery township and to the south of the township on the southern side of the Murchison Hwy.

The mine produces zinc, lead, copper concentrates and gold dore bars via mechanised underground mining methods and employs crushing, grinding and flotation processes in their above ground processing facility.

Unattended monitoring of environmental noise is conducted at 5 locations across the township of Rosebery with GV and ABO monitored at a single location.

Table 2-1 presents spatial information for the environmental noise, GV and ABO monitoring locations. The table also provides location information on the weather stations for the mine that

were used to filter environmental noise data. Figure 2-1 and 2-2 provide aerial views showing the monitoring locations with residential zones shaded in yellow.

Table 2-1: Information on environmental noise, GV and ABO and weather monitoring locations.

Environment noise; GV and ABO; and weather monitoring location information		
Number	Location	Coordinates (MGA)
Environmental noise		
N1	Police House	378530, 5373726
N2	Cohen St	377812, 5374410
N3	Mt Black	379195, 5374213
N4	Murchison St	379063, 5374101
N5	Alec St	378988, 5373396
GV and ABO		
V1	Hospital	378827, 5374072
Weather stations		
W1	Bobadil	376839, 5376290
W2	Overflow Carpark	378748, 5374012
W3	2/5 Dam	378491, 5372628

EPN 7153/3 monitoring locations.

NB: Positions N4 and N5 are additional monitoring locations not specifically required under EPN 7153/3. They were implemented to monitor truck movements to and from the level 3 waste rock dump (WRD) (truck movements to and from this area seldomly occur as the WRD is no longer used) in the case of position N4 and the construction of the 2/5 Dam (as required under Permit Conditions Environmental no. 9084 (R1)), in the case of position N5.

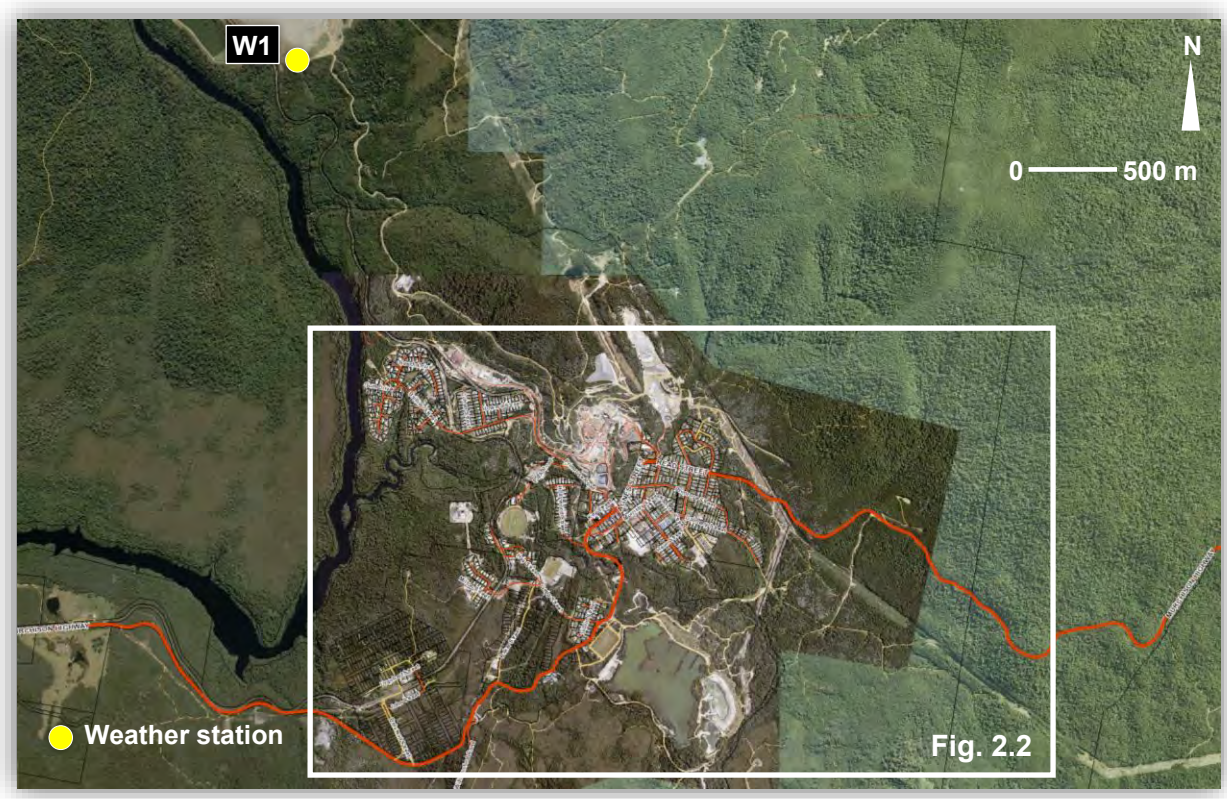

Figure 2-1: Aerial view of Rosebery and surrounds with the location of weather station 1 and the extent of Figure 2.2 marked.

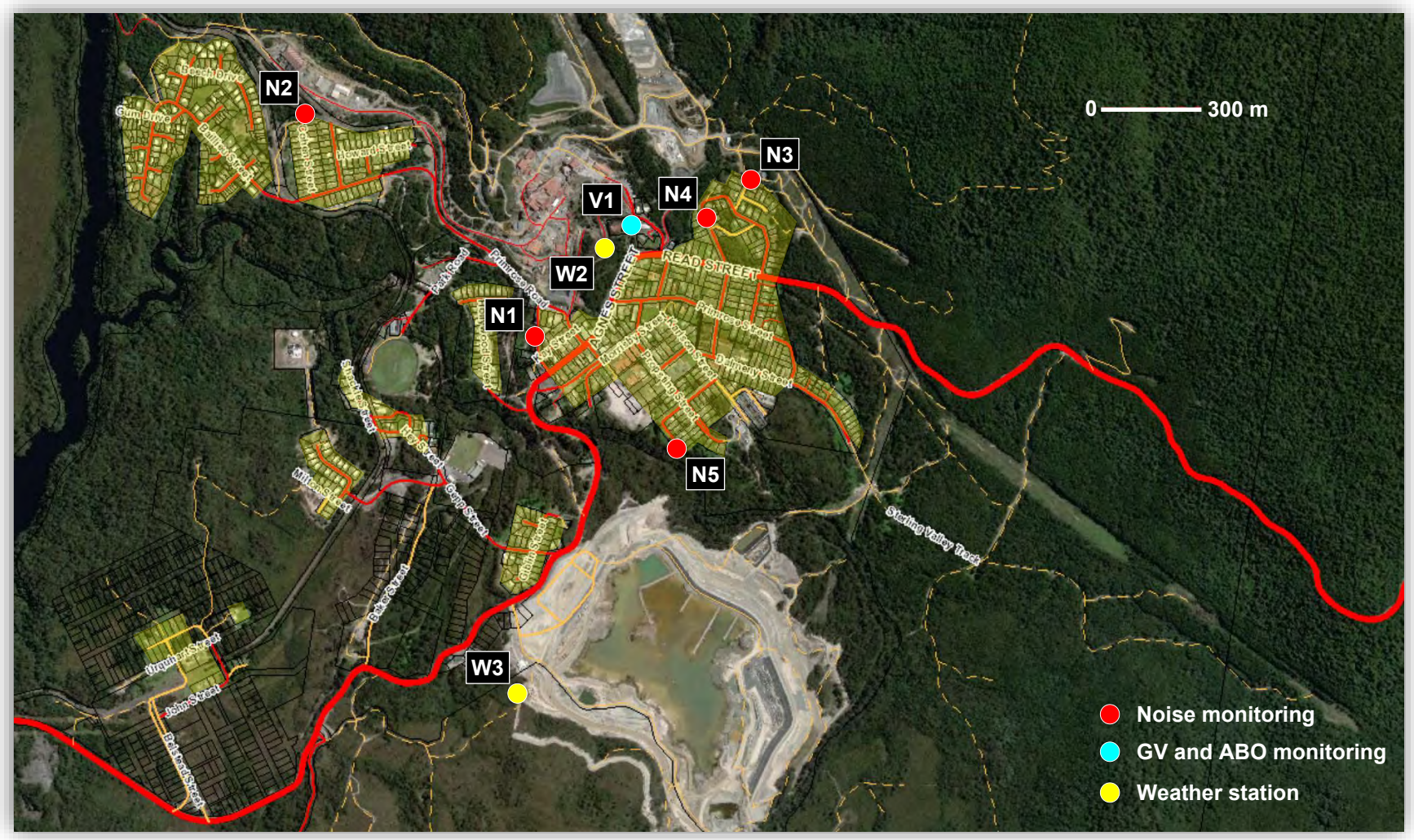

Figure 2-2: Aerial view of Rosebery with environmental noise; GV and ABO; and weather monitoring locations marked.

3 Environmental noise monitoring

Unattended continuous noise monitoring is conducted at 5 locations across the township of Rosebery as shown in Figure 2.2. Acoustic Research Laboratories Ngara Type 1 noise loggers are used to record fast response A-weighted sound pressure levels with 15-minute equivalent continuous (L_{eq}), min, max and 8 Ln-statistic levels (including L_{A90}, L_{A10}) extracted during post download data processing.

Field calibrations are completed approximately weekly, and factory calibration completed once every 2 years by a National Association of Testing Authorities (NATA) accredited laboratory. All monitored data presented here was from NATA laboratory calibrated loggers (calibration certificates, including field calibrators units, are provided in the appendix of this report).

The 5 environmental noise monitoring stations are in general accordance with requirements of section 4 and section 5.2 of the *Tasmanian Noise Measurement Procedures Manual* (July 2004)[1].

Available 15-minute interval data sets for each measurement location were filtered for erroneous weather data and poor weather conditions (i.e. winds speeds in excess of 5 m/s and precipitation), based on 10-minute weather data recorded at the three weather stations shown in Figures 2.1 and 2.2.

3.1 Data sets

Table 3-1 presents overall data availability as a percentage of the 35,040 possible 15-minute intervals available for analysis over the past monitoring year. Available data has subsequently been filtered against adverse weather conditions and measurement overload errors.

NB: 2021 is not a leap year unlike last year which included 35,136 possible intervals.

Table 3-1: Environmental noise monitoring data set summary.

Environmental noise monitoring data set summary				
Location	Recorded intervals		Intervals post filtering	
	count	%	count	%
Alec St	34,300	97.89	24,705	70.51
Cohen St	34,490	98.43	24,713	70.53
Mt Black	31,862	90.93	23,183	66.16
Murchison St	34,755	99.19	25,064	71.53
Police House	34,729	99.11	24,937	71.17

Data availability was generally greater than 98 % except for Mt Black where a number of USB and data conversion errors occurred.

After filtering out adverse weather conditions and meter overloads, between 66 and 71 % of possible intervals were available for analysis, up from 58 to 67 % available from the previous year's data[2].

Generally, at least 22% of the measurement period experienced wind speeds > 5 m/s and/or there was a precipitation reading. This year 0.01%, 0.01% and 0.24% of weather station data was missing from Bobadil, 2/5 Dam and Overflow carpark, respectively which is a significant reduction over previous years. Where station data was unavailable, other station data was relied upon to decide whether noise data should be filtered. Periods where data was unavailable at all three stations were disregarded due to uncertainty in weather patterns.

NB: Due to the conversion from 10-minute weather station data to comparable 15-minute intervals, an additional 6% of weather data was deemed unsuitable for noise measurement results, i.e. 28% rather than 22% of the year was discarded. In principle, a 15-minute interval was only considered acceptable if both of the two closest 10-minute intervals recorded acceptable weather.

From discussions with MMG personnel measurement data was typically unavailable for one of the following reasons:-

- Data lost (unspecified or unknown cause).
- Duplicate data – Data lost during download.
- USB formatting issue.
- Data conversion errors.
- Unit not properly calibrated or drifted from reference value.

3.2 Summary Monitoring results

Table 3-2 provides annual arithmetically averaged L_{Aeq}, L_{A90} and L_{A10} 15-minute levels calculated from the filtered data sets for each measurement location. Levels for the day, evening and night periods are provided with each period defined as follows:-

- Day: 0700 to 1800 hrs
- Evening: 1800 to 2200 hrs
- Night: 2200 to 0700 hrs.

Annual average levels from the 2018/2019 year[2] are also provided for comparative purposes.

Table 3-2: Environmental noise monitoring summary data.

Environmental noise monitoring summary data, average 15-minute Ln-statistics (dBA)										
Location	Period	2020/2021			2019/2020			Difference (dB)		
		L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}
Police House	Day	53	48	54	52	47	53	1	1	1
	Evening	52	48	52	51	48	51	0	1	0
	Night	50	48	50	49	47	50	1	0	1
Cohen St	Day	53	50	54	54	51	55	-1	-1	-1
	Evening	51	49	51	52	50	53	-1	-2	-1
	Night	50	49	50	51	50	52	-1	-2	-1
Mt Black	Day	45	40	45	45	40	46	0	-1	0
	Evening	43	40	44	44	40	45	0	-1	0
	Night	42	40	42	41	39	42	1	0	1
Murchison St	Day	47	41	47	49	43	48	-2	-1	-2
	Evening	45	41	45	48	44	48	-3	-3	-3
	Night	42	40	42	45	43	45	-3	-3	-3
Alec St	Day	45	38	46	45	39	46	-1	0	-1
	Evening	42	37	43	42	38	43	-1	0	-1
	Night	39	36	40	39	37	40	-1	0	-1

Average annual noise levels were generally 1 dB lower than previously seen in the 19-20 monitoring year with the exception of Police House which was up by approx. 1 dB bringing it back in line with the 18-19 monitoring year. A significant reversion in overall levels at Murchison St was seen this year with a typical 3 dB reduction bringing this year' results closer to the lower levels seen in 18-19.

The following subsections provide graphs of monthly average $L_{Aeq,15min}$ day, evening, and night levels (from filtered data) measured at each of the 5 monitoring locations.

3.2.1 Police House

Figure 3-1 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Police House monitoring location.

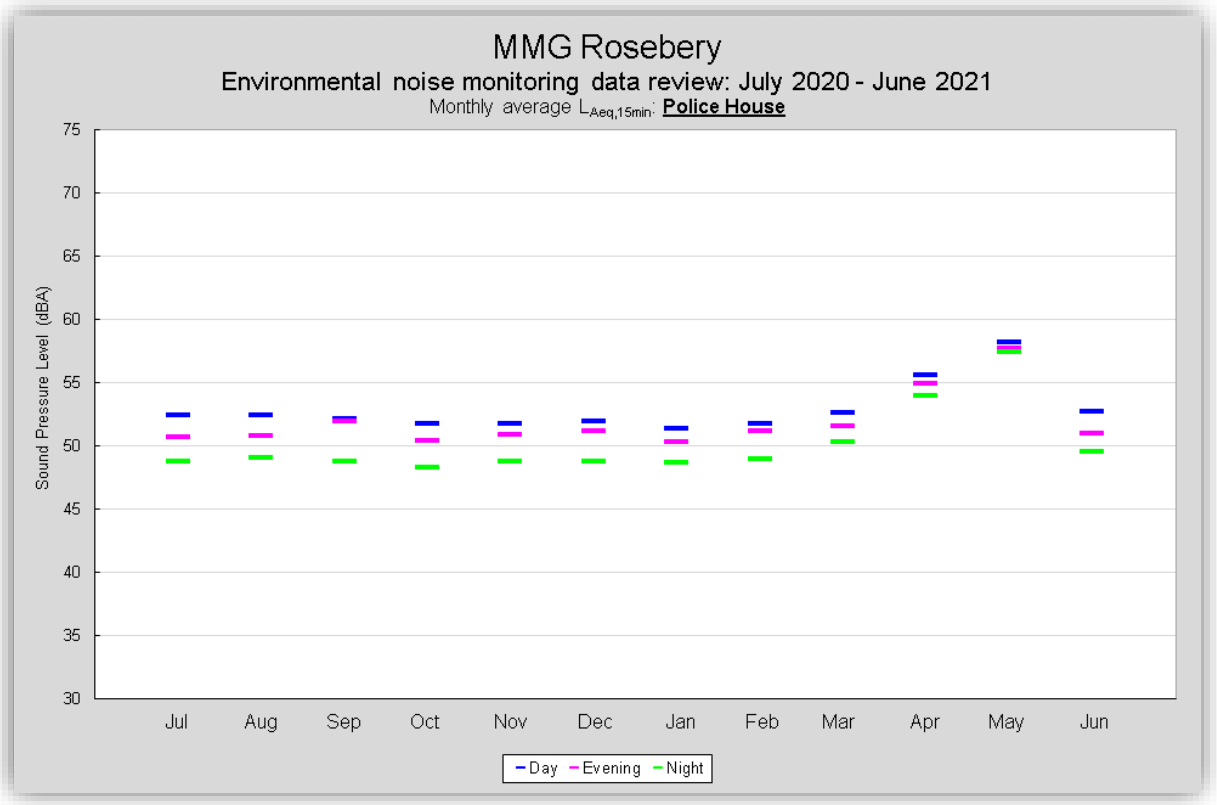

Figure 3-1: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Police House** (N1).

Monthly average $L_{Aeq,15min}$ noise levels were relatively stable throughout the year except for April and May where high background levels were present. During most of the year, measured levels were bounded between 49 dBA at night and 52 dBA during the day suggesting a stable noise environment.

The elevated background levels seen later in the monitoring year was observed to be between 14 April and 24 May when unit 8780CD was used. This meter recorded background levels approx. 7 – 10 dB above the long-term average of 50 dBA seen in adjacent months suggesting that a persistent noise source was present. This is also reflected in the reduction in spread seen between day, evening and night statistics during this period, i.e. a constant noise source running 24/7. Failure to properly calibrate the unit is unlikely noting that no issues were flagged by MMG during this period and that seven successful calibrations occurred. Tarkarri Engineering notes that the subsequent reversion back to a background of 50 dBA did not coincide with a calibration event. A community complaint was received regarding increased noise from the mines effluent treatment plant around this time (see section 5 of this report for details) and this is potentially the cause of the elevated noise levels.

3.2.2 Cohen St

Figure 3-2 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Cohen St monitoring location.

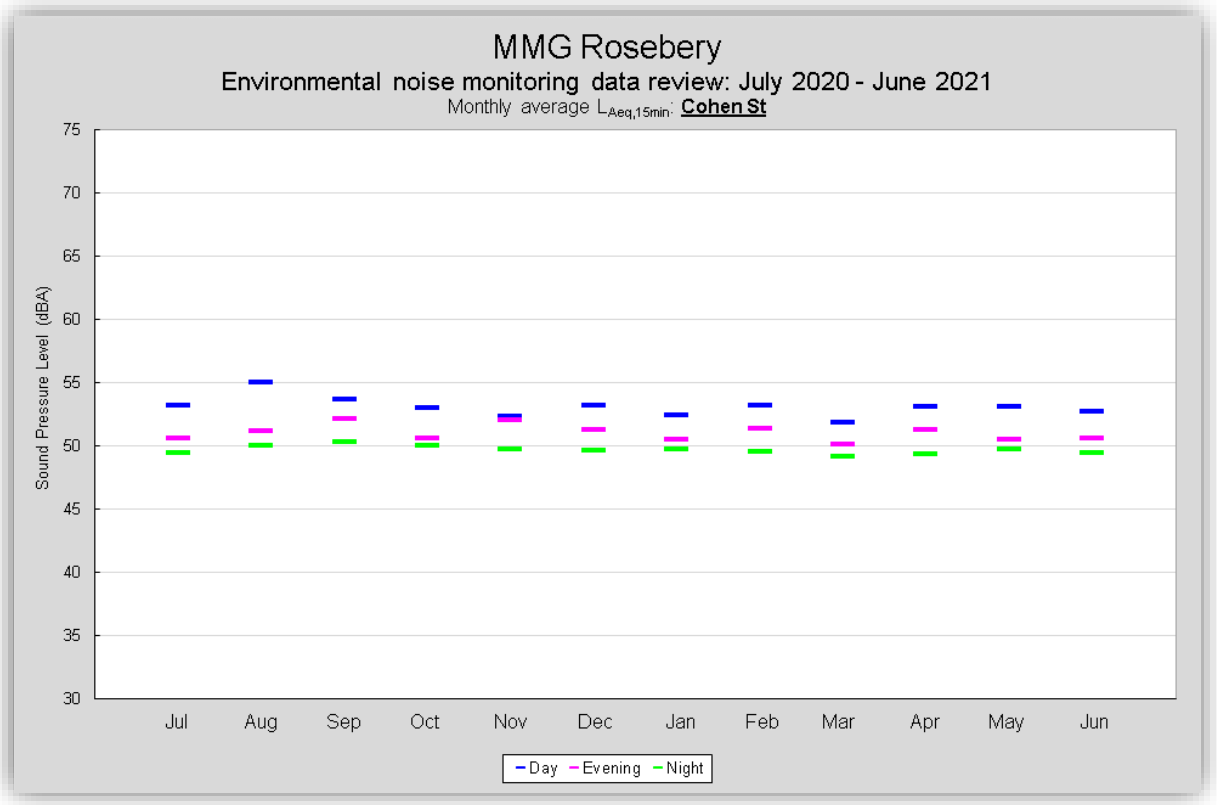

Figure 3-2: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Cohen St** (N2).

Monthly average day, evening, and night $L_{Aeq,15min}$ levels were relatively stable throughout the year with levels bounded between 50 – 54 dBA. An exception to this is seen in August where daytime L_{Aeq} levels reach 55 dBA.

3.2.3 Mt Black

Figure 3-3 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Mt Black monitoring location.

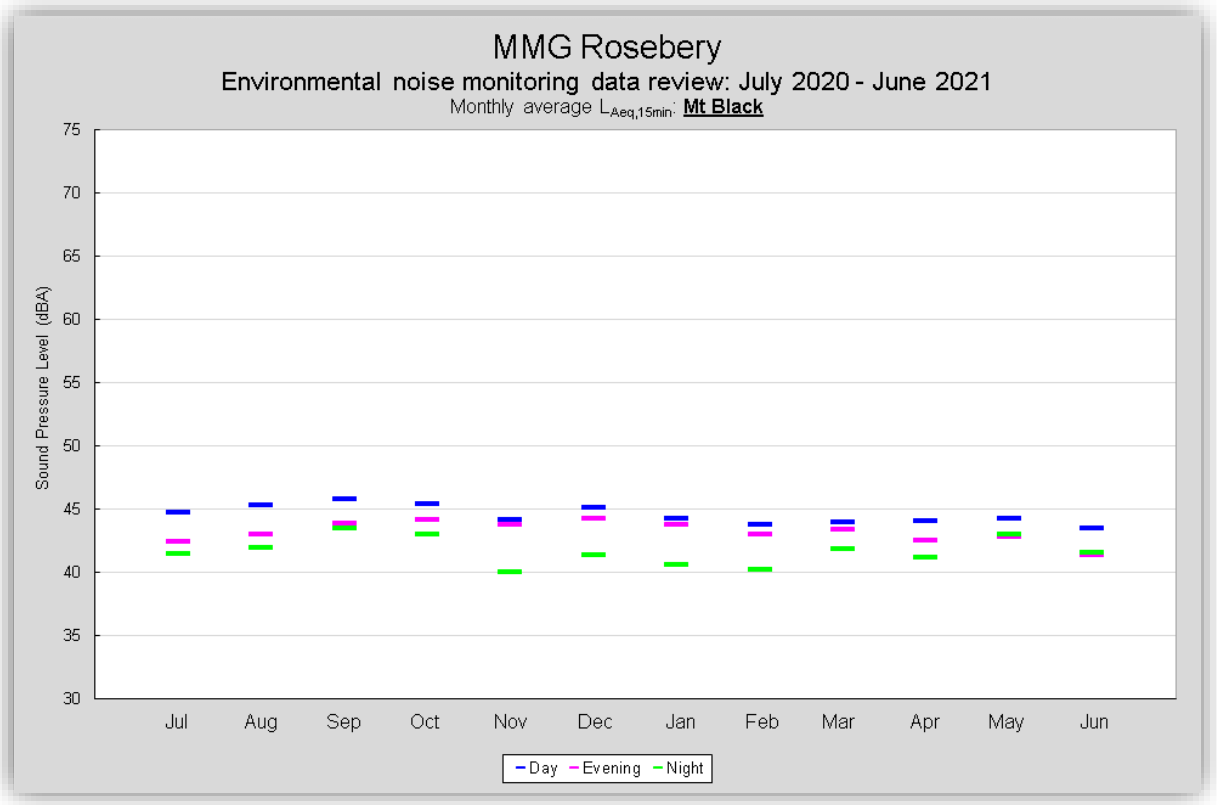

Figure 3-3: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Mt Black** (N3).

Monthly average day, evening, and night L_{Aeq} levels were fairly consistent at this location. Increased separation between day and night L_{Aeq} levels in Summer suggests greater diurnal variation in noise source activity during these months while increasing background levels in spring suggests higher than usual nocturnal noise source activity.

3.2.4 Murchison St

Figure 3-4 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Murchison St monitoring location.

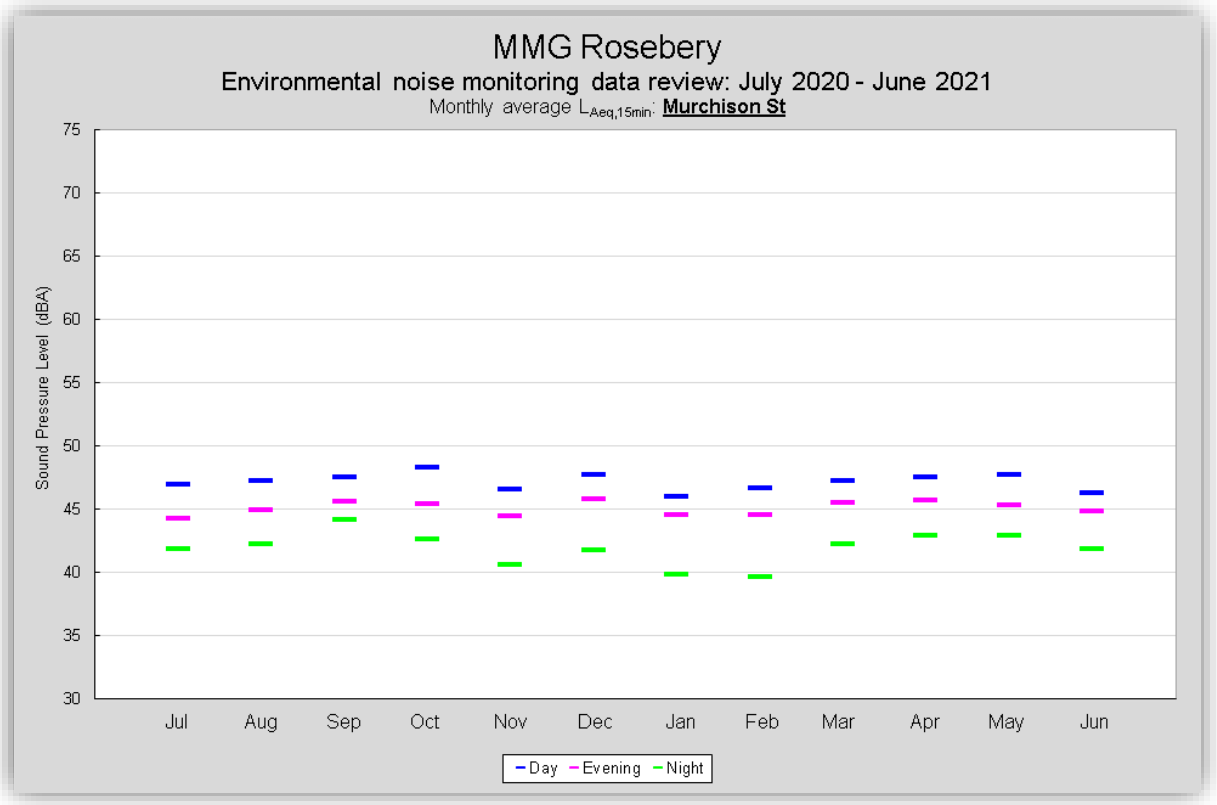

Figure 3-4: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Murchison St** (N4).

Day, evening, and night levels were consistently 3 dB above Mt Black station data (170 m NE from this station) throughout most of the year with higher variability also seen in diurnal patterns.

Significantly lower evening and night-time levels were measured at Murchison St this year with a reduction in significant noise generating activity at the mine is potentially responsible for the 3 dB reduction seen.

A widening gap between day and night statistics between November – February and lower background levels similar to the pattern observed at Mt Black is also seen at this location.

3.2.5 Alec St

Figure 3-5 presents monthly average 15-minute day, evening, and night L_{Aeq} levels at the Alec St monitoring location.

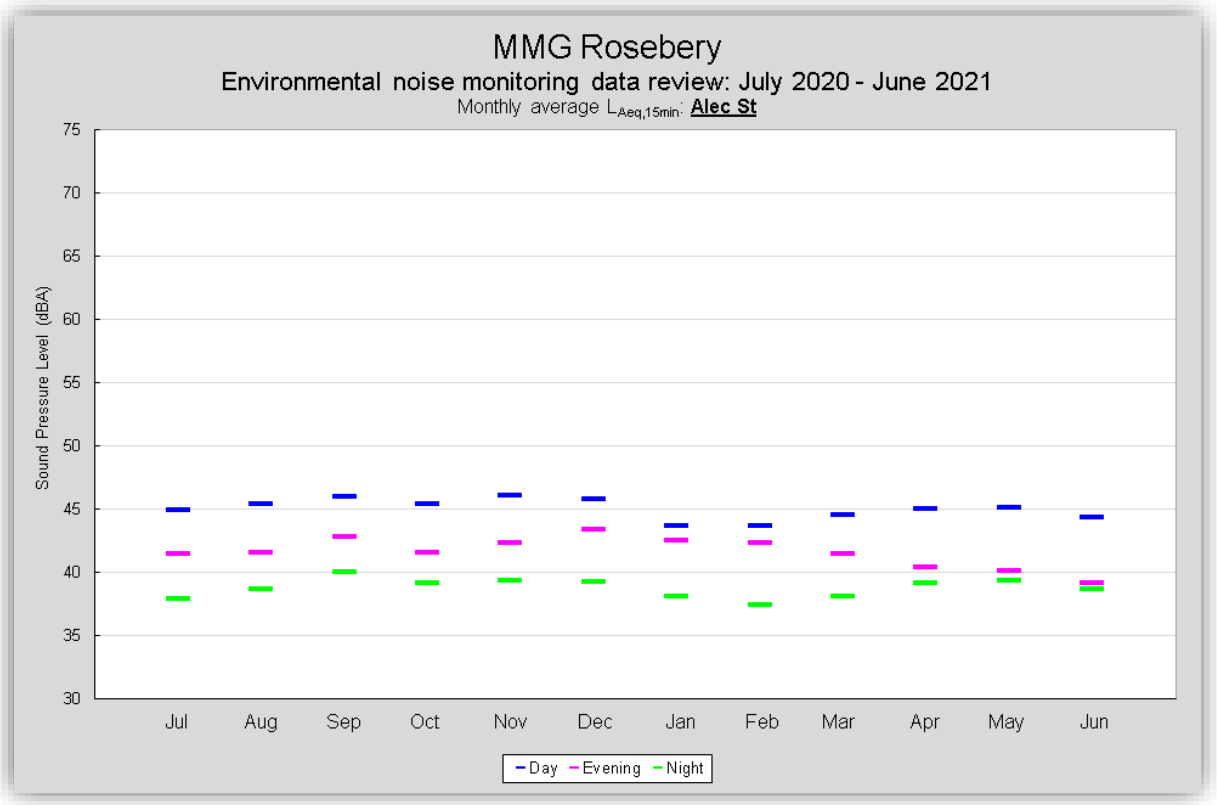

Figure 3-5: Monthly average $L_{Aeq,15min}$ levels for day, evening and night periods, **Alec St** (N5).

Day, evening, and night monthly average L_{Aeq} levels were consistent through the year while generally showing the highest diurnal variation of the 5 monitoring locations. This suggests that transient noise sources (e.g. traffic) controlled the noise environment at this location.

A reduction in average background levels between December and March roughly correlates with the dip seen at Murchison St and Mt Black. Upon further discussion with MMG personnel, this is more likely to be the result of reduced vehicular traffic in the area due to travel restrictions or calmer weather patterns than from MMG activity who note that production rates were at or above average levels during this period.

4 Blast monitoring

GV and ABO is monitored at a single location on the western side of the Rosebery Hospital. An Instantel Minimate Plus monitor is used with an International Society of Explosives Engineers (ISEE) standard triaxial geophone and ISEE linear microphone. 15-minute peak particle velocity (mm/s) and peak linear sound pressure levels (dBL) are recorded. Blasting at the mine occurs during 2 time periods on a daily basis as follows:-

- 0645 to 0700 hrs
- 1845 to 1900 hrs

NB: The evening blasting window has been reduced to 15 mins from 135 mins in previous years[2].

Monitoring is undertaken in general accordance with the relevant guidelines including the *Australian and New Zealand Environment Council* (ANZECC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (September 1990), *Australian Standard AS 2187.2-2006 Explosives storage and use. Use of explosives* and the Tasmania *Quarry Code of Practice* (May 2017).

The measurement of GV and ABO is in general accordance with the provisions of the Appendix J sections J3.2 and 3.3 of *AS 2187.2-2006* with the exception of the location of the microphone which is close (approx. 5 – 10 cm) to the western wall of the Rosebery Hospital.

The Minimate Plus unit is calibrated annually at a NATA accredited laboratory and all data presented here is from within the period of calibration.

4.1 Data set

Of the possible 35,040 15-minute data intervals within the monitoring year, 33,643 (96.01 % of the intervals) were available for analysis; This is an approx. 4% improvement in data availability over last year's data[2] with no recurrence of incorrectly recorded 1 and 14 minute intervals as noted in the 18-19 financial year.

MMG advised Tarkarri Engineering that data collected between 30 November and 14 December was lost due to human error representing approx. 3.8 % of the financial year.

Contrasting with last year's[2] data, very few missing periods due to meter error were detected, only 21 in total, with the largest missing period not due to human error lasting less than two hours. These missing periods account for the remaining 0.15% of the financial year.

The following summarises the significant periods of missing data from the previous financial year:

- 30/11/20 15:10:27 - 14/12/2020 15:29:59 [Data lost due to human error]

4.2 Ground vibration monitoring

Figure 4-1 presents 15-minute peak particle velocity levels measured at the Hospital monitoring location (the highest value of the three orthogonal measurement directions was selected for each interval). Figure 4-2 presents measured levels at scheduled blasting times only. Results are assessed against the following limits applicable under EPN 7153/3:-

- 5 mm/s for 95 % of blasts
- 10 mm/s for 100 % of blasts

Both limits are marked on graphs for the complete data set (Figure 4-1) and during scheduled blasting times (Figure 4-2):-

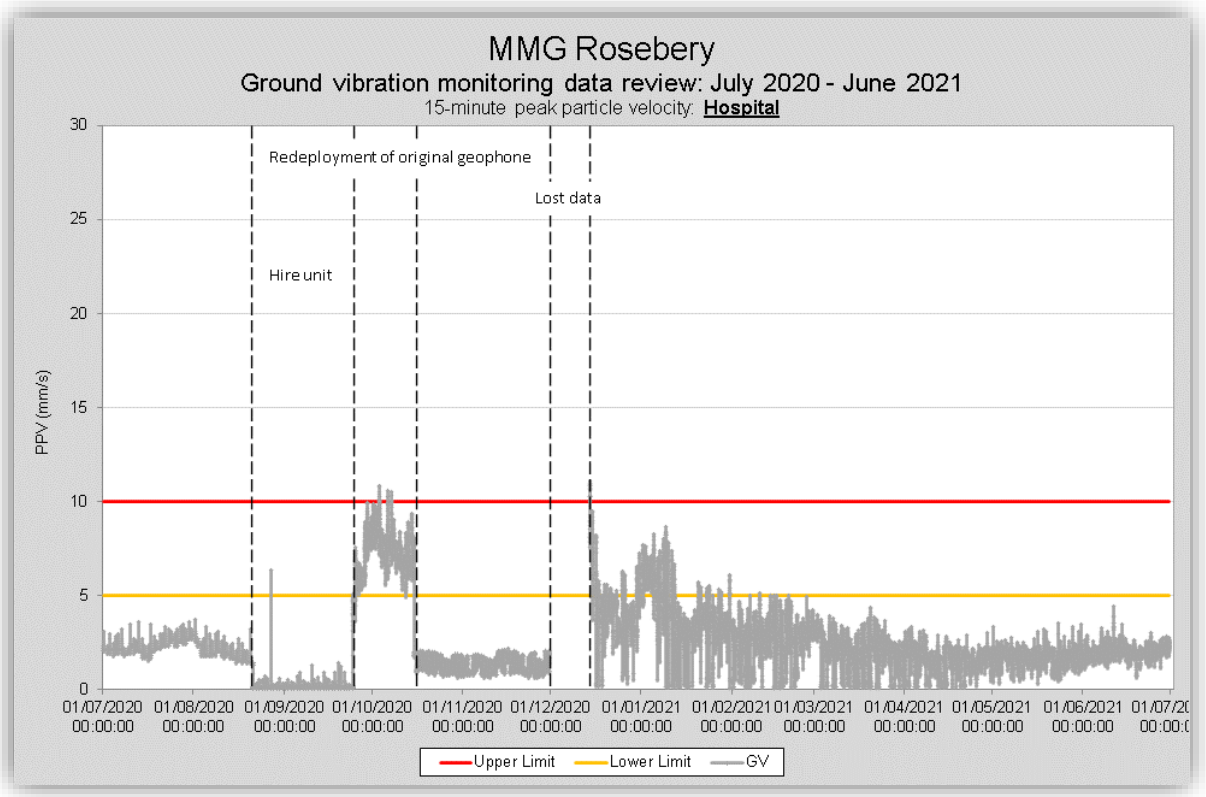

Figure 4-1: 15-minute peak particle velocity levels, **Hospital** (V2).

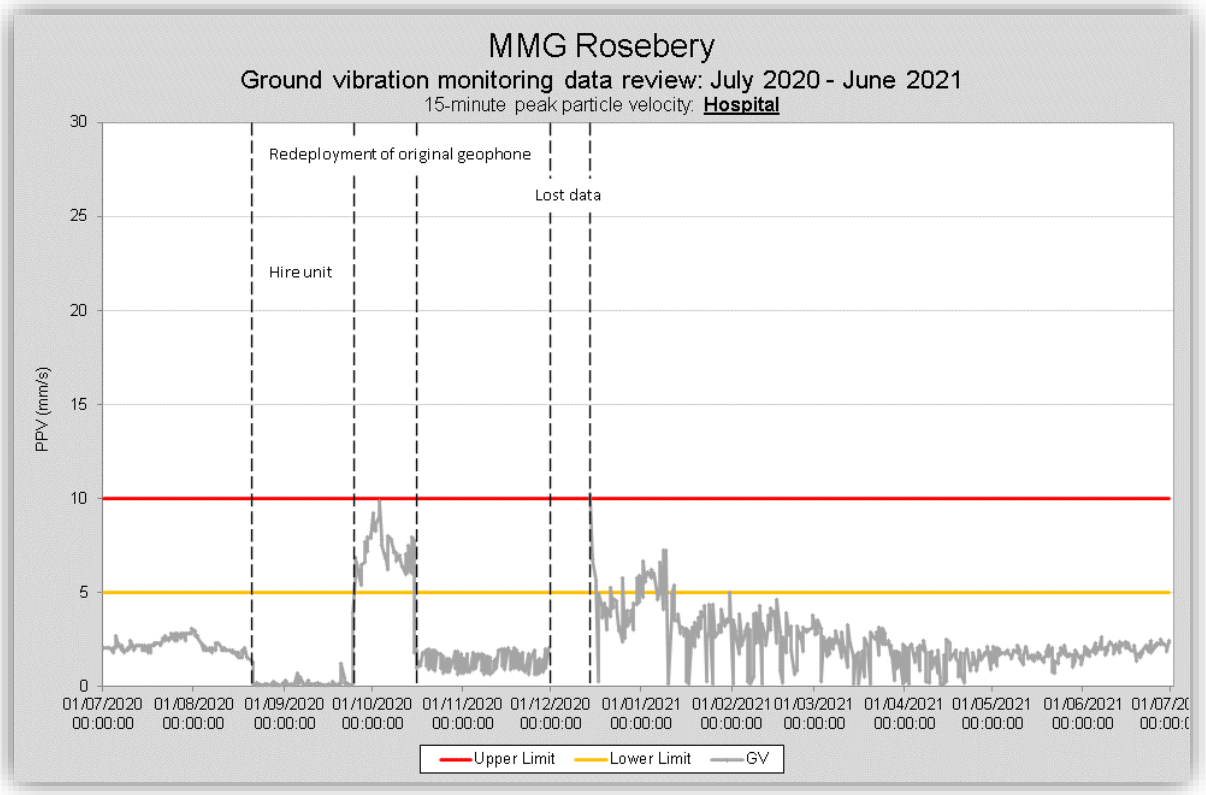

Figure 4-2: 15-minute peak particle velocity levels during scheduled blasting times, **Hospital** (V2).

From the above, Tarkarri Engineering notes higher than usual ambient (i.e. outside of blasting times) PPV levels and the reasons for this requires investigation. Use of a hire unit during calibration provided results more typical of previous years. Tarkarri Engineering notes no measured signal over and above ambient levels was recorded during blasting times. Blasts occurred at distances in excess of 1 km underground this financial year. Given these factors exceedances seen above the 5 mm/s trigger level are highly unlikely to be caused by blasting.

Tarkarri Engineering notes that the MMG owned monitor passed its annual NATA calibration indicating that the local environment in which the meter is situated may be responsible for the abnormal measurements presented above.

4.3 Air blast overpressure monitoring

Figure 4-3 presents 15-minute peak linear sound pressure levels measured at the Hospital monitoring location. Figure 4-4 presents measured levels at scheduled blasting times only. Results are assessed against the following limits applicable under EPN 7153/3:-

- 115 dBL for 95 % of blasts
- 120 dBL for 100 % of blasts

Both limits are marked on graphs for the complete data set (Figure 4-3) and during scheduled blasting times (Figure 4-4) :-

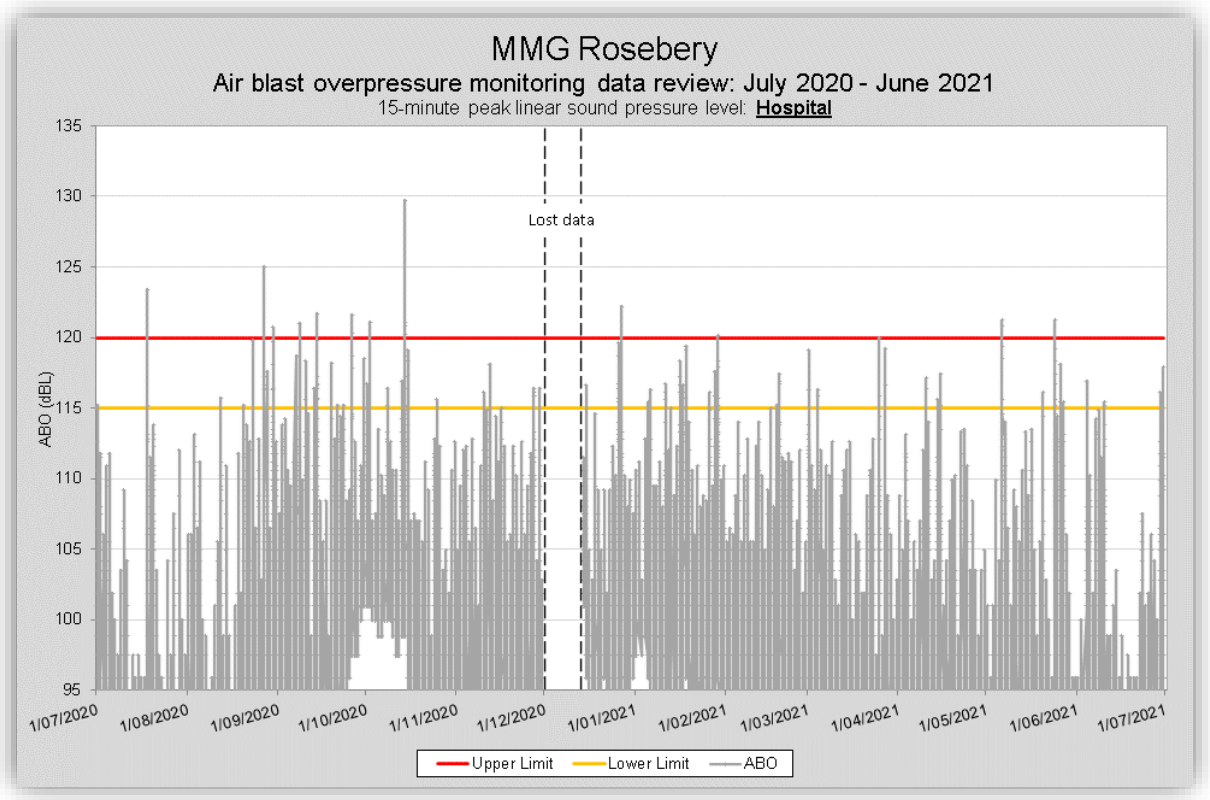

Figure 4-3: 15-minute peak linear sound pressure levels, **Hospital** (V2).

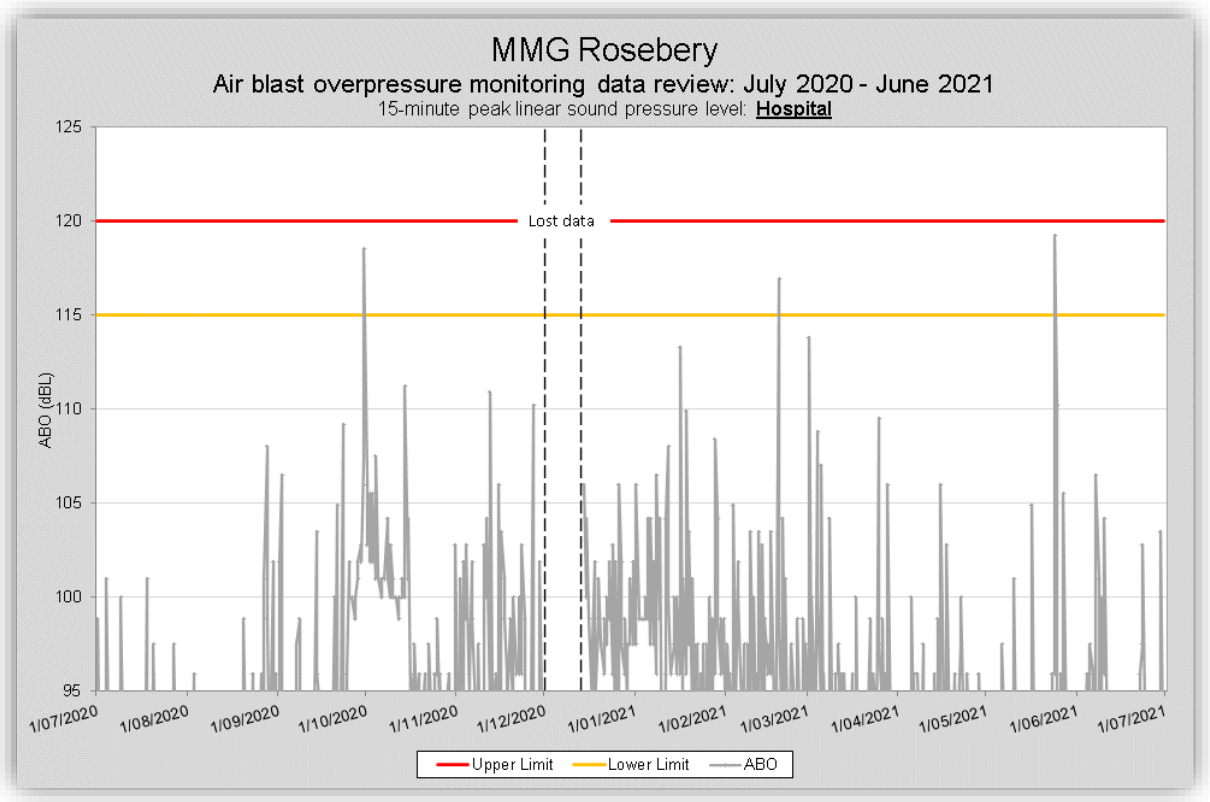

Figure 4-4: 15-minute peak linear sound pressure levels during scheduled blasting times, **Hospital** (V2).

The 115 and 120 dBL limits were exceeded on 122 and 17 occasions, respectively down from last year. Of these, 3 exceedances of the 115 dBL limit occurred within scheduled blasting times at the mine. Analysis of weather data from the 3 MMG weather stations indicates that poor weather conditions (i.e. windspeeds were in excess of 5 m/s and/or rainfall was measured) are likely to have been responsible for the exceedances.

5 Community noise nuisance

A community noise nuisance event occurred during the 2020/2021 annual monitoring period and the nature of the complaint and the actions taken to address it were as follows:-

Complaint:

- Excessive noise from machinery near effluent treatment plant/processing area.

Investigation:

- Source point visited.
- Repair issue with a pump in the processing area identified which was awaiting spare parts.

Corrective action:

- Interim: Container placed to act as a sound barrier.
- Long term: Pump repaired.

6 Conclusions and recommendations

Tarkarri Engineering has conducted a review of environmental noise, GV and ABO monitoring data recorded by MMG Rosebery between 1 July 2020 and 30 June 2021.

The environmental noise monitoring data typically showed annual averages for the L_{Aeq}, L_{A90} and L_{A10} 15-minute levels at monitoring positions N1, N2, N3, N4 and N5 similar to those measured in the previous year[2] except for Murchison Station which was on average 3 dB lower during the evening and night.

GV data ambient levels where consistently high relative to previous years, however, the following factors indicate that breaches of the EPN conditions with regard to ground vibration didn't occur:

1. The meter passed its calibration at a NATA certified lab
2. Levels over and above ambient were not recorded during blasting times.
3. MMG advised that blasting only occurred at distances greater than 1 km underground

Investigations regarding the cause of this should be prioritised and consideration given to establishing regular monitoring and review of the GV data. the ABO data showed that levels recorded during blasting times at the mine were below the EPN limits with recorded exceedances of EPN limits likely due to weather impacts.

6.1 Recommendations

6.1.1 Noise monitoring

Under the site EPN an environmental noise survey is required on a tri-annual basis and the survey methodology requirements under the EPN call for a 10-minute measurement interval (condition N3 3.3.). Tarkarri Engineering recommends that loggers at the 5 monitoring locations are changed to record 10-minute intervals rather than the current 15-minute intervals to bring survey and unobserved monitoring data in line. Approval for this change should be sought from Director of the EPA as per condition N1 1.1 of the mine's EPN (see section 1 of this report).

Tarkarri Engineering notes that condition N1 1.3 states 'measured noise levels are to be adjusted for tonality and impulsiveness in accordance with the Tasmanian Noise Measurement Procedures Manual 2004, or future revisions of this manual, issued by the Director'. For tonality to be addressed as required an '… A-weighted frequency response, a one-third octave spectrum must be measured'[1]. and for impulsiveness to be addressed as required measurements '…using a sound level meter set initially to fast and then impulse time response'[1] must be taken.

The current monitoring systems employed by MMG do not have the capability of measuring a 1/3-octave band spectrum or recording concurrent impulse time response noise levels. The systems would need to be upgraded to allow for these measurements to be taken if this condition is to be addressed.

NB: Tarkarri Engineering notes that without observation or directional noise measurement it would not be possible to determine the source of any tonal or impulsive noise emissions with any accuracy.

The current monitoring systems at the 5 monitoring locations do not provide any qualitative evidence with regard to the sources of noise that produce the recorded noise levels. Tarkarri Engineering recommend that MMG explore installing directional noise monitoring systems where practically possible. This is especially useful at locations close to MMG operations, which would allow for operational noise from the mine to be differentiated from ambient noise sources in the area.

The data loggers are currently downloaded directly from the unit on an approx. weekly basis. Any faults or power issues can therefore only be addressed when physical downloads occur. Tarkarri Engineering recommended that remote access connection to the monitors is considered by the mine. This would allow for monitoring data to be tracked more frequently, particularly if it were patched into the mine's SCADA system, and for power supply data to be viewed and alerts sent where issues may be developing. This would minimise data download problems and would also allow for quicker review and response regarding noise nuisance complaints from the community. It is also possible to have measurement installations with auto-calibration functionality, this would reduce the requirement for regular field calibration.

NB: Lost data and inconsistencies in the data records indicate that download and calibration procedures utilised by MMG for the noise monitoring stations requires review and potential retraining of personnel to minimise loss of data. Particular focus should be on the following:-

- The root cause behind all USB and formatting errors noted by MMG over this financial year are identified and procedures drafted to assist future MMG personnel in properly downloading data. This may include leaving data on the meter until it has been properly transferred to MMG's data repository and reviewed.

The following reminders are provided based on issues seen in previous years:

- Care is taken in handling the microphones at each monitoring station as these are delicate and easily damaged during calibration.
- Ensuring that the field calibrator is activated prior to calibration being initiated and that care is taken during calibration.
- Check of connection points (i.e. cable connections to preamp and sound level meter unit) to ensure no water ingress, corrosion or other damage has occurred.

6.1.2 GV and ABO monitoring

As discussed above for the environmental noise monitoring systems Tarkarri Engineering recommends that remote access connection to the GV and ABO monitor is considered. This would allow post blast review of the monitored data rather than monthly reviews following direct download.

As discussed in section 4 of this report, the current measurement location does not fully comply with the provisions of Appendix J sections J3.2 and J3.3 of *AS 2187.2-2006*. Tarkarri Engineering recommends that the monitoring equipment be relocated to a more suitable position and notes that MMG have submitted a request to the EPA in relation to this and are awaiting a response. An investigation was conducted in March 2021 and detailed in Tarkarri Engineering report 5514_VIB_R which provides recommendations regarding new monitoring location options.

7 Appendix

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Sound Level Meter
IEC 61672-3.2013
Calibration Certificate
Calibration Number C19363

Client Details MMG - Rosebery Mine
Hospital Road
Rosebery TAS 7470

Equipment Tested/ Model Number : ARL Ngara S-Pack
Instrument Serial Number : 878139
Microphone Serial Number : 321297
Pre-amplifier Serial Number : 28265

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	24.2°C	**Ambient Temperature :**	24.1°C
Relative Humidity :	47.9%	**Relative Humidity :**	48.4%
Barometric Pressure :	102.51kPa	**Barometric Pressure :**	102.48kPa

Calibration Technician : Lucky Jaiswal **Secondary Check:** Eloise Burrows
Calibration Date : 27 Jun 2019 **Report Issue Date :** 1 Jul 2019

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N.A.
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	N.A.
15: Long Term Stability	Pass	20: Overload Indication	Pass
16: Level linearity on the reference level range	Pass	21: High Level Stability	Pass

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement :

Acoustic Tests
31.5 Hz to 8kHz: ±0.15dB
12.5kHz: ±0.5dB
16kHz: ±0.29dB
Electrical Tests
31.5 Hz to 20 kHz: ±0.1dB

Environmental Conditions:
Temperature: ±0.2°C
Relative Humidity: ±2.4%
Barometric Pressure: ±0.034kPa

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian national standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C19441

Client Details MMG Rosebery Mine
Hospital Road
ROSEBERY TAS 7470

Equipment Tested/ Model Number : ARL Ngara S-Pack
Instrument Serial Number : 8780CD
Microphone Serial Number : 318897
Pre-amplifier Serial Number : 28201

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	25.9°C	**Ambient Temperature :**	25.9°C
Relative Humidity :	33.1%	**Relative Humidity :**	33.1%
Barometric Pressure :	100.8kPa	**Barometric Pressure :**	100.8kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 24 Jul 2019
Secondary Check: Sandra Minto
Report Issue Date : 30 Jul 2019

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N.A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	N.A
15: Long Term Stability	Pass	20: Overload Indication	Pass
16: Level linearity on the reference level range	Pass	21: High Level Stability	Pass

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement :

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz:	*±0.15dB*	*Temperature*	*±0.2°C*
12.5kHz:	*±0.2dB*	*Relative Humidity*	*±3.4%*
16kHz:	*±0.29dB*	*Barometric Pressure*	*±0.013kPa*
Electrical Tests			
31.5 Hz to 20kHz:	*±0.1dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

NATA

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172
Accredited for compliance with ISO/IEC 17025 - calibration.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration and inspection reports.

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Sound Level Meter
IEC 61672-3:2013

Calibration Certificate

Calibration Number C19440

Client Details MMG - Rosebery Mine
Hospital Road
Rosebery TAS 7470

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 878112
Microphone Serial Number : 321297
Pre-amplifier Serial Number : 28265

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	25.6°C	**Ambient Temperature :**	25.9°C
Relative Humidity :	33.1%	**Relative Humidity :**	33.6%
Barometric Pressure :	100.83kPa	**Barometric Pressure :**	100.8kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 24 Jul 2019
Secondary Check: James Jepsen
Report Issue Date : 31 Jul 2019

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	N/A
15: Long Term Stability	Pass	20: Overload Indication	Pass
16: Level linearity on the reference level range	Pass	21: High Level Stability	Pass

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2015, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement :

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz:	*±0.1dB*	*Temperature*	*±2°C*
12.5kHz:	*±0.5dB*	*Relative Humidity*	*±2.4%*
16kHz:	*±0.9dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz:	*±0.1dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2

This calibration certificate is to be read in conjunction with the calibration test report.

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Sound Level Meter
IEC 61672-3.2013

Calibration Certificate

Calibration Number C19522

Client Details	MMG - Rosebery Mine Hospital Road Rosebery TAS 7470
Equipment Tested/ Model Number :	ARL NGARA
Instrument Serial Number :	8780CC
Microphone Serial Number :	322088
Pre-amplifier Serial Number :	28547

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	23°C	**Ambient Temperature :**	24.6°C
Relative Humidity :	52.3%	**Relative Humidity :**	47.7%
Barometric Pressure :	99.62kPa	**Barometric Pressure :**	99.51kPa

Calibration Technician : Jeff Yu
Calibration Date : 6 Sep 2019
Secondary Check: James Jepsen
Report Issue Date : 6 Sep 2019

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Tonebarst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	N/A
15: Long Term Stability	Pass	20: Overload Indication	Pass
16: Level linearity on the reference level range	Pass	21: High Level Stability	Pass

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Total Uncertainties of Measurement -

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	*±0.18dB*	*Temperature*	*±0.2°C*
12.5kHz	*±0.19dB*	*Relative Humidity*	*±2.4%*
16kHz	*±0.29dB*	*Barometric Pressure*	*±0.015kPa*
Electrical Tests			
31.5 Hz to 20 kHz	*±0.11dB*		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

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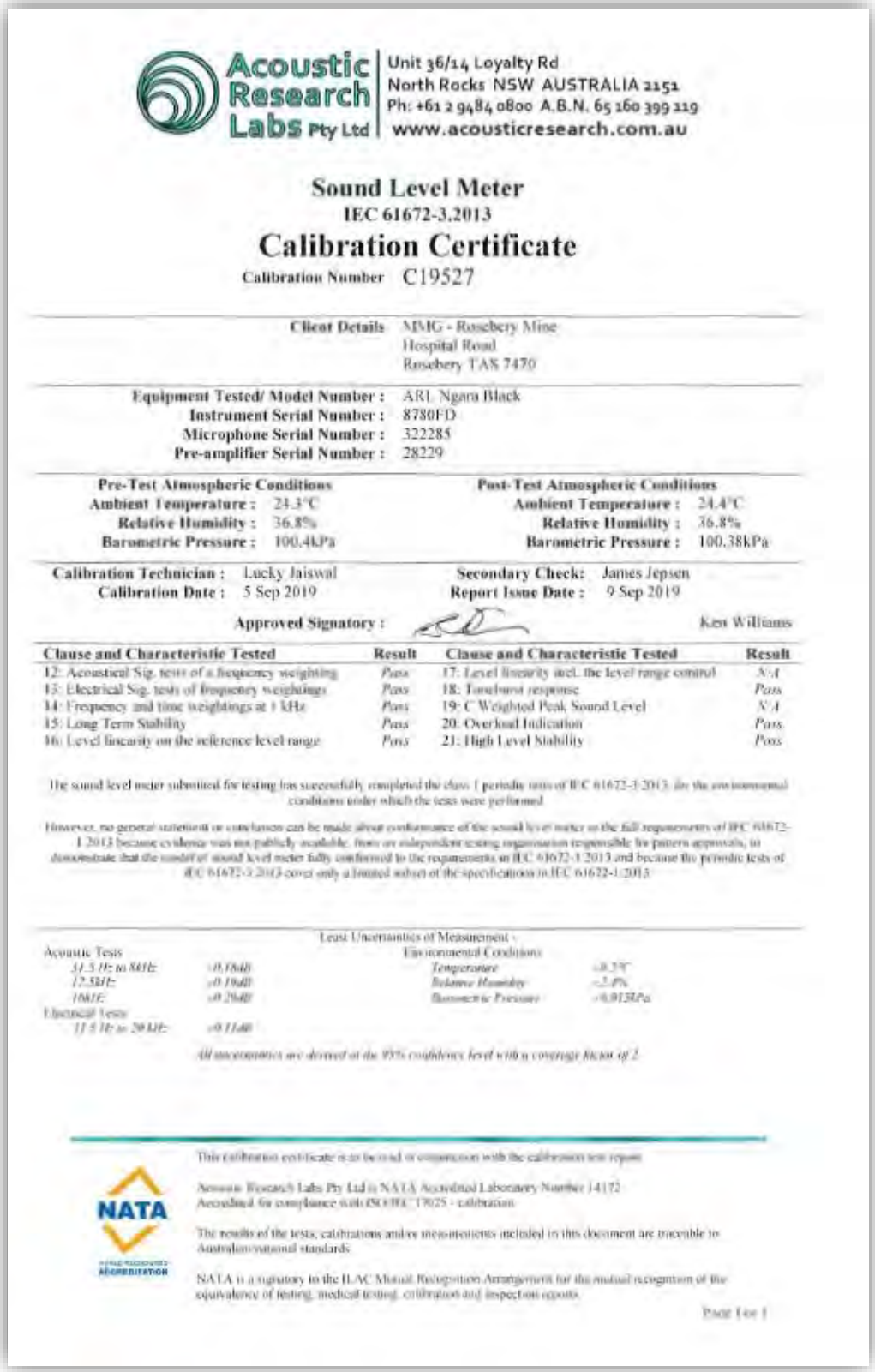

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Sound Level Meter
IEC 61672-3:2013

Calibration Certificate

Calibration Number C19527

Client Details MMG - Rosebery Mine
Hospital Road
Rosebery TAS 7470

Equipment Tested/ Model Number : ARL Ngara Black
Instrument Serial Number : 8780FD
Microphone Serial Number : 322285
Pre-amplifier Serial Number : 28229

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	24.3°C	**Ambient Temperature :**	24.4°C
Relative Humidity :	36.8%	**Relative Humidity :**	36.8%
Barometric Pressure :	100.4kPa	**Barometric Pressure :**	100.38kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 5 Sep 2019
Secondary Check: James Jepsen
Report Issue Date : 9 Sep 2019

Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Tone burst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	N/A
15: Long Term Stability	Pass	20: Overload Indication	Pass
16: Level linearity on the reference level range	Pass	21: High Level Stability	Pass

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2013 for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement :

Acoustic Tests		Environmental Conditions	
31.5 Hz to 8kHz	±0.1dB	Temperature	±0.3°C
12.5kHz	±0.1dB	Relative Humidity	±2.8%
16kHz	±0.2dB	Barometric Pressure	±0.015kPa
Electrical Tests			
31.5 Hz to 20 kHz	±0.1dB		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

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Sound Calibrator
IEC 60942-2017

Calibration Certificate

Calibration Number C19674

Client Details MMG Rosebery Mine
C/O De Bryans Transport Depot
8 River Road, WIVENHOE TAS 7320

Equipment Tested/ Model Number : Pulsar Model 105
Instrument Serial Number : 78234

Atmospheric Conditions
Ambient Temperature : 23.6°C
Relative Humidity : 42.1%
Barometric Pressure : 100.28kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 4 Nov 2019
Secondary Check: Matthew Calleja
Report Issue Date : 5 Nov 2019
Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	Pass
Frequency Generated	Pass
Total Distortion	Pass

	Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
Measured Output	94.0	1000.0	94.1	1000.36

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.1dB*	*Temperature*	*±0.2°C*
Frequency	*±0.01%*	*Relative Humidity*	*±2.4%*
Distortion	*±0.48%*	*Barometric Pressure*	*±0.015kPa*

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

* The tests <1000 kHz are not covered by Acoustic Research Labs Pty Ltd NATA accreditation.

This calibration certificate is to be read in conjunction with the calibration test report.

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Sound Level Meter
IEC 61672-3:2013
Calibration Certificate

Calibration Number C19689

Client Details MMG - Rosebery Mine
Hospital Road
Rosebery TAS 7470

Equipment Tested/ Model Number : ARL Ngara
Instrument Serial Number : 8780CD
Microphone Serial Number : 322710
Pre-amplifier Serial Number : 28201

Pre-Test Atmospheric Conditions		Post-Test Atmospheric Conditions	
Ambient Temperature :	23.2°C	**Ambient Temperature :**	22.8°C
Relative Humidity :	45.1%	**Relative Humidity :**	43.3%
Barometric Pressure :	99.61kPa	**Barometric Pressure :**	99.5kPa

Calibration Technician : Jeff Yu
Calibration Date : 12 Nov 2019
Secondary Check: Max Moore
Report Issue Date : 12 Nov 2019
Approved Signatory : Ken Williams

Clause and Characteristic Tested	Result	Clause and Characteristic Tested	Result
12: Acoustical Sig. tests of a frequency weighting	Pass	17: Level linearity incl. the level range control	N/A
13: Electrical Sig. tests of frequency weightings	Pass	18: Toneburst response	Pass
14: Frequency and time weightings at 1 kHz	Pass	19: C Weighted Peak Sound Level	N/A
15: Long Term Stability	Pass	20: Overload Indication	Pass
16: Level linearity on the reference level range	Pass	21: High Level Stability	Pass

The sound level meter submitted for testing has successfully completed the class 0 periodic tests of IEC 61672-3:2013 for the environmental conditions under which the tests were performed.

However, no general statements or conclusions can be made about conformance of the sound level meter to the full requirements of IEC 61672-1:2013 because evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2013 and because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Least Uncertainties of Measurement :

Acoustic Tests:		Environmental Conditions:	
31.5 Hz to 8kHz:	±0.1dB	Temperature	±0.2°C
12.5kHz:	±0.19dB	Relative Humidity	±2.4%
16kHz:	±0.29dB	Barometric Pressure	±0.015kPa
Electrical Tests:			
31.5 Hz to 20 kHz:	±0.11dB		

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

This calibration certificate is to be read in conjunction with the calibration test report.

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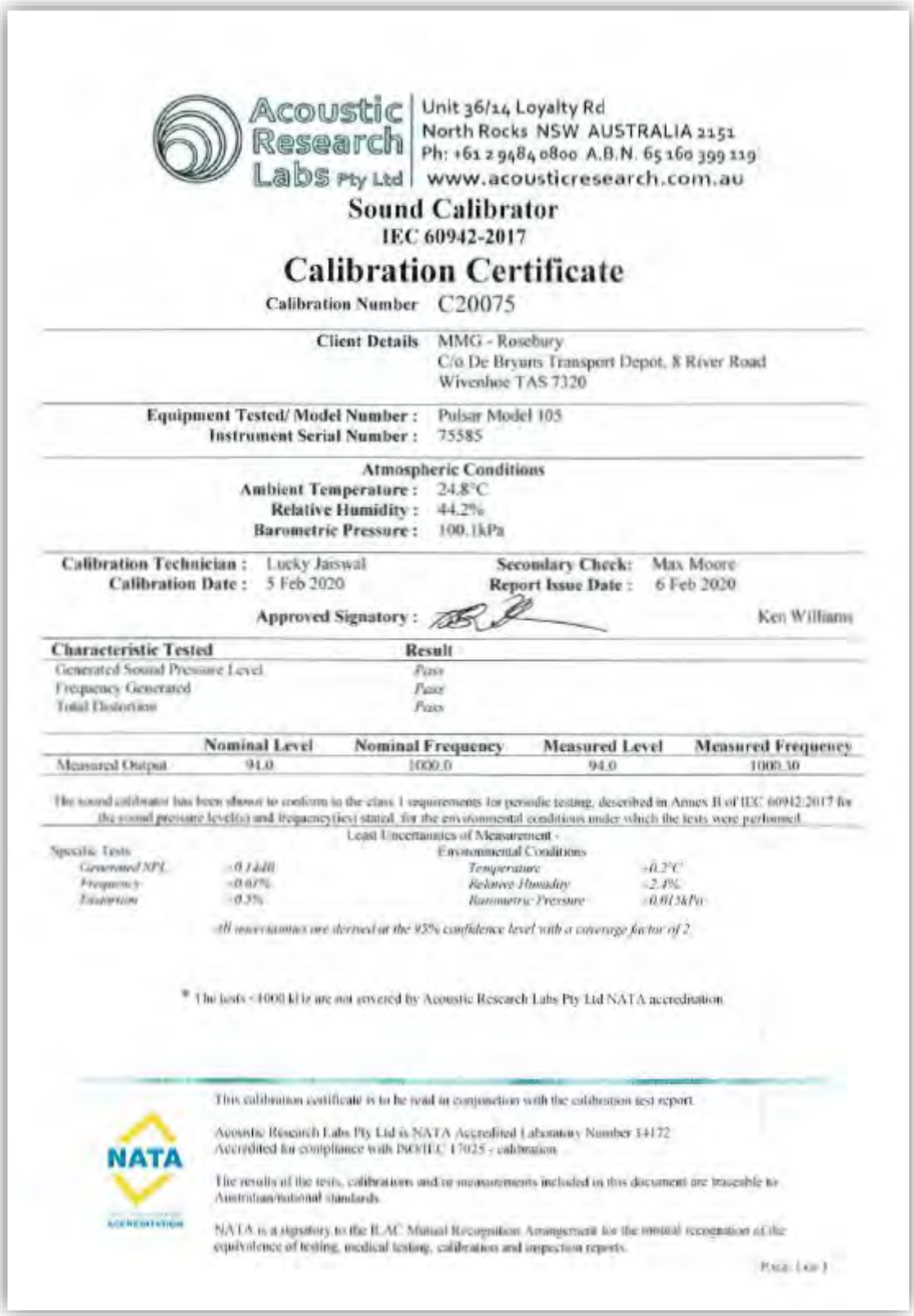

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Sound Calibrator
IEC 60942-2017

Calibration Certificate

Calibration Number C20075

Client Details MMG - Rosebury
C/o De Bryuns Transport Depot, 8 River Road
Wivenhoe TAS 7320

Equipment Tested/ Model Number : Pulsar Model 105
Instrument Serial Number : 75585

Atmospheric Conditions
Ambient Temperature : 24.8°C
Relative Humidity : 44.2%
Barometric Pressure : 100.1kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 5 Feb 2020
Secondary Check: Max Moore
Report Issue Date : 6 Feb 2020

Approved Signatory : Ken Williams

Characteristic Tested	Result
Generated Sound Pressure Level	Pass
Frequency Generated	Pass
Total Distortion	Pass

	Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
Measured Output	94.0	1000.0	94.0	1000.30

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	±0.13dB	Temperature	±0.2°C
Frequency	±0.03%	Relative Humidity	±2.4%
Distortion	±0.3%	Barometric Pressure	±0.015kPa

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

* The tests <1000 kHz are not covered by Acoustic Research Labs Pty Ltd NATA accreditation.

This calibration certificate is to be read in conjunction with the calibration test report.

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Sound Calibrator
IEC 60942-2017

Calibration Certificate

Calibration Number C20124

Client Details MMG - Rosebery (Wivenhoe)
C/o De Bruyns Transport Depot
8 River Rd. Wivenhoe TAS 7320

Equipment Tested/ Model Number : Pulsar Model 105
Instrument Serial Number : 63709

Atmospheric Conditions
Ambient Temperature : 22.9°C
Relative Humidity : 52%
Barometric Pressure : 100.6kPa

Calibration Technician : Lucky Jaiswal
Calibration Date : 21/02/2020
Secondary Check: Max Moore
Report Issue Date : 21 Feb 2020

Approved Signatory : Juan Aguero

Characteristic Tested	Result
Generated Sound Pressure Level	*Pass*
Frequency Generated	*Pass*
Total Distortion	*Pass*

Nominal Level	Nominal Frequency	Measured Level	Measured Frequency
94	1000	94.15	1000.40

The sound calibrator has been shown to conform to the class 1 requirements for periodic testing, described in Annex B of IEC 60942:2017 for the sound pressure level(s) and frequency(ies) stated, for the environmental conditions under which the tests were performed.

Least Uncertainties of Measurement -

Specific Tests		Environmental Conditions	
Generated SPL	*±0.14dB*	*Temperature*	*±0.2°C*
Frequency	*±0.09%*	*Relative Humidity*	*±2.4%*
Distortion	*±0.09%*	*Barometric Pressure*	*±0.015kPa*

All uncertainties are derived at the 95% confidence level with a coverage factor of 2.

* The tests <1000 Hz are not covered by Acoustic Research Labs Pty Ltd NATA accreditation.

This calibration certificate is to be read in conjunction with the calibration test report.

Acoustic Research Labs Pty Ltd is NATA Accredited Laboratory Number 14172.
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APPENDIX E: LAKE PIEMAN – BOBADIL DISCHARGE ZONE BIOMONITORING REPORT (FBM, 2020)

Lake Pieman - Bobadil discharge zone

Biomonitoring Report 2020

Report to:

MMG Pty Ltd, Rosebery Mine

Stephen Mallick

November 2020

fbm

Freshwater Biomonitoring Consulting Service

ABN 60875932248

18 Stoney Steps, South Hobart,
Tasmania, Australia 7004
Phone: 0429 343 097
Email:mallick.fbm@gmail.com

Summary

- This report details the 2020 results of the annual survey of shore biota in Lake Pieman. Sampling was conducted at 18 sites along the eastern shore zone of the lake on 23 October 2020.
- Chlorophyll-a levels were consistently low in Lake Pieman on the day of sampling. The likely cause of the relatively low levels of algae in 2020 was a 1 m drop in lake levels in the four days immediately prior to sampling.
- In the context of these consistently low levels, algae levels in Lake Pieman showed no apparent response to the inflow of the Bobadil discharge.
- The macroinvertebrate fauna collected from the lake shoreline in spring 2020 was also characterized by relatively low diversity and abundance.
- As was the case for algae, the faunal data for spring 2020 showed no spatial pattern that can be attributed to a localised toxicological impact in the vicinity of the Bobadil discharge.
- Possible alternatives for sampling biota in lake Pieman are discussed and compared, and a recommendation is made for continued shoreline sampling of macroinvertebrates and algae, with consideration also given to shifting sampling period to mid-summer to increase the chance of sampling coinciding with a period of relatively stable lake level.

1. Introduction and Background

This report details the 2020 results of the routine annual survey of shore biota in Lake Pieman, based on sampling conducted in spring (October) 2020. This biological monitoring program assesses the ecological status of the area in Lake Pieman influenced by the discharge from the MMG Rosebery mine Bobadil Polishing Pond facility. Sampling is conducted annually as per condition E3 of EPN 7153/3, to "document on-going environmental conditions in the Lake, increase understanding of temporal, spacial and seasonal biological changes, and progress the development of site specific toxicity guidelines for sulphate and zinc in Lake Pieman".

Previous surveys at this location, including those for the previous operators (Zinifex, Ozminerals), have been reported for spring and/or autumn every year from 2004/05 to 2019. The current operator (MMG) is required to report on a single annual survey of lake-shore biota in upper Lake Pieman.

Sampling is conducted at 15 locations along the eastern side of the upper Lake Pieman reach, upstream and downstream of the Bobadil discharge point.

1.1 Context to biological monitoring in Lake Pieman

The Bobadil discharge enters the upper arm of Lake Pieman on its eastern shore, approximately five kilometres downstream of Hydro Tasmania's Bastyan dam on Lake Rosebery. This arm of the lake is frequently highly 'fluvial' (river-like) and experiences large and fluctuating flow rates throughout the year. It also experiences substantial fluctuations in level which are mainly dictated by seasonal variation in inputs to the lake from its catchment and variations in power station throughput at Reece Dam.

The mixing behaviour of the Bobadil discharge is locally complex, with periods of rapid downstream dispersion and dilution during releases from the Bastyan power station, and/or spill from Lake Rosebery, periods of relative stagnation in which a measure of local pooling and multidirectional dispersion occurs within the receiving lake reach, especially in near surface waters. This means that localized biological effects of these discharges may be evident both 'upstream' and 'downstream' of the point of discharge in the lake, though with impacts likely to occur in a predominantly downstream direction.

This variation in dispersion behaviour has a significant influence on the nature and variability of in-lake biological exposure to discharge components. Biological monitoring of the lake in relation to the localised effects of specific discharges is also made difficult due to this variability as well as the inherent dynamics of the Lake's fauna and flora.

Benthic algae and fauna associated with lake edges and near-surface snags can be readily sampled from a boat (Davies et al. 2005) and have been routinely monitored for this program since 2005.

1.1.1 Bobadil discharge

Prior to 2016, the Bobadil dam received wastewater from the Rosebery sewage system (Davies et al. 2005). This contribution of nutrients from town sewage into the Bobadil discharge represented a significant nutrient resource with the potential to locally enhance benthic algal production and lead to shifts in macroinvertebrate fauna.

Analysis of data in the pilot study in autumn 2005 led to the conclusion that the shore fauna and algal density in the vicinity of the Bobadil discharge was a balance between eutrophication effects of raised nutrient levels (increased algae), and potential toxicity of the discharge from mine contaminants leading to reduced diversity of macroinvertebrates (Davies et al. 2005). This toxicological impact of the Bobadil discharge on macroinvertebrate diversity and abundance, while observable, did not appear to be severe (Davies et al. 2005).

With the commissioning of the Rosebery WWTP in 2016, sewage wastewater has been diverted away from the Bobadil dam to the Taswater WWTP situated on the lower Stitt River.

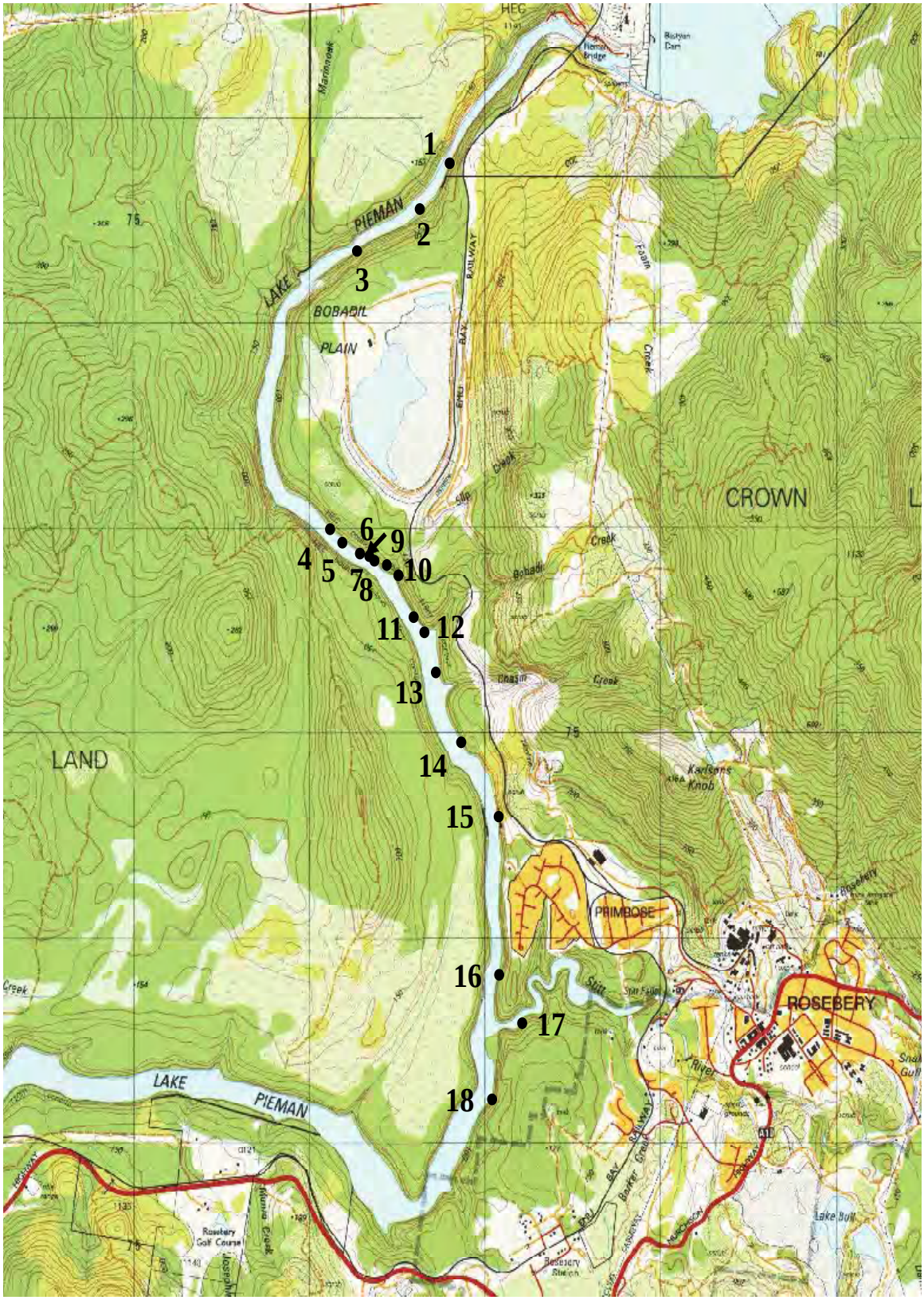


Figure 1. Location of sampling sites in Lake Pieman.

Black arrow indicates location of discharges for MMG at Bobadil. Sites 1-15 are MMG monitoring sites; sites 16-18 are the TasWater sites. 1:25000 map scale, grid squares = 1 km^2.

Table 1. Sampling site locations in Lake Pieman. See Figure 1 for map. Sites 1 to 15 = MMG sites; sites 16 – 18 = new TasWater sites. Grey = location of Bobadil discharge to Lake Pieman.

Site	Easting (GDA 1994)	Northing (GDA 1994)
1	376914	5377951
2	376744	5377727
3	375237	5377539
4	376229	5376187
5	376299	5376097
6	376396	5376081
7	376457	5376035
8	376491	5376003
9	376535	5375973
10	376593	5375947
11	376710	5375746
12	376765	5375672
13	376862	5375437
14	377004	5375113
15	377197	5374778
16	377183	5374033
17	377324	5373793
18	377142	5373406

1.1.2 Algae

Benthic algal growth in Lake Pieman is limited to well lit, shallow shore zones, since light attenuation by high levels of natural dissolved organic compounds is strong. Bowling et al. (1986) reported attenuation to the point that euphotic depths (depths to which photosynthetically active radiation, or PAR, could penetrate and stimulate algal growth) in humic western Tasmanian lakes were only of the order of 0.5 to 2 m depth.

The shoreline of Lake Pieman is complex and highly variable in substrate stability and composition, making it unsuitable for systematic benthic algal sampling. However, surfaces of tree snags located away from the immediate shading effect of overhanging forest do provide a suitable habitat for algal sampling. Such sampling can provide information on the relative magnitude of algal biomass in the vicinity of the Bobadil discharge (Davies et al. 2005).

Surface filamentous algal growth can act as a surrogate indicator for the influence of the Bobadil discharge on the assumption that:

- potential toxic effects of the discharge influence algae growth in the vicinity of the discharge point;

- algal growth near the surface represents at least an intermediate term (ie. days to weeks) response to average nutrient concentrations;
- other habitat conditions (flow rates, water colour etc) are reasonably consistent between the sampled sites;
- Lake levels have been reasonably stable, or declining slowly, prior to sampling: note that rapid changes in lake level prior to sampling may confound any toxic effects of the discharge on algae growth; and
- individual samples consist of sufficient sample units collected from each surface to account for small scale variability in algal biomass.

1.1.3 Benthic macroinvertebrates

Macroinvertebrates can also be sampled from surfaces along the shore-zone or from snags. Their assemblage composition, diversity and abundance may reflect the effect of the Bobadil discharge depending on the toxicity of the discharge material.

Changes in benthic macroinvertebrates are an indicator of the extent of the Bobadil discharge on the assumption that:

- benthic macroinvertebrate abundance and/or diversity growth near the surface/shore represents at least an intermediate term (ca. days to weeks) response to average water quality concentrations;
- toxic effects of the discharge influence benthic macroinvertebrates survival and/or growth;
- other habitat conditions are reasonably consistent between the sampled sites, and that there is no strong local gradient in assemblage composition with distance from the Bastyan dam;
- Lake levels have been reasonably stable, or declining slowly, prior to sampling; note that rapid changes in lake level prior to sampling may confound any toxic effects of the discharge on macroinvertebrate abundance and/or diversity; and
- individual samples are collected from sufficient shore area at each location to account for small scale variability in macroinvertebrate distribution.

2. Methods

2.1 Sites

Sampling was conducted at the 15 MMG and 3 Taswater sites along the eastern shore zone (Figure 1, Table 1) on 23 October 2020. Sites 1-3 are

located well upstream of the discharge point and which are in the vicinity of the reference sites used for water quality conditions. Four sites are located in the reach immediately upstream of the discharge point (sites 4 – 7), and five are located along the reach downstream of the discharge point as far as Bobadil Creek. Three sites (sites 13 – 15) are located between Bobadil Creek and Rosebery township, with site 15 considered to be the most downstream location that could be sampled without the potential for a sustained upstream influence of the water quality from the Stitt River.

Sites 16, 17 and 18 are Taswater sites located immediately upstream of the Stitt River mouth, within Stitt River Bay, and approximately 100 m downstream of the Stitt River.

2.2 Sampling methods

Sampling was conducted as follows:

1. Snag algae. A fixed-area benthic pad scourer (Davies and Gee 1993) was used to sample benthic algae on snag surfaces, with five sample units taken per location within 30 – 50 cm of the water surface. Individual sample units were analysed for total chlorophyll-*a* (by a modified acetone extraction-spectrophotometric method - APHA 1993).

2. Shore-dwelling benthic invertebrates. Sampling was conducted by kick and sweep net sampling with a standard kick net (250 micron mesh) along a 5 m section of shoreline, with one sample collected per site. The resulting material was preserved in formalin.

All macroinvertebrate sample material was floated in a saturated calcium chloride solution, with hand-sorting of the residue. The floated material was then sub-sampled to 20% using the Marchant box-sub-sampler (Marchant 1989). The sub-sample was hand-sorted under magnification. All fauna were counted and identified to family level, with the exception of Nematodes, Oligochaetes, Copepoda, Turbellaria, and Acarina which were not resolved to lower taxonomic levels.

The macroinvertebrate data were analysed as patterns in diversity (number of taxa), abundance and community composition. Macroinvertebrate variables and mean chlorophyll-a values were examined graphically.

3. Results

3.1 Conductivity

Overall, conductivity levels in Lake Pieman (excluding the site immediately downstream of the Bobadil discharge: site 7) in 2020 fell within the range 32 – 54 microS/cm (Figure 2), similar to results in previous years. There was a clear spike in conductivity immediately downstream of the Bobadil outfall (site 7: conductivity 97.7 microS/cm (Figure 2).

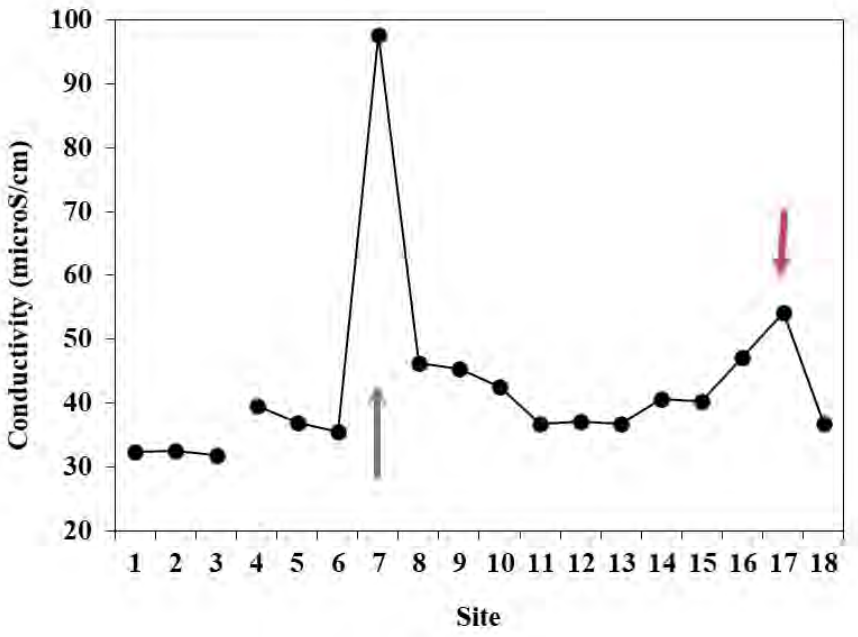


Figure 2. Conductivity in Lake Pieman in Spring 2020. Blue arrow indicates location of Bobadil discharge. Red arrow indicates entrance of Stitt River.

3.1 Algae

Mean chlorophyll-a values for each site are plotted by site in Figure 3 for 2020, and data for all years all are shown in Table 2.

Chlorophyll-a values in 2020 were consistently low in Lake Pieman (overall mean of 1.87 mg/m^2 chlorophyll-a per site; Table 2), with substantial variation substantially between sites (ranging from 0 – 10.6 mg/m^2 chlorophyll-a per site; Figure 3). The mean chlorophyll-a value in 2020 was similar to 2019 levels of chlorophyll-a and represent the lowest levels recorded over the sampling period (Table 2). Overall, there was no apparent pattern in chlorophyll-a levels that could be related to impacts of the Bobadil outfall (Figure 3).

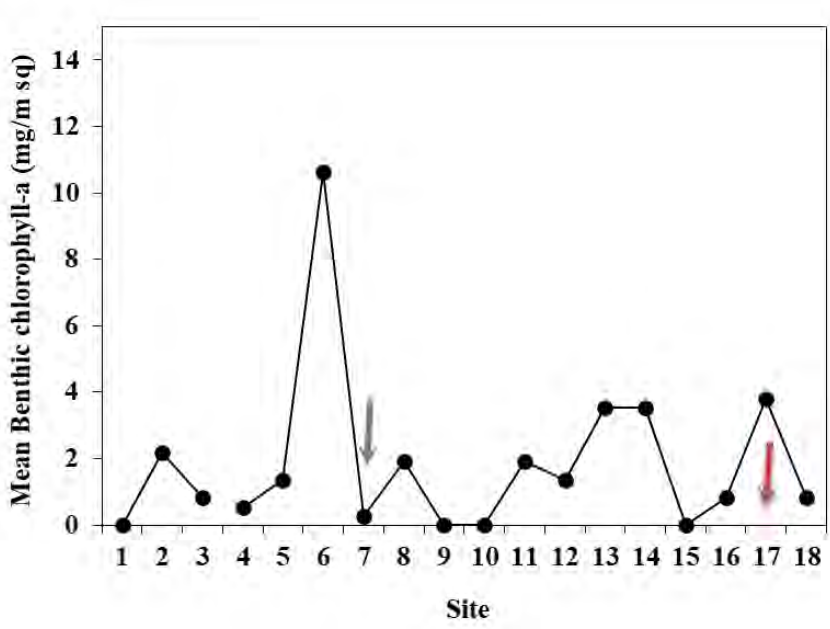


Figure 3. Distribution of mean (n=5) chlorophyll-a on spring snag surfaces in Lake Pieman in Spring 2020, as means of 5 measurements, for each shore site. Blue arrow indicates location of Bobadil discharge. Red arrow indicates entrance of Stitt River.

The upstream reference sites 1 to 3 had an overall mean±SD of 1.00±1.10 mg chlorophyll-a/m^2. The sites immediately upstream of the Bobadil discharge (sites 4-6) had a higher overall mean of 4.17±5.19 mg chlorophyll-a/m^2, with the higher mean value due to raised chlorophyll-a at site 6 (Table 2). The sites subject to mixing of the Bobadil discharge (sites 7-13) had an overall mean of 0.54±1.30 mg chlorophyll-a/m^2. The sites downstream of the Bobadil mixing zone (sites 14-15) had an overall mean of 1.77±2.50 mg chlorophyll-a/m^2.

A two-way t-test indicated no statistically significant difference in mean chlorophyll-a levels downstream of the Bobadil discharge (sites 14 and 15) from the upstream reference sites (sites 1-3) or the mixing zone (sites 7-13) (all $p > 0.2$).

3.2 Macroinvertebrates

Samples of macroinvertebrates collected from the Lake shoreline were characterized by relatively low diversity and abundance (Table 3). The total diversity of benthic aquatic taxa over all sites was 16 taxa in 2020, which was similar to that recorded in 2019 (19 taxa: Mallick 2019), and substantially higher than the diversity recorded in 2018 (7 taxa) which was the lowest recorded in all sampling years.

Spatial patterns in macroinvertebrate diversity (number of taxa) and total abundance are shown in Figure 4a and b. Diversity and abundance were generally low across all sites (< 10 taxa and < 100 animals for all sites), with substantial variation between sites. The most common taxon was oligochaetes (Figure 4c) which was the principal driver of the pattern in abundance. Within the context of a generally low diversity, there was a no obvious pattern in variation in diversity of macroinvertebrates associated with the Bobadil outfall (Figure 4a). Similarly, there was no obvious pattern in variation in total abundance associated with the Bobadil outfall (Figure 4b).

There was a pronounced increase in total abundance (due to increased numbers of oligochaete worms) in Stitt bay and downstream of the Stitt River (Figure 4a and b), which may reflect a eutrophication effect from the Taswater wastewater treatment plant which discharges in to the Stitt River. However comparable numbers of oligochaetes were also recorded at several other sites above the entrance of the Stitt River (Figure 4c). Therefore, the increase in oligochaetes downstream of the Stitt River may reflect other site-specific conditions unrelated to input from the wastewater treatment plant.

Table 2. Mean chlorophyll-a values (as mg/m^2) for snag surfaces in Lake Pieman (mean of 5 measurements) in spring 2020 and all previous years. Light shading indicates site immediately downstream to Bobadil discharge. Years with * are spring sampling, all other years are autumn sampling.

Location	2020*	2019*	2018*	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005
1	0.00	3.54	2.99	33.48	2.99	17.80	8.87	6.32	6.42	6.70	1.14	1.52	0.65	3.81	1.80	2.45
2	2.18	4.36	1.63	36.20	2.18	21.01	10.34	7.84	2.99	3.97	0.49	2.89	10.34	1.09	7.51	2.77
3	0.82	2.99	1.91	16.33	3.54	18.46	16.55	5.93	5.17	5.61	1.53	1.63	5.50	1.69	5.01	0.76
4	0.54	1.63	3.54	3.81	1.09	6.32	6.42	2.29	10.73	9.96	1.74	2.67	0.76	2.50	5.33	1.20
5	1.36	1.36	1.91	2.45	4.36	14.92	5.12	5.93	9.53	12.68	2.50	7.57	0.76	4.19	10.07	2.67
6	10.62	1.09	2.18	2.45	1.09	6.15	3.65	5.93	16.50	3.48	3.75	2.18	1.63	5.06	6.42	0.82
7	0.27	3.54	13.61	3.54	1.36	2.99	0.98	8.06	24.17	9.64	6.75	3.70	1.85	9.04	7.08	3.05
8	1.91	3.81	0.82	3.27	2.18	5.12	2.01	2.99	9.09	2.39	11.49	5.23	1.79	4.74	4.96	4.19
9	0.00	0.82	0.00	2.99	2.18	7.84	3.43	1.20	32.23	18.02	5.88	19.71	3.92	4.25	3.38	18.95
10	0.00	0.00	0.54	2.99	2.99	9.04	1.36	0.98	19.16	6.75	2.45	7.29	20.96	5.01	1.91	11.54
11	1.91	1.09	2.99	2.45	8.17	3.48	1.58	2.07	16.77	7.18	7.78	2.88	1.96	3.43	6.64	1.47
12	1.36	2.99	2.18	2.99	7.08	21.61	3.21	4.46	21.29	4.74	2.89	5.06	4.95	4.79	2.67	1.74
13	3.54	0.27	4.90	2.72	1.91	19.87	7.62	2.34	17.20	10.45	2.89	4.46	16.11	3.97	3.76	8.87
14	3.54	0.82	0.82	20.42	5.99	13.66	5.01	7.02	17.31	6.42	2.62	6.75	8.82	4.36	5.94	5.88
15	0.00	1.09	1.09	6.26	1.91	6.59	0.38	1.63	17.96	0.82	1.25	0.82	2.72	1.74	0.76	0.60
Mean	1.87	1.96	2.74	9.49	3.27	11.66	5.10	4.33	15.10	7.25	3.68	4.96	5.52	3.98	4.88	4.46

Table 3. Macroinvertebrate data from eastern shore zone sampling sites in upper Lake Pieman in spring 2020.
Abundances are n per 20% of 5 m kick sample (approx. n per 0.6 m^2 shoreline habitat).

23-Oct-20		Site:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Class	**Order**	**Family**	**Bobadil outfall**															**u/s Stitt R**	**Stitt Bay**	**d/s Stitt R**
Platyhelminthes	Turbellaria										1								1	1
Nematoda				1									3		17		1			
Mollusca	Bivalvia	Sphaeriidae									1			1						
Annelida	Oligochaeta		42	69	1	3	5			2	4		13	4		1	2	2	81	36
	Hemiptera	Veliidae				1						1					2			2
		Corixidae									9	4		1	10		2			2
	Lepidoptera	Pyralidae						1												
	Collembola													1					1	2
	Diptera	Chironomidae:																		
		subfam; Chironominae	1						1						2				1	
		subfam: Orthocladiinae				2			3				3		8					
		Culicidae																	1	
		Dolichopodidae									1									
		Dip. Unid. Pup.							1						2					
	Trichoptera	Leptoceridae						1												
	Coleoptera	DytiscidaeA											1	1						
	Coleoptera	ElmidaeL																	1	
		Total Abundance	**43**	**70**	**1**	**6**	**5**	**2**	**5**	**2**	**16**	**5**	**20**	**8**	**39**	**1**	**7**	**2**	**86**	**43**
		N Taxa	**2**	**2**	**1**	**3**	**1**	**2**	**3**	**1**	**5**	**2**	**4**	**5**	**5**	**1**	**4**	**1**	**6**	**5**

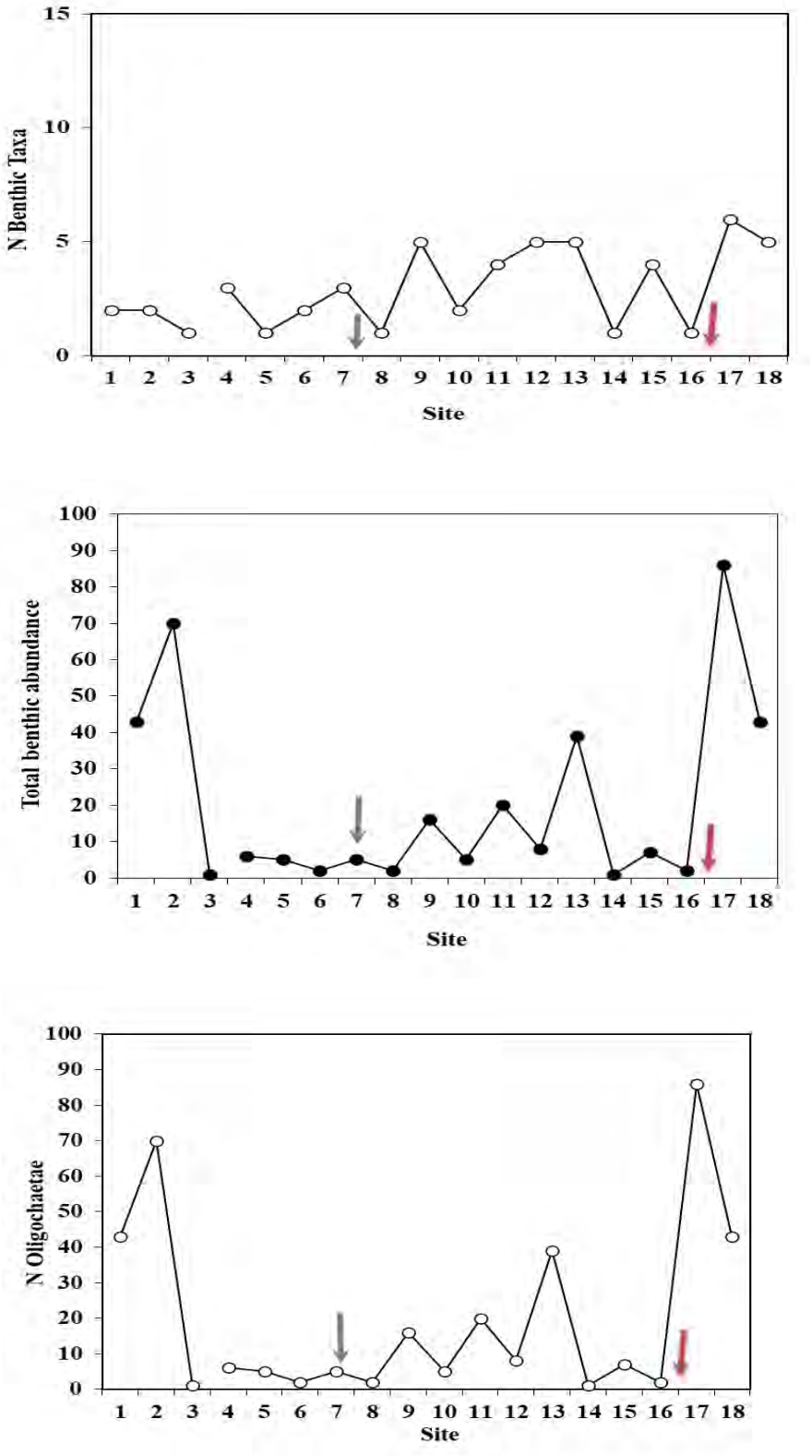


Figure 4. (a) Total number of taxa, (b) total abundance of benthic macroinvertebrates, and (c) total abundance of oligochaetes per sample in spring 2020. Blue arrow indicates location of Bobadil discharge, red arrow indicates entry point of Stitt River.

4. Discussion

4.1 Lake levels on and prior to sampling

Lake Pieman is actively managed for hydroelectric power generation via Hydro Tasmania's Bastyan Dam and Reece Dam. As a result, Lake levels are typically in continual flux (see Figure 5) dictated by seasonal variation in inputs to the lake from its catchment and variations in power station throughput.

Lake levels were approximately 1.7 m below spill level around the period of sampling, with The Hydro Tasmania records for Lake Pieman showing a steady drop in level of approximately 1 m between 19-22 October (Figure 5).

4.2 Algae

Chlorophyll-a levels were very low in Lake Pieman in the spring 2020 sampling, with a similarly low mean mg Chlorophyll-a per site to that recorded in 2019. The most likely cause of low levels in 2020 was the impact of the 1 m drop in Lake levels in the days prior to sampling. Benthic algal growth in Lake Pieman is limited to well lit, shallow shore zones (generally to around 0.5 - 2 m depth). As a result, the drop of 1 m in Lake levels prior to sampling is likely to have resulted in the exposure of previously more deeply inundated Lake-edge habitat with more attenuated algae growth.

Within the context of these low chlorophyll-a levels, the near-surface shoreline and snag fauna of Lake Pieman showed no apparent benthic algal response to the inflow of the Bobadil discharge.

4.3 Macroinvertebrates

The macroinvertebrate fauna collected from the Lake Pieman shoreline in spring 2020 was also characterized by generally low diversity and abundance. As was the case for algae, this low diversity and abundance of macroinvertebrates is likely to reflect the impact of constant variation in Lake levels (specifically a 1 m drop in Lake level in the days prior to sampling).

Within the context of this low diversity and abundance of macroinvertebrates, the near-surface shoreline and snag fauna of Lake Pieman showed no apparent benthic algal response to the inflow of the Bobadil discharge.

5. Comparing sampling approaches for Lake Pieman

Lake Pieman experiences substantial fluctuations in level which are mainly dictated by seasonal variation in inputs to the lake from its catchment and variations in power station throughput at Reece Dam.

Recent reports (Mallick 2018, 2019, and the present 2020 report) from biological sampling of Lake Pieman have highlighted the confounding effects of these Lake level changes on sampling of 'shoreline' habitat, where 'shoreline habitat' signifies the accessible and light-filtered (approximate depth of 1 m) edge of the Lake.

In terms of biological sampling of shoreline biota, such short-term and substantial (> 0.5 m) changes in lake level frequently result in sampling of 'shoreline' habitat which has recently (within several days) been inundated by water (level rise) or the sampling of a shoreline habitat which until recently was at a depth of greater than 1 m (level drop).

This section considers possible alternative approaches/scheduling for Lake sampling to reduce these confounding effects of changes in lake level.

5.1 Sampling of benthic (lake bottom) fauna

Lake benthic (bottom-dwelling) fauna in Lake Pieman are not likely to be impacted by even wide variations in Lake level. However, the Lake benthic fauna of Lake Pieman cannot be readily sampled, due to the combination of Lake depth and unsuitable substrates for remote (boat operated) samplers, as well as the lack of direct contact between the lake bottom and the discharge plume in the vicinity of the discharge point.

5.2 Sampling of planktonic fauna

A possible alternative to sampling of benthic fauna is to sample the Lake's planktonic fauna. The planktonic fauna (consisting primarily of microcrustaceans) occurs in the lake water column proper and is therefore not linked directly to the height/location of the Lake shoreline.

However, while Lake Pieman has an abundant planktonic fauna dominated by copepods, the planktonic fauna is characterised by substantial spatial and temporal variability (Davies 2005). This spatial and temporal variability, combined with the variable input of plankton from Lake Rosebery, prevents interpretation of such data in relation to the immediate influence of the discharge in the vicinity of the mixing zone (Davies 2005; Davies et al. 2005).

5.3 Sampling shoreline biota and seasonal considerations

Benthic algae and fauna associated with the Lake edges and near-surface snags can be readily sampled from a boat (Davies et al. 2005). Shoreline sampling was slected as the best available method of Lake monitoring at the inception of the Lake Pieman monitoring program in 2005 (Davies et al. 2005). The spring (September to November) and autumn (March to May) periods were selected for the Lake Pieman monitoring work to coincide with the biological sampling of the Stitt River using AUSRIVAS sampling protocols which require sampling in these two periods.

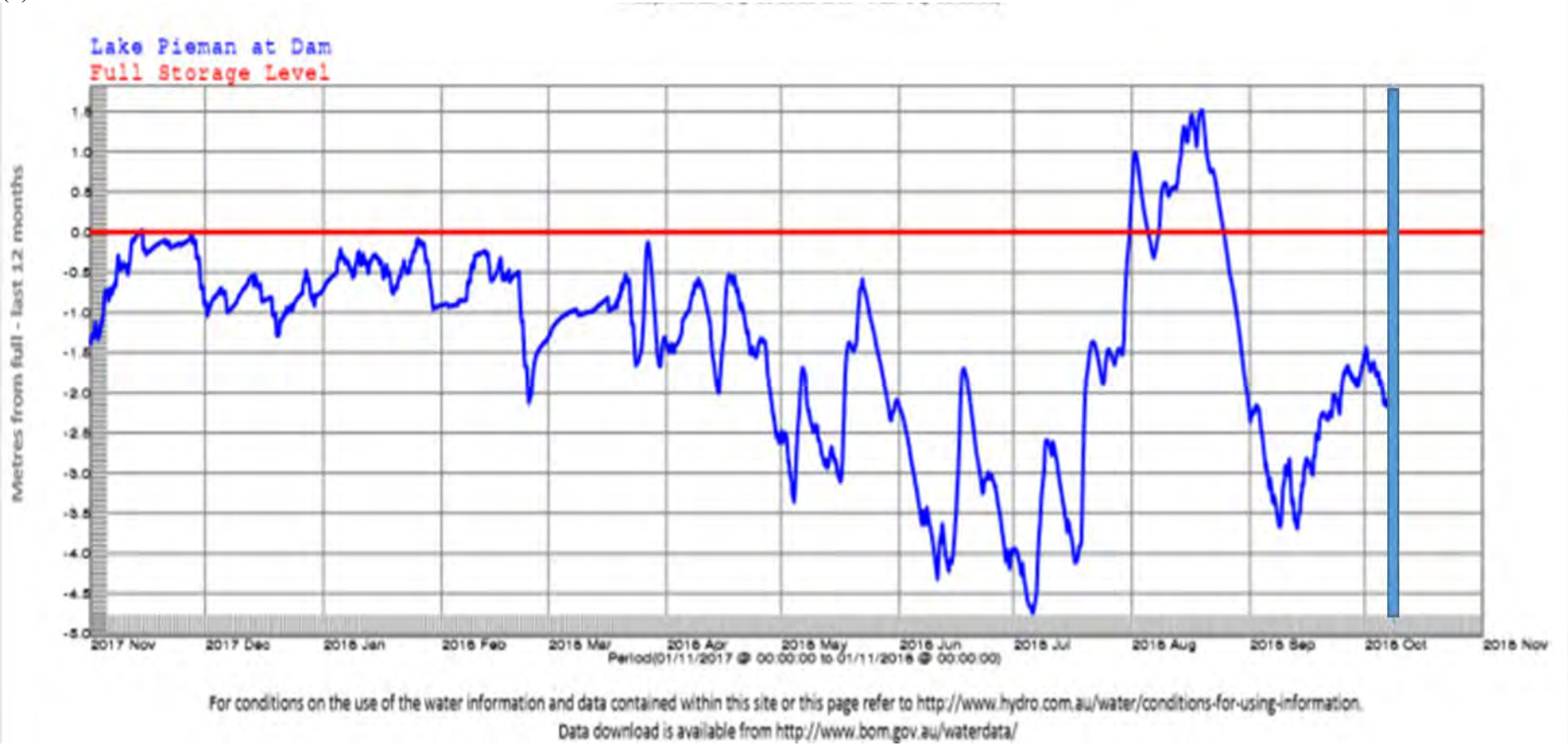
Plots of the level of Lake Pieman in the past three years (2018, 2019 and 2020) and the date of sampling in each year are given in Figure 5. Based on the pattern of Lake level changes in these years, there appears to be a consistent tendency for more stable Lake levels in January/February relative to other periods in the year (Figure 5), possibly associated with reduced water releases by Hydro Tasmania during the dry period of the year.

6. Recommendations for sampling

Given the above considerations, the following recommendations are made:

- Continue with the current sampling of benthic algae and fauna associated with the Lake edges and near-surface snags;
- Consider changing the timing of annual sampling to mid-late summer (January/February);
- If logistically feasible, monitor Lake levels from early January onwards in each year, and instigate sampling where levels appear to be in a phase of relative stability.

(a) 2018


Lake Pieman at Dam
Full Storage Level
Metres from full - last 12 months
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
2017 Nov
2017 Dec
2018 Jan
2018 Feb
2018 Mar
2018 Apr
2018 May
2018 Jun
2018 Jul
2018 Aug
2018 Sep
2018 Oct
2018 Nov
Period(01/11/2017 @ 00:00:00 to 01/11/2018 @ 00:00:00)
For conditions on the use of the water information and data contained within this site or this page refer to http://www.hydro.com.au/water/conditions-for-using-information.
Data download is available from http://www.bom.gov.au/waterdata/

(b) 2019


Lake Pieman at Dam
Full Storage Level
Metres from full - last 12 months
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
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2018 Dec
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(c) 2020

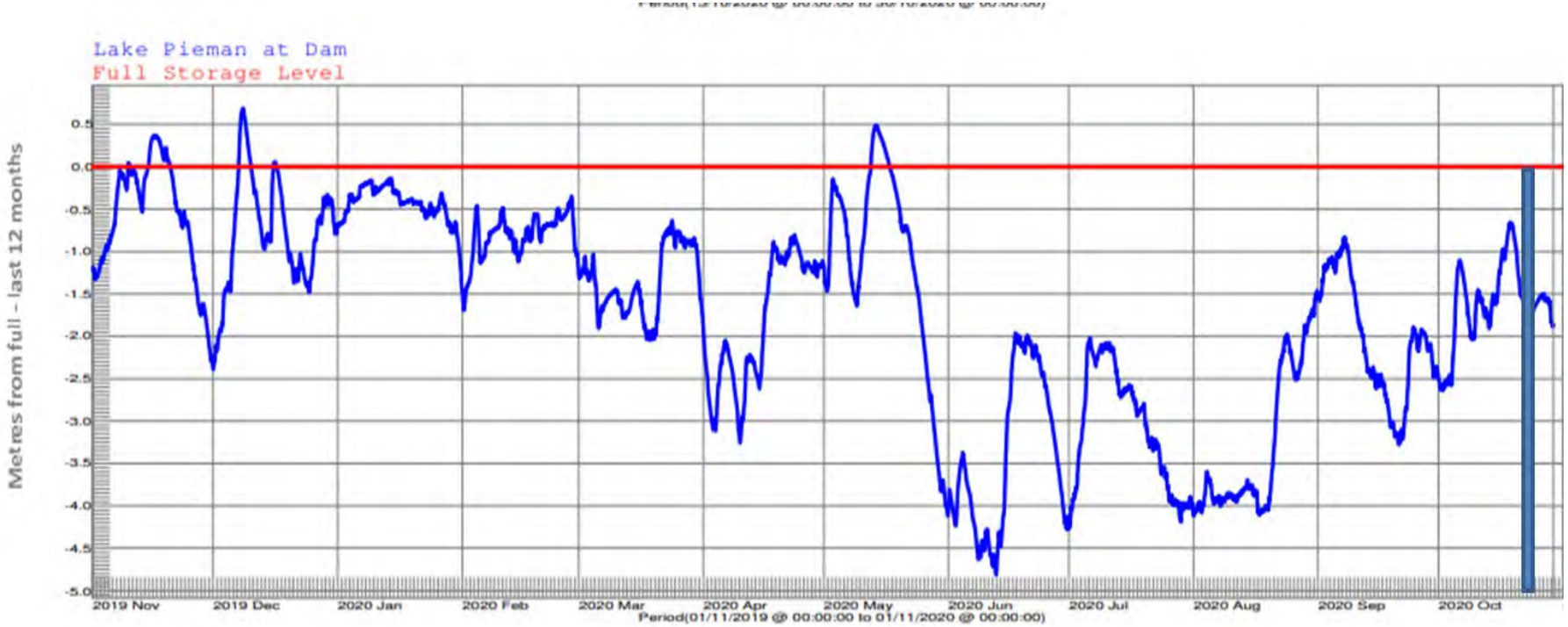

Figure 5. Lake Pieman levels in (a) 2018, (b) 2019, and (c) 2020. Sampling dates are shown by shaded bar. Source: Hydro Water: https://www.hydro.com.au/water/lake-levels.

5. References

APHA 1993. Standard Methods for Water and Wastewater Analysis. APHA-AWWA, Vol. 19., Princetown USA.

Bowling LC, Steane MS and Tyler PA 1986. The spectral distribution and attenuation of underwater irradiance in Tasmanian inland waters. Freshwat. Biol. 16:313-335.

Davies PE, 2005. Lake Pieman Biological Investigations: Issues of Biological Monitoring for the Mixing Zone and Lake. Discussion document for Zinifex. 3 pp.

Davies PE, Cook LSJ and Sloane T 2005. Definition of Bobadil discharge mixing zone in Lake Pieman by in-lake biological sampling. Report to Zinifex Pty Ltd, Rosebery Mine. March 2005. 22 pp.

Davies PE, Cook LSJ and Sloane T 2006a. Lake Pieman - Bobadil discharge zone Biomonitoring Report Autumn 2006. Report to Zinifex Pty Ltd, Rosebery Mine. September 2006. 18 pp.

Davies PE, Cook LSJ and Sloane T 2006b. Lake Pieman - Bobadil discharge zone Biomonitoring Report Spring 2006. Report to Zinifex Pty Ltd, Rosebery Mine. 18 pp.

Davies PE, Cook LSJ and Sloane T 2007. Lake Pieman - Bobadil discharge zone Biomonitoring Report Autumn 2007. Report to Zinifex Pty Ltd, Rosebery Mine. July 2007. 19 pp.

Davies PE, Cook LSJ and Sloane T 2008. Lake Pieman - Bobadil discharge zone Biomonitoring Report Autumn 2007/08. Report to OzMinerals Pty Ltd, Rosebery Mine. September 2008. 23 pp.

Davies PE, Cook LSJ and Sloane T 2009. Lake Pieman - Bobadil discharge zone Biomonitoring Report 2008/09. Report to OzMinerals Pty Ltd, Rosebery Mine. August 2009. 22 pp.

Davies PE, Cook LSJ and Sloane T 2010. Lake Pieman - Bobadil discharge zone Biomonitoring Report 2009/10. Report to MIM Pty Ltd, Rosebery Mine. August 2010. 22 pp.

Davies PE, Cook LSJ and Sloane T 2011. Lake Pieman - Bobadil discharge zone Biomonitoring Report 2010/11. Report to MIM Pty Ltd, Rosebery Mine. July 2011. 20 pp.

Davies PE and Cook LSJ 2012. Lake Pieman - Bobadil discharge zone Biomonitoring Report 2012. Report to MMG Pty Ltd, Rosebery Mine. July 2012. 22 pp.

Davies PE and Cook LSJ 2013. Lake Pieman - Bobadil discharge zone Biomonitoring Report 2013. Report to MMG Pty Ltd, Rosebery Mine. August 2013. 21 pp.

Davies PE and Cook LSJ 2014. Lake Pieman - Bobadil discharge zone Biomonitoring Report 2014. Report to MMG Pty Ltd, Rosebery Mine. July 2014. 20 pp.

Davies PE and Cook LSJ 2015. Lake Pieman - Bobadil discharge zone Biomonitoring Report 2015. Report to MMG Pty Ltd, Rosebery Mine. July 2015. 20 pp.

Davies PE and Mallick S 2016 Lake Pieman - Bobadil discharge zone Biomonitoring Report 2016. Report to MMG Pty Ltd, Rosebery Mine. September 2016. 20 pp.

Davies AL and Gee JHR 1993. A simple periphyton sampler for algal biomass estimates in streams. Freshwat. Biol. 30, 47-51.

Mallick, S. 2018. Lake Pieman - Bobadil discharge zone Biomonitoring Report 2018. Report to MMG Pty Ltd, Rosebery Mine. November 2018. 12 pp.

Mallick, S. 2019. Lake Pieman - Bobadil discharge zone Biomonitoring Report 2019. Report to MMG Pty Ltd, Rosebery Mine. November 2018. 9 pp.

Marchant R 1989. A subsampler for samples of benthic invertebrates. Aust. Soc. Limnol. Bull. 12, 49-52.

APPENDIX F: BIOLOGICAL CONDITION OF THE RING AND STITT RIVERS: SPRING 2020 AND AUTUMN 2021 (FBM, 2021)

Biological Condition of the Ring and Stitt Rivers: Spring 2020 and Autumn 2021

Report to MMG, Rosebery

SA Mallick

May 2021

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Summary

- The Ring and Stitt Rivers were surveyed for macroinvertebrates and fish in spring 2020 and autumn 2021.
- The Ring River remains in a degraded condition, particularly in the lower reaches.
- Diversity and abundance in the Ring River remain severely depressed downstream of Williamsford, with a general decline in the AUSRIVAS O/E scores (an index of macroinvertebrate health) and total macroinvertebrate abundance moving downstream.
- Both Bakers Creek and Dolcoath Creek remain in a highly degraded condition.
- The primary reason for the poor condition of river fauna communities in the Ring River continues to be pollution from the Hercules mine via Bakers Creek.
- Overall, the Stitt River is in a substantially better ecological condition than the Ring River.
- The results of the present survey confirm an ongoing improvement in the condition of the lower Stitt River, with all sites in the Stitt River including the lowest reaches now supporting a range of clean-water macroinvertebrate taxa.
- Furthermore, both adult and juvenile brown trout were recorded throughout the Stitt River in autumn 2021. These results indicate a healthy breeding population of brown trout is now present throughout the river.
- However, the numbers of brown trout captured was substantially lower in the two most downstream sites, suggesting that a degree of pollution-mediated depression of the fish population persists in the lower reaches of the Stitt River.
- Further surveys are required to confirm this ongoing improvement in the macroinvertebrate fauna and fish populations of the lower reaches of the Stitt River.

Introduction and Aims

This report describes the results of surveys conducted in 2020/21 in the Ring and Stitt Rivers, comprised of one spring 2020 and one autumn 2021 seasonal sampling event for macroinvertebrates and fish.

This report forms part of what is now a routine biomonitoring exercise for the Ring and Stitt catchments required under EPN 7153/3. Surveys under this program have been previously reported for autumn and spring annually from 2005/06 to 2019/20 (Davies et al. 2005a, b; 2006a, b; 2007 – 2017; Mallick 2018, 2019, 2020).

The primary aims of this monitoring are to:

- describe the status of macroinvertebrate and fish assemblages in the Ring and Stitt Rivers; and
- evaluate changes over time and relate these to environmental conditions (especially habitat and water quality) and management actions associated with MMG mine operations.

The current monitoring program follows the protocol used by Davies et al. (2004), with sampling of instream fauna at a number of sites in the Ring River and selected tributaries, in the Stitt River both upstream and downstream of pollution sources, and in a reference river, the Sterling River.

2. Methods

2.1 Field sampling

A survey was conducted of benthic macroinvertebrates and fish moss in the Stitt and Ring Rivers, at:

1. Four sites in the mid to lower Stitt River, located:
   - downstream of the outflow of the wetlands associated with 2 & 5 Dam (Bull Lagoon) (site S3);
   - adjacent to the Rosebery sports ground (S4); and
   - immediately upstream of Stitt Falls (S5).
   - downstream of the Stitt Falls (S6) - as part of a survey of WWTP wastewater effects requested by TasWater, the results of which are also reported here;
2. Five sites in the Ring River located:
   - at Williamsford (site R1)
   - upstream of the Bakers Creek junction (R2)
   - downstream of Bakers Creek (R3)
   - upstream of the Dolcoath Creek inflow (R5); and
   - at the Murchison Highway Bridge (R6).
3. Two sites in Ring River tributaries:
   - In Bakers Ck and Dolcoath Creeks upstream of their junction with the Ring (sites B1 and D1).
4. Four reference ('control') sites:
   - three in the Stitt River upstream of the Bull Lagoon outflow (sites S0, S1 and S2 – with S0 added since autumn 2012); and
   - one site on an adjacent river system unaffected by acid drainage (the Sterling River, site STR1).

Site details are provided in Table 1, and locations shown in Figures 1 to 3. Spring 2020 sampling was conducted on 29 September - 2 October (Stitt River sites) and 21-22 October (Ring River sites). Autumn 2021 sampling was conducted between 5-8 April 2021.

2.1.1 Environmental variables

A number of environmental variables were also measured at each site for use in bioassessment and analysis of relationships with the biota. These include % area of the study reach as riffle, run, pool and snag mesohabitats and of stream substrates (boulder, cobble, gravel, sand, silt and bedrock), as well as % cover of silts, moss, algae, and

organic detritus, conductivity, temperature, channel gradient and dimensions, and ratings for bank erosion, and riparian, aquatic and trailing vegetation density.

Table 1. Details of stream study sites sampled for macroinvertebrates in the catchments of the Ring, Stitt and Sterling Rivers. * Site R4 no longer sampled due to poor access track conditions. 'Distance from source' is stream length measured on 1:25,000 map from the head of the stream drainage.

River or Creek	Site Code	Description	Easting (AGD)	Northing (AGD)	Distance from source (km)	Catchment area (km^2)	Altitude (m)
Ring River	R1	Williamsford Rd	376387	5368471	3	2.6	400
	R2	u/s Baker Ck	375587	5367946	4.25	5.5	340
	R3	d/s Baker Ck	375512	5367858	4.5	7.6	330
	*R4	at ford	372475	5369433	9.75	27.7	185
	R5	u/s Dolcoath Ck	371423	5371009	12.5	31	126
	R6	Murchison Hway	371312	5371495	12.9	34.9	120
Baker Ck	B1	u/s Ring R junction	375612	5367821	1.13	1.85	335
Dolcoath Ck	D1	u/s Ring R junction	371337	5371083	2.38	3.4	125
Sterling River	STR1	Murchison Hway	384453	5374898	5.5	16.6	170
Stitt River	S0	at top bridge	379451	5371735	5.2	19.8	190
	S1	u/s Mountain Ck	379687	5372833	6.8	33	145
	S2	u/s tailings	379387	5373173	7.3	35.9	140
	S3	d/s tailings	379072	5373181	7.6	36.5	137
	S4	Sports Gd footbridge	378287	5373533	8.6	36.7	128
	S5	road bridge	378187	5373871	9	37	120
	S6	d/s Stitt Falls	378012	5373883	9.2	39.9	101

2.1.2 Macroinvertebrates

At each site, two types of sampling for benthic macroinvertebrate were conducted – quantitative (surber) sampling, and semi-quantitative AUSRIVAS sampling. These methods give different types of information. Surber sampling provides a strictly quantitative assessment of abundance. AUSRIVAS sampling provides indices of difference in community composition from an 'expected' fauna under undisturbed 'reference' conditions.

The two sampling methods were conducted as follows:

Quantitative sampling: benthic macroinvertebrates were quantitatively sampled in riffle habitats, by taking 10 'surber' samples of the benthos, by hand disturbance of the stream bed to a maximum depth of 10 cm into the substrate within a 30 x 30 cm quadrat immediately upstream of a 500-micron mesh net surber sampler. The 10 sample units were pooled at each site to provide a single composite sample, which was preserved in neutral buffered formalin (10%) prior to processing in the laboratory. Samples were subsequently elutriated with saturated calcium chloride solution, and the floated material

(eluant) was separated. The remaining residue and the eluant were both hand sorted. All animals preserved were counted under magnification without identification.

AUSRIVAS sampling: rapid assessment protocol (RAP) sampling of benthic macroinvertebrates was conducted using the standard Tasmanian AUSRIVAS sampling protocol, in riffle habitat (fast flowing, typically cobble-bed, shallows). Sampling was conducted by foot-disturbance the stream substrate immediately upstream of a 250 micron mesh kick net, over a total length of 10 m of riffle. Samples were live-picked on site using the standard Tasmanian AUSRIVAS protocol, with picking for 30 min, maximizing the diversity in the picked sample of animals present in the kick net sample, while also preserving the relative abundance of the dominant taxa.

All quantitative and AUSRIVAS macroinvertebrate samples were identified and counted at the family level without identification.

2.1.3 Fish

Quantitative electrofishing was conducted in the Sterling (STR1) Stitt Rivers (S1-S5) in both spring 2020 and autumn 2021 to establish the abundances and fish species present. Electrofishing at S0 was ceased in Autumn 2020 due to the high energy nature of the site making fish results heavily dependent on flows. Sites were surveyed using a Smith-Root backpack electroshocker for a standard 20-minutes battery time. The survey involved moving slowly up- or down-stream at a site and attempting to cover the major habitat types present (riffle, runs, pools, edges). All captured fish were identified, assigned to an age class (juvenile/adult) and released at site of capture.

2.2 Data analysis

Several forms of data analysis are conducted for macroinvertebrates.

2.2.1 Abundance and diversity measures

Taxon richness (number of families) was derived from AUSRIVAS samples. Total abundance data was derived from quantitative Surber counts.

2.2.2 AUSRIVAS analysis

Spring and autumn season macroinvertebrate RAP data were entered into Tasmanian AUSRIVAS presence/absence models to derive O/E (observed over expected) scores. O/E scores allow deviations from reference condition to be quantified based on changes in the presence of expected taxa within the sample.

2.2.3 Tasmanian River Condition Index (TRCI) Aquatic Life Condition Assessment

For the TRCI assessment, sampling and data analysis followed the protocol described by NRM South (2009, 2009a). The TRCI Aquatic Life Macroinvertebrate Indicator (MI) provides an integrated score for the condition of benthic macroinvertebrate communities. The score takes into account three key aspects of macroinvertebrate community condition:

- *Expectedness* - the proportion of taxa expected to occur at the site under unimpaired conditions that are actually observed at the site (O/Epa scores), combined with the ratio of observed to expected scores for pollution sensitivity of the sampled community - the 'SIGNAL' score;
- *Abundance* - the density of individuals per unit area of river bed; and
- *Composition* - the proportion of environmentally sensitive taxa from the 'EPT' taxonomic grouping in the sample.

The above values were entered into the TRCI aquatic life condition scoring and integration algorithm (NRM South 2008) to generate scores for individual metrics and integrated scores and ratings for the overall condition of macroinvertebrates.

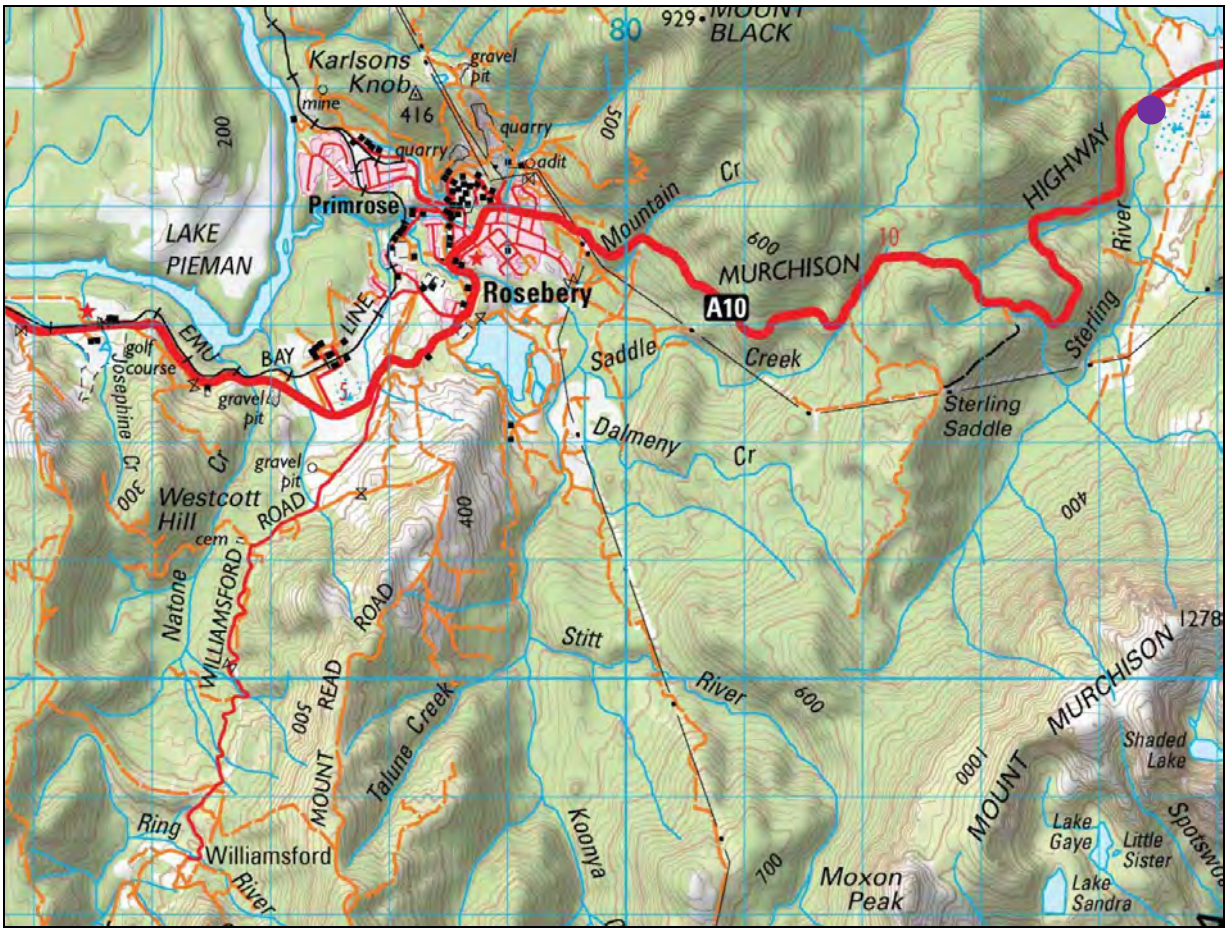


Figure 1. Map of study area showing location of Sterling River reference site (purple circle) in relation to the Stitt River and upper Ring River.

Grid squares = 1 km. Map scale 1:100 000 (TasMap).

Figure 2a. Map of study sites in the upper Ring River catchment. Blue arrow shows point of confluence between Bakers Creek and the Ring River.

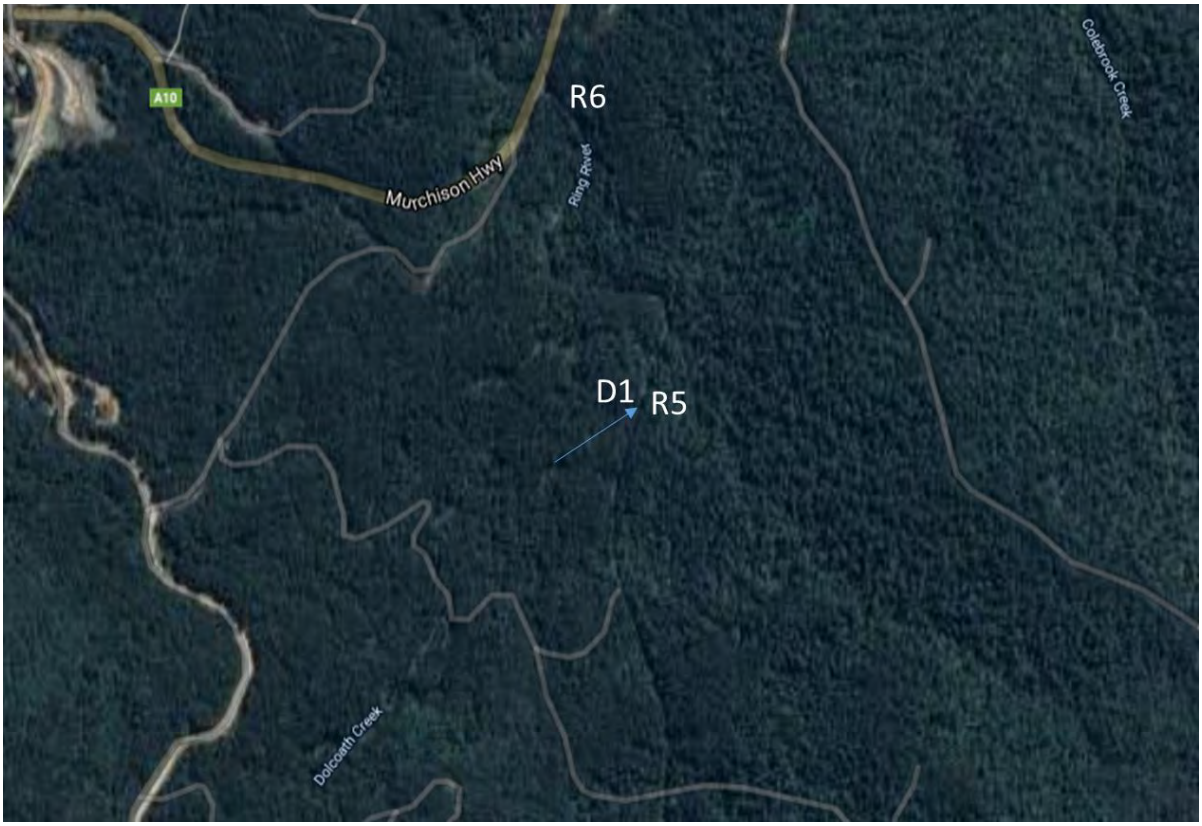


Figure 2b. Map of study sites in the lower Ring River catchment. Blue arrow shows point of confluence of Dolcoath Creek and the Ring River

Figure 3a. Map of study sites in the upper Stitt River catchment.

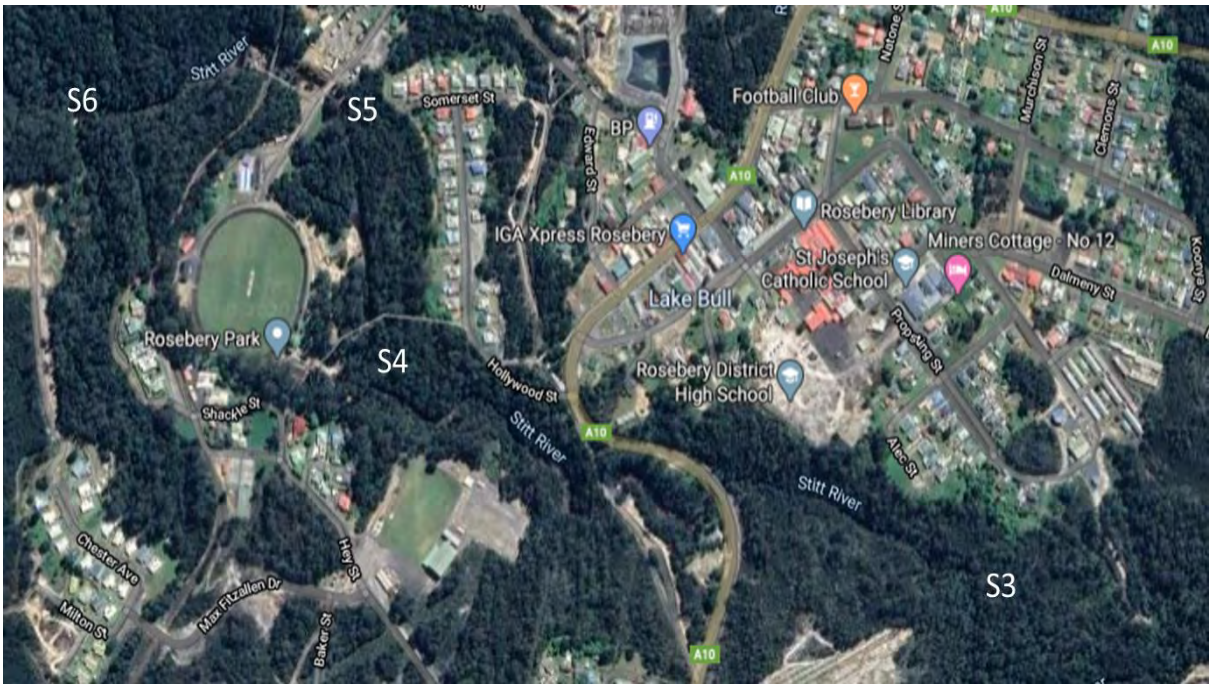


Figure 3b. Map of study sites in the lower Stitt River catchment.

3. Results

3.1 Reference sites

The macroinvertebrate fauna of the reference sites in the Sterling (STR1) and upper Stitt River (sites S0, S1, S2) continues to be relatively healthy and diverse (Tables 2 and 3). Overall reference means for family–level taxa per site (AUSRIVAS samples) were slightly lower in spring 2020 (mean number of taxa = 14.5) compared to autumn 2021 (mean number of taxa = 18.8) (Tables 2 and 3). Mean abundances (from Surber samples) in reference sites were relatively low in both seasons (mean abundances per square meter of stream bed = 664 in spring 2020 and 474 in autumn 2021, respectively) (Table 5).

The reference-site fauna continues to be dominated by Leptophlebiid mayflies, worms, chironomid midges, Grypopterygid stoneflies, elmid beetles and a range of caddis larvae (Tables 2 and 3). This 'clean water' fauna has remained broadly consistent in composition since 2004. Several of these groups are sensitive to metals and acid mine drainage, and are generally absent or severely depressed in abundance when exposed to pollutants.

The results of the AUSRIVAS analyses for the Sterling River and three Stitt River reference sites are given in Tables 2 and 3. O/E values (an index of macroinvertebrate health) were intermediate for reference sites in spring 2020 (Table 2), and consistently high for reference sites in autumn 2021 (Table 3). For both seasons, reference sites were placed either in the upper range of impairment band B ('similar to reference'), or in impairment band A ('equivalent to reference') (Tables 2 and 3).

Table 2. Macroinvertebrate data from AUSRIVAS sampling in Spring 2020, for the Stitt, Sterling and Ring Rivers, and for Bakers Creek and Dolcoath Creek. #1 and # 2 are replicate AUSRIVAS samples.

		Stream:	**Ring River**										**Baker Ck**	**Dolcoath Ck**
		Site:	R1		R2		R3		R5		R6		B1	D1
			#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#1
Class	**Order**	**Family**												
Annelida	Oligochaeta		1					1						
Arachnida	Acarina				1	1								
Insecta	Plecoptera	Eustheniidae	23	37	1	6		2	1	3				
		Gripopterygidae	30	35	2	15	2	2	13	11	2	3		
		Notonemouridae	1	4	8	5			3	32	12	2	1	
	Ephemeroptera	Leptophlebiidae	1		5					1	1			
	Odonata	Telephlebiidae		1										
	Collembola		1											
	Diptera	Chironimidae												
		subfam: Chironominae								2	1			
		subfam: Orthocladiinae	13	22	4	2			6	16	1			
		subfam: Podonominae	18	7	16	16					2			
		subfam: Tanypodinae										1		
		Simuliidae	2		1	1								
		Tipulidae				9					1			
		Athericidae									2			
		Blephariceridae						1						
		Ceratopogonidae											1	
		Dip. Unid. Pup.				1								
	Trichoptera	Calocidae		2	1									
		Hydrobiosidae		1	1						1	1		
		Hydropsychidae	3			1								
		Leptoceridae			1	1								
		Philopotamidae	1											
		Philorheithridae						1				1		
	Coleoptera	ElmidaeA							1					
		ScirtidaeL	26	23	8	3								
		N Taxa	**12**	**9**	**12**	**12**	**1**	**5**	**5**	**6**	**9**	**5**	**2**	**0**
		O/Epa	**0.49**	**0.39**	**0.54**	**0.49**	**0.05**	**0.25**	**0.20**	**0.25**	**0.39**	**0.20**	**0.11**	**-**
		Band	**B**	**C**	**B**	**B**	**D**	**C**	**C**	**C**	**C**	**C**	**D**	**-**
		EPT	**0.50**	**0.56**	**0.58**	**0.42**	**1.00**	**0.60**	**0.60**	**0.67**	**0.44**	**0.80**	**0.50**	**-**

Table 2a (cont.)		Stream:	Sterling River		Stitt River													
		Site:	STR1		S0		S1		S2		S3		S4		S5		S6	
Class	**Order**	**Family**	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2
Annelida	Oligochaeta		4	4			5	1	5	4	2	4	11	6	8	4	3	3
Arachnida	Acarina								1				2	1	2			
Crustacea	Amphipoda	Paramelitidae	9	8	4	3	5	14	7	9	1	12	1	2		2		
Insecta	Plecoptera	Eustheniidae			12	10	6	2	4	10	4	7		1		1	1	2
		Austroperlidae			1	3												
		Gripopterygidae	32	8	18	26	16	26	18	15	11	20	6	121	19	22	8	21
		Notonemouridae		1		1									1		3	2
	Ephemeroptera	Leptophlebiidae	28	50	24	17	22	21	10	35	15	29	31	22	22	20	25	13
		Baetidae			11	20	8	11	9	10	13	7	11	10	3	4		
	Odonata	Telephlebiidae					1		1		1							
		Austrocordulidae			2					1								
	Diptera	Chironomidae:																
		subfam: Chironominae	4	3	1		1	1	5	3	2	8				2	1	2
		subfam: Orthocladiinae	24	21			4	2	10	6	4	2	20	10	12	8	4	5
		subfam: Podonominae	8		7	10	7	7	2	3	18	12	14	4	2	9	10	2
		subfam: Tanypodinae																1
		Simuliidae			2	10	3	3	2	1		4			3	2	1	
		Tipulidae	1	4			2	1	6			1		1			1	1
		Athericidae												1	2	1		1
		Blephariceridae				1											1	
		Dip. Unid. Pup.	1			1			1			1			2	1	1	2
	Trichoptera	Calocidae			1													
	Trichoptera	Conoesucidae				1				1	1							
		Hydrobiosidae	20	15	16	9	15	10	23	17	15	27	4	12	13	7	5	10
		Hydropsychidae					1	1	3						2	1		
		Leptoceridae	3	3		1				1	1	1		2	2	1		2
		Philopotamidae				2				1								
		Philorheithridae			2	2		4	2		1	12	2	8		3	1	3
	Coleoptera	ElmidaeA								3	2	10		2	3	2	1	1
		ElmidaeL	1									1						
		ScirtidaeL	4	7				1		3	6	4	17	12	6	15	40	21
		N Taxa	**13**	**11**	**13**	**16**	**14**	**15**	**17**	**17**	**16**	**18**	**11**	**16**	**16**	**18**	**16**	**17**
		O/Epa	**0.54**	**0.44**	**0.59**	**0.69**	**0.69**	**0.69**	**0.79**	**0.74**	**0.74**	**0.79**	**0.49**	**0.74**	**0.64**	**0.79**	**0.64**	**0.69**
		Band	**B**	**C**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**	**B**
		EPT	**0.31**	**0.45**	**0.62**	**0.69**	**0.43**	**0.47**	**0.41**	**0.47**	**0.50**	**0.39**	**0.45**	**0.44**	**0.44**	**0.44**	**0.38**	**0.41**

Table 3. Macroinvertebrate data from AUSRIVAS sampling in Autumn 2021, for the Stitt, Sterling and Ring Rivers, and for Bakers Creek and Dolcoath Creek. #1 and # 2 are replicate AUSRIVAS samples.

		Stream:	**Ring River**										**Baker Ck**	**Dolcoath Ck**
		Site:	R1		R2		R3		R5		R6		B1	D1
			#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#1
Class	**Order**	**Family**												
Arachnida	Acarina		1	2	1									
Crustacea	Amphipoda	Paramelitidae				1								3
Insecta	Plecoptera	Eustheniidae		30	4	2		2	2	2		1		
		Austroperlidae	1	1								1		
		Gripopterygidae	8	20	5	9	1	9	16	12		2		
		Notonemouridae	7	4	23	12	1	12	2	3				1
	Ephemeroptera	Leptophlebiidae	1	2	2									
	Diptera	Chironomidae:												
		subfam: Chironominae		18										
		subfam: Orthocladiinae	4	5					2					2
		subfam: Podonominae	1	2										
		Simuliidae		2						1				
		Tipulidae	1											
	Trichoptera	Hydrobiosidae			1									
		Hydropsychidae	1	6										
		Leptoceridae			1			1						2
		Philopotamidae		1		2								
		Philorheithridae	1		1		1		1	2				6
	Coleoptera	ElmidaeA	1	1						1	1	1		
		ElmidaeL										1		
		ScirtidaeL	17	7	9	11		1						
		DytiscidaeL	1		1									
		N Taxa	**13**	**14**	**10**	**6**	**3**	**5**	**5**	**6**	**1**	**5**	**0**	**5**
		O/Epa	**0.80**	**0.86**	**0.53**	**0.36**	**0.18**	**0.30**	**0.28**	**0.34**	**0.06**	**0.28**	**-**	**0.30**
		Band	**B**	**A**	**B**	**C**	**C**	**C**	**C**	**C**	**D**	**C**	**-**	**C**
		EPT	**0.46**	**0.50**	**0.70**	**0.67**	**1.00**	**0.80**	**0.80**	**0.67**	**0.00**	**0.60**	**-**	**0.60**

Table 2b (cont.)		Stream:	Sterling River		Stitt River													
		Site:	STR1		S0		S1		S2		S3		S4		S5		S6	
Class	**Order**	**Family**	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2	#1	#2
Annelida	Oligochaeta		1	1			4	1	1	3	2		4	2		1		1
Arachnida	Acarina		1	1	1	3	1		2	2	1	1	5	2	1		1	21
Crustacea	Amphipoda	Paramelitidae	13	19	10	4	12	13	8	9	12	1		1				
Insecta	Plecoptera	Eustheniidae	2	2	5	9	7	2	4	6		3	1	2	1	1	1	
		Austroperlidae	1	3	3		2	1		1		1	1					
		Gripopterygidae	5	2	10	20	6	5	12	18		7	5	3	20	8	26	12
		Notonemouridae												1		2	4	3
	Ephemeroptera	Leptophlebiidae	22	18	8	18	14	12	21	18	9	27	9	13	12	23	5	6
		Baetidae		1	9	13	2	2	8	10	1	2	1	5	1			
	Odonata	Telephlebiidae		1	3													
	Diptera	Chironomidae:																
		subfam: Chironominae	2	5		1				1			3	3			1	1
		subfam: Orthocladiinae	3	4	1	2			1	5		1		1			13	12
		subfam: Podonominae		2	1		1		1				3	2				
		Simuliidae	1		1	6	2		2	1	1		1	2	9	1	1	
		Tipulidae	2	4	3	2	1	2	1	1			2	2	1			
		Athericidae													1	1		
		Ceratopogonidae						1										
		Empididae	1															
		Dip. Unid. Pup.	1														2	
	Trichoptera	Conoesucidae				6	4	2		3	1							1
		Helicophidae						1										
		Hydrobiosidae	15	13	13	7	20	14	22	25	16	21	12	25	14	20	21	35
		Hydropsychidae			2	1	1		4	4	3					1		1
		Hydroptilidae	1	1														
		Leptoceridae	5	16	1	1	6	7	3	1	21	15	18	10	17	17	7	9
		Philopotamidae	5	1	1	4												
		Philorheithridae	5	10		1	3	3	3	4	6	7	3	8	3	4	1	1
	Coleoptera	ElmidaeA	3	4	6	12	5	7	5	5	6	17	18	14	8	11	6	3
		ElmidaeL	2			6	3	3		1		2	1				2	
		ScirtidaeL		3			1	2	2	2	2	10	14	14	12	10	16	9
		PsepheniidaeL	1			1									1			
		N Taxa	**21**	**20**	**17**	**19**	**19**	**17**	**17**	**20**	**13**	**14**	**17**	**18**	**14**	**13**	**15**	**14**
		O/Epa	**1.12**	**1.12**	**0.99**	**1.11**	**1.11**	**0.93**	**0.96**	**1.13**	**0.74**	**0.79**	**0.96**	**1.01**	**0.78**	**0.72**	**0.77**	**0.77**
		Band	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**B**	**B**	**A**	**A**	**B**	**B**	**B**	**B**
		EPT	**0.43**	**0.50**	**0.53**	**0.53**	**0.53**	**0.59**	**0.47**	**0.50**	**0.54**	**0.57**	**0.47**	**0.44**	**0.50**	**0.62**	**0.47**	**0.57**

3.2 Ring River

3.2.1 Conductivity

In both spring 2020 and autumn 2021, conductivity in the uppermost Ring River site (R1 at Williamsford) was comparable to the Sterling River reference site (Figure 4). In both seasons, conductivity in the Ring River increased sharply immediately below Bakers Creek (R3), then declined to lower levels by the two most downstream sites. The conductivity in Dolcoath Creek was at intermediate levels in both seasons, while the conductivity in Bakers Creek was again very high in both seasons.

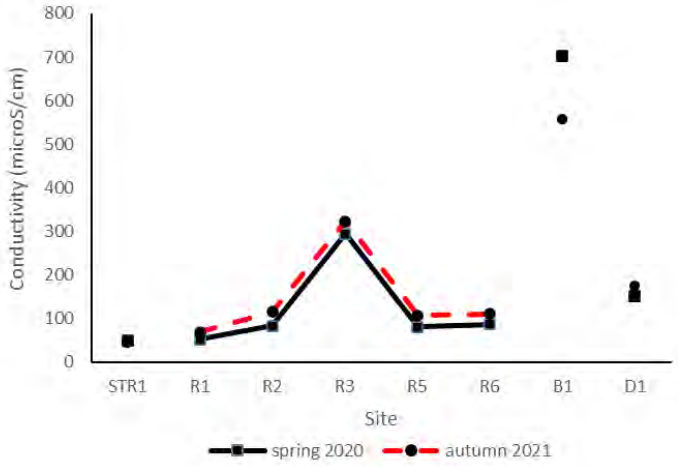


Figure 4. Conductivity (µS/cm) at the five Ring River sites, plus the Sterling River reference site and Bakers Creek and Dolcoath Creek, in spring 2020 and autumn 2021.

3.2.2 Macroinvertebrates

Macroinvertebrate abundance at the uppermost Ring River site (R1) was considerably lower than the abundance in the Sterling River, particularly in spring 2020 (Figure 5). As in previous years, abundance declined sharply downstream of R1 in both seasons (Figure 5). Macroinvertebrate abundance in Bakers Creek was extremely low (nil animals in spring 2020), as has been the case in all previous years (Figure 5).

Macroinvertebrate diversity (from AUSRIVAS samples) tended to decline between R1 to R3 in both seasons, with a partial recovery in taxon richness at the two most downstream sites R5 and R6, particularly in spring 2020 (Figure 6). Taxon richness in Dolcoath Creek was very low in spring 2020 (nil animals), before recovering in autumn 2021 (5 taxa) to be comparable with the lower Ring River sites. Taxon richness was consistently very low in Bakers Creek, as has been the case in all previous years (Figure 6).

The faunal composition of samples from the most upstream site R1 at Williamsford included a range of stoneflies and beetles, but lacked a range of caddisfly and mayfly families which were present at reference sites (Tables 2 and 3). The presence of scirtid beetles at R1 also indicates a persistent low to moderate level of metal pollution in the upper Ring River, as has been observed in previous years. In general, the low abundance of pollution-sensitive taxa (e.g. Leptophlebiid mayflies and caddisflies) across all Ring River sites including the most upstream site R1 (Tables 2 and 3) indicates that the Ring River continues to experience a degree of water quality impairment associated with metals.

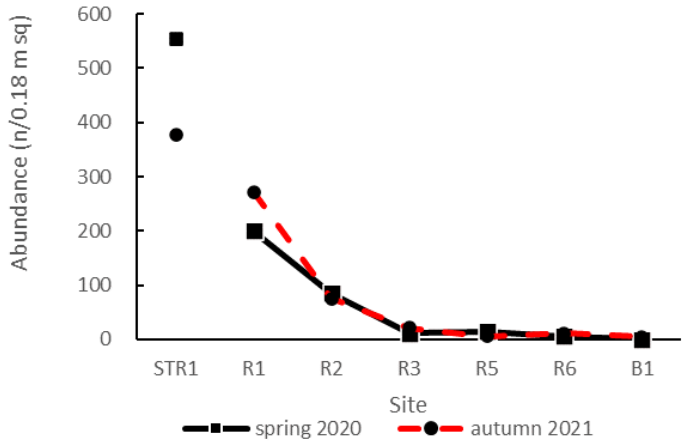


Figure 5. Trends in total benthic macroinvertebrate abundance (from Surber data) in spring 2020 and autumn 2021 at the five Ring River sites and Bakers Creek, plus the Sterling River reference site.

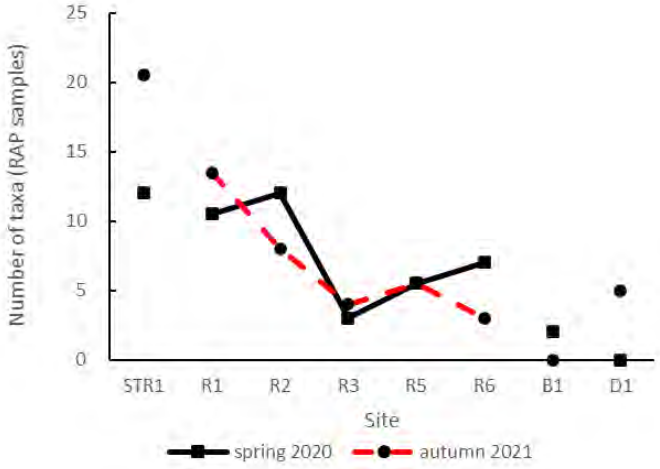


Figure 6. Trends in taxon richness (mean of two RAP samples) in spring 2020 and autumn 2021 at the five Ring River sites, plus the Sterling River reference site and Bakers Creek and Dolcoath Creek.

The results of the AUSRIVAS analyses for the Ring River are given in Tables 2 and 3 for spring 2020 and autumn 2021, and are presented graphically in Figure 7 for the autumn seasons from 2017 to 2021. In all years, the uppermost Ring River site at Williamsford has been located in the mid to lower range of AUSRIVAS impairment band B ('near reference condition') or in the upper range of impairment band C ('moderately impaired'). The Ring River sites downstream of Williamsford have been placed in impairment band C or D ('severely impaired'), with the exception of site R5 in 2017 which was placed in the lower range of impairment band B (Figure 7). In most years, there has been a general tendency for O/E values to decline moving downstream from R1 to R3 (downstream of Bakers Creek), with O/E values then increasing slightly at the two lower Ring River sites R5 and R6 (Figure 7).

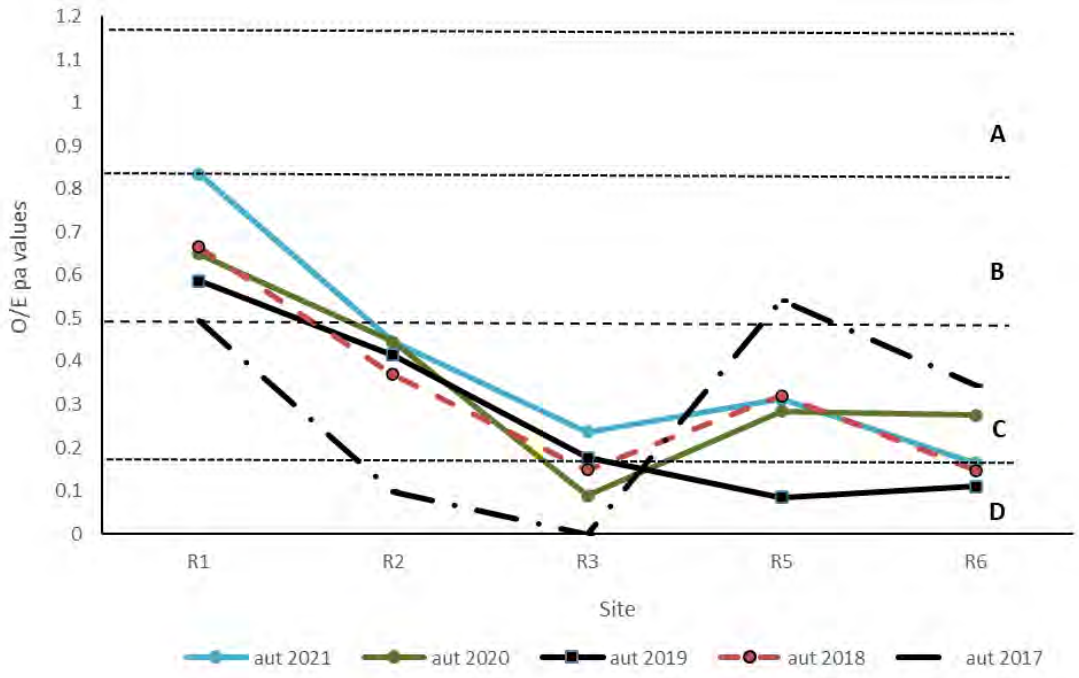


Figure 7. Trends in O/Epa values at the five Ring River sites in the autumn seasons for 2017 to 2021. O/Epa values are the mean of two RAP replicates. AUSRIVAS impairment bands A - D are also shown.

3.3 Stitt River

3.3.1 Conductivity

Conductivity levels in the Stitt River in spring 2020 ranged between 42.0 to 47.1 µS/cm, with a slight overall trend for increasing conductivity moving downstream (Figure 8). In autumn 2021, conductivity levels in the Stitt River were consistently higher, with the exception of S3 which had an anomalously low reading. In autumn 2021, conductivity ranged from 56.5 to 74.4 µS/cm (excluding anomalous site S3), with again an overall trend for increasing conductivity moving downstream (Figure 8).

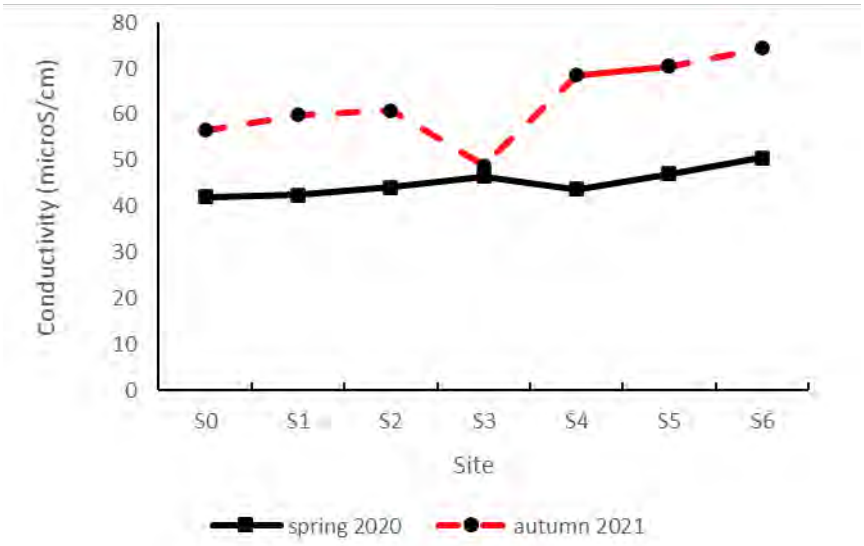


Figure 8. Conductivity (µS/cm) in spring 2020 and autumn 2021 at the Stitt River sites S0 to S6.

3.3.2 Macroinvertebrates

Total macroinvertebrate abundances for the Sterling River (STR1) and Stitt River reference sites (S0, S1 and S2) and for the downstream Stitt River sites (S3-S6) are shown in Figure 9. Total abundances varied substantially between sites in both seasons, however in both seasons there was an overall trend for abundance to decline moving downstream (Figure 9).

Macroinvertebrate diversity (from AUSRIVAS samples) in the Stitt River in spring 2020 and autumn 2021 is shown in Figure 10. In spring 2020, there was no indication for a decline in taxa diversity moving downstream. In spring 2020, the mean number of taxa for reference sites and downstream Stitt River sites was 14.5 and 16.0 taxa/site, respectively, with the difference being not significantly different (two-way t-test, $t = 1.38$, $P > 0.05$).

In contrast, in autumn 2021, there was an overall decline in taxa diversity moving downstream. In autumn 2021, the mean number of taxa for reference sites and downstream Stitt River sites was 18.8 and 14.8 taxa/site, respectively, with the difference being significantly different (two-way t-test, $t = 4.67$, $P < 0.01$).

In both spring 2020 and autumn 2021 seasons, the fauna of all Stitt River sites including in the lower reaches included a broad and similar range of clean-water taxa, including a range of EPT (Ephemenoptera, Plecoptera and Trichoptera) families, and a range of dipteran and beetle taxa (Tables 2 and 3).

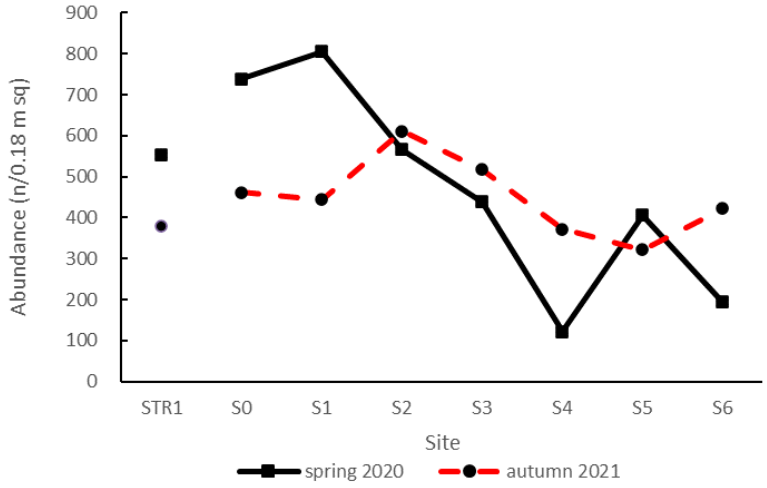


Figure 9. Trends in total benthic macroinvertebrate abundance (from Surber data) in spring 2020 and autumn 2021 in the Sterling River and in the Stitt River sites S0 to S6.

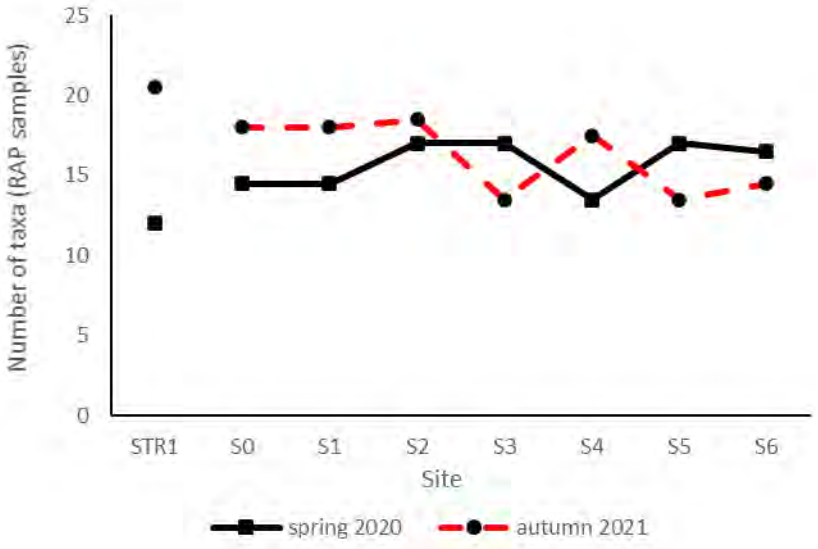


Figure 10. Trends in taxon richness (mean of two RAP samples) in spring 2020 and autumn 2021 in the Sterling River reference site and in the Stitt River sites S0 to S6.

The results of the AUSRIVAS analyses for the Stitt River are given in Tables 2 and 3 for the spring 2020 and autumn 2021 seasons, and are presented graphically in Figure 11 for the autumn season from 2017 to 2021. O/E values have shown a general trend for a decline moving downstream in most years, including in autumn 2021 (Figure 11). However, the results in autumn 2021 indicate that conditions in the Stitt River were relatively good down to the lowest reaches of the river, with all sites falling in either impairment band A ('equivalent to reference') or the upper range of impairment band B ('near reference condition') (Figure 11).

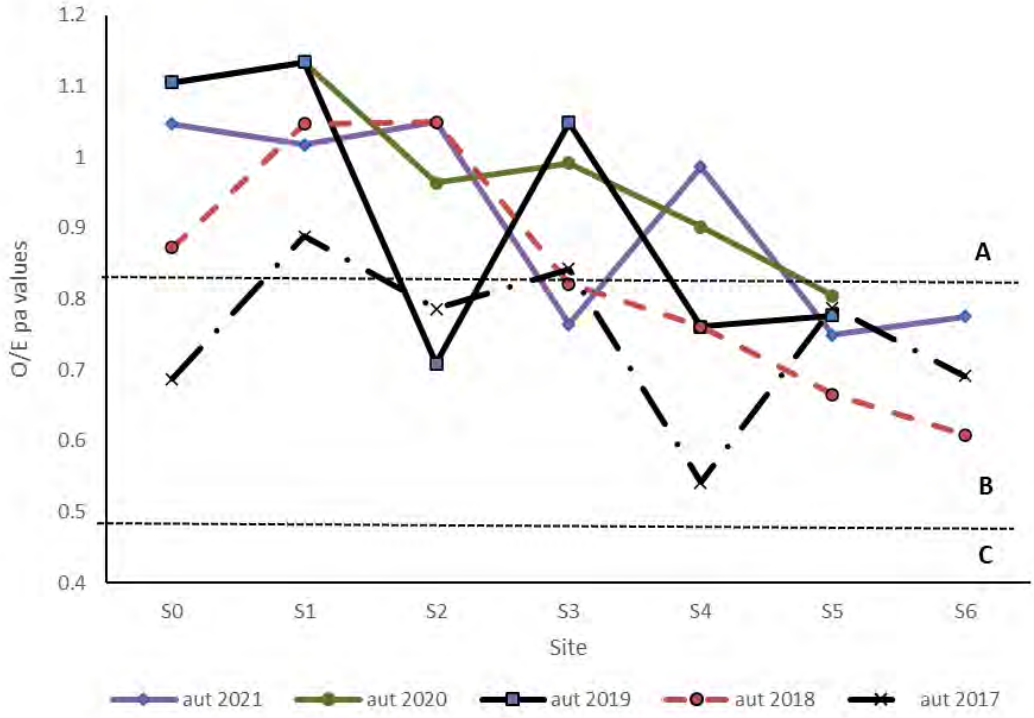


Figure 11. Trends in O/Epa values for the Stitt River sites S0-6 in the autumn season for 2017 to 2021. O/Epa values are the mean of two RAP replicates. AUSRIVAS impairment bands are also shown.

3.2.3 Fish

Fish were surveyed in Stitt River sites S1 to S5 and in the Sterling River (Table 4). In spring 2020, adult brown trout were recorded at all Stitt Rivers sites down to and including S5, with juvenile trout also captured at Stitt River site S2 (Table 4). In autumn 2021, both adult and juvenile brown trout were recorded at all Stitt River sites (see Figure 12), with generally lower numbers captured in the lower reaches (Table 4). These data

suggest relatively clean-water conditions were present in the Stitt River in autumn 2021, with a healthy breeding population of brown trout present throughout the river including the lower reaches.

Table 4. Fish caught in spring 2020 and autumn 2021 in the Sterling and Stitt Rivers.

(a) Spring 2020

		River:	Sterling River	Stitt River				
		Site:	at Murchison Hway	u/s Mountain Ck	u/s tailings	d/s tailings	at footbridge	at road bridge
Species	**Life stage**		STR1	S1	S2	S3	S4	S5
Salmo trutta	Adult		7	11	9	9	1	1
	Juvenile				4			
Galaxias brevipinnis				1				

(b) Autumn 2021

		River:	Sterling River	Stitt River				
		Site:	at Murchison Hway	u/s Mountain Ck	u/s tailings	d/s tailings	at footbridge	at road bridge
		Date	06/04/2021	07/04/2021	07/04/2021	07/04/2021	06/04/2021	06/04/2021
Species	**Life stage**		STR1	S2	S2	S3	S4	S5
Salmo trutta	Adult		29	26	17	14	2	4
	Juvenile		20	4	6	2	3	9

3.4. TRCI River Condition assessment

A TRCI analysis was carried for the autumn 2021 survey results. Macroinvertebrate monitoring results used as inputs to the TRCI scoring are shown in Table 5. The results of the TRCI assessment of macroinvertebrate community condition are shown in Table 6.

The condition rating for the macroinvertebrate community in the Ring River in autumn 2021 ranged from Moderate at the uppermost site (R1 at Williamsford), through Poor in the middle reaches (sites R2 to R5), to Very Poor for the most downstream site R6 (Table 6). The Poor to Very Poor rating for the sites downstream of R1 was due to a low composition metric (absence of expected families) and a low rating on the abundance metric due to very low total abundances (Tables 5).

The three Stitt River reference sites S0, S1 and S2 had a macroinvertebrate condition rating of Moderate. For the lower reaches of the Stitt River, site S4 also had a macroinvertebrate condition rating of Moderate, while site S3 (immediately below the 2/5 TSF) and the two most downstream sites S5 and S6 had a condition rating of Poor (Table 6).

Figure 12. Adult and juvenile brown trout captured in the lower Stitt River (at site S5 at Footbridge).

Table 5. Results for macroinvertebrates used to derive TRCI Indicator and Metric scores for all sites in autumn 2021.

	Ring River					Bakers Ck	Dolcoath Ck	Stitt River							
AUSRIVAS	R1	R2	R3	R5	R6	B1	D1	STR1	S0	S1	S2	S3	S4	S5	S6
Mean O/Epa	0.83	0.45	0.24	0.31	0.17	-	0.30	1.12	1.05	1.02	1.05	0.76	0.99	0.75	0.77
Mean O/Epa Band	A	C	C	C	C	-	C	A	A	A	A	B	A	B	B
Mean SIGNAL O/E	0.99	1.01	1.14	1.21	1.23	-	0.84	0.94	1.02	1.00	0.92	0.92	0.93	1.06	0.94
Mean EPT	0.53	0.50	0.80	0.63	0.62	-	0.60	0.46	0.53	0.56	0.49	0.55	0.46	0.56	0.52
Abundance (per m^2)	272	76	21	6	11	4	-	378	461	444	611	517	372	322	422

Table 6. TRCI Macroinvertebrate scores for autumn 2021.

Stream	Site	Expectedness MIe	Abundance MIa	Composition MIc	Condition MI
Ring River	R1	High	Low	High	Moderate
	R2	Moderate	Low	High	Poor
	R3	Moderate	Low	High	Poor
	R5	Moderate	Low	High	Poor
	R6	Moderate	Low	Moderate	Very Poor
Sterling River	STR1	High	Low	High	Moderate
Stitt River	S0	High	Low	High	Moderate
	S1	High	Low	High	Moderate
	S2	High	Low	High	Moderate
	S3	Moderate	Low	High	Poor
	S4	High	Low	High	Moderate
	S5	Moderate	Low	High	Poor
	S6	Moderate	Low	High	Poor

4. Discussion

4.1. Ring River

The Ring remains in a degraded condition. Diversity and abundance remain depressed downstream of R1, with a concomitant decline in the O/E scores moving downstream from the Williamsford site. The TRCI macroinvertebrate assessment rated all Ring River sites downstream of Williamsford as being in Poor or Very Poor condition due to low abundance and the absence to a number of expected families.

Both Bakers and Dolcoath Creeks remain in a highly degraded condition. Bakers Creek is the principal source of contaminants for the Ring River, and Bakers Creek continues to have very high conductivity and extremely low macroinvertebrate abundance and diversity. The primary reasons for poor condition of river fauna communities in the Ring continue to be pollution from the Hercules mine area via Bakers Creek.

4.2 Stitt River

Overall, the Stitt River is in a substantially better ecological condition than the Ring River. There also appears to have been some additional improvement in the condition of the lower Stitt River over the past 12 months.

Davies et al. (2017) noted a substantive improvement in the lower Stitt River in autumn 2017. Diversity and abundance had both increased compared to previous years, and the presence of several key water-quality sensitive taxa at all downstream sites was a strong sign of improved aquatic conditions. Also in autumn 2017, and for the first time since fish surveys began in 2006, Davies et al. (2017) recorded the presence of fish throughout the lower reaches of the Stitt River.

The subsequent survey of macroinvertebrates and fish in spring 2017 (Mallick and Davies 2018) noted continuing signs of improvement in the lower Stitt. However, the subsequent survey in autumn 2018 found a return to the pre-2017 conditions, with a general decline in macroinvertebrate community condition and the disappearance of trout from the Stitt River sites downstream of the 2/5 TSF dam (Mallick and Davies 2018).

More recent survey results in spring 2018/autumn 2019 and spring 2019/autumn 2020 have recorded a steady improvement in the condition of the lower Stitt River. The results from the present spring 2020/autumn 2021 survey suggest relatively clean-water conditions again prevail in the Stitt River, with a range of clean-water macroinvertebrate taxa present at all sites in the Stitt River including in the lower reaches. Furthermore, the presence of a breeding population of brown trout throughout the Stitt River in autumn 2021 indicates that the relatively healthy macroinvertebrate fauna of the river now also supports a breeding population of brown trout, although numbers of trout captured continues to be depressed in the lower reaches of the Stitt River.

5. References

Davies AL and Gee JHR 1993. A simple periphyton sampler for algal biomass estimates in streams. Freshwat. Biol. 30, 47-51.

Davies PE and Cook LSJ 2002. Aquatic bioassessment of the Savage River catchment. 2001 Survey report. SRRP Project 038. Final Report to DPIWE, January 2002. 55 pp.

Davies PE, Cook LSJ and Sloane T 2004. Biological Condition of the Ring and Stitt Rivers: Survey of fish and macroinvertebrates, 2003/04. Final Report to Pasminco, 37 pp.

Davies PE, Cook LSJ and Sloane T 2005a. Biological Condition of the Ring and Stitt Rivers: Survey of macroinvertebrates, autumn 2005. Final Report to Pasminco, 24 pp.

Davies PE, Cook LSJ and Sloane T 2005b. Biological Condition of the Ring and Stitt Rivers: Survey of macroinvertebrates, spring 2005. Final Report to Pasminco, 16 pp.

Davies PE, Cook LSJ and Sloane T 2006a. Biological Condition of the Ring and Stitt Rivers: Survey of macroinvertebrates, autumn 2006. Final Report to Pasminco, 26 pp.

Davies PE, Cook LSJ and Sloane T 2006b. Biological Condition of the Ring and Stitt Rivers: Survey of macroinvertebrates, spring 2006. Final Report to Pasminco, 22 pp.

Davies PE, Cook LSJ and Sloane T 2007. Biological Condition of the Ring and Stitt Rivers: Survey of macroinvertebrates, autumn 2007. Final Report to Zinifex, 25 pp.

Davies PE, Cook LSJ and Sloane T 2008. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2007 and Autumn 2008. Final Report to OZ Minerals, Rosebery, 29 pp.

Davies PE, Cook LSJ and Sloane T 2009. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2008 and Autumn 2009. Final Report to OZ Minerals/MMG, Rosebery, 31 pp.

Davies PE, Cook LSJ and Sloane T 2010. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2009 and Autumn 2010. Final Report to MMG, Rosebery, 31 pp.

Davies PE, Cook LSJ and Sloane T 2011. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2010 and Autumn 2011. Final Report to MMG, Rosebery, 32 pp.

Davies PE and Cook LSJ 2012. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2011 and Autumn 2012. Final Report to MMG, Rosebery, 33 pp.

Davies PE and Cook LSJ 2013. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2012 and Autumn 2013. Final Report to MMG, Rosebery, 34 pp.

Davies PE and Cook LSJ 2014. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2013 and Autumn 2014. Final Report to MMG, Rosebery, 34 pp.

Davies PE and Cook LSJ 2015. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2014 and Autumn 2015. Final Report to MMG, Rosebery, 40 pp.

Davies PE, Mallick SA and Cook LSJ 2016. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2015 and Autumn 2016. Final Report to MMG, Rosebery, 34 pp.

Davies PE, Mallick SA and Cook LSJ 2017. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2016 and Autumn 2017. Final Report to MMG, Rosebery, 34 pp.

Davies PE, Mitchell N and Barmuta LE 1996. The impact of historical mining operations at Mount Lyell on the water quality and biological health of the King and Queen River catchments, western Tasmania, Mount Lyell Remediation R&D Program, Supervising Scientist Report 118, Office of the Supervising Scientist, Barton ACT.

Mallick SA and Davies PE 2018. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2017 and Autumn 2018. Final Report to MMG, Rosebery, 34 pp.

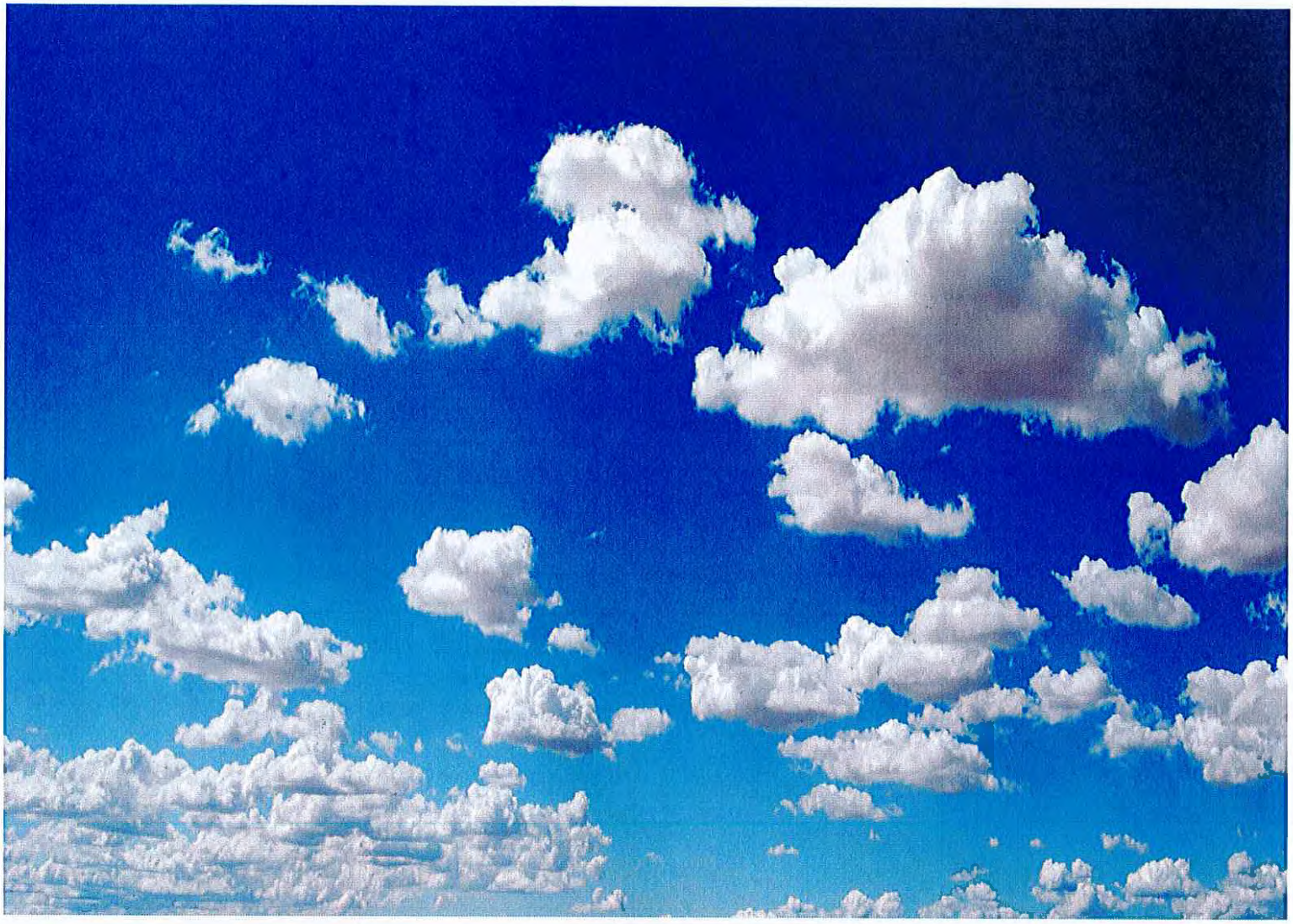
Mallick SA 2019. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2018 and Autumn 2019. Final Report to MMG, Rosebery, 34 pp.

Mallick SA 2020. Biological Condition of the Ring and Stitt Rivers: Survey of aquatic biota, Spring 2018 and Autumn 2019. Final Report to MMG, Rosebery, 30 pp.

NRM South (2009). Tasmanian River Condition Index Reference Manual. NRM South. Hobart.

NRM South 2009a. Tasmanian River Condition Index Aquatic Life Field Manual. NRM South. Hobart.

APPENDIX G: ANNUAL AIR QUALITY REVIEW – FY21 (ERM, 2021)



Annual Air Quality Review – FY21

Rosebery Mine

03 September 2021

Project No.: 0516238

The business of sustainability

ERM

Document details	
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Client Name	MMG

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Signature Page

03 September 2021

Annual Air Quality Review – FY21

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EXECUTIVE SUMMARY

MMG's Rosebery Mine is an underground polymetallic base metal mine located in the township of Rosebery, Tasmania.

MMG has an obligation under its Environmental Protection Notice (EPN 7153/3, PCE 9084 & Rosebery Dust Mitigation Plan) to report annually on aspects of its air quality monitoring programmes (EPN 7153/3 conditions A2-A5, G7 2.7 & PCE 9084 conditions A4-5 & G6 1.7). The air quality monitors include of high volume air samplers (HVAS) with co-located DustTraks and dust deposition gauges (DDG). The EPN and PCE include compliance and trigger limits for ambient particulate matter (TSP, PM_{10}) and metals concentrations (lead, cadmium, zinc) and dust deposition rates.

The FY21 period has no deviations from the EPN monitoring requirements as all analysis was completed by ALS Environment as per the Australian Standard for analysis (a NATA accredited laboratory – NATA Accreditation No. 825). The FY21 period had two sampling deviations from the schedule.

Two sampling days of HVAS monitoring were missed and the completed investigation showed a scheduling issue that resulted in one filter to be used for two sample periods at each HVAS location. This invalidated the HVAS samples for the run dates of the 15/5/2021 and 21/5/2021. The missed events were reported to the EPA on 25/05/2021 with corrective actions implemented to minimise this error reoccurring in the future.

The HVAS and DDG compliance against the relevant EPN and PCE conditions are presented in Table 1 and Table 2, respectively.

There were reported exceedances of the trigger levels for monthly total deposited dust and monthly deposited dust above background at AD21 and AD22. An investigation into the exceedance of the dust deposition trigger level at AD21 and AD22 were expected to be due to dust from highly localised emissions from the nearby resurfacing roadworks.

No exceedances of the compliance limits were reported which indicate that the Rosebery Mine activities are a low environmental risk to air quality and that the current dust mitigation controls are appropriate.

Based on this review, it is recommended that the air quality monitoring network be reviewed and consolidated. Considering the low environmental risk to air quality and the typical annual rainfall, a small targeted network could provide more meaningful information regarding the mining operations dust impact.

In addition to the annual air quality review, the dust management performance was also reviewed. The review concluded the Rosebery Mine should continue its current mitigation management and mitigation measures. It is also recommended that the proposed mitigation and inspection triggered levels are reviewed within three years to understand if they are sufficient to assist in the continued control of dust from site.

Table 1: HVAS Compliance against EPN condition A2 and PCE condition A4

Statistic	Pollutant	AD3	AD2.1	Giblin St	Alec St	AD3	AD2.1	Giblin St	Alec St
		Trigger Level				Compliance Limit			
24 hour average	TSP	✓	✓	✓	✓	-	-	-	-
	PM_{10}	✓	✓	✓	✓	✓	✓	✓	✓
	Lead (as TSP)	✓	✓	✓	✓	-	-	-	-
	Cadmium (as PM_{10})	✓	✓	✓	✓	-	-	-	-
	Zinc (as PM_{10})	✓	✓	✓	✓	-	-	-	-
Annual Average	TSP	-	-	-	-	✓	✓	✓	✓
90 day average	Lead (as TSP)	-	-	-	-	✓	✓	✓	✓

Green ticks denote compliance with the respective trigger level or compliance limit
Grey crosses denote exceedances of the respective trigger level
Red crosses denote exceedances of the respective compliance limit

Table 2: DDG Compliance against EPN condition A3 and PCE condition A5

Site	Monthly Deposited Dust above background	Monthly Total Deposited Dust	Annual Average Deposited Dust above background	Annual Average Total Deposited Dust
	Trigger Level		Compliance Level	
AD3	✓	✓	✓	✓
AD4	✓	✓	✓	✓
AD11	✓	✓	✓	✓
AD21	✗	✗	✓	✓
AD22	✗	✓	✓	✓
BG3	✓	✓	✓	✓

Green ticks denote compliance with the respective trigger level or compliance limit
Grey crosses denote exceedances of the respective trigger level
Red crosses denote exceedances of the respective compliance limit

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1. INTRODUCTION

MMG's Rosebery Mine is an underground polymetallic base metal mine located in the township of Rosebery, Tasmania. MMG has an obligation under its Environmental Protection Notice (EPN 7153/3, PCE 9084 & Rosebery Dust Mitigation Plan) to report annually on aspects of its meteorological, dust deposition and ambient air quality monitoring programmes (EPN 7153/3 conditions A2-A5, G7 2.7 & PCE 9084 conditions A4-5, G6 & M3).

As per EPN 7153/3 Condition A5-3, an analysis of the annual air quality must be performed annually. ERM was engaged to perform this report for FY21. This report summarises dust deposition and air quality monitoring data against the EPN and PCE conditions. In addition, a review of the dust mitigation plan was performed to understand if the current plan is sufficient to minimise environmental risk.

The purpose of this report is to understand the environmental risk from operations at the Rosebery Mine and recommend additional monitoring or mitigation, if necessitated.

1.1 EPN and PCE Requirements

MMG is required to comply with the conditions detailed in EPN 7153/3 and PCE 9084. Within these documents, the following compliance limits and triggers apply for the high volume air sampling (HVAS), as presented in Table 1.1, and dust deposition gauges (DDG), as presented in Table 1.2.

As per paragraph 2 in section A3 of EPN 7153/3, monthly deposition measurements must be adjusted to account for the background deposition rate. For each sampling month, the background is defined as the minimum of the measured dust deposition rates.

The relevant sections of the report that complies with the EPN section A5-3 Reporting of monitoring are summarised in Table 1.3.

Table 1.1: HVAS compliance limits and trigger levels

Pollutant	Compliance Limit	Trigger Levels
Total Suspended Particles (TSP)	0.090 mg/m^3 Annual average	0.150 mg/m^3 24 hour average
Particulate Matter sub 10 micron (PM_{10})	0.150 mg/m^3 24 hour average	0.050 mg/m^3 24 hour average
Lead (as TSP)	0.0015 mg/m^3 90 day average	0.0087 mg/m^3 24 hour average
Cadmium (as PM_{10})	-	0.000003 mg/m^3 24 hour average [1]
Zinc (as PM_{10})	-	0.015 mg/m^3 24 hour average [1]

1. 24 hour average was not specified within the EPN and PCE documents but was applied to be consistent with the other trigger level averaging periods

Table 1.2: Dust deposition gauge compliance limits and trigger levels

Pollutant	Compliance Limit	Trigger Levels
Deposited dust	2.0 g/m^2/month as an annual average increase above background at/or beyond the site boundary.	2.0 g/m^2/month as an increase above background at/or beyond the site boundary (monthly trigger level).
Deposited dust	4.0 g/m^2/month as an annual average at/or beyond the site boundary.	4.0 g/m^2/month as total deposition experiences at/or beyond the site boundary (monthly trigger level).

Table 1.3: EPN condition A5-3 – relevant report section

EPN A5-3 condition		Report Section
3.1	tabulated high volume air sampler, and dust and metals deposition results for the entire year, showing intermediate values as well as final monitoring results	Final monitoring results are provided in Section 3.1 and 3.2 with additional plots provided in Appendix A
3.2	tabulated annual averages of the deposition increment above background, supported by deposition isopleths or graphs	Section 3.2 with additional plots in Appendix A
3.3	monthly deposition isopleths or graphs of total dust and metal deposition and increment above 'background'	Section 3.2 with additional plots in Appendix A
3.4	Summaries of all exceedances occurring within the reporting year, describing the results of any investigations undertaken and the mitigation measures that were adopted in response	Section 3.1 and 3.2 with investigations provided in Section 3.3
3.5	Any supporting data analysis or description necessary to aid interpretation of the dataset	Additional plots provided in Appendix A

1.2 Monitoring Locations

As dictated within EPN 7153/3 and PCE 9084, the locations and ID's for the air quality monitoring sites are presented in Table 1.4 and Figure 1.1.

The monitoring network, required by EPN 7153/3, consists of four HVAS locations with a TSP and PM_{10} monitor at each location. There are eleven DDG's installed across the township of Rosebery, including a background gauge at the Rosebery golf course (BG3). As per the criteria presented in Table 1.2, the DDGs within the site boundary are AD1.1, AD2, AD5, AD23 and AD25. The dust deposition results at these locations are presented in Appendix A, however the trigger levels and compliance limits do not apply as they are located within the site boundary.

Table 1.4: Monitoring locations

Monitoring Site ID	Monitoring Location Description	Location (WGS 84 Zone 55S)	
		Easting (km)	Northing (km)
HVAS (EPN)			
AD2.1	Former PMR Training Centre on Arthur Street	378.63	5,374.00
AD3	15 Beech Street (near the Filter Plant)	377.71	5,374.49
Giblin St	Giblin Street	378.63	5,373.18
Alec St	Alec Street	378.97	5,373.41
DDG (EPN within the site boundary)			
AD1.1	Mine Office Building on Hospital Road	378.81	5,374.19
AD2	Former PMR Training Centre on Mill Road	378.66	5,373.91
AD5	Breaker Station/Crusher	378.65	5,374.23
AD23	Filter Plant Carpark	377.78	5,374.51
AD25	Passing Bay on Filter Plant Road	378.27	5,374.21
DDG (EPN at/or beyond the site boundary)			
AD3	15 Beech Drive (near the HVAS)	377.70	5,374.49
AD4	Near Rosebery Station	378.61	5,373.18
AD11	Front yard of 1 Howard Street	377.90	5,374.38
AD21	Backyard in 9 Murchison St	379.07	5,373.89
AD22	Frontyard of 21 Dalmeny St	379.29	5,373.60
BG3	Rosebery Golf Course	375.59	5,372.78

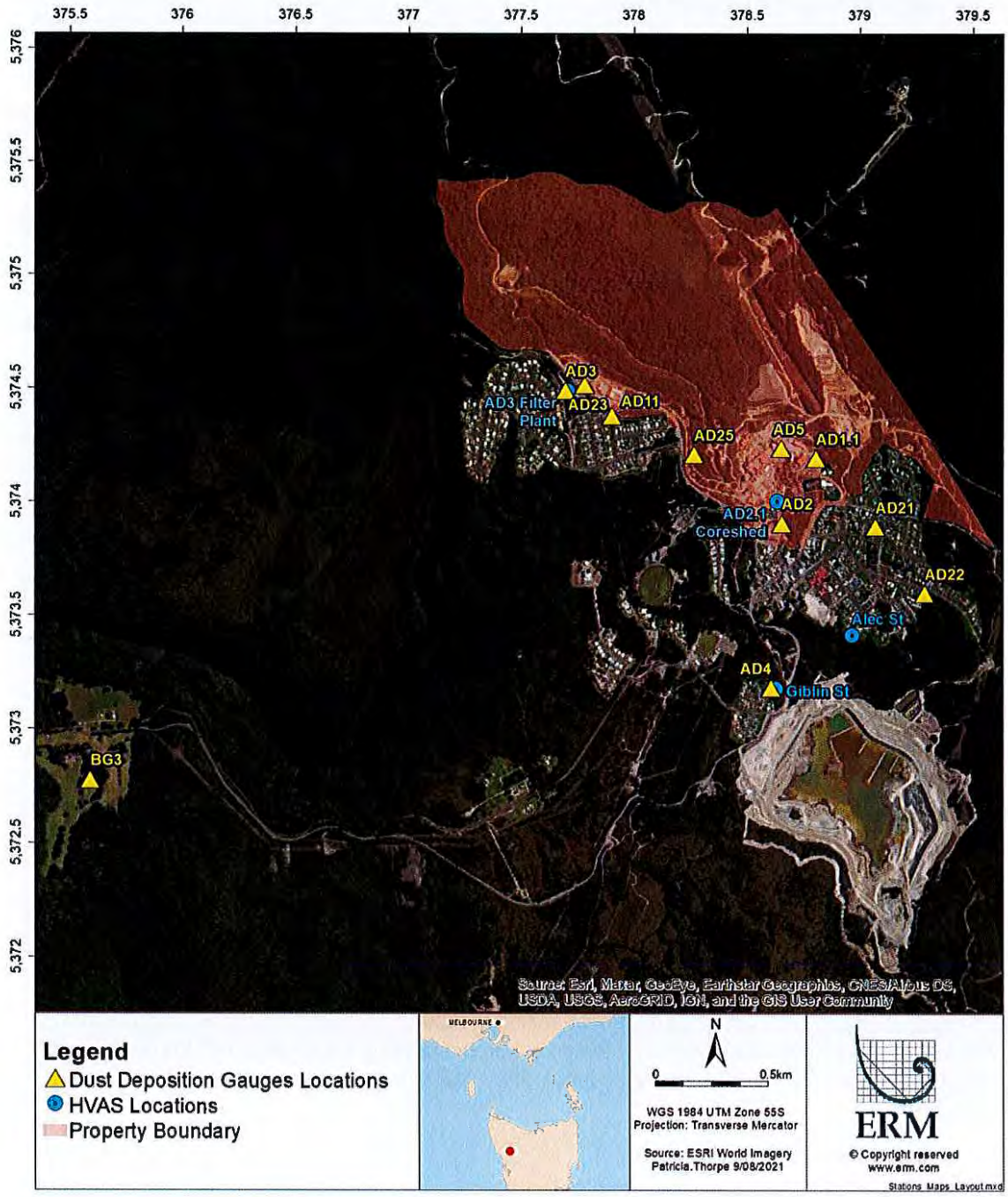

Figure 1.1: Monitoring locations

2. SAMPLING PROCEDURES

2.1 High Volume Air Sampling

The HVAS monitors sample TSP and PM_{10}. The captured particulate matter is then measured for compositions of lead (as TSP), cadmium (as PM_{10}) and zinc (as PM_{10}). Arsenic and copper are also tested, however trigger levels and compliance limits of these substances are not included as part of EPN/PCE. Sampling of 24 hour average concentrations ($\mu g/m^3$) occurs 1 in every 6 days.

A total of two sampling days across the FY21 monitoring period were not completed. MMG carried out an investigation to understand the reason for the missing results. The outcome showed a scheduling issue of the collection of the HVAS filter samples that caused two samples to be taken with the same filter at each HVAS location. This invalidated the HVAS samples for both run dates of the 15/5/2021 and 21/5/2021. The missed events were reported to the EPA on 25/05/2021 (MMG, 2021a) with corrective actions implemented to minimise this error reoccurring in the future.

A list of the unavailable sampling days is provided below in Table 2.1. All HVAS monitors were externally calibrated by Ecotech in January 2021 with periodic internal flow calibrations throughout the year.

Table 2.1: Unavailable HVAS sampling days

Sample Date	Location	Comment
15/05/2021	All location	Scheduling issues resulted in the filter used for two 24 hour sampling periods. All samples for both run dates were invalidated.
21/05/2021	All locations	

Sampling and analysis of TSP was performed using the EA143-MV method and referenced to *Australian/New Zealand Standards AS/NZS3580.9.3:2015: Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method* (Australian and New Zealand Standards, 2015).

Sampling and analysis of PM_{10} was performed using *Australian Standards AS3580.9.6:2015: Determination of suspended particulate matter – PM_{10} high volume sampler with size-selective inlet – Gravimetric method, Monitoring Analysis* (Australian Standards, 2015).

TSP, PM_{10} and metals analysis was performed by a NATA accredited laboratory (ALS Environmental – NATA Accreditation No. 825, Site No. 1656). Residue from the high volume samplers were digested in nitric acid and analysed for metals by inductively coupled plasma mass spectrometry (ICPMS).

There were no recorded deviations from the sampling procedures for the HVAS sampling in FY21 (MMG, 2021b). The HVAS air monitoring complies with the applicable elements of EPN condition M1 as samples are tested at a NATA accredited laboratory which is analysed as per Australian Standards.

2.2 Dust Deposition Gauges

Monthly dust deposition gauge bottles are sent to ALS Environmental for analysis (NATA Accreditation No. 825, Site No. 13778). Total solids (mg), total insoluble matter (TIM, g/m^2/month), total soluble matter (g/m^2/month) and metals (arsenic, cadmium, copper, lead, manganese and zinc, $\mu g/m^2$/month) are analysed. Note that only TIM has trigger levels and compliance limits in EPN 7153/3.

Sampling for total soluble matter, total insoluble matter and total solids was conducted referencing *Australian Standards AS/NZ 3580.10.1 2016: Methods for sampling and analysis of ambient Determination of particulate matter - Gravimetric method* (Australian Standards, 2016).

There were no recorded deviations from the sampling procedures for the DDG sampling in FY21 (MMG, 2021b). The dust deposition monitoring complies with the applicable elements of EPN condition M1 as samples are tested at a NATA accredited laboratory which is analysed as per Australian Standards.

3. AIR QUALITY MONITORING RESULTS

3.1 High Volume Air Sampling

This section presents the results of the FY21 HVAS monitoring data and analysis.

Table 3.1 summarises the HVAS data and the compliance against the trigger level and compliance limits as noted by the green tick. Exceedances of the trigger levels are denoted by a grey cross with exceedances of the compliance limit shown by a red cross.

The 24 hour average and 90 day average provided in Table 3.1 represents the maximum averages for FY21.

Two samples days were considered invalid due to scheduling issues. If the analysis results were reported below the limit of reporting, half the limit of reporting was adopted for reporting.

In FY21, there were no exceedances reported of the trigger levels or compliance limits for all HVAS locations. The graphical results for all HVAS data are presented in Appendix A.

Table 3.1: HVAS monitoring results

Statistic	Pollutant	Trigger Level (mg/m^3)	Compliance Limit (mg/m^3)	AD3 (mg/m^3)			AD2.1 (mg/m^3)			Giblin St (mg/m^3)			Alec St (mg/m^3)		
				Value	TL	CL	Value	TL	CL	Value	TL	CL	Value	TL	CL
24 hour average [a]	TSP	0.150	-	0.034	✓	-	0.076	✓	-	0.021	✓	-	0.031	✓	-
	PM_{10}	0.050	0.150	0.019	✓	✓	0.035	✓	✓	0.013	✓	✓	0.026	✓	✓
	Lead (as TSP)	0.0087	-	0.0018	✓	-	0.0011	✓	-	0.000058	✓	-	0.00010	✓	-
	Cadmium (as PM_{10})	0.000003	-	0.0000014	✓	-	0.0000018	✓	-	0.00000015	✓	-	0.00000015	✓	-
	Zinc (as PM_{10})	0.015	-	0.00099	✓	-	0.00073	✓	-	0.000044	✓	-	0.000082	✓	-
Annual Average	TSP	-	0.090	0.013	-	✓	0.029	-	✓	0.0094	-	✓	0.013	-	✓
90 day average [b]	Lead (as TSP)	-	0.0015	0.00058	-	✓	0.00038	-	✓	0.000026	-	✓	0.000031	-	✓
Number of valid data points (TSP) [c]				58	-	-	58	-	-	58	-	-	58	-	-
Number of valid data points (PM_{10}) [c]				58	-	-	58	-	-	58	-	-	58	-	-

a. The 24 hour average represents the maximum in FY21.

b. The 90 day average represented the maximum in FY21.

c. Two events were invalidated due to mishap of scheduling of filter change (total number of valid data points is 60)

Green ticks denote compliance with the respective trigger level or compliance limit

Grey crosses denote exceedances of the respective trigger level

Red crosses denote exceedances of the respective compliance limit

3.2 Dust Deposition Gauges

This section presents the results of the FY21 DDG monitoring data and analysis.

Table 3.2 summarises the dust deposition against the trigger levels and compliance limits as presented in Table 1.2. The monthly deposition and background contributions for DDG at or beyond the site boundary are presented in Figure 3.1. All monthly dust deposition gauge results are presented in Appendix A.

It is important to note that five or more months were considered invalid at each location due to high rainfall events flooding the gauges, as shown in Table 3.2. As less than six months of data was considered valid for AD11 the annual averages are not considered true annual averages. However, as the invalid data are due to large amount of rainfall, the dust deposition during these periods would be low. This means that the calculated annual averages with the less than six months of data is a conservative representation of the annual conditions.

Exceedances of deposition gauge AD21 was reported for the monthly trigger limits for both the total and increase above background values. Exceedances of AD22 were reported for the monthly trigger limit above background values. The exceedance investigations for these gauges are further discussed in Section 3.3.

No exceedances of the compliance limit were reported for any deposition gauges at or beyond the site boundary for FY21.

Table 3.2: DDG monitoring results at or beyond the boundary

Site	Number of valid samples	Monthly Deposited Dust above background (g/m^2/month)		Monthly Total Deposited Dust (g/m^2/month)		Annual Average Deposited Dust above background (g/m^2/month)		Annual Average Total Deposited Dust (g/m^2/month)	
Trigger Level		**2**		**4**		**-**		**-**	
Compliance Limit		**-**		**-**		**2**		**4**	
AD3	6	0.70	✓	2.3	✓	0.30	✓	1.0	✓
AD4	7	1.3	✓	1.5	✓	0.29	✓	0.59	✓
AD11	5	1.7	✓	2.2	✓	0.50	✓	0.84	✓
AD21	7	**3.8**	✗	**4.3**	✗	1.2	✓	1.5	✓
AD22	7	**2.5**	✗	3.0	✓	0.60	✓	1.2	✓
BG3	6	1.5	✓	2.9	✓	0.50	✓	1.2	✓

Green ticks denote compliance with the respective trigger level or compliance limit
Grey crosses denote exceedances of the respective trigger level
Red crosses denote exceedances of the respective compliance limit

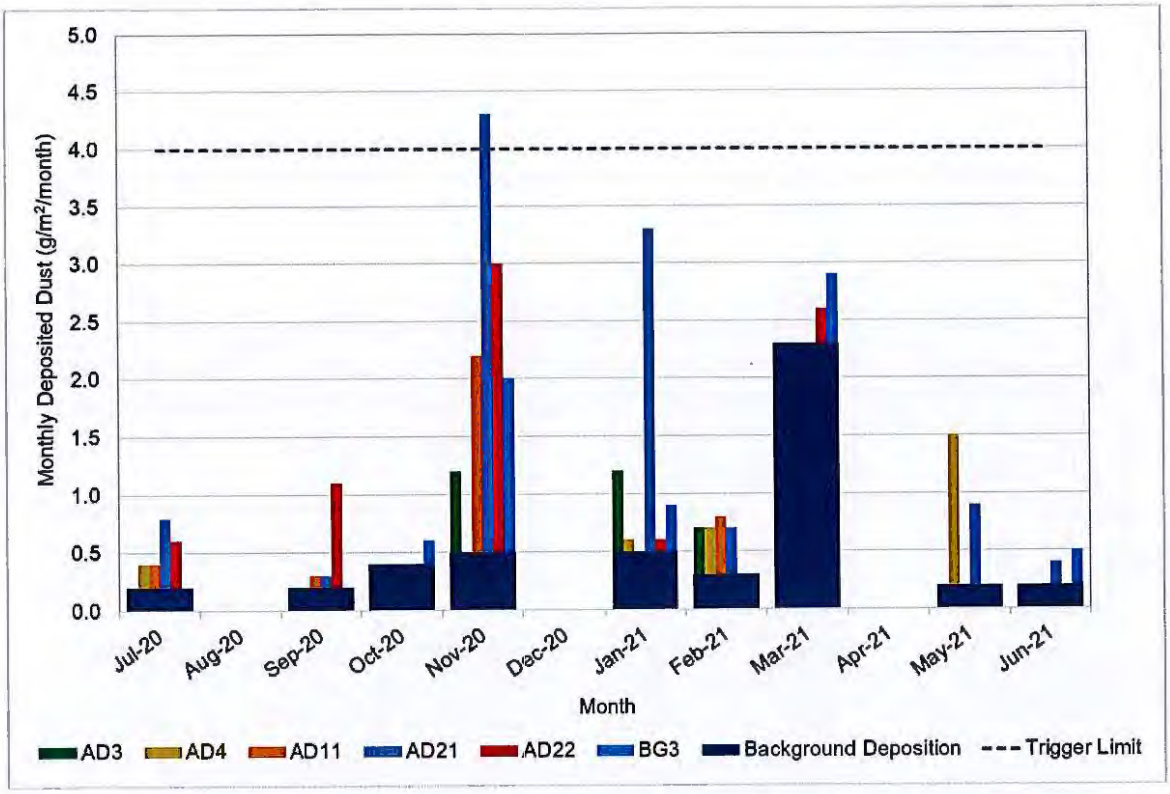

Figure 3.1: Total monthly deposition for sites at or beyond the site boundary

3.3 Trigger Level Exceedances Investigations – AD21 and AD22

Exceedance of the total monthly deposited dust trigger limits at AD21 and AD22 and deposited dust above background trigger level at AD21 were reported in November 2020. Exceedance of the monthly dust above background trigger level at AD25 was reported in February 2021.

An investigation into the deposition trigger levels for AD21 and AD22 during November 2020 was reported to EPA Tasmania on 01 February 2021 (MMG, 2021c). The exceedance at AD21 was reported in January 2021 and reported to EPA Tasmania on 16 February 2021 (MMG, 2021d).

The investigations concluded that the most likely cause of the elevated deposition results at AD21 and AD22 was be due resurfacing of the roads in the vicinity of the gauges. The roadworks occurred between October 2020 and February 2021. The prevailing westerly wind direction, higher temperatures and lower rainfall in November 2020 and January 2021 likely contributed to the elevated deposition at AD21 and AD22. Lower dust deposition results were observed at the other dust deposition gauges within the site for this period.

3.4 Summary

There were no exceedances of the compliance limits for all HVAS and DDG locations.

Two monthly trigger level DDG exceedances at AD21 were reported for deposition above background and one exceedance of total monthly deposited dust. One exceedance was also reported for deposition above background trigger lever at AD22. The most likely cause of this dust deposition exceedances was the highly localised emissions from the roadworks conducted in proximity to the DDGs.

As no exceedances of the compliance limits were reported, it is indicated that MMG's Rosebery mine is a low environmental risk to air quality and that the current dust mitigation controls are appropriate.

Based on this review, it is recommended that the air quality monitoring network be reviewed and consolidated. Considering the low environmental risk to air quality and the typical annual rainfall, a small targeted network could provide more meaningful information regarding the mine's dust impact.

As per EPN 7153/3 condition A3-4:

> *Measurements at the 'additional sites' (BG3, AD11, AD21, AD22, AD23 and AD25) are to continue until such time as an annual pattern can be established and a full 12-month dataset is compiled. This data is to be analysed in a report presented to the Director, containing recommendations and a request for approval to remove specific 'additional sites' from the monitoring network. Monthly monitoring must continue at all of the 'additional sites' until the Director provides approval to remove the individual sites.*

These additional sites have been collecting data for over nine years which is sufficient to establish an annual pattern. As per conditions A3-4, an analysis of these sites is recommended to be able to remove these additional sites from the monitoring network. This will allow for consolidation of the monitoring network.

4. REVIEW OF DUST MANAGEMENT PERFORMANCE

MMG have a dust mitigation plan (SHEC Excellence, 2015) that outlines the dust mitigation measures to reduce the environmental risk associated with the generation of dust at the Rosebery Mine. The dust mitigation plan was updated with a review by ERM (2020) and submitted to EPA Tasmania on 31 March 2020 (MMG, 2020). This plan was approved with the temporary subaerial tailings deposit in the 2/5 Dam TSF on 21 December 2020 (EPA Tasmania, 2020)

This plan fulfils the requirements of section A6 of EPN 7153/3.

The dust mitigation plan and review includes the following:

- sources of potential dust from the Rosebery mine;
- details on the real-time monitoring network (four DustTrak's co-located with the HVAS monitors and site meteorological monitoring);
- the real-time inspection and mitigation level triggers, as presented in Table 4.1;
- general responses when real-time inspection or mitigation level triggers occur; and
- meteorological conditions that are considered conducive to dust events.

The review (2020) proposed new trigger levels as presented in Table 4.1.

Table 4.1: Real-time dust trigger levels in dust mitigation plan

Averaging period	Current Inspection Level (µg/m^3)	Current Mitigation Level (µg/m^3)
15 minutes	300	500
60 minute	200	350

Source: Proposed real-time dust trigger levels provided in Dust Mitigation Plan Review (ERM, 2020)

4.1 Summary of Inspection and Mitigation Level Alerts

The number of alerts and alert days[1] of the inspection and mitigation levels, as presented in Table 4.1, are summarised in Table 4.2. The provided 15 minute and 60 minute rolling averages reported by the telemetry network were used in the analysis.

In late 2020, with the assistance of EPA Tasmania, site specific calibration factors were applied to the DustTraks to reduce the amount of dust alarms of 'inspection' and 'mitigation' levels due smoke haze from nearby residence. It is recommended that the calibration factors are validated yearly to assess their appropriateness.

Table 4.2: Number of alerts and alert days

		AD3	AD2.1	Giblin St	Alec St
Number of Alerts	*Inspection Level*				
	15 minute	9	26	7	53
	60 minute	44	273	2,936	97
	Mitigation Level				
	15 minute	0	0	4	7
	60 minute	0	0	4	0
Nu mbe r of	*Inspection Level*				
	15 minute	1	1	2	18

[1] An alert day is defined as a day where one or more alert of the mitigation or trigger level is raised.

		AD3	AD2.1	Giblin St	Alec St
	60 minute	3	2	4	13
	Mitigation Level				
	15 minute	0	0	1	2
	60 minute	0	0	1	0
Data Capture [a]		87%	97%	53%	72%

a. Data capture excludes missing data points invalidated during the data analysis. These invalidated data points were still provided in the real-time alerts.

4.2 Summary of Dust Management Performance

Analysis of the air quality monitoring network (HVAS and DDG monitoring data) shows that the performance of the dust management at the Rosebery Mine is sufficient in mitigating fugitive dust.

There were a number of alerts of the inspection and mitigation levels of the DustTrak monitoring network throughout FY21. The majority of the alerts received occurred at Alec Street and Giblin Street during winter and were related to woodfire smoke from the nearby residents. The installation of the two DRX DustTrak units at Alec Street and Giblin Street in addition to the site specific calibration factors assisted with reducing the number of alerts of the inspection and mitigation levels as compared to previous years.

4.3 Recommendations for Future Dust Management

Based on the review of air quality monitoring network, it is recommended that the Rosebery Mine continue its current mitigation management and mitigation measures. It is also recommended that the mitigation and inspection trigger levels are reviewed every three years to understand if they are sufficient to assist in the continued control of dust from site.

5. REFERENCES

Australian and New Zealand Standards. (2015). *AS/NZS3580.9.3:2015 Determination of suspended particulate matter – Total suspended particulate matter (TSP) – High volume sampler gravimetric method.*

Australian Standards. (2015). *AS3580.9.6:2015 Determination of suspended particulate matter – PM10 high volume sampler with size-selective inlet – Gravimetric method, Monitoring Analysis.*

Australian Standards. (2016). *AS/NZS 3580.10.1:2016: Methods for sampling and analysis of ambient Determination of particulate matter - Gravimetric method.*

Australian/New Zealand Standard. (2016). Methods for sampling and analysis of ambient air. *Part 1.1: Guide to siting air montioring equipment.*

EPA Tasmania. (2016). Permit Conditions - Environmental No. 9084. Environmental Protection Authority Tasmania.

EPA Tasmania. (2020). *MMG ROSEBERY MINE - APPROVAL FOR TEMPORARY SUBAERIAL TAILINGS DEPOSIT IN THE 2/5 DAM TSF.* EPA Tasmania.

ERM. (2020, March 23). Dust Mitigation Plan Review - Rosebery Mine. *Project No.: 0531994 - issued 23 March 2020.* ERM Australia Pacific Pty Ltd.

MMG. (2017). ROS ENVIRONMENTAL SAMPLING QUALITY CONTROL REQUIREMENTS. MMG Rosebery.

MMG. (2020). *MMG Rosebery –Dust Mitigation Plan* . MMG Rosebery.

MMG. (2021a, 06 17). Missed HVAS Sampling Events - Investigation Summary. *Memorandum.*

MMG. (2021b). per comms between Bowen Wagenknecht and Rebecca Chalmer - recieved 5/8/2021. *RE: MMG Rosebery 2021 AMRMR CPORT.* MMG.

MMG. (2021c, February 01). MEMORANDUM. *Subject: DUST DEPOSITION TRIGGER NOTIFICATION.* MMG Rosebery.

MMG. (2021d, February 16). MMG Rosebery - DDG Trigger Notification . MMg.

SHEC Excellence. (2015). *Dust Mitigation Plan: Rosebery Mine.* Prepared by SHEC Excellence for MMG Rosebery Mine.

APPENDIX A ADDITIONAL PLOTS

Additional HVAS Data

The individual day 24 hour HVAS plots are presented in Figure 5.1 to Figure 5.5. The 90 day average Lead (as TSP) is presented in Figure 5.6.

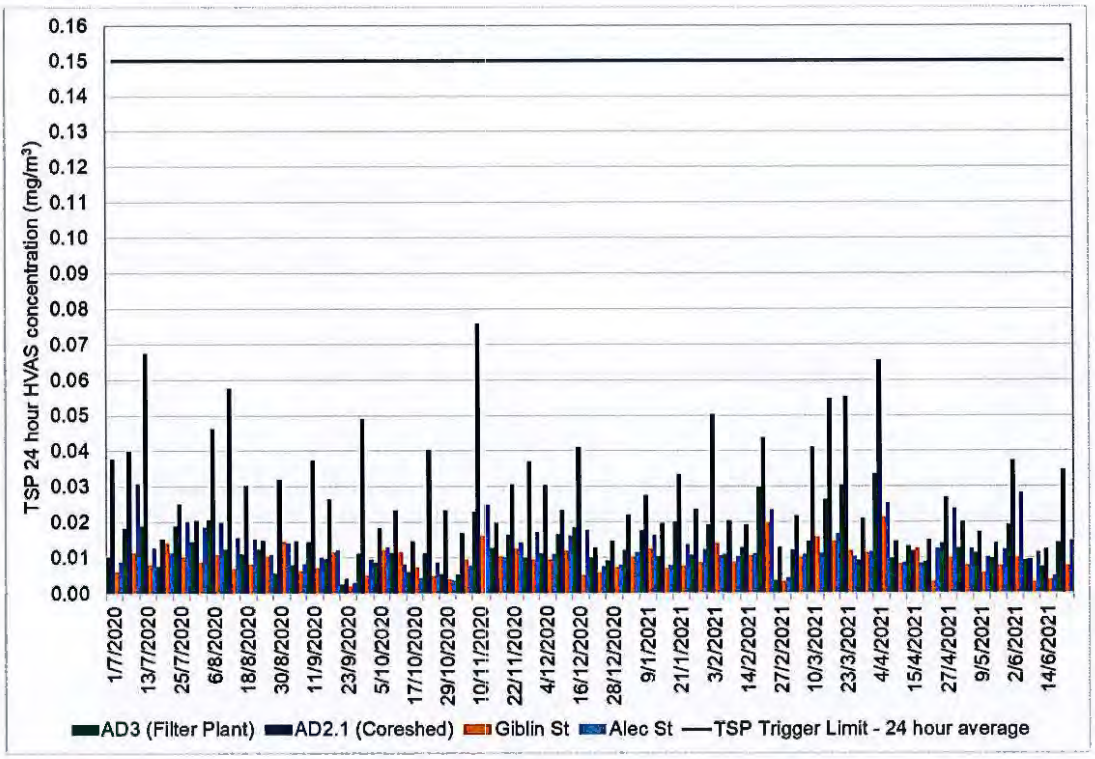

Figure 5.1: TSP HVAS 24 hour averages for FY21

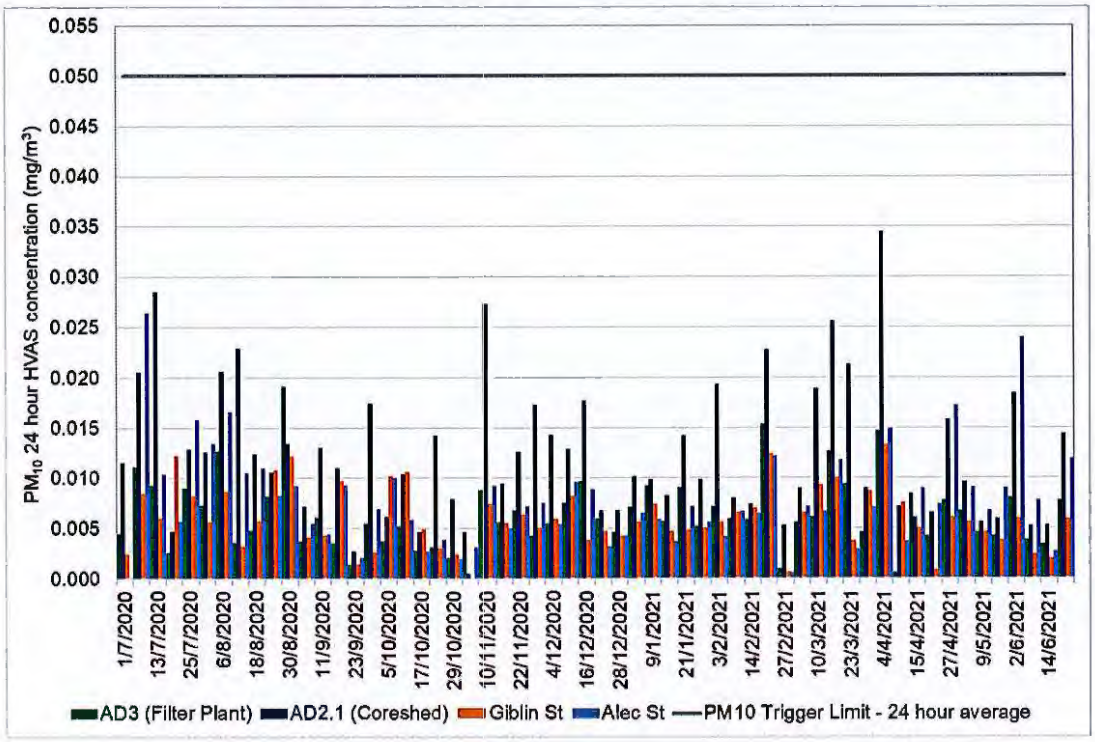

Figure 5.2: PM_{10} HVAS 24 hour averages for FY21

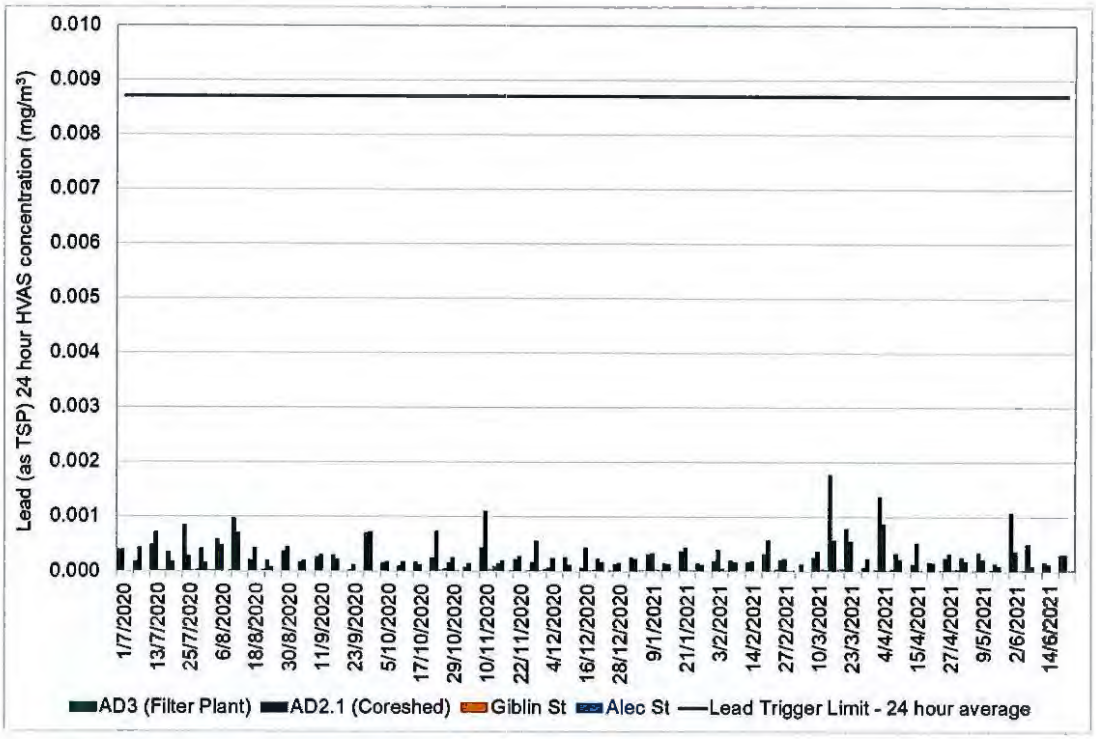

Figure 5.3: Lead (as TSP) HVAS 24 hour averages for FY21

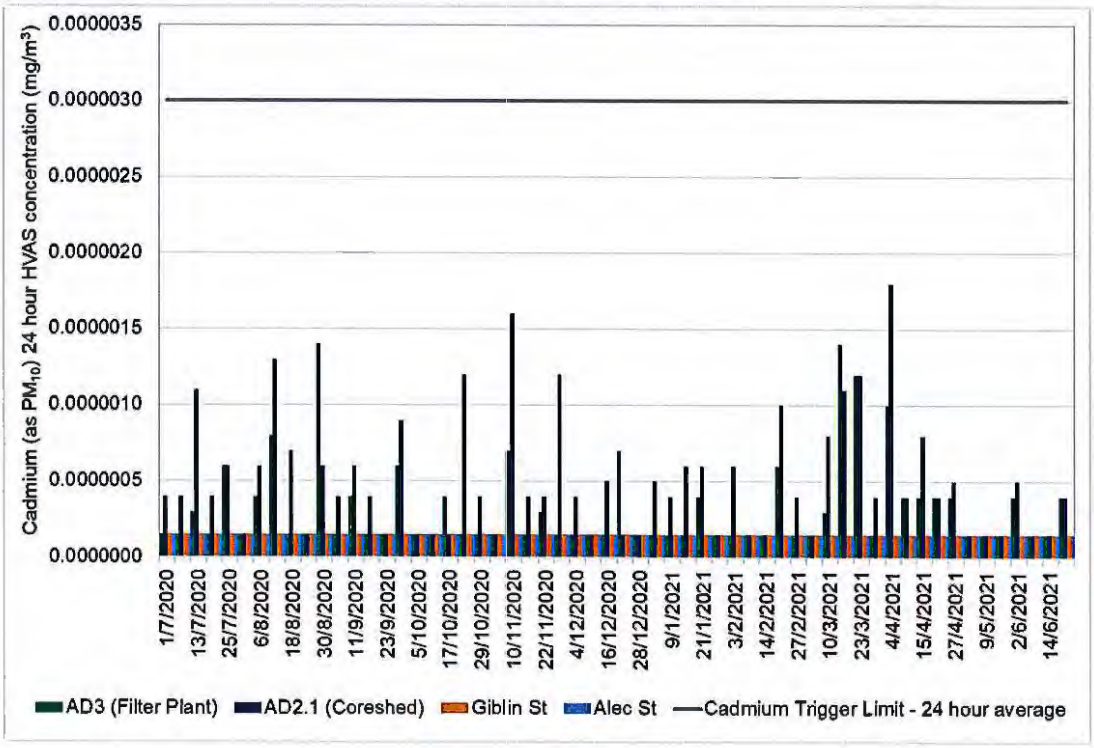

Figure 5.4: Cadmium (as PM_{10}) HVAS 24 hour averages for FY21

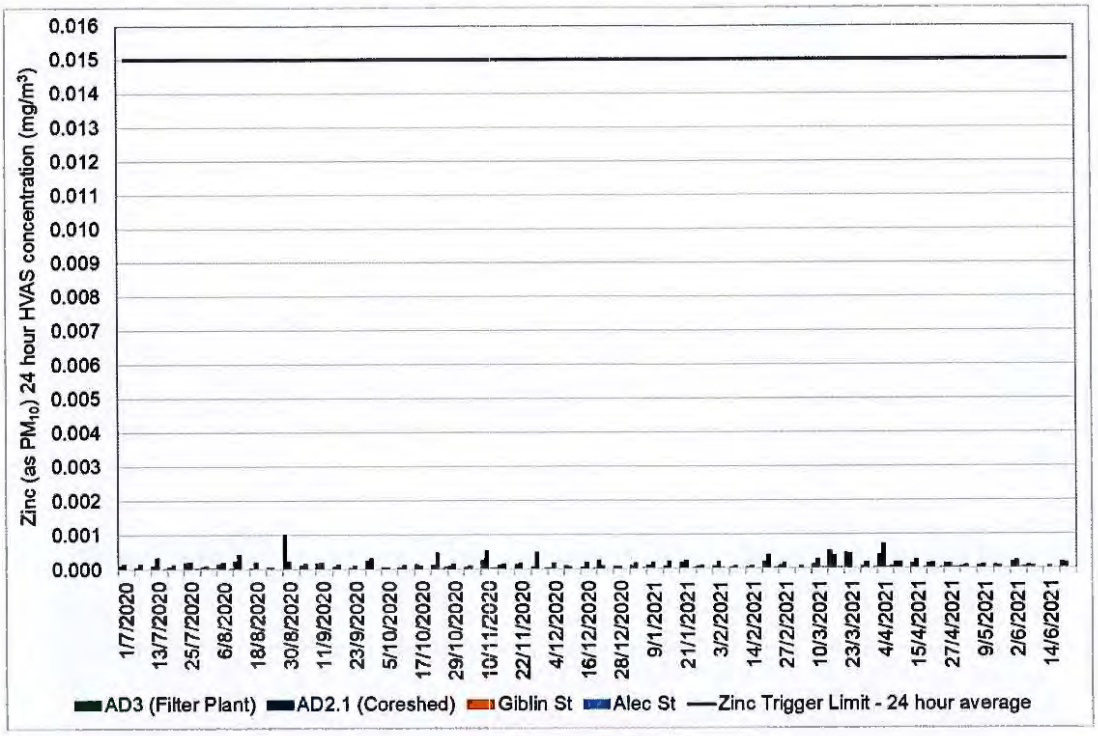

Figure 5.5: Zinc (as PM_{10}) HVAS 24 hour averages for FY21

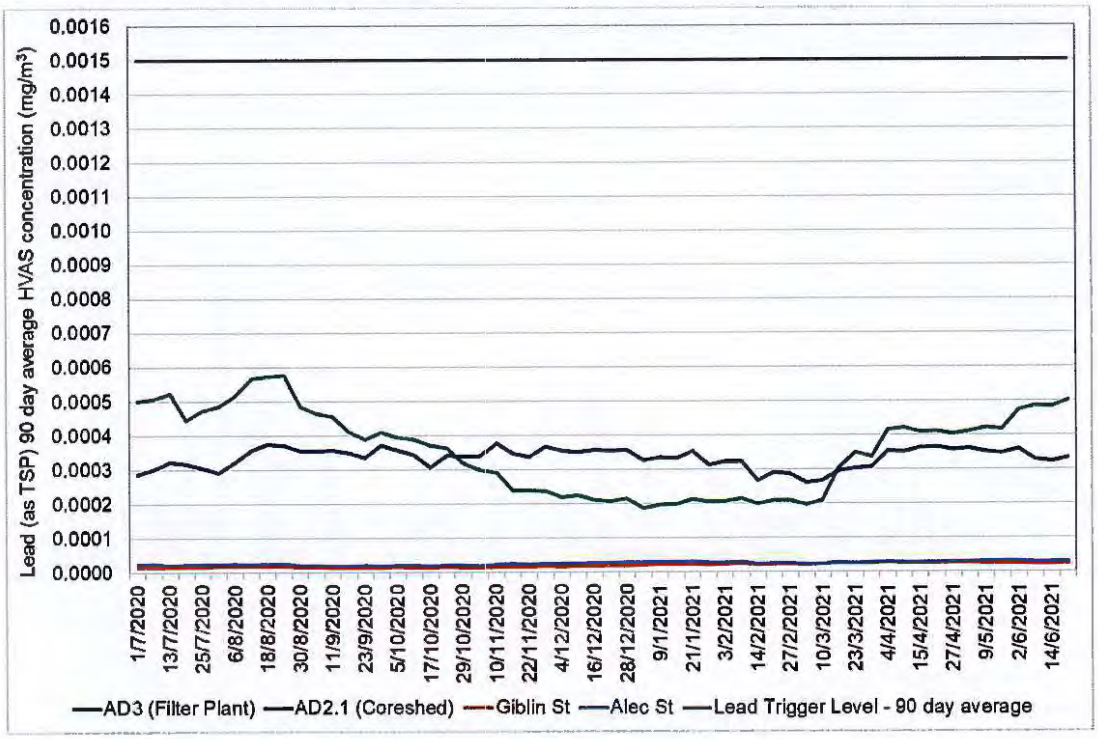

Figure 5.6: Lead (as TSP) HVAS 90 day average for FY21

Deposition Data

The monthly deposition and monthly deposition above background for sites at or beyond the boundary are presented Figure 5.7 and Figure 5.8. The monthly dust deposition at all sites are presented in Figure 5.9.

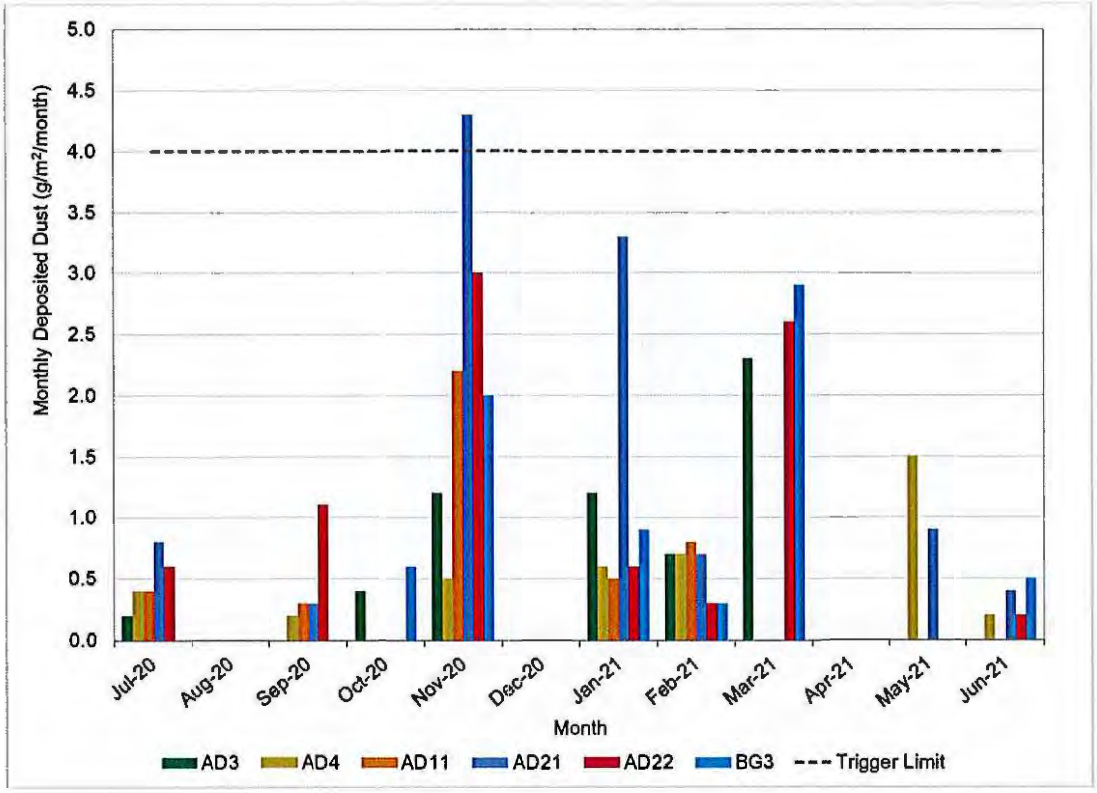

Figure 5.7: Monthly deposition for sites at or beyond the site boundary

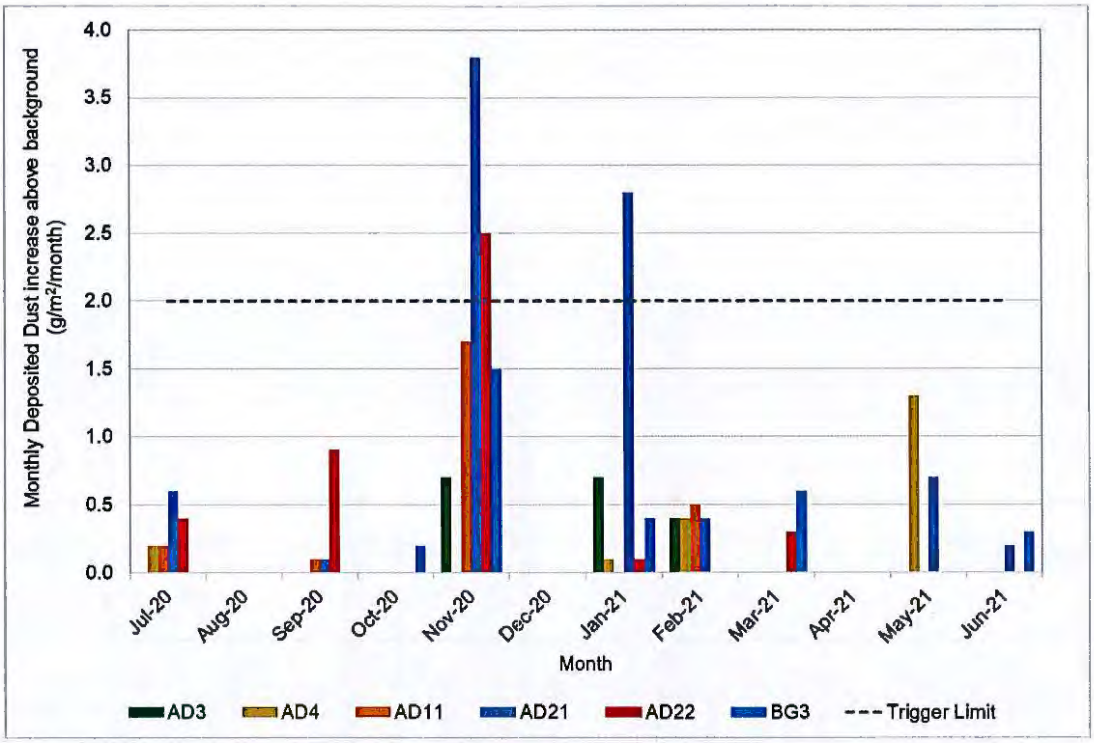

Figure 5.8: Monthly deposition above background for sites at or beyond the site boundary

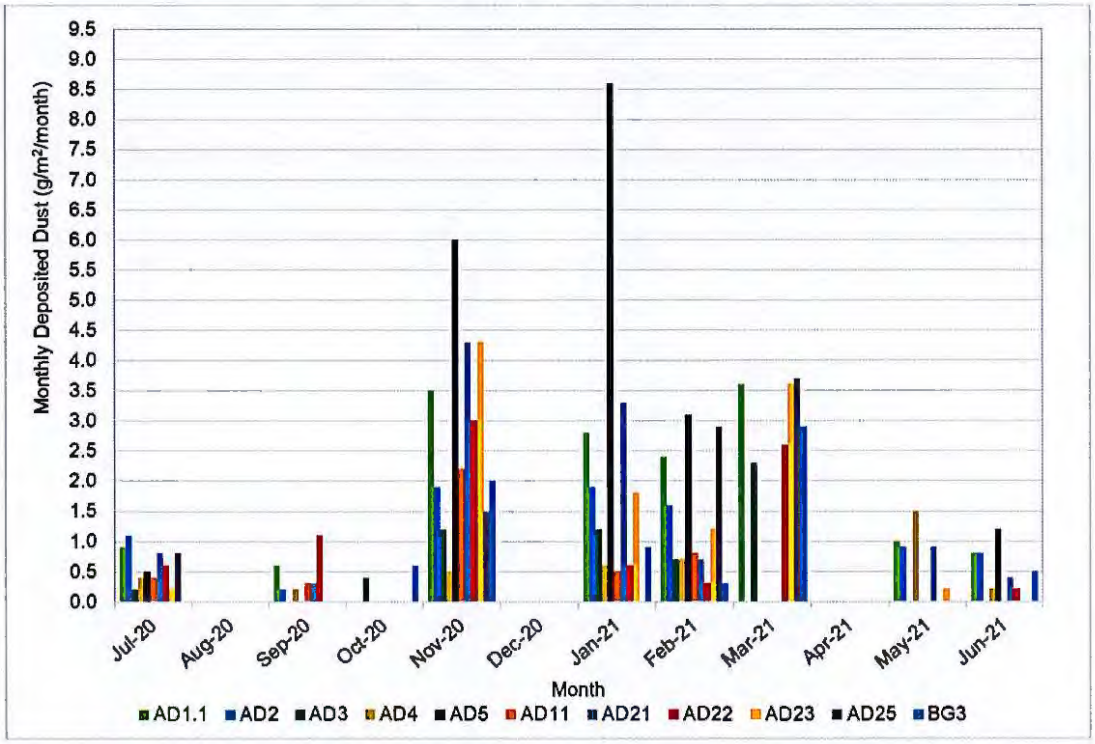

Figure 5.9: Monthly deposited dust at all sites

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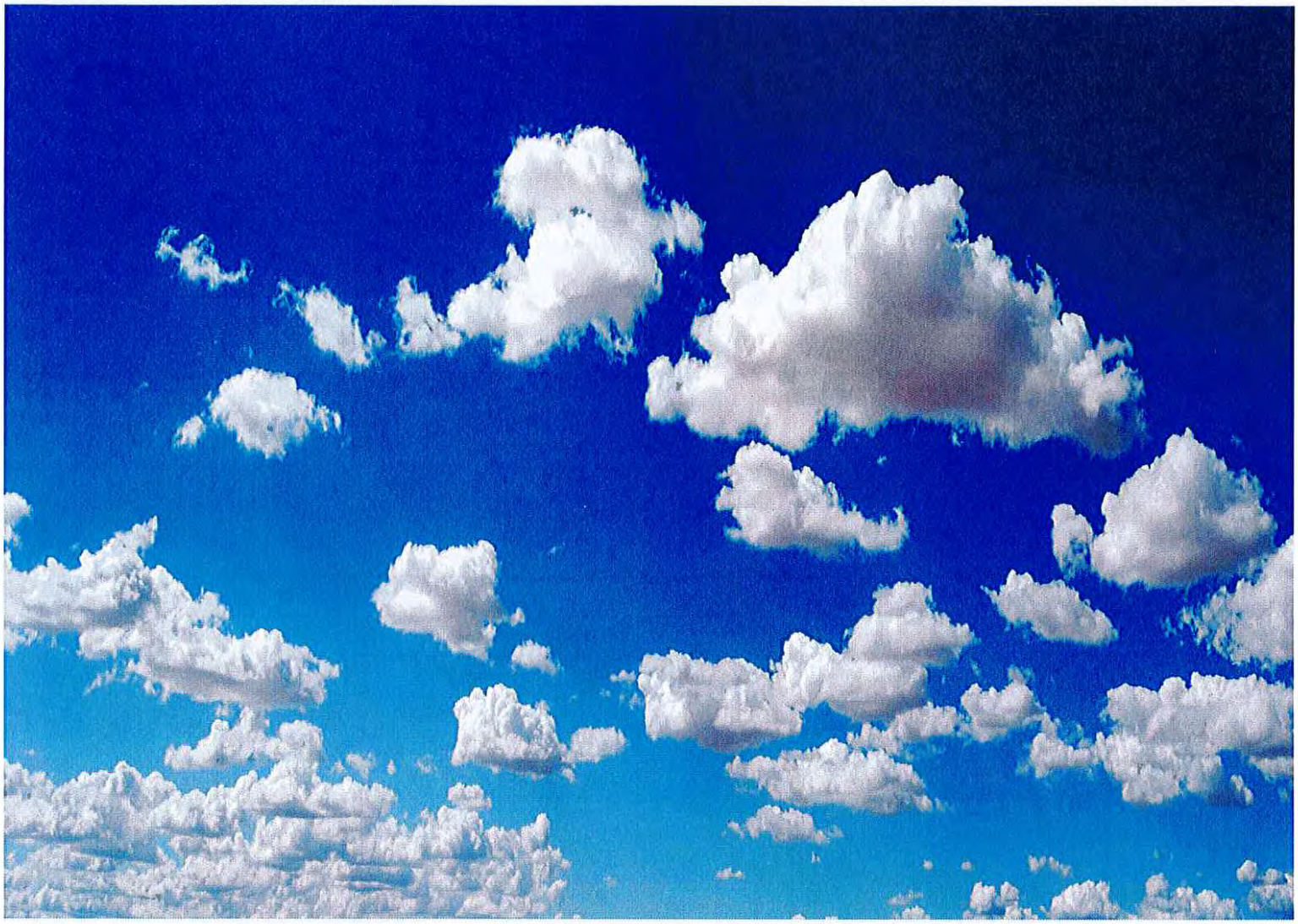
APPENDIX H: ANNUAL METEOROLOGICAL REVIEW – FY21 (ERM, 2021)



Annual Meteorological Review – FY21

Rosebery Mine

18 August 2021

Project No.: 0516238

The business of sustainability

ERM

Document details	
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Signature Page

18 August 2021

Annual Meteorological Review – FY21

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1. INTRODUCTION

MMG's Rosebery mine is an underground polymetallic base metal mine located in the township of Rosebery, Tasmania. MMG has an obligation under its Environmental Protection Notice (EPN 7153/3, PCE 9084 & Rosebery Dust Mitigation Plan) to report annually on aspects of its meteorological, dust deposition and ambient air quality monitoring programmes (EPN 7153/3 conditions A2-A5, G7 2.7 & PCE 9084 conditions A4-5, G6 & M3).

As per EPN 7153/3 condition A4-3, an analysis of the climate must to be performed annually. ERM was engaged to perform this review for the financial year 2021 (FY21) period. This report summarises the dominant meteorological conditions at site and examines diurnal and seasonal variability in wind speed and direction, temperature, relative humidity and rainfall.

2. METEOROLOGICAL LOCATIONS

There are three 10 m mast meteorological stations operated by MMG that are located close to Rosebery (2/5 Dam station, Bobadil station and Carpark station), as presented in Figure 2.1.

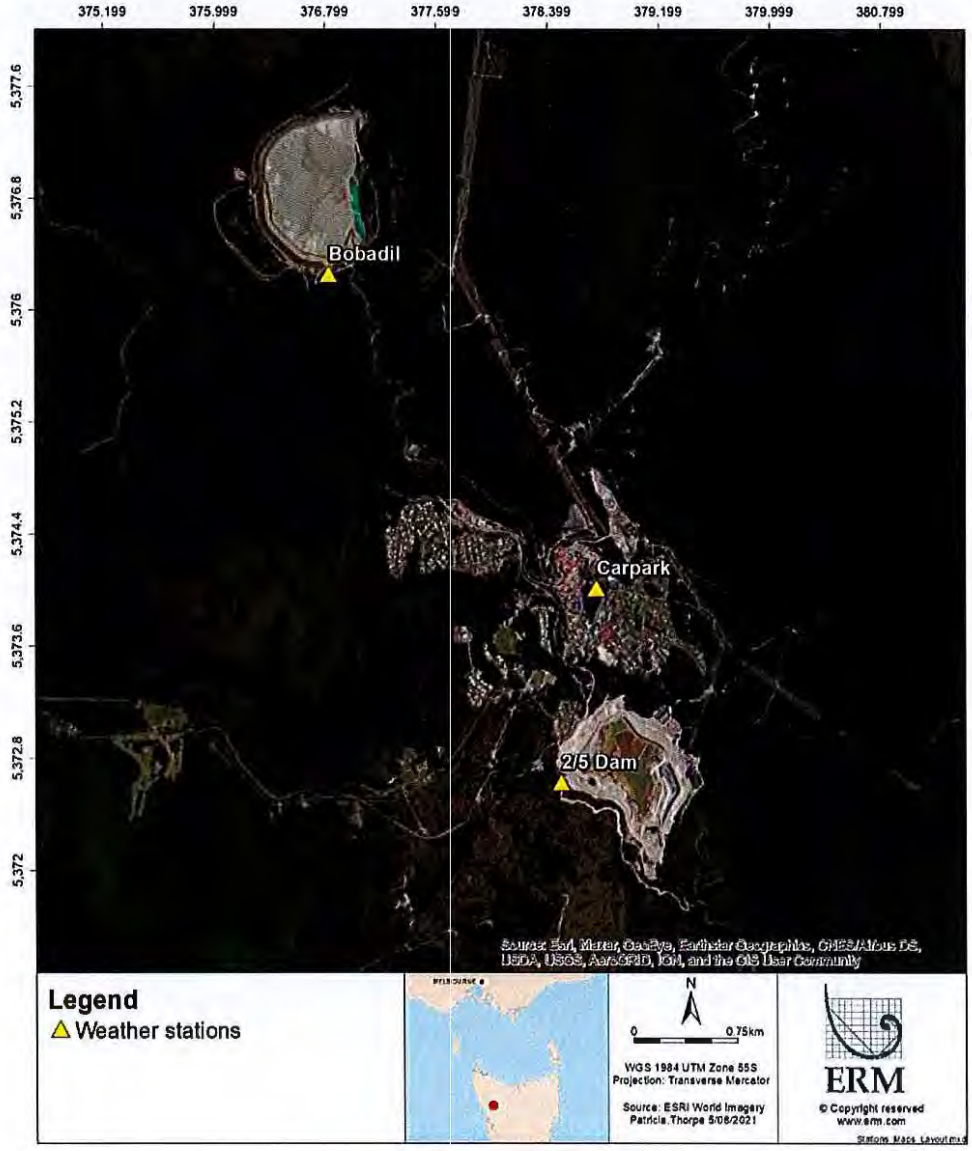


Figure 2.1: Meteorological station locations

3. METEROLOGICAL ANALYSIS

The meteorological stations record wind speed and direction, temperature, relative humidity and rainfall with values reported on a 10 minute, hourly and daily average basis.

In the FY19 Annual Meteorological Review[1], a validation exercise to confirm the averaging technique of the 10 minute to hourly data was completed. The comparison showed that hourly averaging technique was considered valid and appropriate for use in the data analysis. As the method was shown valid and is still currently in use, MMG supplied FY21 hourly data only and it was used for this meteorological review[2]. The summary of the FY21 meteorological review is presented in Table 3.1.

3.1 Data validation

Data validation of the meteorological dataset was conducted taking in consideration equipment calibration, data statistics and comparison to previous recorded data.

As described in the Australian Standard AS3580.19:2020[3] Methods for sampling and analysis of ambient air:

- All data shall be treated as valid unless there is evidence or sound scientific principles which support the invalidation of the data;
- When data are invalidated it should be confirmed that previous reported data are not affected;
- When critical criteria or operational criteria exceed the specified control limits, data shall be invalidated back to the most recent calibration or valid measurements.
- Identify causes of invalidation of data such as power failure or instrument malfunction.

In the FY20 Annual Meteorological Review, an error was observed with the wind directions sensor at the Carpark monitoring station. Replacement of this sensor was due in the annual calibrations, however, the calibrations were delayed due to COVID-19 travel restrictions. The wind sensor was replaced during the FY21 annual calibrations that were performed on 25 July 2020[4]. Due to the error in the wind direction sensor, the data from the Carpark station prior to the calibration was considered invalid and excluded from the review.

Table 3.1: Summary of FY21 meteorological review

Summary and Meteorological Parameter		Station		
		Carpark	2/5 Dam	Bobadil
Data Capture (%)	Wind speed and direction	93.2% [a]	99.9%	99.9%
	Temperature	99.7%	99.9%	99.9%
	Relative Humidity	99.7%	99.9%	99.9%
	Rainfall	99.7%	99.9%	99.9%
Data Quality [b]	Wind speed and direction	High	High	High
	Temperature	High	High	High
	Relative Humidity	High	High	High
	Rainfall	High	High	High

[1] ERM (2019) Annual Meteorological Review – Rosebery Mine, Project No.: 0516238, ERM, issued 6 August 2019.

[2] MMG (2021a) per coms between Rebecca Chalmer and Bowen Wagenknecht, received 16 July 2021.

[3] Australian Standard AS3580.19:2020 (2020). Methods for sampling and analysis of ambient air, Method 19: Ambient air quality data validation and reporting.

[4] MMG (2021b) per coms between Rebecca Chalmer and Bowen Wagenknecht, received 5 August 2021.

Summary and Meteorological Parameter		Station		
		Carpark	2/5 Dam	Bobadil
Variability between sites	Wind speed and direction	Predominate westerlies	Predominate westerlies	Predominate northerlies and south westerlies
	Temperature	Little variability between sites with the warmest mean temperatures in January 2021 and cooler mean temperatures in July 2020.		
	Relative Humidity	Little variability between sites with higher humidity in summer and lower humidity during winter.		
	Rainfall	Similar trend observed between sites with April 2021 being the wettest month. Lower rainfall was observed at the Carpark station.		

a. Due to an error in the wind direction sensor, the wind speed and wind direction from the Carpark station was excluded prior to the calibration date (25 July 2020).

b. Data quality is based on instrument maintenance and calibrations as per manufacturer's standards.

3.2 Wind Speed and Wind Direction

Wind roses were used to determine the dominant wind patterns at the Rosebery mine. Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (N, NNE, NE, etc.). The bar at each wind direction in the wind rose represents winds blowing from that direction, e.g. north. The length of the bar represents the frequency of occurrence of winds from that direction, while colour of the bar corresponds to wind speed category. With the resulting figure, it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

Wind roses for FY21 for three stations onsite are presented in Figure 3.1. The 2/5 Dam and Carpark wind roses show predominate westerly wind directions with infrequent easterlies. The Bobadil wind rose shows the dominate winds were south westerly and northerly.

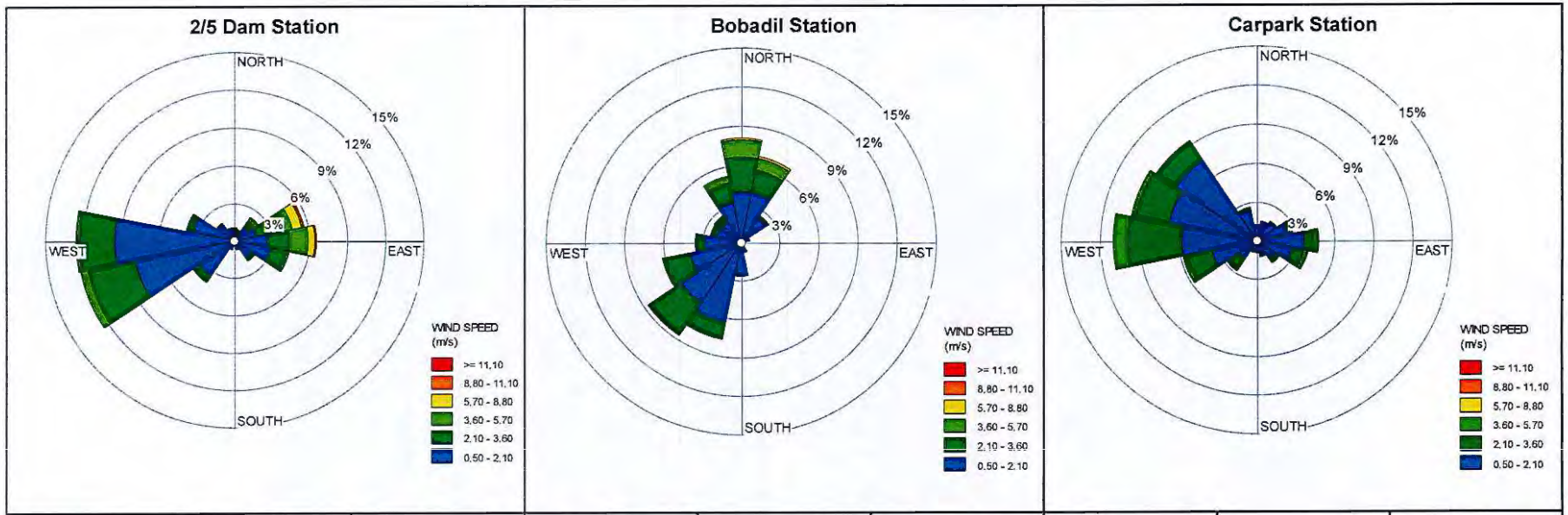
The three wind roses indicate that wind speeds were very low at the Rosebery mine, with a high frequency of calm conditions[5]. These low wind speeds are likely the result of the surrounding terrain, as the Rosebery mine is surrounded by tall hills that shelter it from the wind. The differences in the dominant wind directions at the three sites are also most likely a consequence of the terrain, with the dominant westerly flow in the region being slightly modified by the hills.

Seasonal and time of day wind roses for each weather station are shown in Figure 3.2 to Figure 3.7.

There was minimal seasonal variation in wind direction at the 2/5 Dam and the Carpark stations, with easterly winds being slightly more common in winter and spring. South westerly winds dominated at the Bobadil station during summer, while northerly winds were more frequent in winter and spring. Both northerly and south westerly winds were frequent during autumn at the Bobadil station.

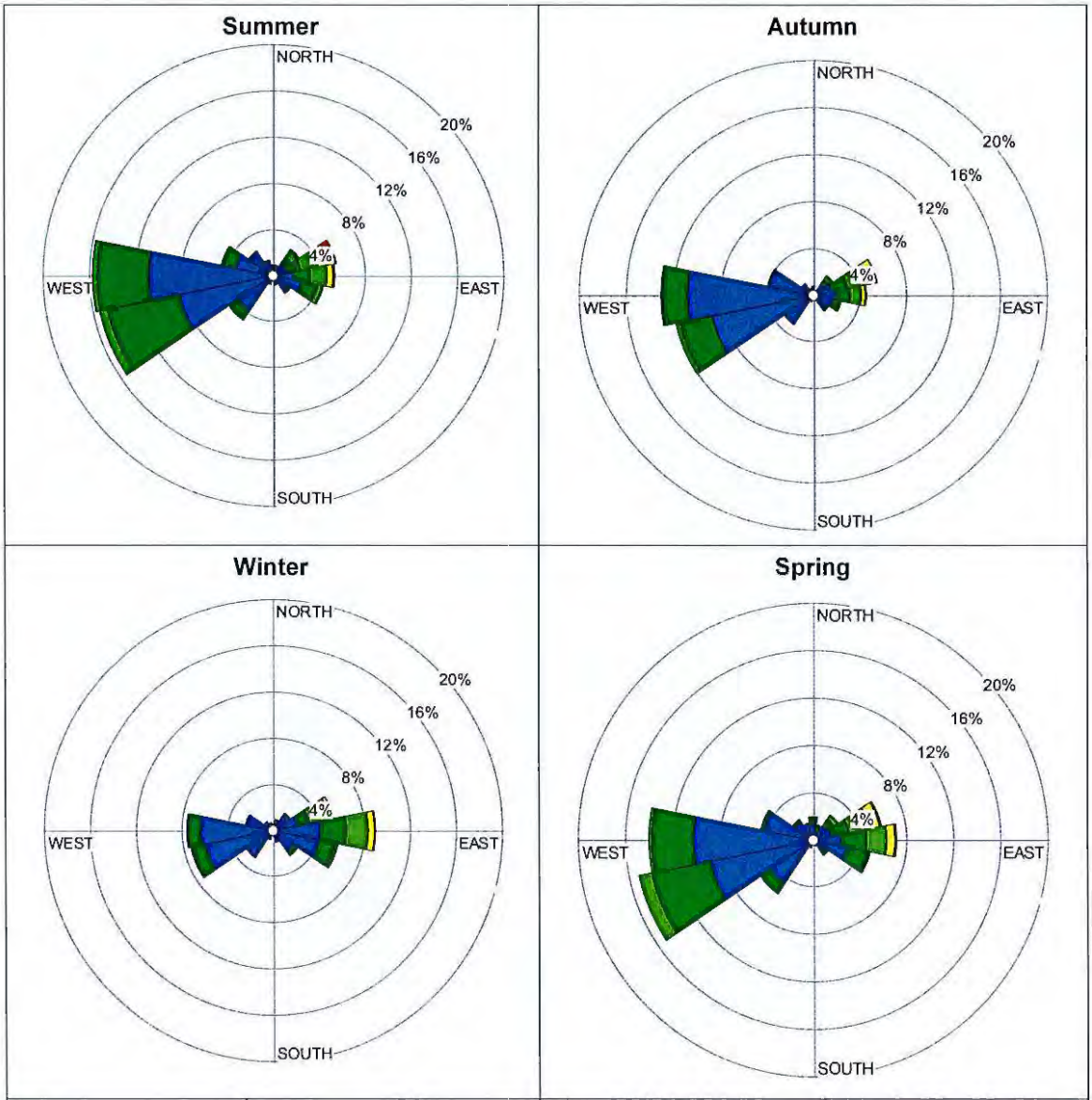
Westerly winds were particularly dominant during daytime hours (between 8am and 8pm) at the 2/5 Dam and the Carpark station. South westerly winds were also frequent at the Bobadil station during daytime hours (between 8am and 8pm), highlighting the dominance of westerly winds in the region.

[5] Calm conditions are defined with a wind speed less than 0.5 m/s



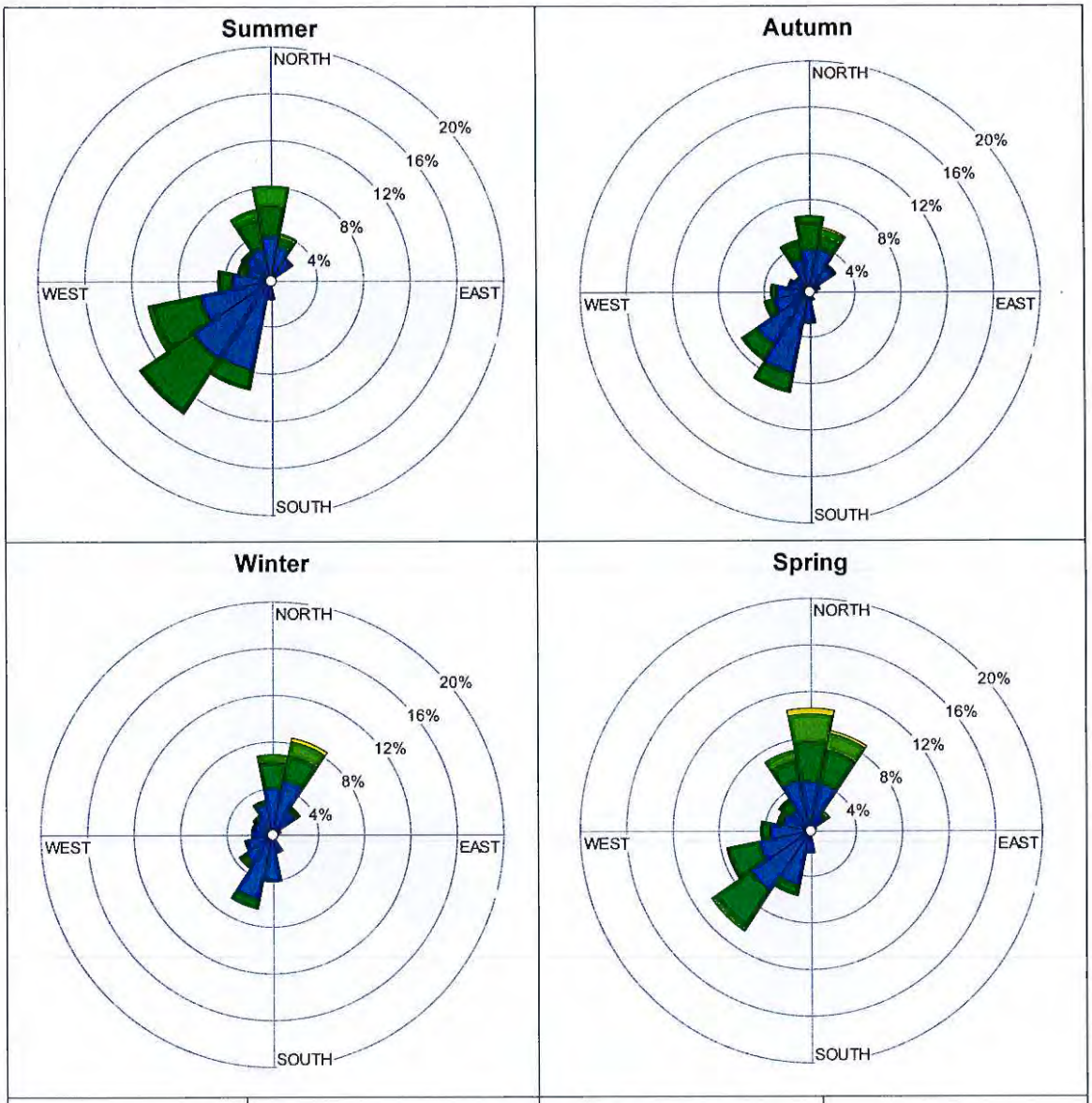
Average wind speed (m/s)	*Calm winds (%)*	*Data Availability (%)*	*Average wind speed (m/s)*	*Calm winds (%)*	*Data Availability (%)*	*Average wind speed (m/s)*	*Calm winds (%)*	*Data Availability (%)*
1.1	39	100	1.0	41	100	1.1	30	93.2

Figure 3.1: Annual wind roses for FY21



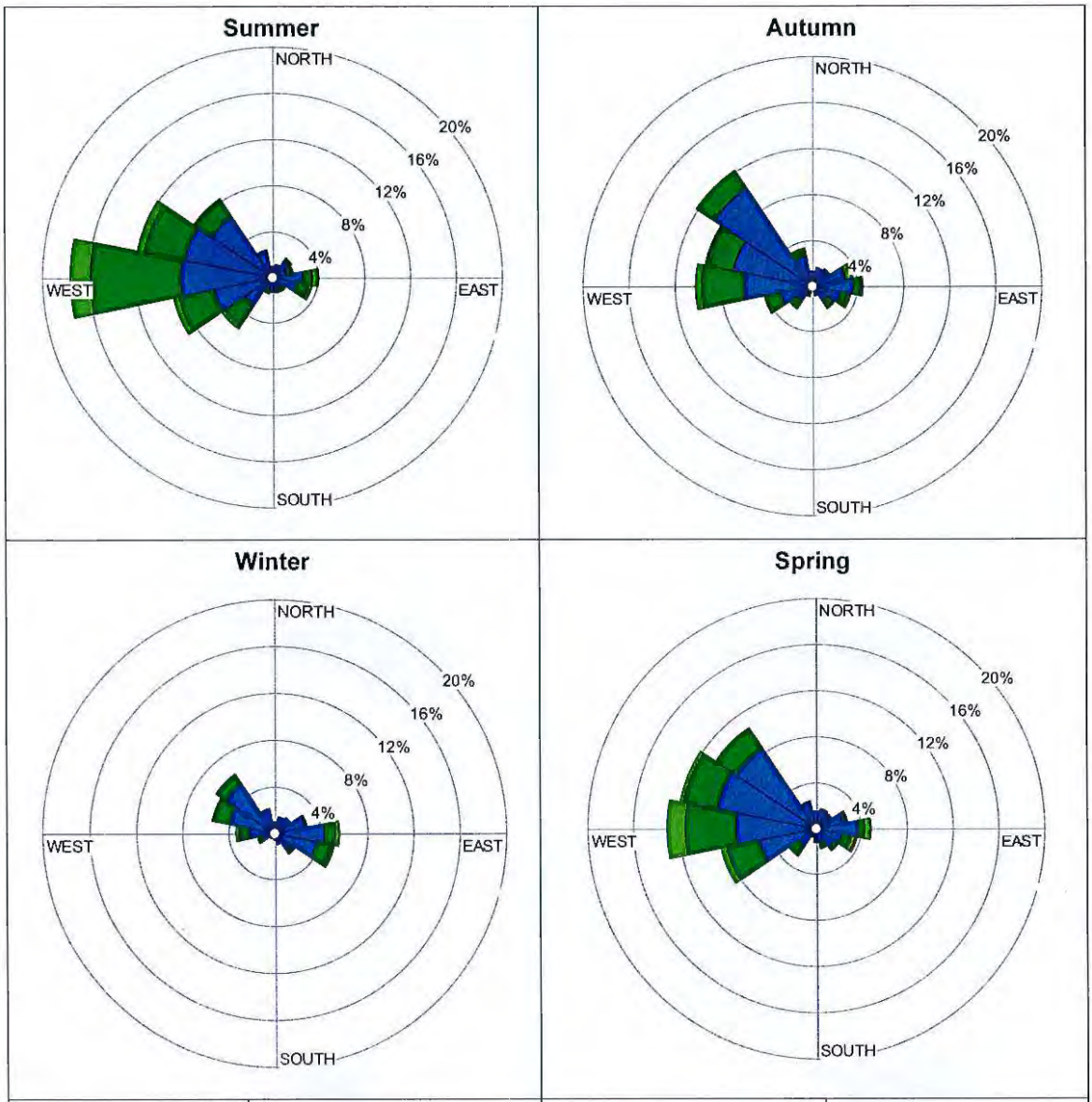
Season	*Average wind speed (m/s)*	*Calm winds (%)*
Summer	1.4	31
Autumn	0.9	47
Winter	0.9	49
Spring	1.4	30

Figure 3.2: Seasonal wind roses period – 2/5 Dam Station



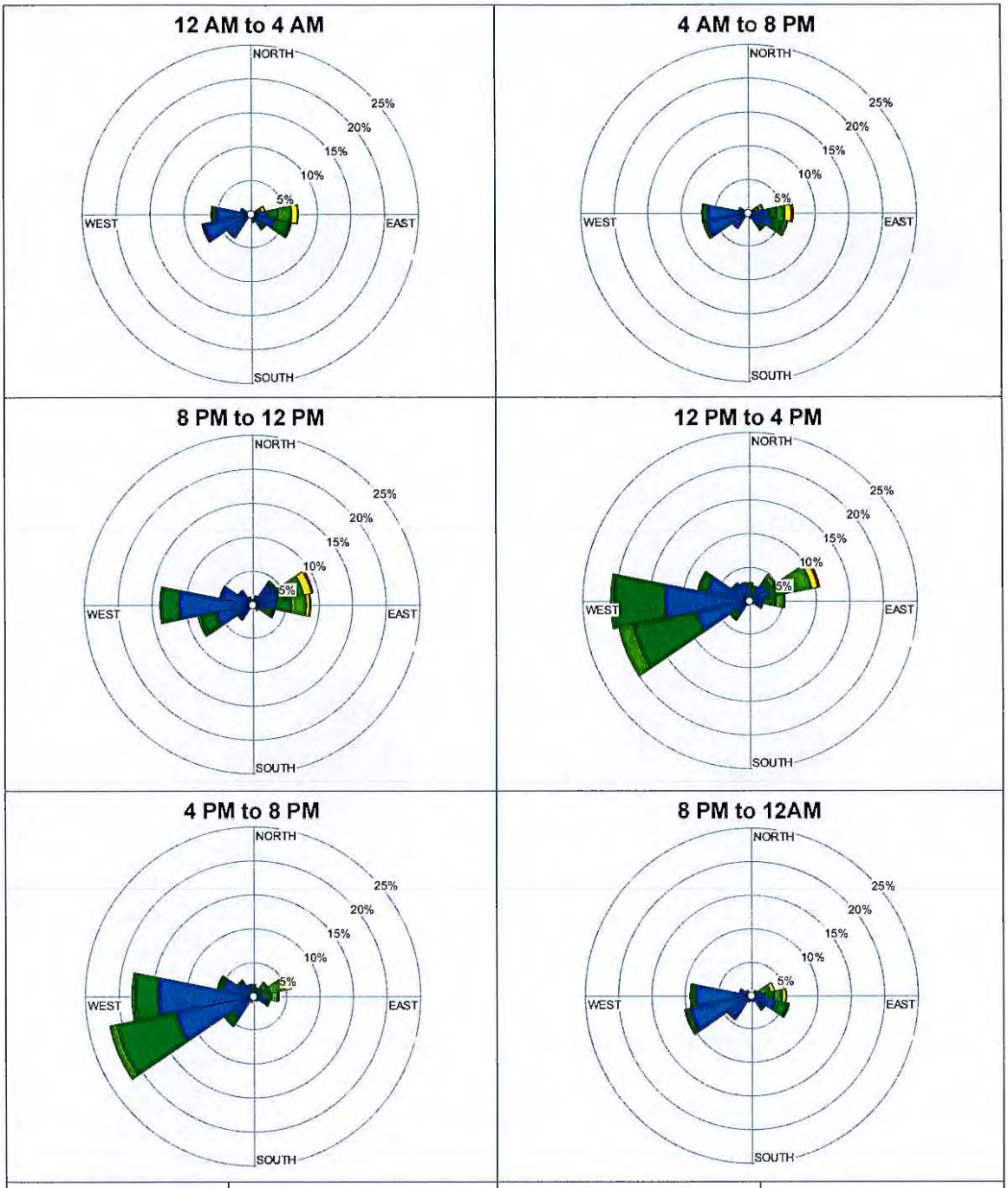
Season	*Average wind speed (m/s)*	*Calm winds (%)*
Summer	1.2	32
Autumn	0.8	47
Winter	0.7	52
Spring	1.3	34

Figure 3.3: Seasonal wind roses – Bobadil station



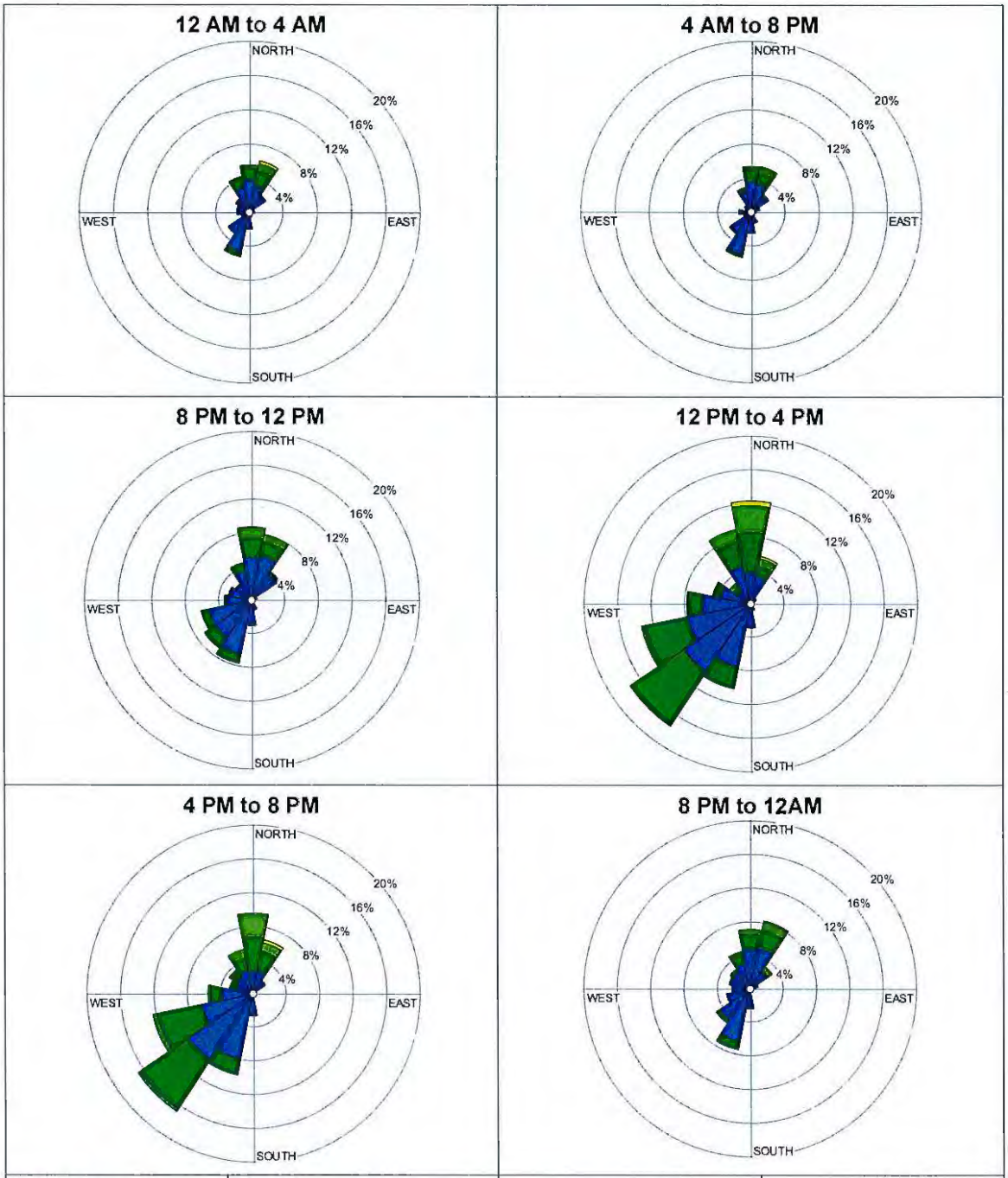
Season	*Average wind speed (m/s)*	*Calm winds (%)*
Summer	1.4	25
Autumn	1.0	37
Winter	0.8	74
Spring	1.2	28

Figure 3.4: Seasonal wind roses – Carpark station



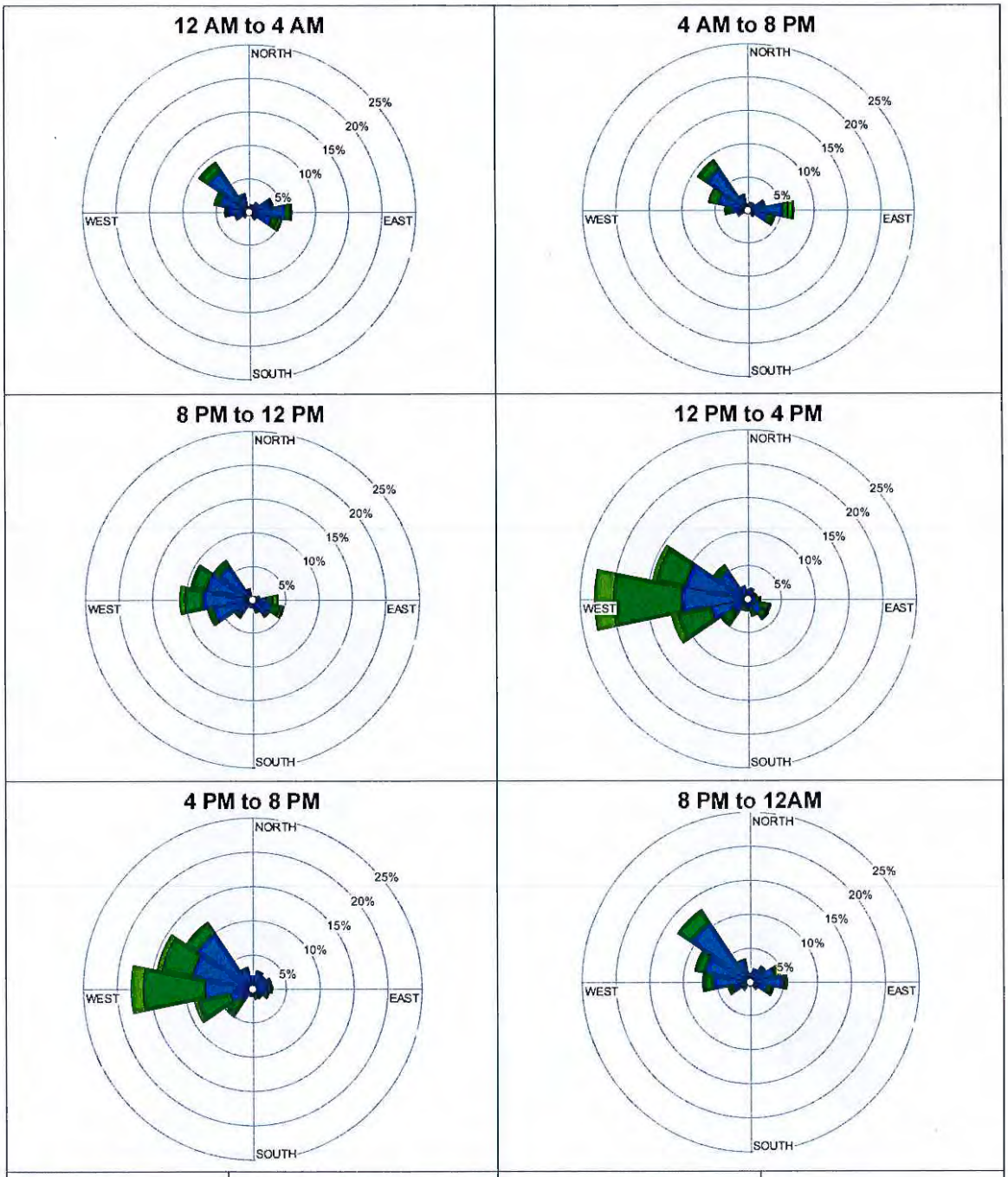
Time of day	*Average wind speed (m/s)*	*Calm winds (%)*
12 AM to 4 AM	0.7	58
4 AM to 8 PM	0.7	60
8 PM to 12 PM	1.2	36
12 PM to 4 PM	1.8	11
4 PM to 8 PM	1.5	23
8 PM to 12 AM	0.8	50

Figure 3.5: Time of day wind roses – 2/5 Dam Station



Time of day	*Average wind speed (m/s)*	*Calm winds (%)*
12 AM to 4 AM	0.5	63
4 AM to 8 PM	0.5	64
8 PM to 12 PM	0.9	39
12 PM to 4 PM	1.8	11
4 PM to 8 PM	1.6	21
8 PM to 12 AM	0.8	49

Figure 3.6: Time of day wind roses – Bobadil station



Time of day	*Average wind speed (m/s)*	*Calm winds (%)*
12 AM to 4 AM	0.7	46
4 AM to 8 PM	0.7	50
8 PM to 12 PM	1.0	34
12 PM to 4 PM	1.7	9.0
4 PM to 8 PM	1.7	10
8 PM to 12 AM	0.9	32

Figure 3.7: Time of day wind roses – Carpark station

3.3 Temperature

Figure 3.8 to Figure 3.10 present the monthly mean, maximum and minimum air temperatures at the three weather stations. The figures indicate that the site experiences a cool temperate climate with the warmest mean temperatures occurring in January 2021 and coolest temperatures occurring in July and August 2020. Maximum air temperatures at the site (~ 33 °C) occurred in January 2021, while the coldest temperatures were recorded in August 2020 (~-2.1°C).

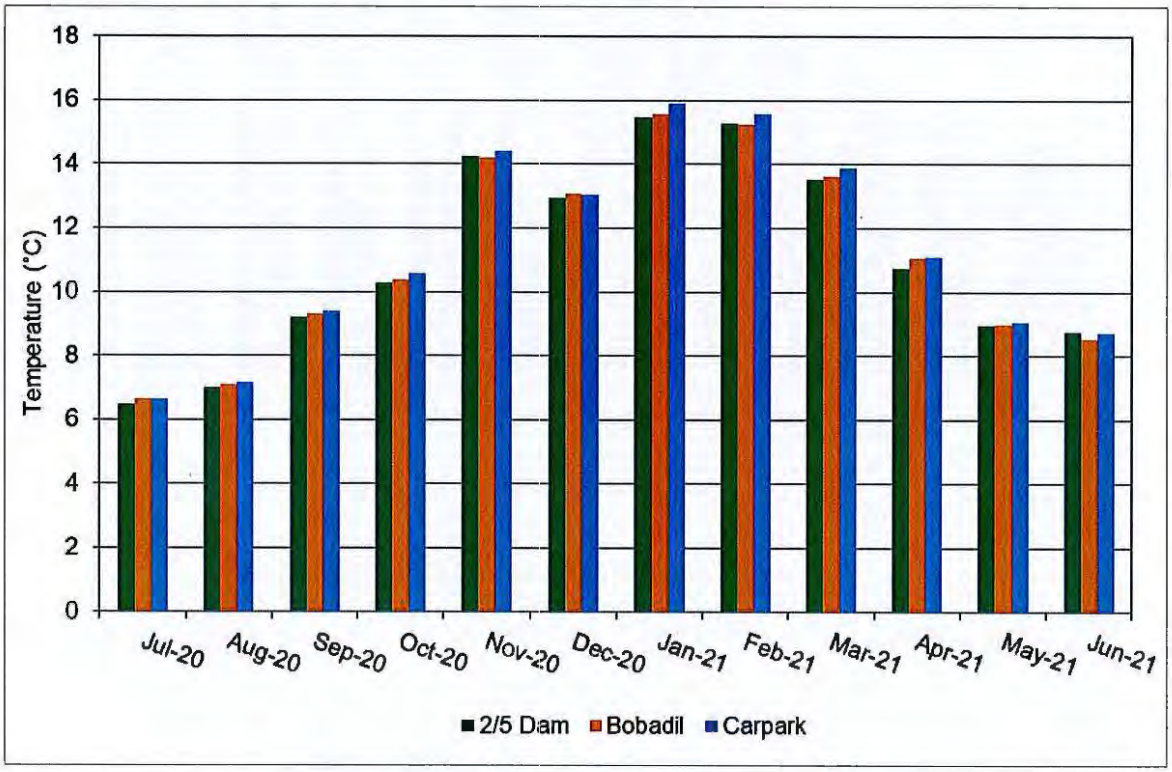


Figure 3.8: Mean monthly temperatures at all stations

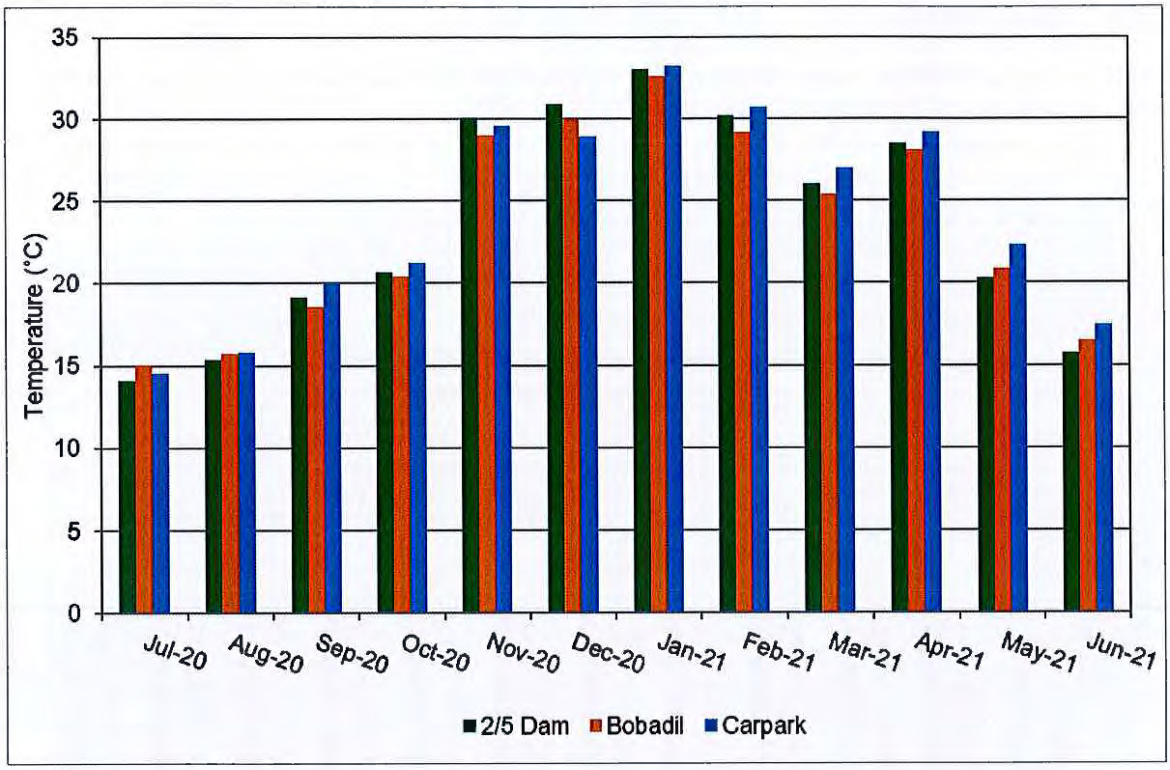


Figure 3.9: Maximum monthly temperature at all stations

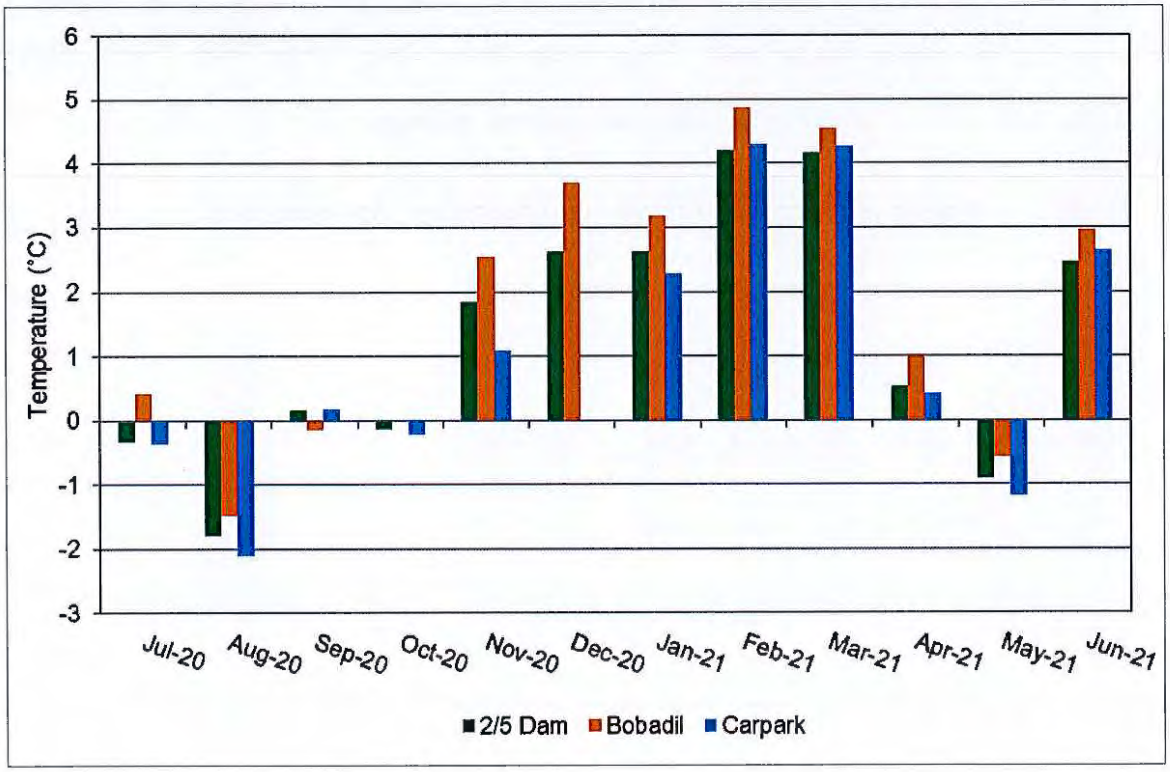


Figure 3.10: Minimum monthly temperature at all stations

3.4 Relative Humidity

Figure 3.11 presents the mean monthly relative humidity at the weather stations. Humidity was lowest during the spring and summer months (~70-80%) and highest during winter (~90%).

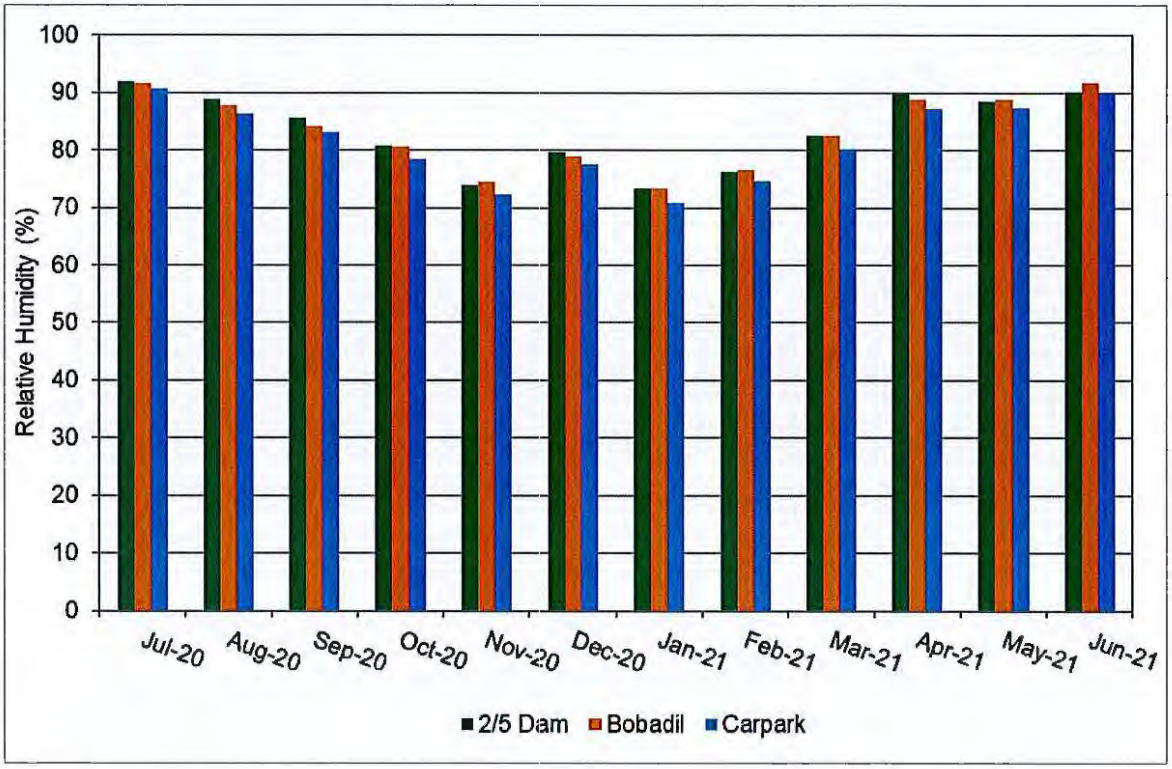


Figure 3.11: Average monthly relative humidity at all stations

3.5 Rainfall

Figure 3.12 presents the monthly total rainfall at the three weather stations. The figure shows that the site experienced a wet autumn with less rainfall occurring in the summer months. The wettest month for 2/5 Dam and Bobadil station was April 2021 and for the Carpark station was August 2020. The lowest rainfall at all stations occurred in November 2020 (<80 mm). Rainfall was generally lower at the Carpark station for FY20 compared to the other two stations. Historically, the Bobadil site has experienced the lowest rainfall. FY21 experienced less total rainfall compared with the FY20 and FY19 annual meteorological reviews.

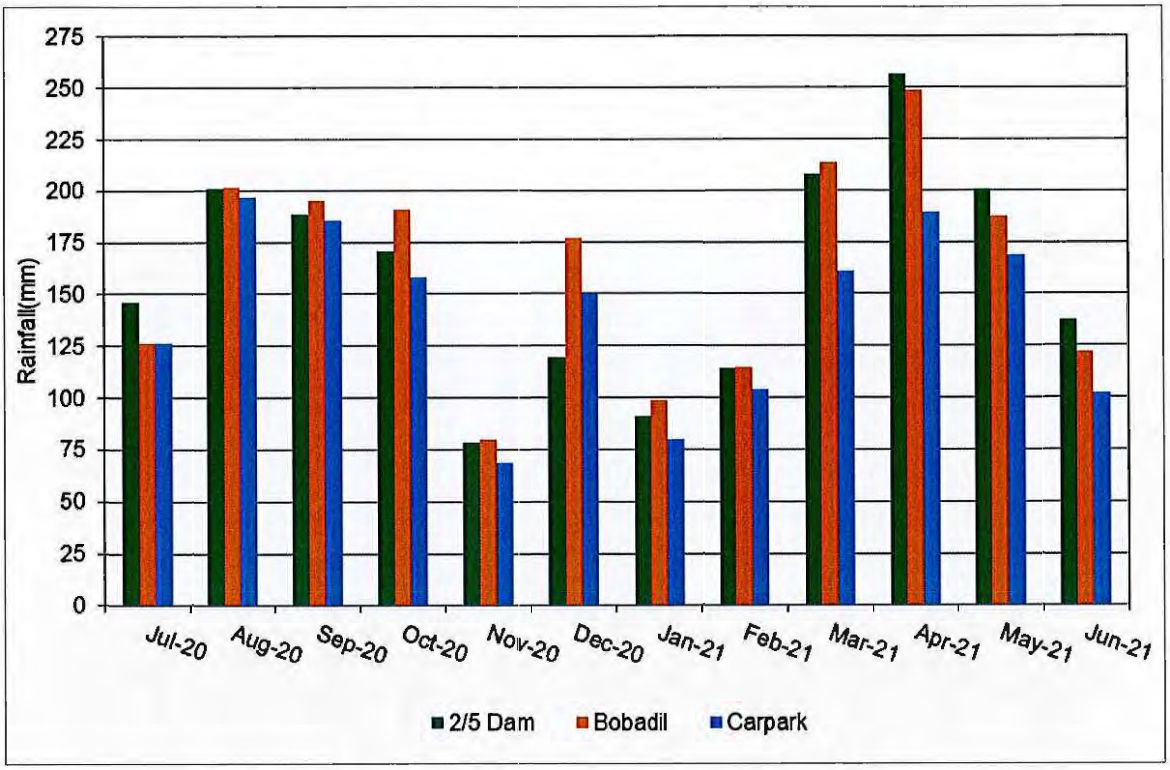


Figure 3.12: Total monthly rainfall at all stations

4. SUMMARY

Table 4.1 summarises the important meteorological parameters at the three weather stations for the measurement period of FY21.

The meteorological review for FY21 has shown that weak westerly winds dominate during the daytime hours at the Rosebery mine, particularly at the Carpark and 2/5 Dam stations. The low wind speeds are likely a result of the surrounding terrain sheltering the mine site. Temperature, relative humidity and rainfall data for FY21 indicated that the Rosebery mine site experiences a cool, wet and humid climate with wetter autumn months and drier summers.

Table 4.1: Meteorological data summary table

Site	Mean air temperature (°C)	Maximum air temperature (°C)	Minimum air temperature (°C)	Average wind speed (m/s)	Average RH (%)	Total Precipitation (mm)
2/5 Dam	11.1	33.0	-1.8	1.2	83	1,910
Bobadil	11.1	32.6	-1.5	1.1	83	1,954
Carpark	11.3	33.2	-2.1	1.1 [a]	82	1,689
Average	**11.2**	**32.9**	**-1.8**	**1.1**	**83**	**1,851**

a. Due to an error in the wind direction sensor, the wind speed and wind direction from the Carpark station was excluded prior to the calibration date (25 July 2020).

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APPENDIX I: MMG ROSEBERY WATER QUALITY MONITORING REVIEW 2020 - 2021 (TECHNICAL ADVICE ON WATER, 2021)

MMG Rosebery Water Quality Monitoring Review 2020 - 2021

V1

Final

21 September 2021

A Report to MMG Rosebery

Lois Koehnken

♦♦♦*Technical Advice on Water*♦♦♦

DOCUMENT TYPE:	Report	
TITLE:	Annual Water Quality Monitoring Review 2020-2021	
VERSION:	V1.1 Final	
CLIENT:	MMG Rosebery	
PREPARED BY:	Lois Koehnken	V1.1 Final: 21 Sept 2021 V1 Final: 10 Sept 2021 Draft: 31 Aug 2021
DISTRIBUTED TO:	Adam Pandelis, Senior Advisor SHEC Delivery Bowen Wagenknecht Advisor SHEC Rod Cooper A/ Advisor SHEC	Electronic .doc

Contents

1 Introduction

The following Tables and graphs summarise water quality results from MMG Rosebery for the monitoring period 1 July 2020 to 30 June 2021. Table 1 summarises chemical parameter names and acronyms used in the description of water quality results.

Table 1-1. Summary of terms and water quality parameter names.

Name	Description/Definition
2 / 5	Redeveloped 2 and 5 Tailings Storage Facility (TSF)
Al	Aluminium
ANZECC	Australia and New Zealand Environment and Conservation Council
BO	Bobadil Outfall monitoring point
BTEX	Volatile organic compounds: benzene, toluene, ethylbenzene and xylene
Cd	Cadmium
Cu	Copper
CN	Cyanide
DO	Dissolved Oxygen – measured in either mg/L or percent saturation (%Sat)
EC	Electrical conductivity, measured in the units µS/cm
ETP	Effluent Treatment Plant
EPA	Environment Protection Authority Tasmania
Fe	Iron
GB	Groundwater bore
Mn	Manganese
NATA	National Association of Testing Authorities (Australia)
Pb	Lead
pH	Measure of concentration of hydrogen ions in water
T	Temperature
TN	Total nitrogen
TP	Total phosphorus
TPH	Total Petroleum Hydrocarbons
TSF	Tailings Storage Facility
TSS	Total suspended solids
WAD-CN	Weak acid dissociable cyanide - the component of cyanide that is most biologically available and reactive
WRD	Waste Rock Dump
Zn	Zinc

1.1 Changes to water management since EPN 7153/3 was issued

The MMG Rosebery site, including Hercules, operates under EPN 7153/3 which was issued in October 2011. Since that time, substantial changes to water management at MMG Rosebery have occurred related to the re-development of the 2 / 5 TSF which is now the primary site for tailings disposal. Water quality monitoring at the 2 / 5 TSF is governed by a revised water quality monitoring plan that was initially approved in 2018, and revised and subsequently approved in July 2021. Tailings, process water and some additional water required for tailings conveyance are now discharged to the redeveloped 2 / 5 dam, with the decant returned to the ETP for lime-dosing and discharge to Lake Pieman via the Bobadil TSF. Stormwater runoff and mine water continue to be collected, treated at the ETP and discharged via the Bobadil TSF. The licenced discharge point, Bobadil Outfall (BO) remains unchanged.

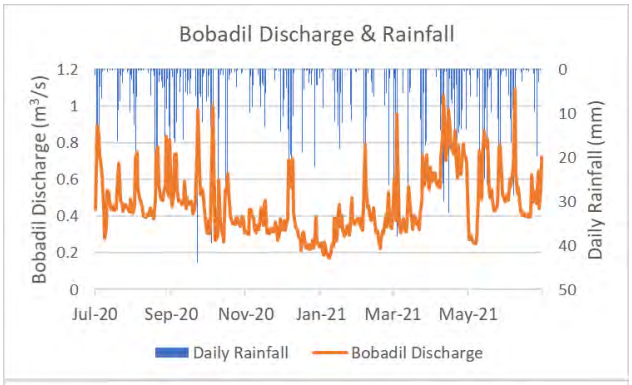
2 Bobadil Tailings Storage Facility Discharge

A summary of the monitoring results collected at the Bobadil Outfall (BO) during the 2020-2021 monitoring period is contained in Table 2-1.

Table 2-1. Bobadil tailings discharge monitoring results during the 2020-2021 monitoring period.

Requirement	Findings
Monitoring Frequency	Continuous, weekly and monthly parameters were monitored as per requirements in the EPN with the following exceptions (notwithstanding contradictions in EPN, e.g. nutrients listed as both weekly and monthly): • Temperature is not recorded at BO on a continuous basis but weekly results are collected • There are 51 weekly results for WAD CN and Total CN, with no result reported for the week of June 8 2021. This was due to a mix up with the sampling bottle rendering the sample unable to be analysed. Values throughout the year were all <0.012 mg/L, with most below the LoR of 0.004 mg/L. • All parameters required to be monitored on a weekly basis were determined, with some parameters monitored more frequently than required in the EPN
Compliance with EPN discharge limits	• Rainfall during the 2020 - 2021 monitoring year was below average, 1954 mm recorded at the Bobadil rain gauge compared with the long-term average of 2,224 mm (1911 – 2018 at Renison Bell, Tasmania, Figure 2-1). In general the winter was 'dry' and the autumn was 'wet'. Maximum discharge from BO was <1.2 m^3/s which is lower than in previous years. The lack of extreme flows resulted in more uniform pH throughout the year, without any exceedances of the 95th or compliance targets (Figure 2-2). Similar to previous years, laboratory pH values are lower than in-situ measurements suggesting that the pH declined in the samples following collection. This decline does not affect metal concentrations as the metals have already been removed and captured in the TSF. • The consistent pH control maintained low metal concentrations in the discharge, with no exceedances of the EPN limits for metals or sulphate recorded (Figure 2-4). • One elevated Total Petroleum Hydrocarbon (TPH) reading of 1.17 mg/L was recorded on 22 December 2020 at BO which exceeded the EPN limit of 0.05 mg/L. Re-analysis following silica gel (SG) clean-up of the sample returned a TPH value of 0.47 mg/L, which also exceeds the EPN limit. Additional investigations by the laboratory determined that there was an analytical error associated with the initial SG result, and subsequent testing found the TPH level was below the compliance limit. The false positive and description of the investigations was reported to the EPA.
Comparison with EPN investigation trigger levels	The 95th percentile values of the data set collected between 1 July 2020 to 30 June 2021 were below the 95th percentile investigative triggers for all parameters. The following triggers were exceeded based on a rolling 12-month average of weekly results (e.g. if 3 values in the preceding 52 weeks exceeds the 95th percentile trigger an investigation is initiated): • The 95th percentile value for Electrical conductivity was below the trigger value for the 2020 – 2021 monitoring year. Compliance monitoring in 29 December 2020 recorded an EC value of 2,000 μS/cm,

	which was equivalent to the EPN Compliance Limit and resulted in the 95th percentile for the previous 12-month period exceeding the 1,700 µS/cm target (Figure 2-3). There is variability between the field, laboratory and continuous monitoring results, but all data sets show the highest EC values during late December 2020 and early January 2021. The event was internally investigated by MMG and the elevated value was linked to excessive lime dosing at the effluent treatment plant coinciding with low rainfall. • The 95th percentile for Total Nitrogen in the 12-month rolling data set exceeded the 5.5 mg/L target on 28 July 2020 when a value of 5.9 mg/L was recorded. Exceedance of this trigger has occurred previously, with sources of total nitrogen including the ore body, the lime reagent, degradation of cyanide, and explosives used underground. The company observed increased TN in the 2/5 dam during the same period, suggesting the ore body is the source of the higher values. The incident was internally investigated. The 95th percentile value for TN over the 2020-2021 monitoring set is 5.3 mg/L.
Significant trends - reporting period	• The pH control in the Bobadil TSF has resulted in low metal concentrations in the discharge from BO throughout the monitoring year.
Significant trends - longer period	• Zinc concentrations showed a decrease in 2020-2021 relative to the previous year, which had recorded higher values as compared to pre 2019 (Figure 2-6). The median value for the present monitoring year was 0.019 mg/L, compared to 0.051 during the previous year. The 2015 – 2019 results all had medians between 0.021 and 0.026 showing the most recent zinc results are substantially lower. Possible reasons for the decrease include: additional water being used in the system to transport tailings to 2/5 dam, most of the tailings being discharged in 2/5 dam promoting retention of zinc with the tailings, and lower storm water inflows associated with the lower than average rainfall. Sulphate levels were slightly lower as compared to the previous year (2020-2021 median = 673 mg/L as compared to 689 mg/L in 2019-2020), with both values about 10% lower than the previous 4 years. This change is consistent with additional water in the system and less stormwater runoff. It is unknown if sulphate is being retained as gypsum in the 2/5 dam.
Comment	The monitoring requirements at BO should be revised to reflect the present water management system, and the lack of sewage entering the 2/5 TSF. Parameters which should be reviewed with the aim or eliminating or reducing the frequency of monitoring include: Faecal Coliform / Thermotolerant coliforms, total nutrients (which are listed on both the weekly and monthly monitoring schedule) mercury (which isn't listed in the monitoring schedule but has a discharge limit) and TPH which is listed as both monthly and six-monthly. Monitoring frequency should be included in the review based on the large number of parameters that are consistently below discharge targets.



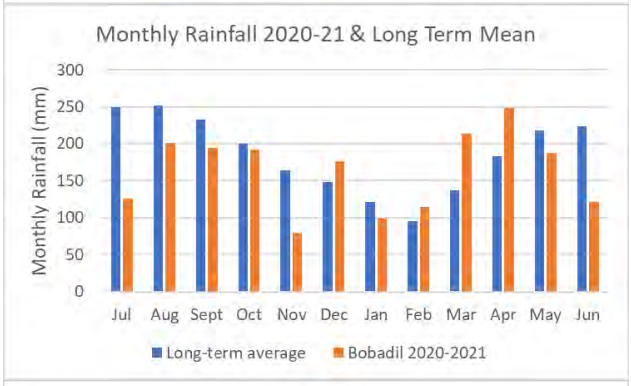


Figure 2-1. (top) Daily rainfall at Bobadil and discharge at BO 1 Jul 2020 to 30 Jun 2021, and (bottom) 2020-2021 monthly rainfall at Bobadil weather station compared to long-term (1911-2018) monthly averages at Renison Bell (Renison data from BOM).

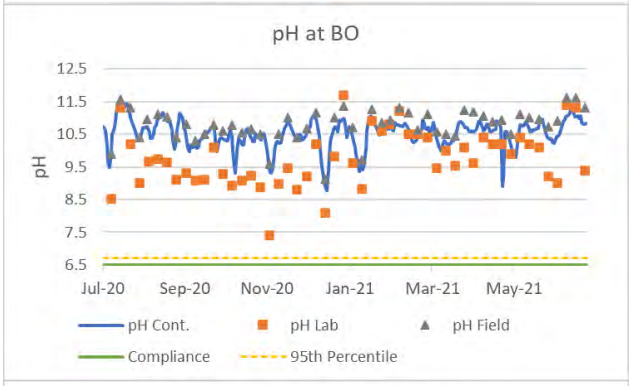


Figure 2-2. Weekly field, laboratory and continuous pH (daily averaged) results from BO, Jul 2020-Jun 2021.

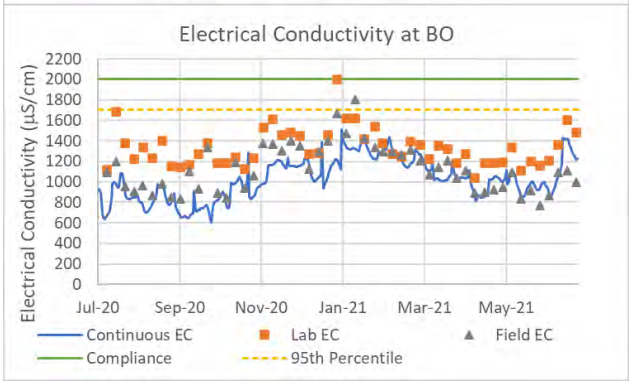


Figure 2-3. Weekly field, laboratory and continuous EC results from BO, Jul 2020-Jun 2021.

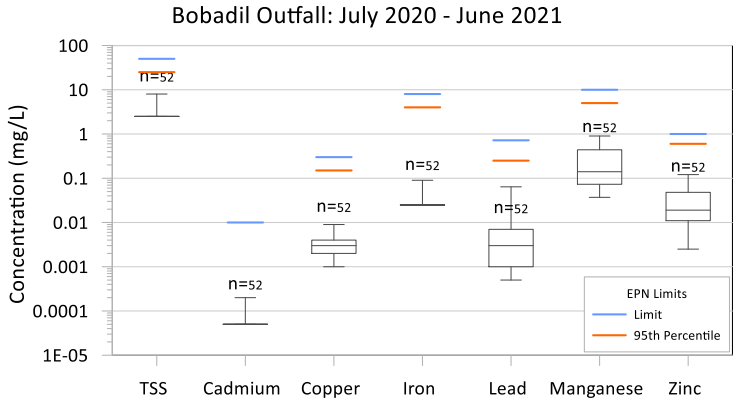


Figure 2-4. Box and whisker plot of TSS and total metal monitoring results at BO for 2020-2021 compared to EPN limits and 95th percentile trigger. Box encompasses 5th to 95th percentile values, minimum and maximum values indicated by the whiskers.

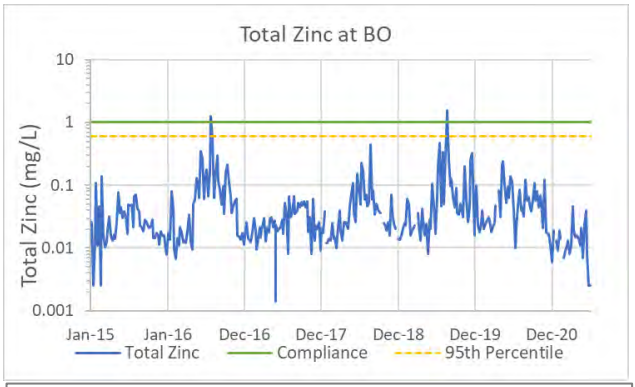


Figure 2-5. Total zinc concentrations from July 2015 to June 2021.

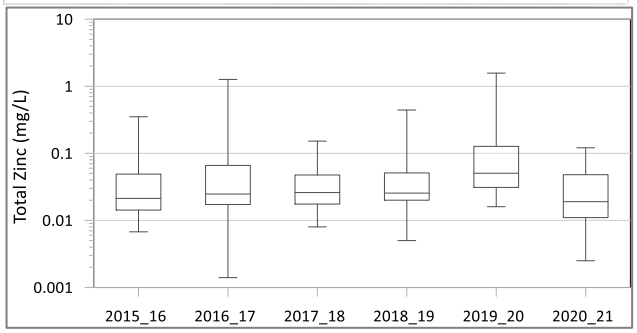


Figure 2-6. Comparison of total zinc concentrations at BO over the past 6 monitoring years (Jul to Jun). The box encompasses the 25th to 75th percentile values, and the 'whiskers' extend to the minimum and maximum values.

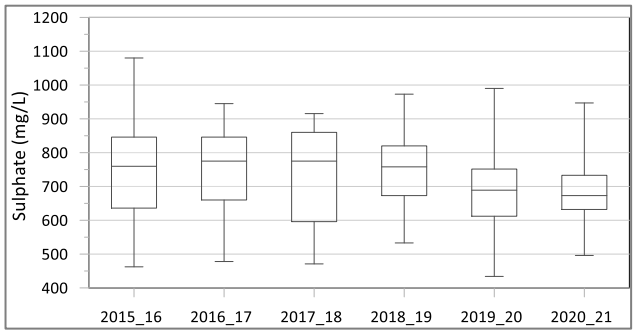


Figure 2-7. Comparison of sulphate concentrations at BO over the past 6 years. The box encompasses the 25th to 75th percentile values, and the 'whiskers' extend to the minimum and maximum values.

3 Internal Bobadil TSF Monitoring (BI and BF)

The results for monitoring at internal sites in the Bobadil TSF (BI, BF) are summarised in Table 3-1.

Table 3-1. Summary of monitoring results from internal monitoring sites at Bobadil TSF.

Requirement	Findings
Monitoring Frequency	At BI and BF all parameters were monitored 12 times on a monthly basis.
Significant trends reporting period	• Tailings discharge to Bobadil only coincided with two monthly monitoring occasions (February and June 2021) with TSS values exceeding 55,000 mg/L. TSS results for the other months are <7,500 mg/L. BI has higher TSS levels when no tailings are being discharged to the TSF. • pH values at BO are generally 0.5 to 1 pH units lower than at BI, which is about 0.5 to 1 unit lower than at BF (Figure 3-2). • Sulphate concentrations at BF show high variability, and concentrations at BI are lower than at BO, with median values increasing by about 10% (610 mg/L to 673 mg/L) between the sites, recognising the difference in sample numbers. The higher and more uniform concentrations at BO are likely attributable to seepage input from the dam wall (Figure 3-3). • Metals show a reduction in concentrations between BI and BO except cadmium and manganese (Figure 3-4). Cadmium is at or near the LoR at both sites. Manganese increases between the sites, suggesting an additional input or leaching from tailings or stored sludges is occurring. • At BI, median total metal concentrations at BI in 2020 -2021 were substantially lower for iron, lead, manganese and zinc, and similar to the previous year for aluminium, cadmium and copper. This likely reflects the lower volume of tailings discharged to Bobadil as compared to previous years. The fluctuations in inflowing metals have not affected the quality of discharge at BO (Table 2-1).
Comment	The monthly results from BF and BI are not used for day to day management of the site, but are useful for understanding how water quality in the TSF is changing following the reduction in tailings deposition.

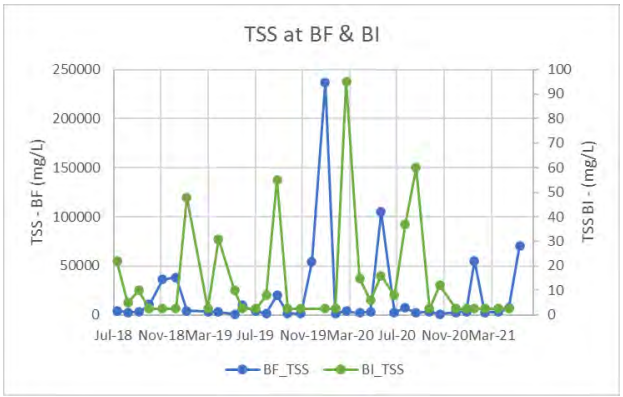


Figure 3-1. TSS results from BF and BI for July 2018 to June 2021 showing higher TSS at BI when TSS at BF is low.

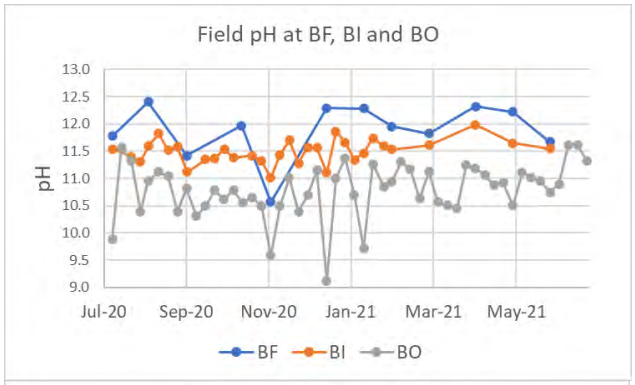
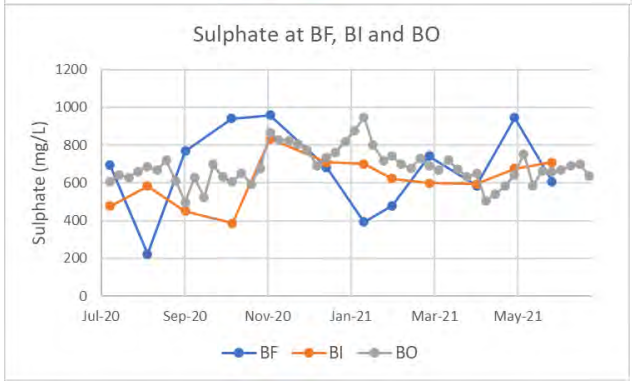


Figure 3-2 Comparison of Field pH at BF, BI and BO for July 2020-June 2021.



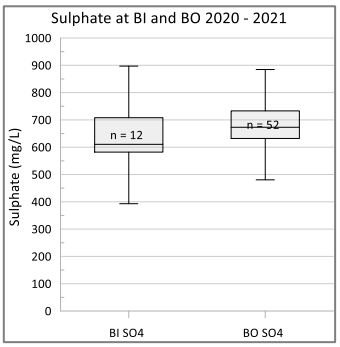


Figure 3-3. (left) Time series of sulphate at BF, BI and BO July 2020-June 2021 (right) box and whisker plots comparing concentrations at BI and BO.

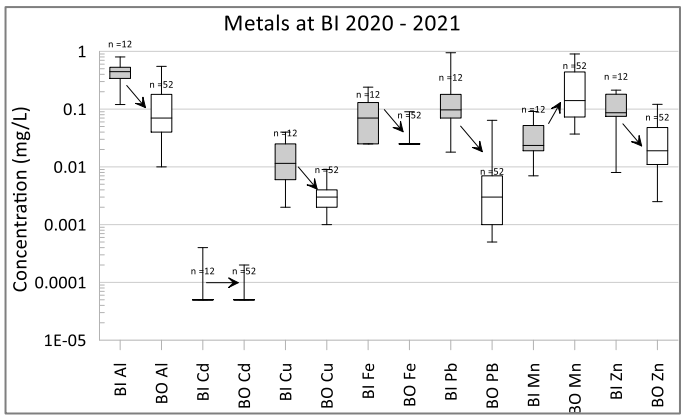


Figure 3-4. Comparison of total metal concentrations at BI and BO in 2020 – 2021.

Table 2. Comparison of median total metal concentrations at BI in 2017-18, 2018-19, 2019-20 and 2020-21.

	Al tot	Cd tot	Cu tot	Fe tot	Pb tot	Mn tot	Zn tot
17-18	0.350	0.0001	0.005	0.049	0.951	0.028	0.129
18-19	0.570	0.0004	0.016	0.220	0.229	0.073	0.294
19-20	0.460	<0.0001	0.016	0.130	0.170	0.058	0.141
20-21	0.445	<0.0001	0.012	0.075	0.097	0.024	0.087

4 Bobadil TSF Seeps

EPN 7153/3 includes a requirement to monitor seepage from the Bobadil Dam based on observations of seepage flows at the time of preparation of the EPN (Figure 4-1). The intention of seepage monitoring is to understand diffuse inputs to the environment from the TSF. Since that time, several lifts of the dam wall have been completed, and the sub-surface hydrology

of the site has altered, as evidenced by the lack of flow in several historic seepage points. Other seeps have been eliminated by expansion of the TSF. A summary of the monitoring results from the Bobadil TSF seeps are contained in Table 4-1.

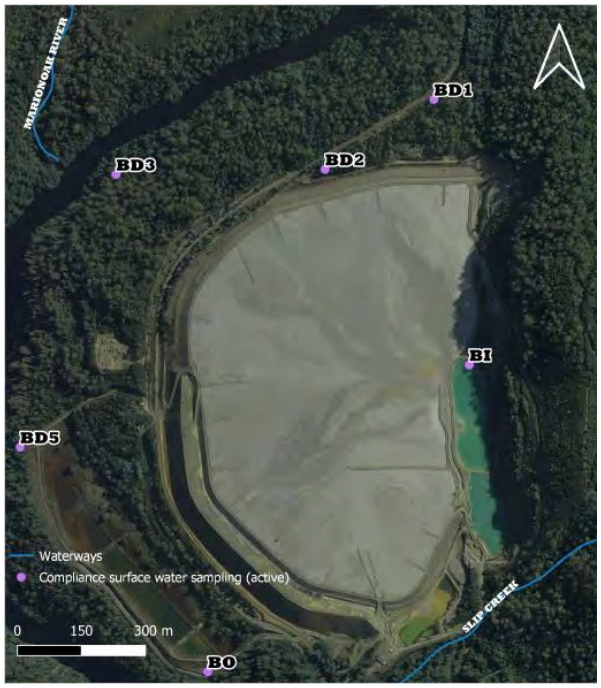


Figure 4-1. Location of Bobadil Seeps at commencement of EPN 7153/3.

Table 4-1. Summary of monitoring results from Bobadil TSF seeps in 2020 – 2021 monitoring year.

Requirement	Findings
Monitoring Frequency	Quarterly monitoring was completed as required. Samples were not collected at: • BD1 no monitoring occurred during the year due to no flow • Seep BD4 has not been monitored for many years as it was covered by expansion of the TSF. Seeps in addition to those listed in the EPN are monitored.
Compliance with EPN	All parameters were determined on the collected samples as required with the following exceptions: • Flow rates were only able to be recorded at BD3 in March 2021 (0.2 L/s) and June 2021 (0.2 L/s), BD5 in March 2021 (0.80 L/s) and June 2021 (1.25 L/s). Consistent with previous years monitoring samples collected on other dates reflect stagnant water or flow too low to be recorded.
Significant trends - reporting period	• Overall the water quality results are similar to previous years. • Seeps BD3 and BD5 continue to have pH 6 and 7.5 with pH in BD2 ranging between 4 and 6 in 2020 – 2021 (Figure 4-2). • Total zinc values at BD2 continue to be elevated as compared to seeps BD3 and BD5 (Figure 4-3). Maximum concentrations in BD2, BD3 and BD5 during the monitoring year were <1.0 mg/L, which is the EPN discharge limit at BO. • Lead results are within the range of previous findings (Figure 4-4).

	• Sulphate concentrations in BD3 and BD5 ranged from 630 mg/L to 711 mg/L, which is in the range of the discharge from Bobadil (range = 500 – 950 mg/L). Concentrations in seep BD2 continues to be considerably lower. • Zinc fluxes at BD3 were 0.2 g/day in June 2021, and 3.5 g/day and 1.8 g/day at BD5 in March and June 2021, respectively. Sulphate fluxes from the same sites were 11 kg/day, 47 kg/day and 75 kg/day, respectively.
Comments	• The lack of flow at most of the seep sites reflects the changes in hydrology due to expansion of the TSF. • The seepage monitoring strategy should be revised to focus on seeps where regular flow occurs.

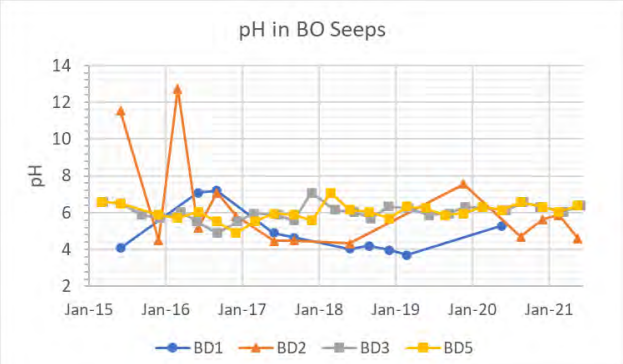


Figure 4-2. pH results from Bobadil seeps, June 2015 to Jun 2021.

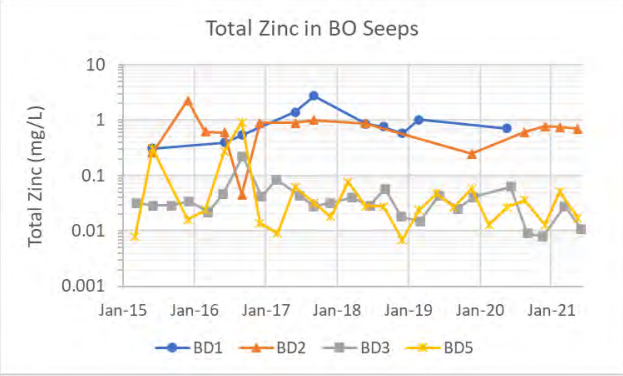


Figure 4-3. Total zinc results from Bobadil seeps, June 2015 to Jun 2021. Note log scale.

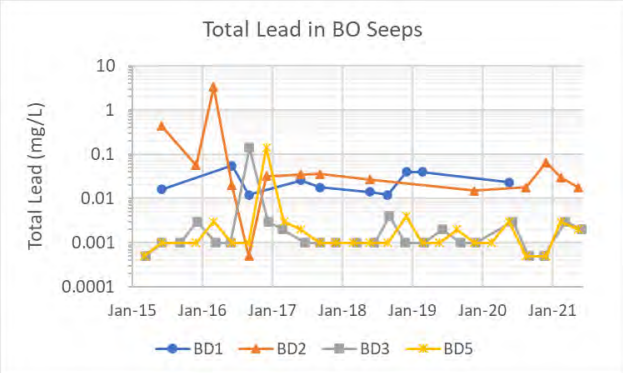


Figure 4-4 Total lead results from Bobadil seeps, June 2015 to Jun 2021. Note log scale.

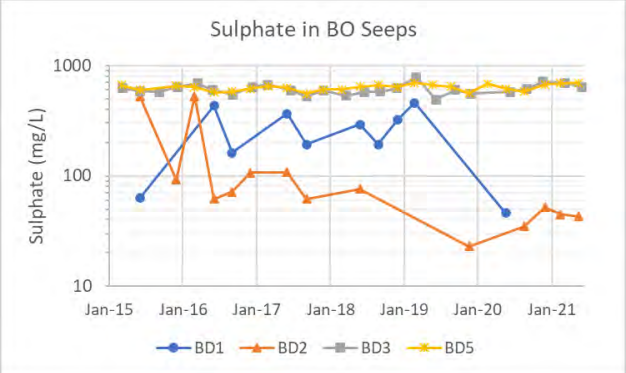


Figure 4-5 Sulphate concentrations in the Bobadil seeps June 2015 to June 2021. Note log scale.

5 Bobadil TSF Groundwater Monitoring

The location of groundwater monitoring bores near the Bobadil TSF is shown in Figure 5-1, and a summary of groundwater monitoring results is contained in Table 5-1.

Figure 5-1. Location of groundwater monitoring bores near the Bobadil TSF. Note, GB41, GB42 and GB43 are not included in the requirements for the annual review, but are part of the groundwater network managed by MMG.

Table 5-1. Summary of the 2020-2021 monitoring results from the groundwater bores located near Bobadil TSF.

Requirement	Findings
Monitoring Frequency	• Monitoring of bores GB4, GB6, GB7S, and GB8S was completed in October 2020 and April 2021. • Bore GB5 does not exist due to expansion of the TSF facility. • Bore GB9 was decommissioned in September 2020 following approval from the EPA to discontinue monitoring at the site due to sampling difficulties. Some results are available for October 2020.
Compliance with EPN	All parameters were determined as specified in the EPN with the following exceptions: • There is no pH value for bore GB7D in April 2021 due to the pH level not being stable within 7 L of low flow sampling. Field pH increased from 6.38 to 6.50 over the 7L.

Significant trends - reporting period	• The results are consistent with previous monitoring. The deeper bores (GB6D, GB7D, GB8D and GB9) tend to have higher pH and higher concentrations of alkalinity. This may reflect seepage from the TSF entering the shallow aquafers, combined with the ingress of naturally acidic surface waters. • The shallow bores (GB4, GB6S, 7S, and 8S) generally have higher concentrations of zinc, manganese and sulphate as compared to the deeper bores, consistent with the TSF being a source to these bores. • Bore GB7S, located between the dam and Lake Pieman continues to record the highest total zinc levels. The deep water in the bore (GB7D) contains comparatively low levels of zinc and sulphate. • The results continue to support a conceptual model of the shallow aquifer, composed of glacial till, being hydraulically connected to the dam, with elevated zinc, manganese and sulphate, with the deeper groundwater system largely isolated from impacts.
Other comments	The groundwater monitoring results are difficult to interpret due to the low number of bores and the bores intersecting different aquifers. The water quality results need to be integrated with a groundwater flow model to provide more information. The groundwater monitoring regime should be reviewed.

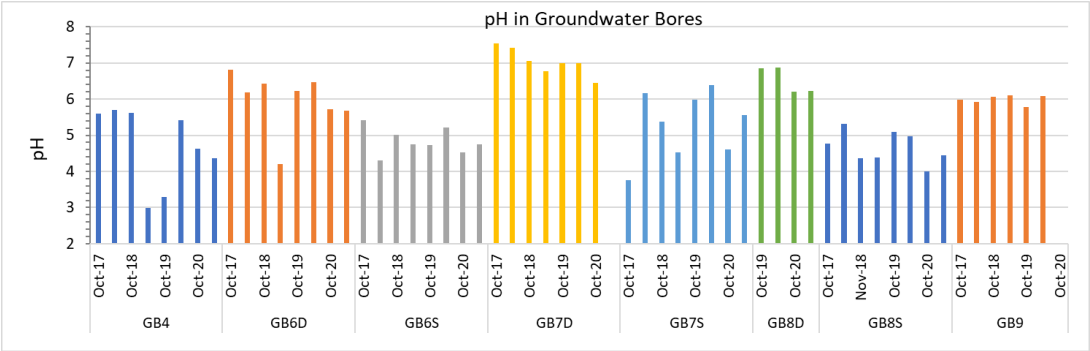


Figure 5-2. pH in groundwater samples collected near Bobadil TSF 2017 – June 2021.

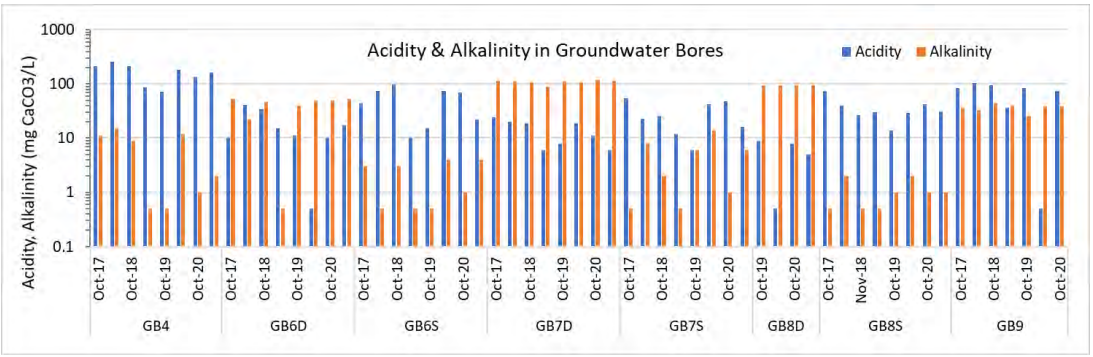


Figure 5-3. Alkalinity and acidity in groundwater samples collected near Bobadil TSF, 2017- June 2021.

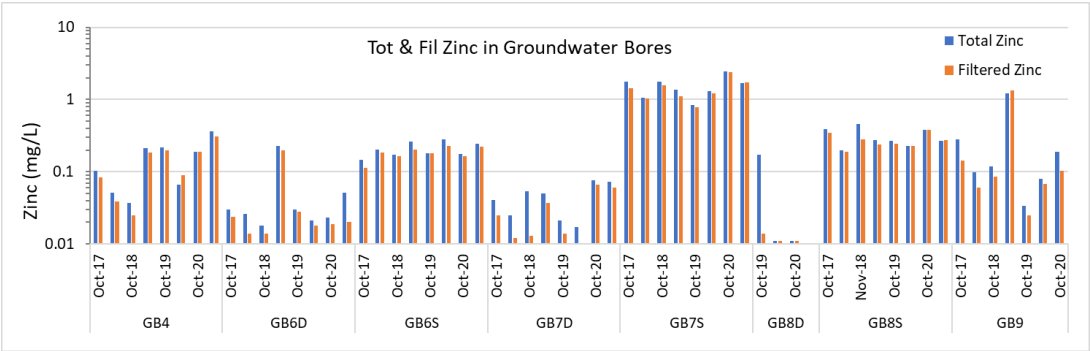


Figure 5-4. Total and filtered zinc results from groundwater samples collected near Bobadil TSF, 2017- June 2021.

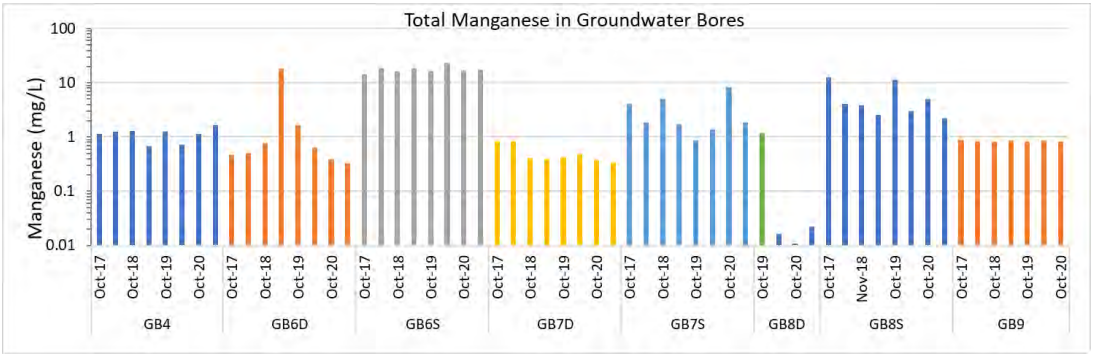


Figure 5-5. Manganese results from groundwater samples collected near Bobadil TSF 2017 –June 2021.

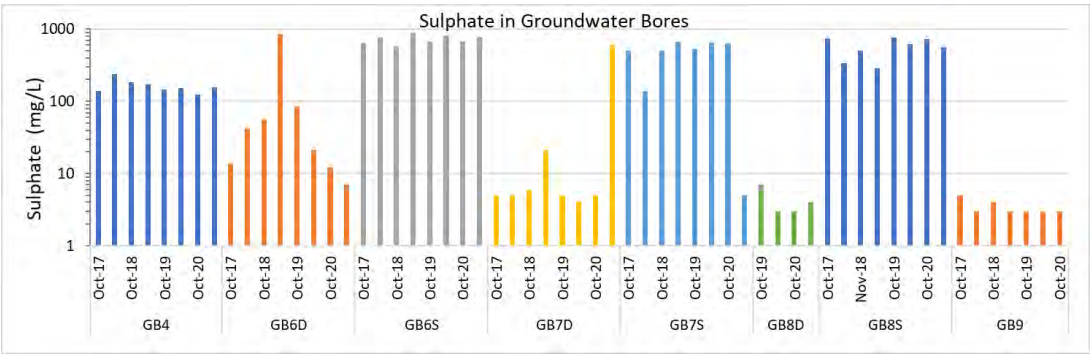


Figure 5-6. Sulphate results from groundwater samples collected near Bobadil TSF 2017 – June 2021.

6 2 / 5 TSF Monitoring Results

The redevelopment of the 2/5 TSF has required a revision to the water quality monitoring regime as compared to the requirements listed in EPN 7153/3. The revised monitoring strategy is based on the plan developed by Pitt & Sherry (Feb 2018) with some subsequent changes proposed by MMG due to logistical issues. The water quality monitoring sites related to the 2 / 5 TSF that were sampled in July 2020 to June 2021 are listed in Table 6-1.

Table 6-1. Summary of water quality monitoring at 2 / 5 dam since redevelopment of the TSF.

Water	Type of Monitoring or Location	Station Names in MMG Database
Surface Water	**Grab samples**	
	3 Surface water samples from TSF	SW01, SW02, SW03
	Decant Return	DW01
	Clean Water Diversion upstream of TSF	CWDD01
	Seepage Collection Drain	SCD01, SCD02
	Seepage Collection Pond	SCP01
	Discharge to Stitt River	SD
	Stitt River upstream of 2/5	WL8
	Stitt River downstream of TSF	SR02
	Stitt River downstream of Stitt Falls	SR03
	Stitt River upstream of L Pieman (downstream of Rosebery Ck)	U/S Pie
	Seepage from TSF emanating along Murchison Highway	MHS2
	Seepage from downstream TSF emanating along Murchison Highway	MHS3
Groundwater*	Pumped from groundwater bores	GB12, 13, 14S, 14D, 15, 16, 21H, 22H, 23H, 25H, 26H, 27H, 28H

***Groundwater bores previously designated as GB21 – GB28 are now designated as GB21H-GB28H to avoid confusion with bores located near the 3 Level Open Cut with the same numbering.**

During the 2020-2021 monitoring year there were no unintentional discharges from the 2/5 TSF into the Stitt River. Compliance water quality m monitoring is based on the sites listed in Table 6-1 and Figure 6-1, and monitoring compliance is summarised in Table 6-2.

Figure 6-1. Monitoring locations at the 2/5 TSF following redevelopment. SR03 and U/S Pie are located downstream of SR02, off of the photo.

Table 6-2. Summary of monitoring results related to discharge from the 2 and 5 Dam.

Requirement	Findings
Compliance with Water Quality Monitoring Strategy	Monitoring at 2/5 Dam was completed as required under the Feb 2018 Monitoring Plan except for the following. A change to the monitoring regime has been approved by the EPA in July 2021 and does not apply to the results from 2020-2021, however where available the additional sites / parameters are included in the review. • SD: Spillway- No water quality results because no water was discharged from the 2 / 5 TSF into the Stitt River Additional parameters were reported for many of the surface water sites.
Significant trends during reporting period	Surface water: • The pH in the surface water in the TSF (SW01, SW02, SW03), and water pumped back to the ETP (DW01) ranged between pH 6.2 and 7.5 during the monitoring year (Figure 6-2). There is little variability between the sites, with the small))differences likely reflecting the relative distance of sites from tailings discharge points and seepage inflow. • Total zinc in the TSF was below 1 mg/L except on the final sampling in June 2020, when concentrations ranged from 1.2 to 1.4 mg/L (Figure 6-3). There was little variability between the sites except in December 2020 when total zinc at SW02 was 0.86 mg/L, and the other sites recorded values between 0.40 and 0.50 mg/L.

	• Sulphate concentrations show seasonal changes, with concentrations of up to 450 mg/L recorded in the summer, as compared to 200 – 300 mg/L recorded during winter and spring (Figure 6-4). Stormwater and mine water are not discharged to the 2/5 TSF so the seasonal change likely reflects differences in incident rainfall on the dam. Seepage • Flow monitoring of the SCD01 and SCD02 seeps, seepage return from the Seepage Pond (SCP01) and the Decant Return from 2/5 to the ETP (DW01) shows that flow at SCD01 and SCD02 range from 2-5 L/s, and 7-9 L/s, respectively. SCD01 shows moderate correlation with rainfall patterns and likely reflects runoff from the dam wall, but SCD02 is more uniform (Figure 6-5). The higher flow rates at SCD02 are reflected in the water quality at SCP01, which is similar to the SCD02 inflow. • The combined flow from SCD01 and SCD02 accounts for most of the water being pumped back to the TSF from the Seepage Collection Pond. Pump back rates range from about 10 to 15 L/s, with the combined seepage inflow to the pond ranging from 7 to 14 L/s (Figure 6-6). • The volume of seeps pumped back to the TSF is small compared to the volume of water pumped back to the ETP from 2/5 dam via the Decant Return (DW01) (Figure 6-7). Pump rates at DW01 increased in late March 2021 following installation of a second water return line. Average monthly return rates at DW01 ranged from about 25 L/s to 150 L/s. • pH in the seeps, seepage pond and TSF (DW01) (Figure 6-8) show lower levels in SCD02 and the SCP01 as compared to seep SCD01 or the TSF. SCD02 and SCP01 show a distinct increasing trend, with DW01 results also showing an increase since 2020. • Total zinc concentrations show similarities to pH, with SCD02 and SCP01 having elevated concentrations compared to SCD01 and the TSF. SCD01, SCD02 and SCP01 show decreasing trends, with the results at DW01 displaying stability since early 2019. • Sulphate concentrations have remained relatively steady in SCD01, SCD02 and SCP01 but concentrations at DW01 have increased over the summer months. This may reflect changes in the ore, less rainwater inflow, or increased pumping altering mixing within the dam (Figure 6-10). • Iron concentrations at the seepage and TSF sites show similar trends as previous years, with elevated levels in SCD02 and the SCP. • Overall, SCD02 continues to have poor water quality, with SCD01 having better quality, and showing reductions in zinc over time. The similarity between SCD01 and DW01 suggests that water in the TSF may be the source of the SCD01 seep, whereas SCD02 may be derived from underlying historic acid producing material. • pH levels in the Clean Water Diversion (CWDD01) and the sites in the Stitt River show CWDD01 generally has the lowest pH values, with pH in the Stitt River typically ranging from 5.5 – 7.5 (Figure 6-12). pH at the new SR03 and U/S Pie monitoring sites show a decrease relative to SR02, but a longer time-series is required to confirm this trend.

	• Total zinc results show similar trends as previous years at CWDD01, with higher values recorded during the summer period. This may be due to higher groundwater inputs during the drier months. Zinc values at WL8 and SR02 are also consistent with previous ranges. The new sites show a small increase in zinc between SR02 and SR03 and a large increase between SR03 and U/S Pie. This large increase is attributable to the inflow from Rosebery Creek and likely other diffuse sources. (Figure 6-13). • Sulphate concentrations show similar behaviour to zinc, with increased levels at CWDD01 in summer and increasing levels downstream of WL8. Overall sulphate concentrations remain low in the Stitt River, at < 20mg/L (Figure 6-14). Groundwater: • Similar to previous years the groundwater results vary on different sides of the TSF, and reflect regional groundwater flow combined with impacts from historic and present operations. • GB23H, located near the western embankment continues to record relatively low pH and the highest zinc and sulphate concentrations (Figure 6-15, Figure 6-16, Figure 6-17). This is consistent with the bore intersecting water that is similar in composition to the seepage being discharged along the Murchison Highway. • The lowest concentrations of sulphate and zinc are found in bores GB21H, GB15, GB16 and GB14 which are located either upslope or away from the TSF and capture the local/regional groundwater conditions. • All TPH and BTEX values were below the LoR except in bore GB12D where the C_{10}-C_{14} TPH component was at the LoR of 0.1 mg/L and Benzene was at the LoR of 0.002 mg/L in May 2021. GB12D is located at the southeastern toe of the eastern embankment, near the seepage collection system, and the source of the contaminants is unknown. • Bore GB23H shows increasing trends of sulphate, acidity, filtered manganese and iron, and total arsenic (Figure 6-18, Figure 6-19). pH has increased in the bore since establishment, but it is unknown what is driving the increasing concentrations. It could be that an increase in water levels associated with filling of the 2/5 TSF has inundated 'new' contaminated material. Water monitored in this bore is likely contributing to the MHS2 seep. Murchison Highway Seeps (MHS2, MHS3) • The quality of water in the MHS2 and MHS3 seeps differ considerably, and the differences are consistent with the conceptual model of MHS2 being derived from seepage from the 2/5 TSF, and MHS3 reflecting groundwater draining predominantly historic fill (Figure 6-20 to Figure 6-23). • MHS3 has more acidic pH values, lower sulphate, acidity iron, arsenic and manganese, but higher zinc concentrations as compared to MH2. • The MHS2 seep quality is similar to GB23H, with arsenic concentrations in the 0.14-0.18 mg/L range. Arsenic and iron show similar trends suggesting the arsenic is associated with iron oxy/hydroxides

	• The large fluctuations in sulphate in both MHS2 and MHS3 suggest there are periodic influxes of clean surface or groundwater water to the seep
Recommendations	• Water levels in the bores should be analysed with respect to rainfall and the water level in the TSF to understand what is controlling groundwater infiltration. This information would provide a context for interpreting water quality in the bores.

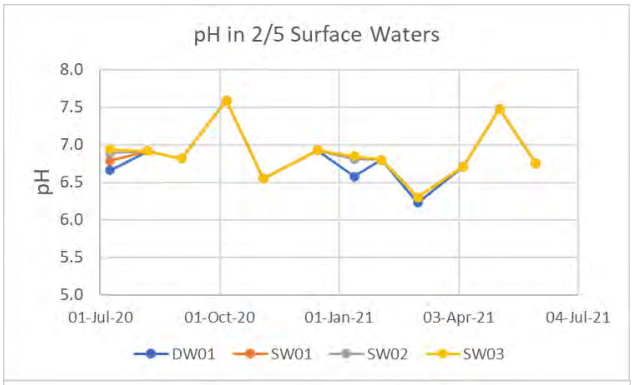


Figure 6-2. pH in 2/5 TSF surface water and decant return, July 2020 to June 2021.

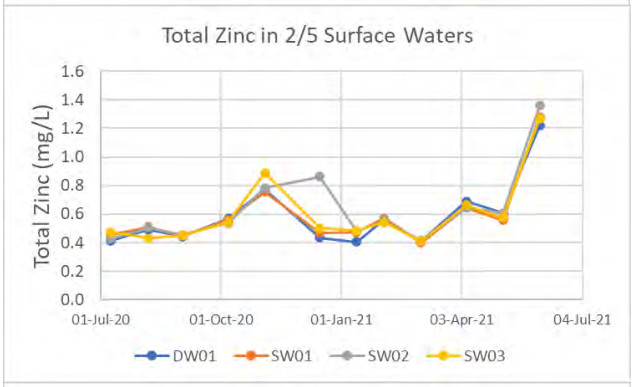


Figure 6-3. Total zinc in 2/5 TSF surface water and decant return, July 2020 to Jun 2021.

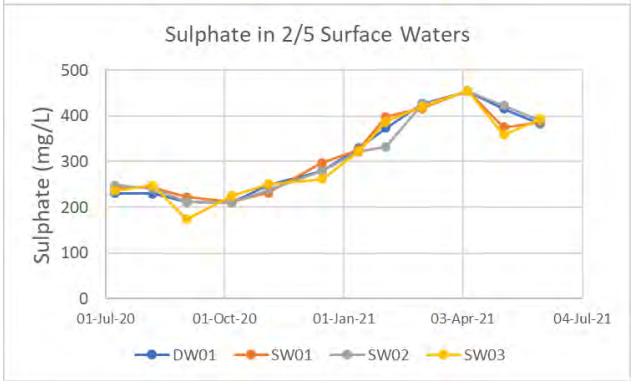


Figure 6-4. Sulphate in 2/5 TSF surface water and decant return, July 2020 to Jun 2021.

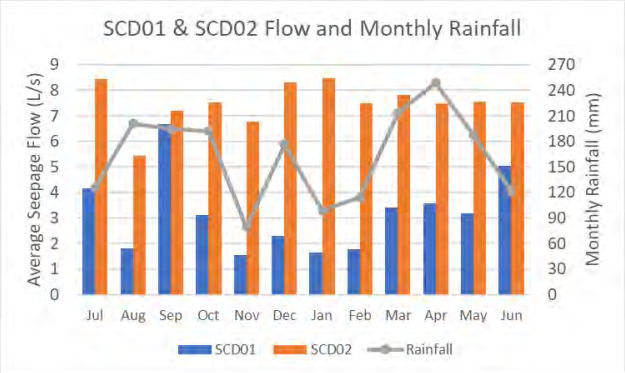


Figure 6-5. Average monthly flow rates in seepage drains SCD01 and SCD02 compared to total monthly rainfall.

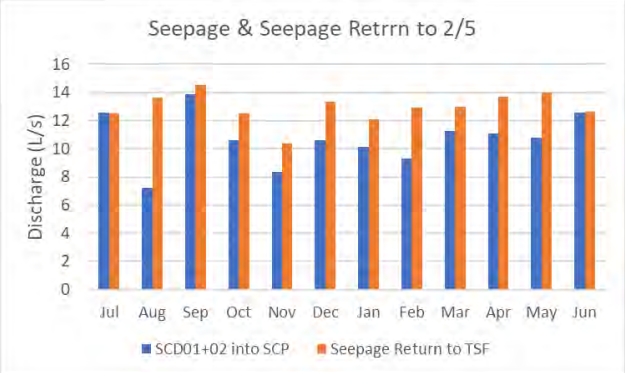


Figure 6-6. Comparison of average monthly combined flow rate in SCD01 and SCD02 with average monthly seepage return rate to 2/5 dam.

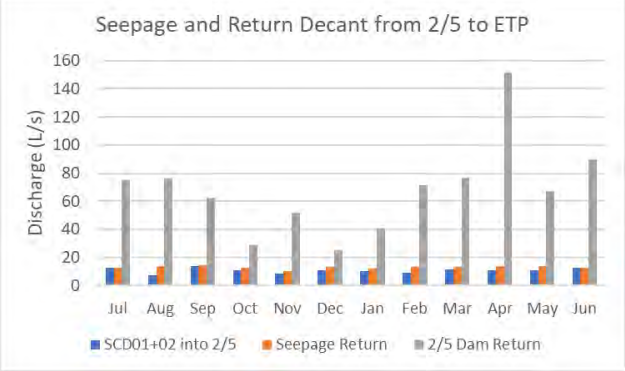


Figure 6-7. Comparison of seepage flow rates into Seepage Collection Pond, Seepage Return flow rates into 2/5 Dam, and Decant return from 2/5 dam to ETP.

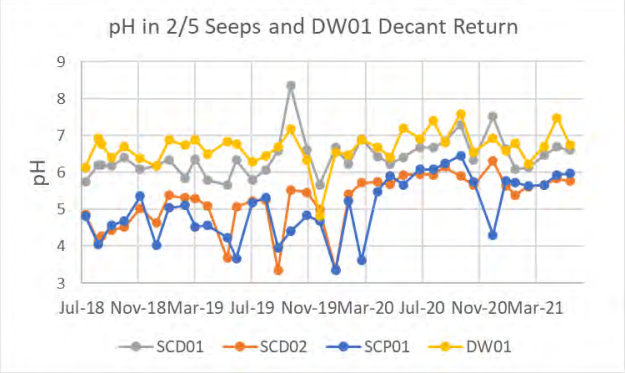


Figure 6-8. pH in 2 / 5 seepage drains SCD01 and SCD02 and in the seepage collection pond SCP01 Jul 2018 to Jun 2021.

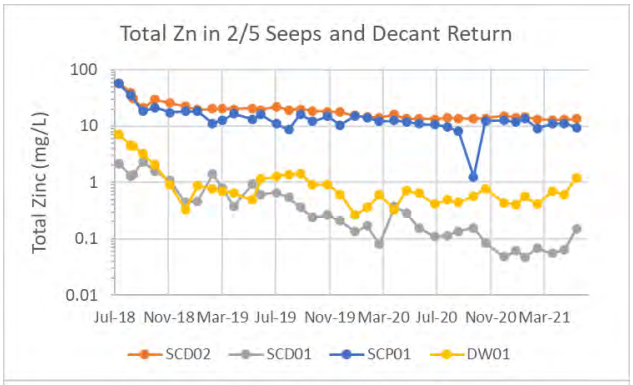


Figure 6-9. Total Zinc in 2 / 5 seepage drains SCD01 and SCD02, in the seepage collection pond SCP01 and the DW01 decant return to ETP Jul 2018 to Jun 2021. Note log scale.

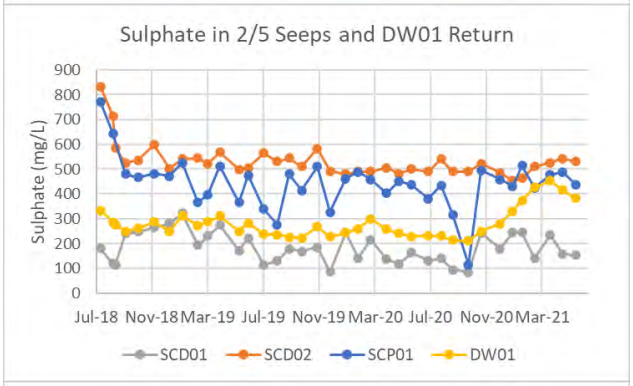


Figure 6-10. Sulphate in 2 / 5 seepage drains SCD01 and SCD02, in the seepage collection pond SCP01 and the DW01 decant Jul 2018 to Jun 2021.

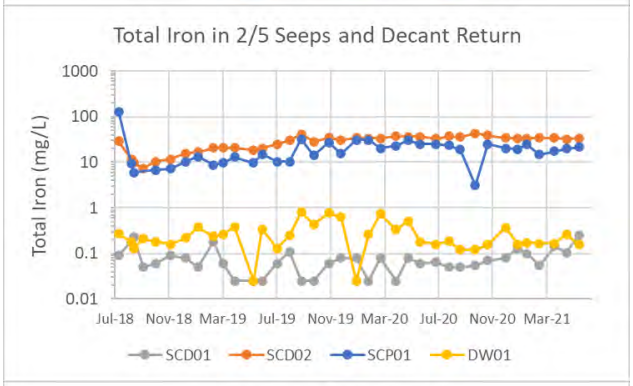


Figure 6-11. Total iron in 2 / 5 seepage drains SCD01 and SCD02, in the seepage collection pond SCP01 and the DW01 decant Jul 2018 to Jun 2021.

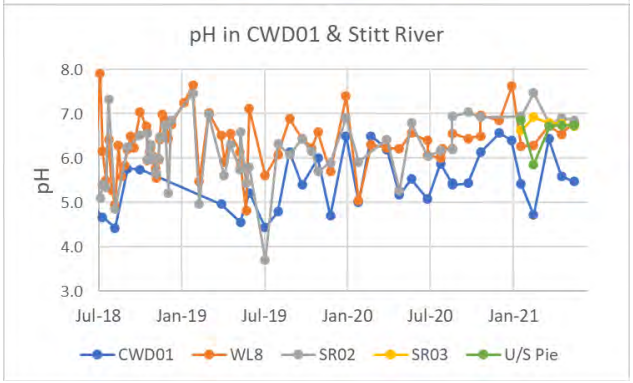


Figure 6-12. pH at Clean Water Diversion and the Stitt River at WL8 , SR02, SR03 an U/S Pie from Jul 2018 to Jun 2021.

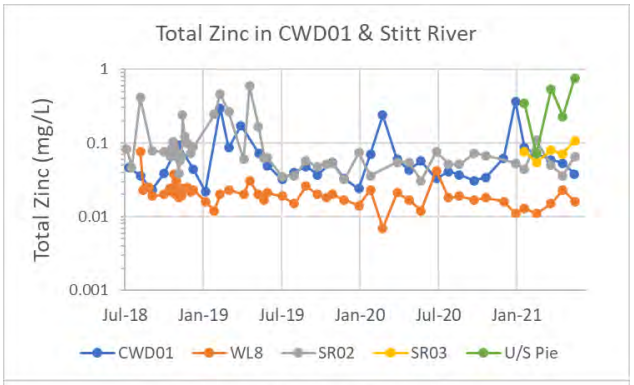


Figure 6-13. Total zinc concentration in the Clean Water Diversion and the Stitt River at WL8 and SR02 Jul 2018 to Jun 2021. Note log scale.

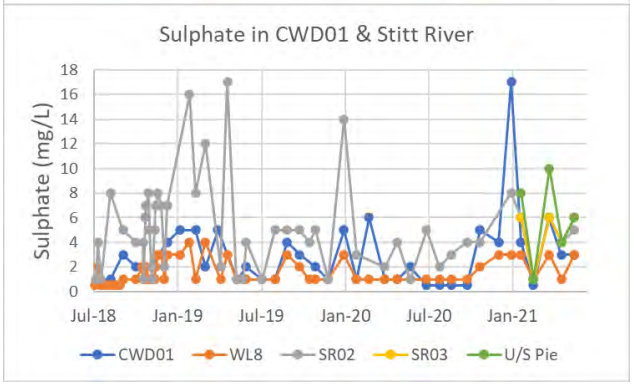


Figure 6-14. Sulphate concentrations in the Clean Water Diversion and the Stitt River sites Jul 2018 to Jun 2021.

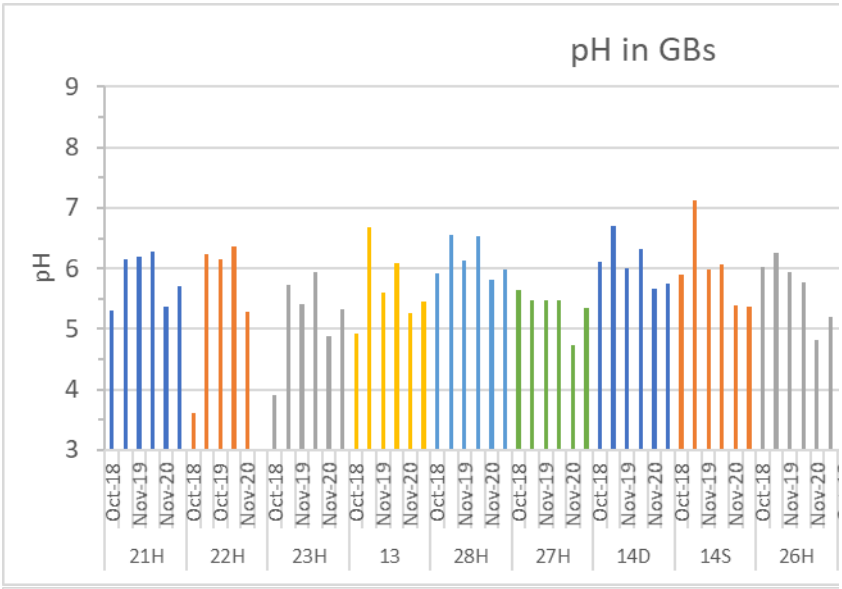


Figure 6-15. pH in the 2 and 5 ground water bores. Sites are shown in clockwise direction beginning at site GB21H, located on the southern side of the impoundment. Sites GB15 and GB16 are located east of the Stitt River. Sampling was completed in Nov 2020 and May 2021

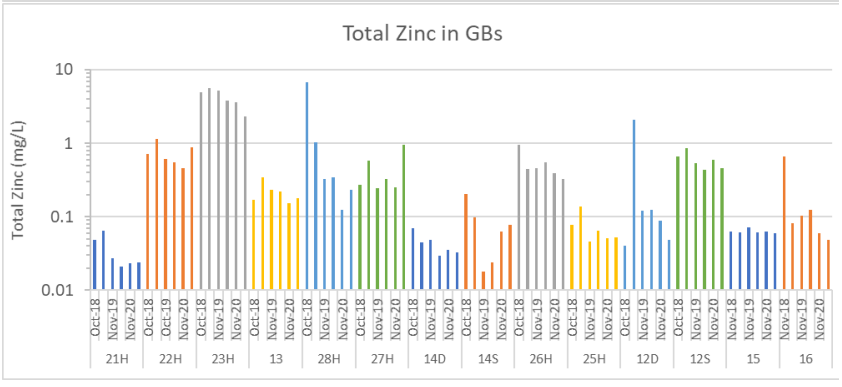


Figure 6-16. Total zinc in 2 and 5 groundwater bores. Sites are shown in clockwise direction beginning at site GB21H, located on the southern side of the impoundment. Sites GB15 and GB16 are located east of the Stitt River. Sampling dates were Oct 18, Apr 19, Nov 19 and Apr 20, Nov 20, May 21.

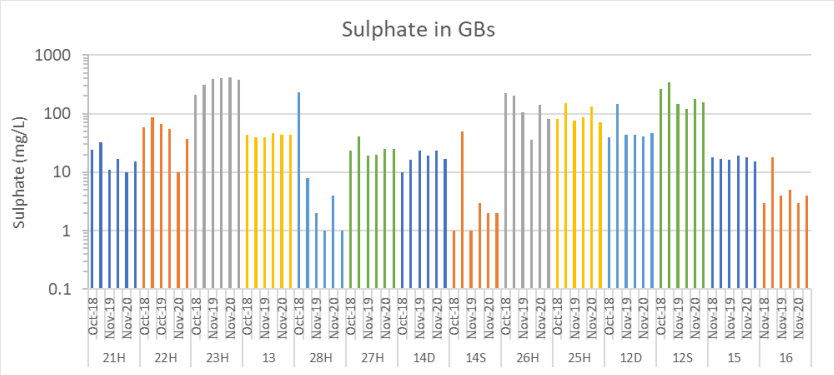


Figure 6-17. Sulphate in 2 and 5 groundwater bores. Sites are shown in clockwise direction beginning at site GB21H, located on the southern side of the impoundment. Sites GB15 and GB16 are located east of the Stitt River. Sampling dates were Oct 18, Apr 19, Nov 19 and Apr 20, Nov 20, May 21.

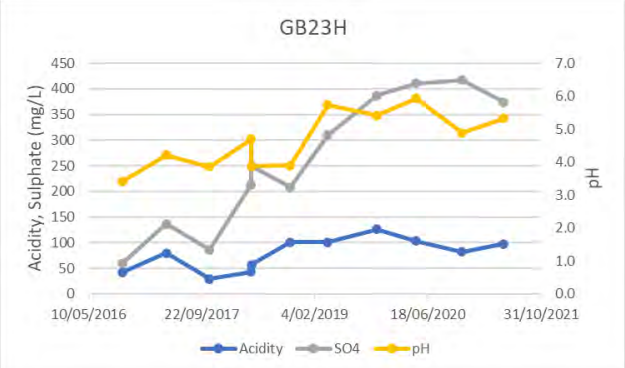


Figure 6-18. Acidity, sulphate and pH in GB23H 2016 – 2021.

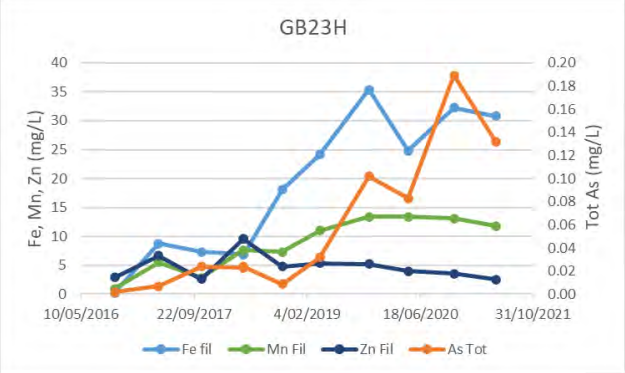


Figure 6-19. Filtered iron, manganese and zinc and total arsenic in GB23H 2016 – June 2021.

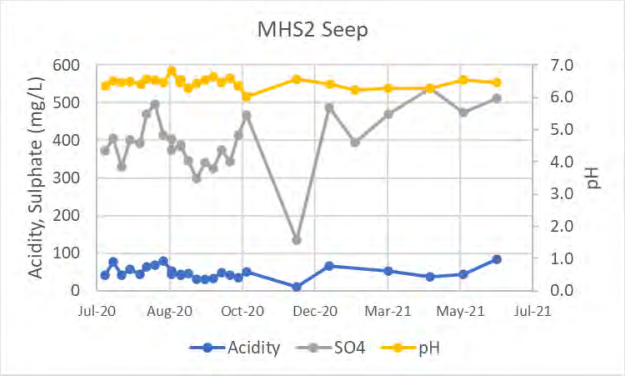


Figure 6-20. Acidity, sulphate and pH in the MHS2 Seep, July 2020 – June 2021

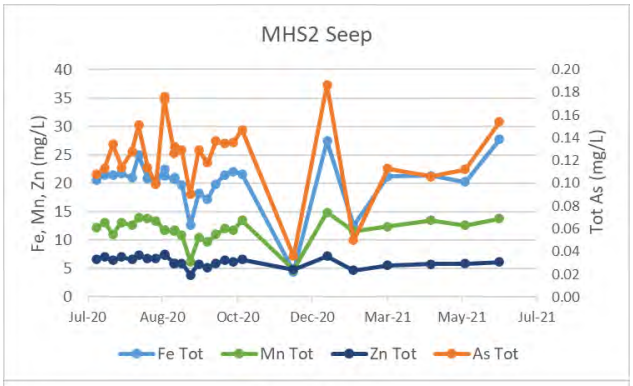


Figure 6-21. Total iron, manganese, zinc and arsenic in the MHS2 Seep, July 2020 – Jun 2021.

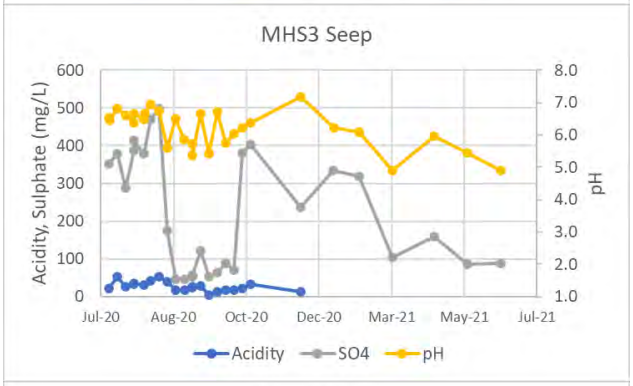


Figure 6-22. Acidity, sulphate and pH in the MHS3 Seep, July 2020 – June 2021

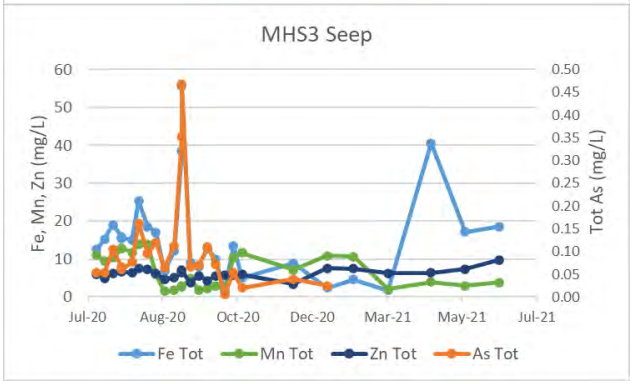


Figure 6-23. Total iron, manganese, zinc and arsenic in the MHS3 Seep, July 2020 – Jun 2021

7 Stitt River upstream of 2 and 5 Dam

A summary of the monitoring results collected at site WL8 upstream of the 2 and 5 Dam is contained in Table 7-1.

Table 7-1. Summary of monitoring results from the Stitt River upstream of 2 and 5 Dam in 2020-2021.

Requirement	Findings
Monitoring Frequency	EPN 7153/3 contains the monitoring requirements for WL8 in 2020-2021. Some results for WL8 were presented in Section 6. The requirements have been revised starting July 2021 under the new 2/5 TSF Water Quality Monitoring Plan. • Continuous river level is recorded in the Stitt River upstream of 2 and 5 Dam by Entura under contract to TasWater. Flow results based on the river level are provided to MMG Rosebery by TasWater (Figure 7-1).

	• Continuous Electrical Conductivity and Temperature are no longer monitored at the site, but weekly monitoring of these parameters is completed as shown in Figure 7-2. • All other parameters were monitored on a monthly basis as required.
Compliance with EPN	There are no requirements in the EPN other than monitoring frequency and parameters to be determined. All parameters were determined on an at least monthly basis. Additional parameters were also analysed.
Significant trends reporting period	• Flow in the Stitt River was moderate in 2020 – 2021 with several events >30 m^3/s, but none >40 m^3/s. Monitoring coincided with flow <2.5 m^3/s in all months. • pH values were consistent with previous results, with values between 6 and 7. EC values were lower during the winter than recorded over the previous 4 years. Values increased in the summer, but remained lower than 2018-2020 (Figure 7-2). • Metal concentrations were low and similar to previous years (Figure 7-3). Sulphate concentrations (not shown) were all below 4 mg/L, consistent with the last 3 years. • Total and filtered zinc concentrations remained similar to previous results, with the exception of one total zinc value in July 2020 that was >0.04 mg/L. TSS remained below the LoR in the sample (Figure 7-4) suggesting the zinc was associated with very fine particulates.
Long-term trends	• No changes have been detected in the water quality of the Stitt River compared to previous monitoring years. The decrease in EC may reflect a shift to reliance on field EC values rather than laboratory values.

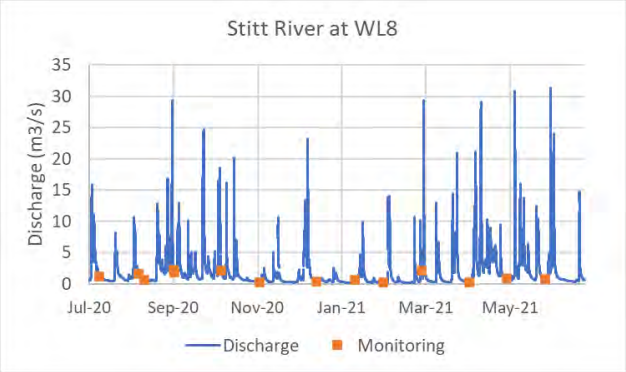


Figure 7-1. Discharge in the Stitt River upstream of 2/5 dam July 2020 to June 2021. Sampling dates are indicated by dots.

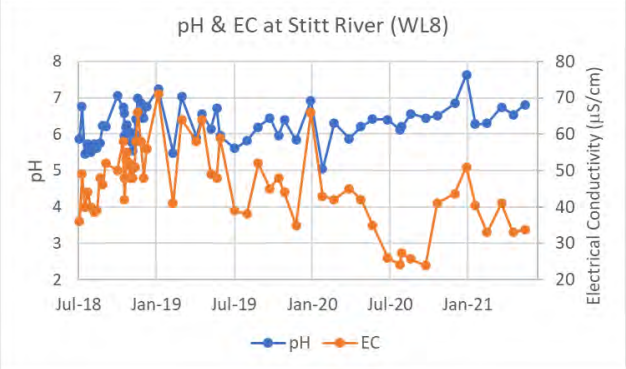


Figure 7-2. Field pH, and Electrical Conductivity in the Stitt River July 2018 – June 2021.

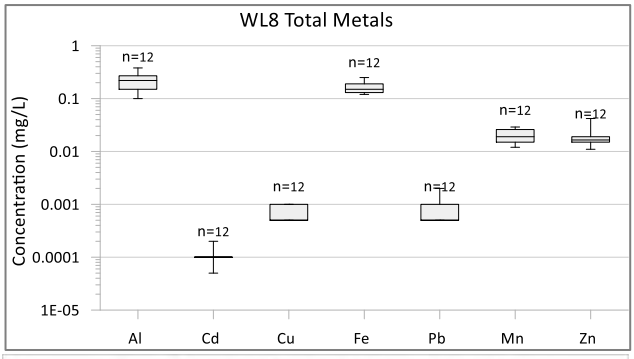


Figure 7-3. Box and whisker graph of metals in Stitt River upstream of 2 and 5 dam (WL8) for July 2020 to June 2021. Box and whisker plot as described in Figure 2-4.

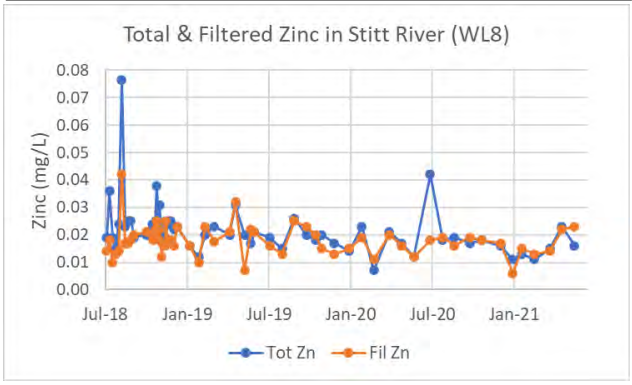


Figure 7-4. Total and filtered zinc values at WL8 in July 2018-to June 2021.

8 Hercules Monitoring

A summary of the monitoring results from the Hercules Mine site are contained in Table 8-1.

Table 8-1. Summary of monitoring results from the Hercules Mine site collected in 2020-2021.

Requirement	Findings
Monitoring Frequency	All sites were monitored at the frequency required in the EPN. All parameters were determined as required except for the following: • At Baker Creek (BCs) continuous flow is missing for 14 May-18 May and 24 Jun to 26 Jun, 2021; continuous EC is missing for 14 May to 18 May 2021
Compliance with EPN	Monitoring frequency and parameters determined are the only requirements in the EPN. With the exception of the previously listed data gaps all monitoring was completed as required and results for all parameters were reported. Additional parameters were monitored at the sites that are not required in the EPN.
Significant trends - reporting period	• Flow results at BC2 are substantially different from previous years, with an annual average flow of 0.09 m^3/s compared to 0.40 m^3/s in the previous 2 years. The 2020-2021 monitoring year was drier than average, but this large decrease likely reflects the probe upgrades and enhanced maintenance at the flow monitoring site. The flow monitoring is under review by the MMG Closure Study. • The continuous pH and field pH results show a discrepancy, with the field results recording lower pH values. (Figure 8-1, Figure 8-3, Figure 8-5). • EC at all sites decreases with increased flow. pH increases with increased flow in Baker Creek, but decreases with increased flow at the other two sites, reflecting an influx of acidic water.

	• The field and laboratory EC results tend to bracket the continuous EC, with the field results lower and lab results higher than the continuous values (Figure 8-2, Figure 8-4, Figure 8-6). • The results from WSP are slightly lower as compared to 7L. There is a correlation between total zinc concentrations at the two sites (R^2 = 0.80), with the WSP results suggesting about 20% dilution between the two sites. This is higher than the 10% dilution estimated in 2019-2020 and may be due to damage to the AD collection system. Metal concentrations at the two sites are shown in Figure 8-7. • The range of monthly metal concentrations is similar to previous years, with the WSP having the highest concentrations (but lowest flows). The concentrations in Baker Creek are slightly lower but flow rates are substantially higher (Figure 8-8). • Seasonal patterns continue to be present in the time-series of metal concentrations, with the highest concentrations occurring during the drier summer months (Figure 8-9, Figure 8-10). • Metal and sulphate loads on monitoring days based on the water quality results and average daily flow rate show an average of 2.0 tonnes/day of sulphate and 0.49 tonnes/day of total zinc are discharged from the site. These results are substantially lower than the estimate for the previous year (4.3 t/day SO_4 and 1.1 t/day Zn), with the difference likely attributable to the considerably lower flow measurements at Baker Creek. The results show Baker Creek continues to transport the largest load even with the lower flow rates (Figure 8-11). • The concentrations of zinc at the Ring River Bridge (upstream of Hercules) ranged from 0.50 to 0.95 mg/L, similar to previous year (Figure 8-12). A large increase occurs between the Bridge site and the Ring above Baker Creek site, and is attributable to inflow from the WSP and runoff from the mine road. Baker Creek enters the Ring downstream of the Ring above Baker site. The resultant concentrations in the lower Ring River at Highway are a net increase of 1 to 5 mg/L compared to the Ring at Bridge site. • Flow has been gauged in the Ring River at the Murchison Highway since October 2020. Using the average daily flow rates and total zinc results at the sites yields the zinc fluxes shown in Figure 8-13. During low flow (Jan, Feb, May, Jun) there is good balance between the sites, and the input from Hercules can account for the flux recorded at the downstream site. During periods of high flow, calculated loads are higher from Hercules than recorded at the Murchison Highway site. This is likely due to rapid flow fluctuations affecting the balances, and / or the storing of zinc in the river system. Sulphate (Figure 8-13) shows similar trends. For both parameters, the loads at the Highway site can be accounted for by inputs from Hercules.
Comments	The continuous recording pH and EC probes should be checked and calibrated as frequently as feasible, and flow at Baker Creek should be checked.

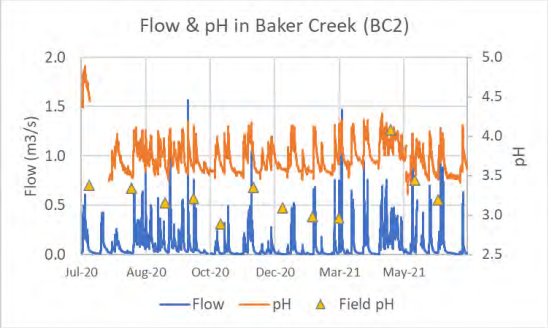


Figure 8-1. Continuous flow, pH and monthly field pH results in Baker Creek upstream of the Ring River.

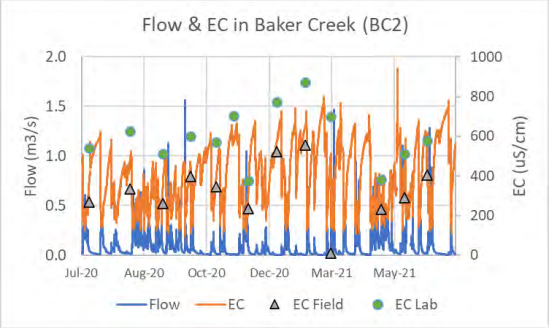


Figure 8-2. Continuous flow, EC and monthly field and laboratory EC results in Baker Creek upstream of the Ring River

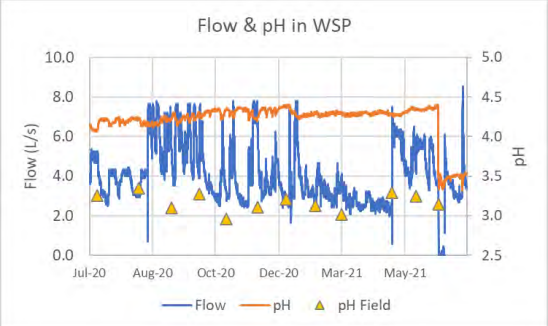


Figure 8-3. Continuous flow, pH and monthly field pH results in the Williamsford Settling Pond.

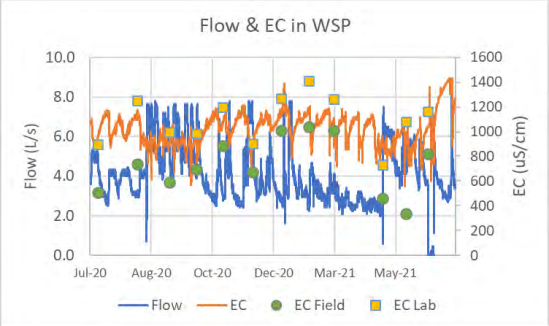


Figure 8-4. Continuous flow, EC and monthly field and laboratory EC results in the Williamsford Settling Pond

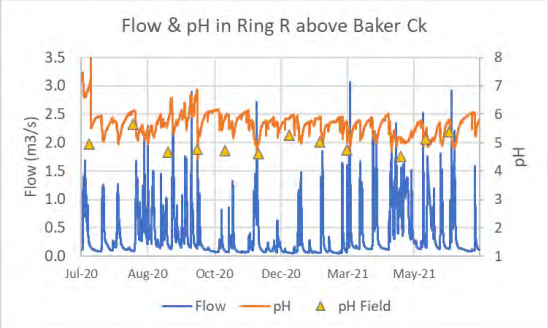


Figure 8-5. Continuous flow, pH and monthly field pH results in the Ring River upstream of Baker Creek

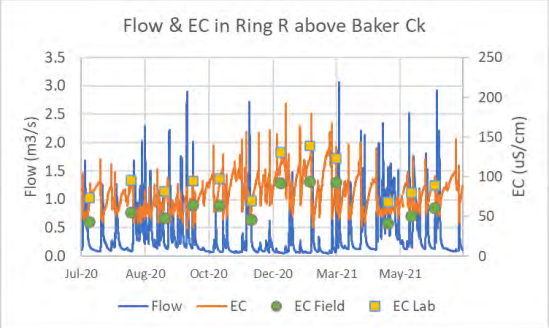


Figure 8-6. Continuous flow, EC and monthly field EC results in the Ring River upstream of Baker Creek

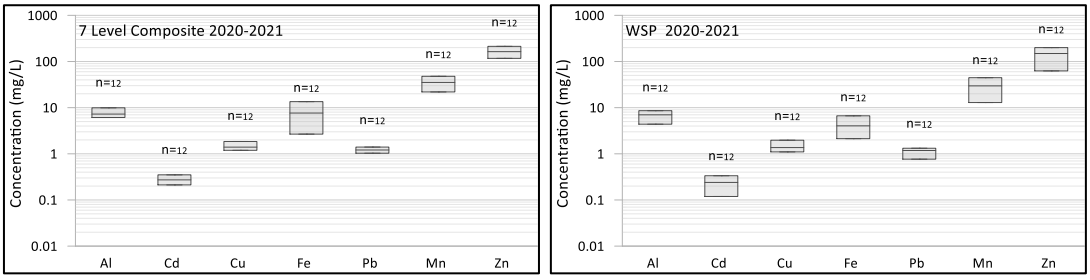


Figure 8-7. Box and whisker plot of total metal concentrations at the 7L composite site and the Williamsford Settling Pond in 2020-2021. Note log scale.

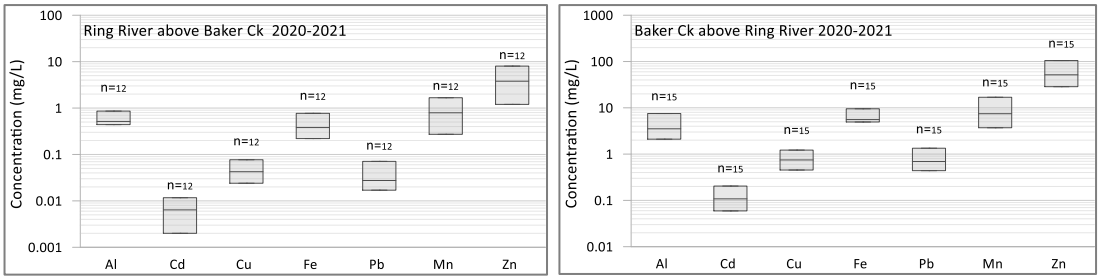


Figure 8-8. Box and whisker plot of total metal concentrations in the Ring River upstream of Baker Creek (left) and Baker Creek upstream of Ring River in 2020-2021 (right). Note log scale on Ring River graph is different from other figures (min = 0.001 mg/L, max = 100 mg/L).

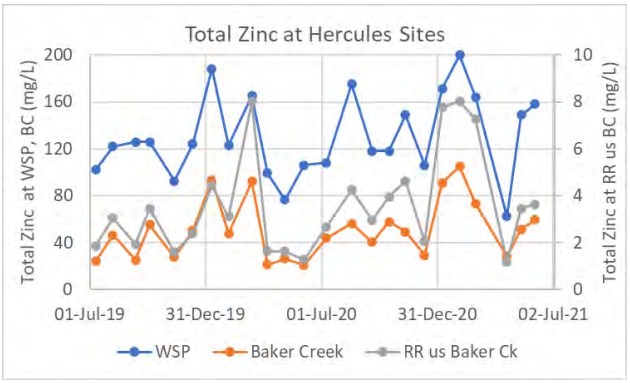


Figure 8-9. Time-series of monthly total zinc results at the Williamsford settling pond, Baker Creek and Ring River above Bakers Creek. Note the Ring River results are plotted at a 20-fold lower scale.

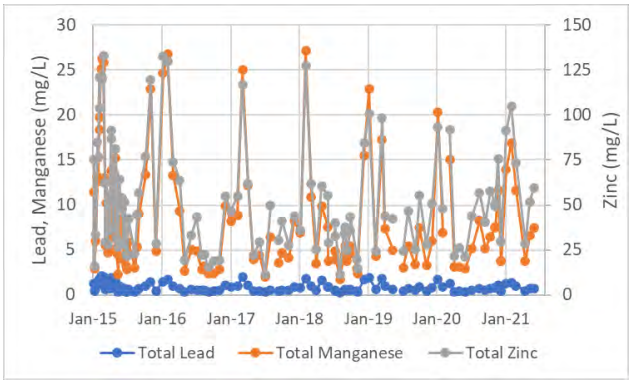


Figure 8-10. Total manganese, zinc and lead in Baker Creek showing similar seasonal trends as previous years.

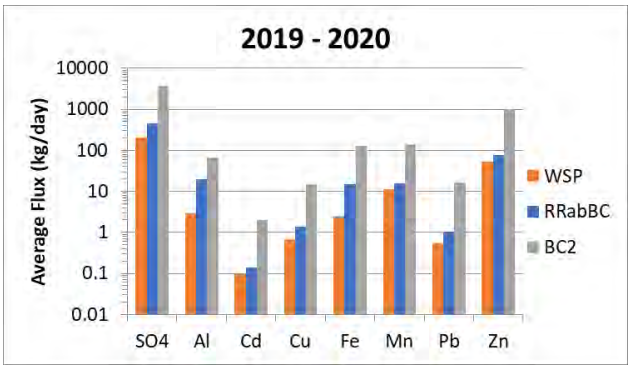
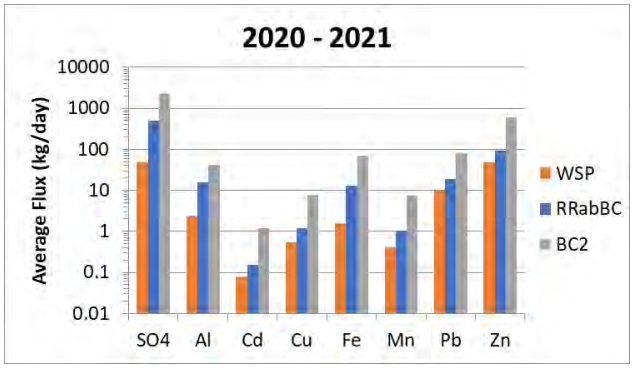


Figure 8-11. Average sulphate and total metal loads in the WSP, Ring River above Baker Creek and Baker Creek based on the monthly monitoring results and daily flow on the monitoring date 2019 – 2020 (top) and 2020-2021 (bottom). Note log scale



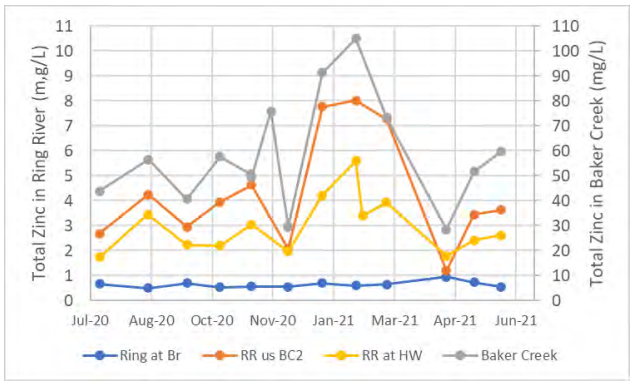


Figure 8-12. Total zinc in Ring River at Bridge upstream of WSP, upstream of confluence with Baker Creek (RR us BC), in Baker Creek upstream of Ring River and at the Murchison Highway (RR at HW). Note Baker Creek scale is 10-times greater than Ring River scale

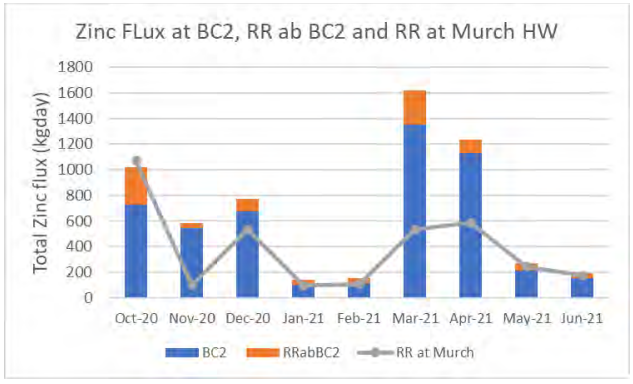


Figure 8-13. Comparison of combined zinc fluxes at Baker Creek and Ring River above Baker Creek, with zinc flux at Ring River at Murchison Highway. Oct 2020 to Jun 2021.

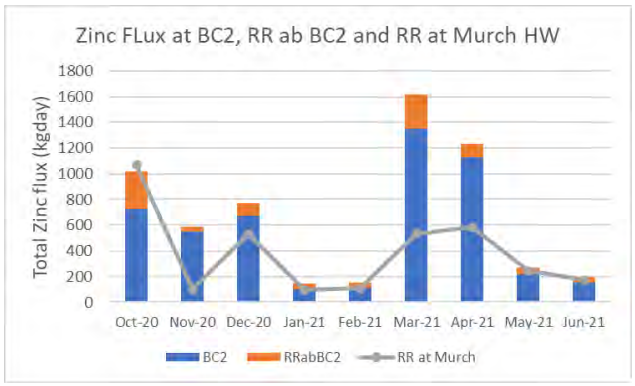


Figure 8-14. Comparison of combined sulphate fluxes at Baker Creek and Ring River above Baker Creek, with zinc flux at Ring River at Murchison Highway Oct 2020 to Jun 2021.

9 Stormwater monitoring

A summary of the stormwater monitoring results collected in 2020-2021 on the Rosebery lease is contained in Table 9-1. The improved collection and treatment of stormwater on the

mining lease over the past years has resulted in a large reduction of runoff from the site. All flow in upper Filter Plant Creek (FPC1 and FPC2) and Primrose Creek (PC1 and PC2) is collected and directed to the ETP for treatment. Site FPC3 is located downstream of the Filter Plant ponds and collects predominantly runoff from the residential area, including inflows from historic waste rock located around the residential area. Filter Plant Creek ultimately enters Lake Pieman in the flooded arm of the Stitt River.

Water diverted away from the 4L WRD area by Assay Creek is discharged from site and enters the Stitt River between Rosebery Creek and Stitt Falls. Water that has come in contact with the WRD area is collected and directed to the ETP for treatment and discharge via Bobadil.

Rosebery Creek receives diffuse inputs from the mine site as well as groundwater and runoff from areas outside of the mine site, such that not all of the load is attributable to the mine site. Rosebery Creek flows into the Stitt River upstream of Stitt Falls.

Table 9-1. Summary of stormwater monitoring results collected on the Rosebery mine lease in 2020-2021.

Requirement	Findings
Monitoring Frequency	Quarterly sampling was completed at all stormwater sites as required.
Compliance with EPN	All sites were monitored for the required parameters at the required frequency. There were no accidental releases of stormwater to the environment during the monitoring year. Due to improvements in storm water management the water monitored at sites FPC1, FPC2 and PC1 and PC2 do not enter the environment, so do not reflect runoff from the MMG operation.
Significant trends - reporting period	• Flow was present at all sites on all sampling days consistent with rainfall coinciding with monitoring dates (Figure 9-1). Flows of 5 L/s and 1.5 L/s were recorded at AC2 in March and June 2021, respectively. In Rosebery Creek, flow was only recorded between April and June 2021 (Figure 9-6). • In Assay Creek, the recent monitoring results were within the historic range of results, and there was little difference between the upstream AC1 and downstream AC2 site. This is due to the water being directed away from the WRD and other contaminated areas (Figure 9-2). • In Primrose Creek, concentrations were within historic ranges, and consistent with previous results, the concentrations decreased between the sites reflecting the inflow of clean water (Figure 9-3). • In Filter Plant Creek monitoring results were within historic ranges. Concentrations increased between FPC1 and FPC2, but decreased at FPC3. This reflects the collection and direction to treatment of water from between FPC2 and FPC3 (Figure 9-4). • In Rosebery Creek, the results were within historic ranges. The monitoring results show a large increase in all parameters between the RC1 and RC2 monitoring sites. This is due to stormwater and other diffuse inputs (Figure 9-5). • Flow estimates for Rosebery Creek were made for the Sept 2020 to May 21 sampling periods based on flow in the Stitt River (Figure 9-6). Estimated and measured flows ranged from 16 L/s to 513 L/s on the monitoring days, and calculated zinc loads ranged from 6 to 112 kg/day. The 112 kg/day is the highest load measured to date in the river.

	• Average zinc loads in Rosebery Creek upstream of the Stitt based on the 25 measurements obtained since September 2014 are 24 kg/day, with a median value of 15 kg/day.
Comments	Stormwater monitoring should be revised to reflect water streams leaving the lease site rather than streams that are collected within the Lease site and directed to the ETP. It would be useful to target storm events for stormwater monitoring in Rosebery Creek to better understand how contaminant transport varies with flow rates.

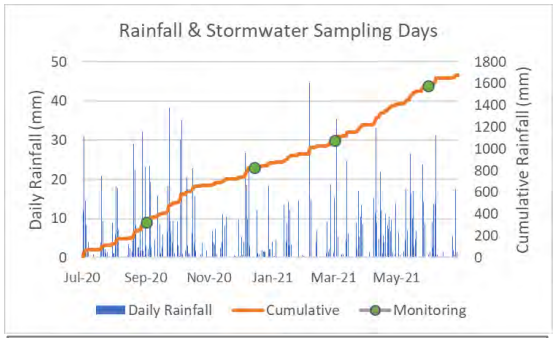


Figure 9-1. Daily rainfall during monitoring year and dates of quarterly stormwater sampling.

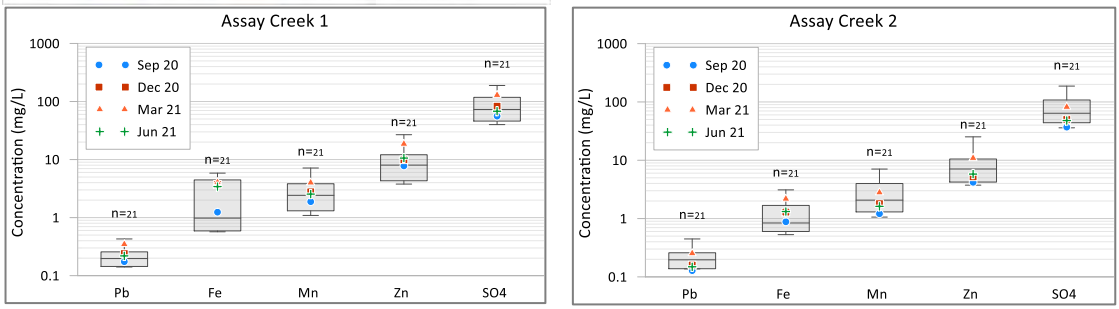


Figure 9-2. Total lead, iron, manganese, zinc and sulphate concentrations in Assay Creek 1 and Assay Creek 2 stormwater sites. The boxes encompass the 5th to 95th percentile monitoring results collected between Jan 2015 and Jun 2020, and the monitoring results collected from Jul 2020 to Jun 2021 are shown as data points.

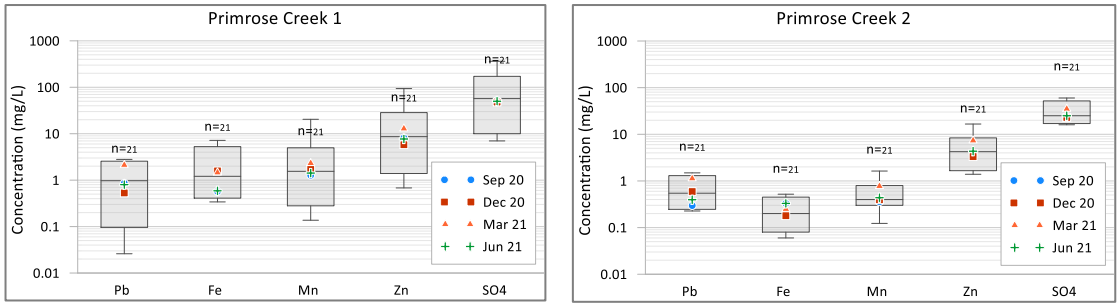


Figure 9-3. Total lead, iron, manganese, zinc and sulphate concentrations in Primrose Creek stormwater sites PC1 and PC2. The boxes encompass the 5th to 95th percentile monitoring results collected between Jan 2015 and Jun 2020, and the monitoring results collected from Jul 2020 to Jun 2021 are shown as data points.

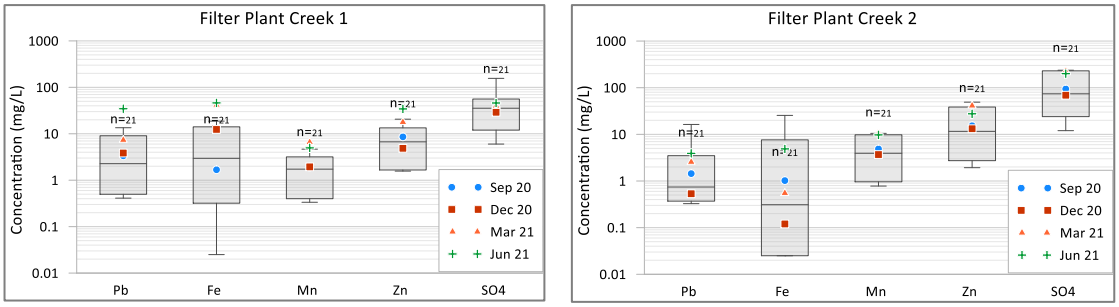


Figure 9-4. Total lead, iron, manganese, zinc and sulphate concentrations in Filter Plant Creek stormwater sites FPC1, FPC2 and FPC3. The boxes encompass the 5th to 95th percentile monitoring results collected between Jan 2015 and Jun 2020, and the monitoring results collected from Jul 2020 to Jun 2021 are shown as data points.

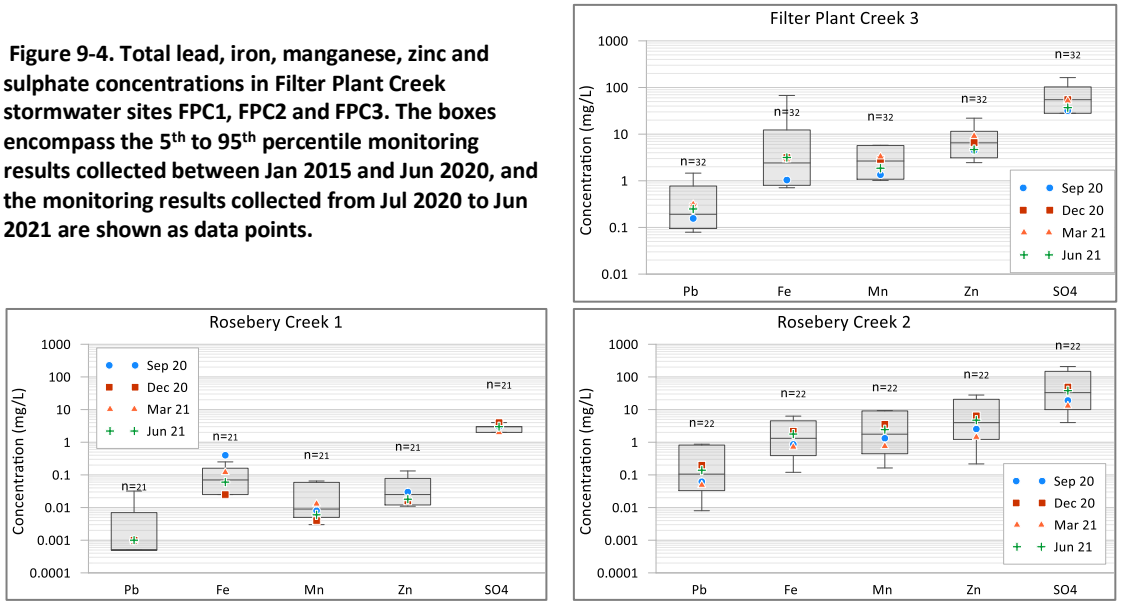


Figure 9-5. Total lead, iron, manganese, zinc and sulphate concentrations in Rosebery Creek stormwater sites RC1 and RC2. The boxes encompass the monitoring results collected between Jan 2015 and Jun 2020, and the monitoring results collected from Jul 2020 to Jun 2021 are shown as data points.

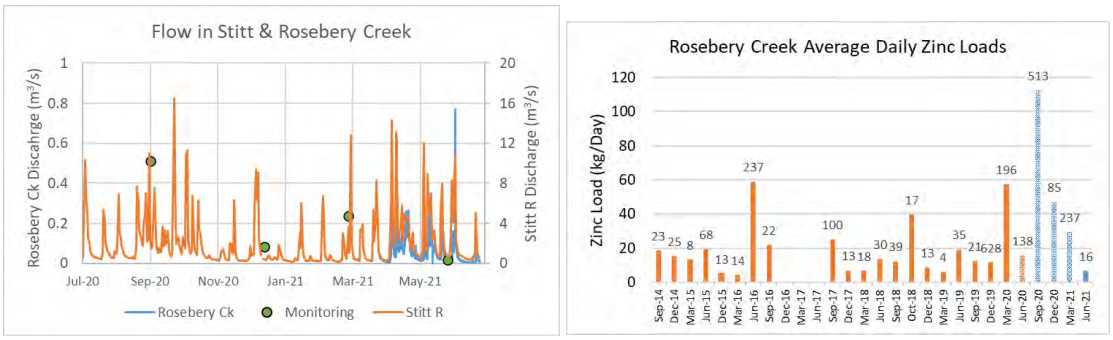


Figure 9-6. (left) Discharge in Stitt River (Jul 2020- Jun 2021) and Rosebery Creek (April 2021 to Jun 2021). Green point indicates storm water sampling dates. No flow data is available prior to April 2021 in Rosebery Creek; (right) Estimated zinc loads at RC2 based on flow measurement at Rosebery Creek gauging site on monitoring days, or estimate based on flow in the Stitt River Sept 2014 to June 2021. Data labels indicate the flow rate in Rosebery Creek in L/s on the sampling day. Stippled fill indicates estimated flow, blue bars show 2020-2021 results.

10 Underground Mine Water Monitoring

A summary of the underground mine water monitoring results is contained in Table 10-1.

Table 10-1. Summary of underground mine water monitoring results for 2020-2021.

Requirement	Findings
Monitoring Frequency	Monthly sampling was completed at all sites as required.
Compliance with EPN	All required parameters were monitored.
Comments	At the 17L Pump and 8L Adit sites monitoring results were consistent with concentrations recorded since March 2020, when levels decreased most likely due to an increase in water use underground. Lead values at 8L Adit did not decrease, and remain within the long-term range of results. Values at NED and HOR are also within the range of previous results (Figure 10-1).

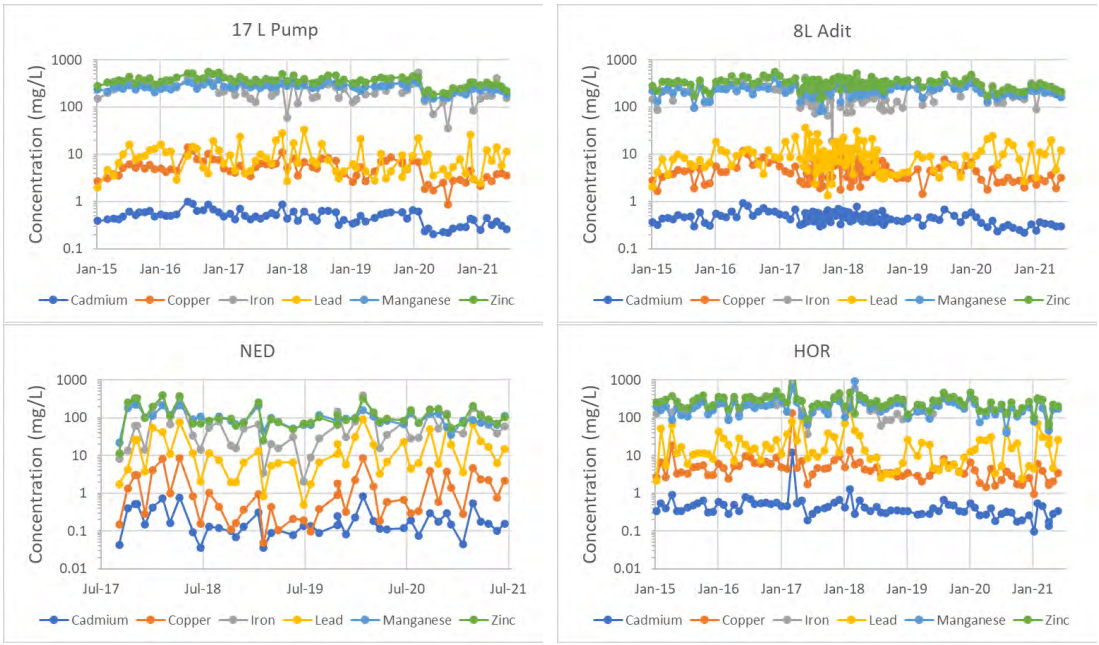


Figure 10-1. Total metal concentrations at underground sites. Time series for NED is shorter due to no access to site between 2015 and 2017.

11 Lake Pieman Monitoring

A summary of the monitoring results collected from Lake Pieman is contained in Table 11-1.

Table 11-1. Summary of monitoring results from Lake Pieman in 2020-2021.

Requirement	Findings
Monitoring Frequency	Quarterly water quality sampling was completed as specified in the EPN.
Compliance with EPN	There are no requirements in the EPN other than monitoring frequency and parameters determined. All parameters were determined as required.
Significant trends - reporting period	• The Bastyan Power Station operated intermittently prior to and on each of the monitoring days in 2020-2021 (Figure 11-1). When operating, discharge from the power station ranged from ~130 to 150 m^3/s.

	• The discharge from BO ranged from about ~0.3 m^3/s to ~0.8 m^3/s during the monitoring days, with most discharge around 0.4 m^3/s (Figure 11-1). When operating, flow from Bastyan provides ~160- to 500-fold mixing. • Despite fluctuating power station operations, temperature, EC, pH and DO showed little variability with depth or between monitoring sites. Water temperature varied by about 2°C across all sites on each monitoring occasion, and pH values ranged from 5.7 to 7.0 across all sites and dates. The water column profiles of EC show higher values at PBS3 on most runs, which is located downstream of the BO discharge (Figure 11-2). The higher EC values do not persist, with values at PBS4 and PBS5 similar to PBS2. Overall the EC values are very low at all sites and depths. • The metal results are within the range of historic results. One elevated zinc level was recorded in surface waters at PBS5, downstream of the Stitt River, in March 2021, and several bottom samples recorded elevated zinc levels (Figure 11-3). The 0.088 mg/L value recorded in the bottom water at PBS3 is the highest recorded in bottom waters since 2014 (Figure 11-4). The associated sulphate concentration was low (6 mg/L), consistent with the low EC values. • The filtered zinc results show little difference for most sites and dates, except for March 2021 at PBS3 where the total zinc concentration of 0.088 mg/L is much higher than the filtered value of the elevated bottom water total zinc value of 0.014 mg/L. The values are consistent with the elevated zinc being associated with particulates (Figure 11-5). • All sulphate concentrations were ≤12 mg/L except for the bottom sample at PBS2 (SO4 = 31 mg/L) and PBS3 (SO4 = 18 mg/L) in September 2020. EC was slightly higher at depth at PBS2 and PBS3 during this period, suggesting either BO water moved upstream or the presence of a local diffuse source. Surface sulphate results are shown in (Figure 11-6). • The median and 95th percentile values for total zinc across all sites were 0.016/L and 0.060 mg/L, respectively, which are above the ANZECC (2019) 95th percentile trigger value of 0.008 mg/L. The median is similar to the 90th percentile protection level (0.015 mg/L). These results are well below the No Observable Effects levels of 0.23 mg/L obtained through site specific toxicity testing by MMG using Pieman water and a local ceriodaphnia in 2006. The results for copper were low in 2020-2021, with the median value below the LoR of 0.001 mg/L, and the median equivalent to the LoR (0.001 mg/L). These values are below the ANZECC (2000) trigger value of 0.0014. The results for cadmium and lead were also below ANZECC (2019) target values.
Longer term trends	The results from 2020-2021 are consistent with the understanding of mixing within Lake Pieman, with the operation of the power station resulting in uniform water column characteristics and overall low metal and sulphate concentrations. There appeared to be little input from the Stitt River during the monitoring runs this year as compared to previous years.

Comments	A review of ambient monitoring in Lake Pieman should be completed, with consideration given to targeting days with different power station operating conditions, and to consider inclusion of a monitoring site further downstream where the Ring River enters the lake (recognising other sources affect this area of the lake).

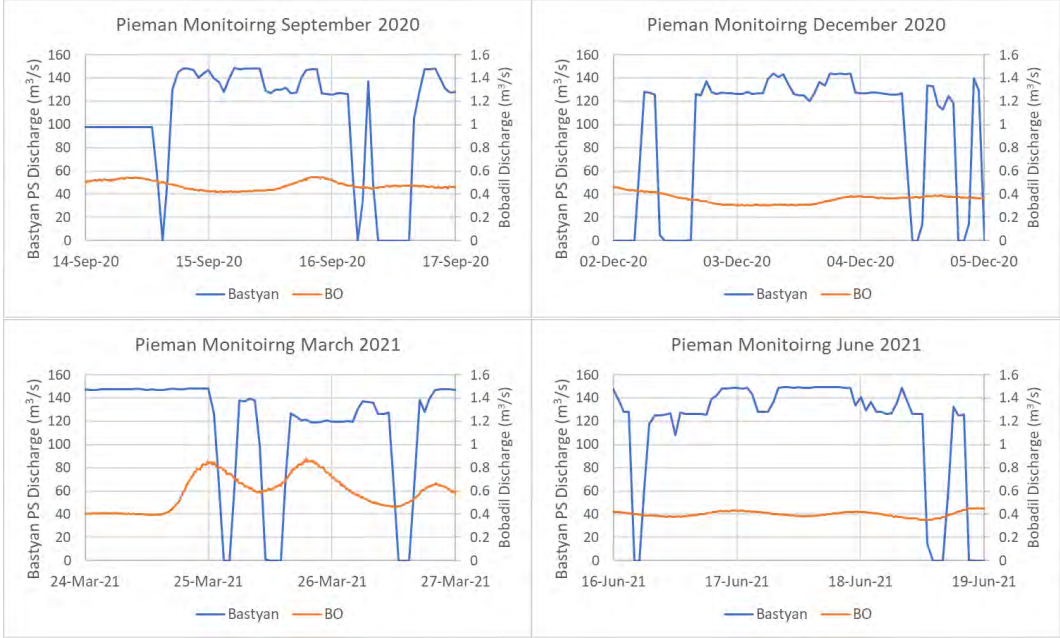


Figure 11-1. Discharge at Bastyan Power Station and Bobadil TSF the two days prior to, and on the day of, Lake Pieman monitoring (sampling dates shown on each graph). Note 100-fold difference in scales for the two discharge sites.

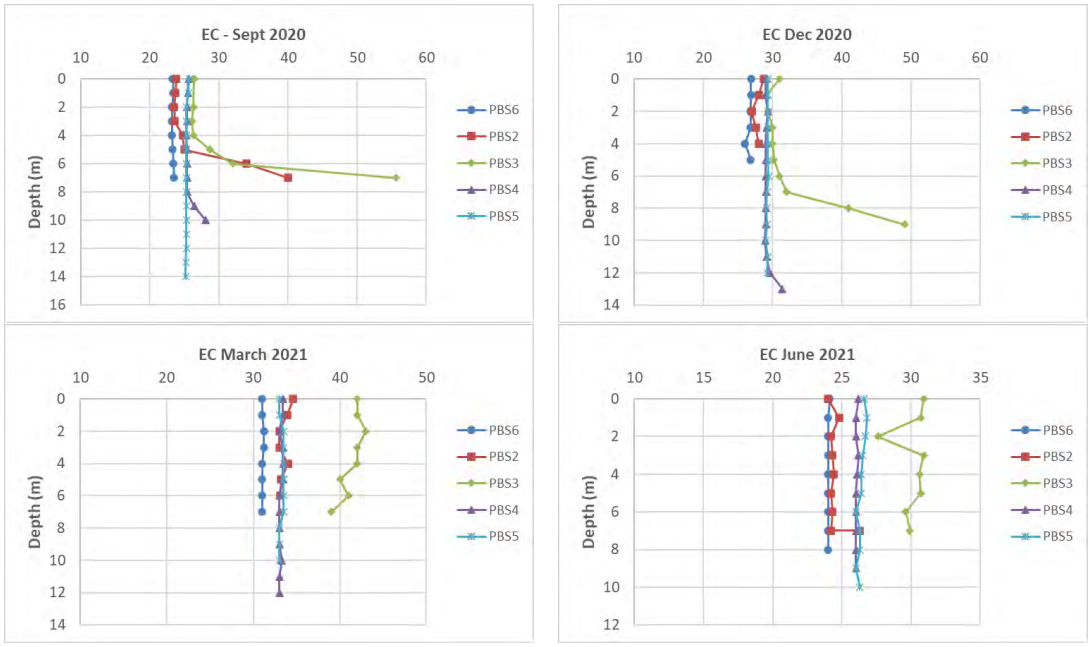
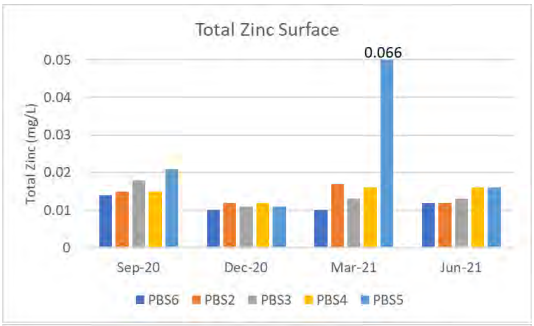
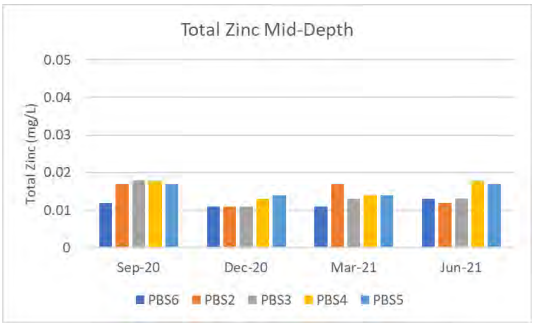


Figure 11-2. Electrical conductivity results for Lake Pieman monitoring sites on each monitoring date in 2020-2021. Results are listed in a downstream direction, e.g. PBS6 is at the upstream end of L Pieman.





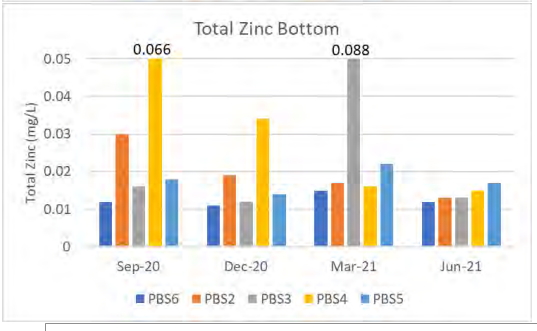
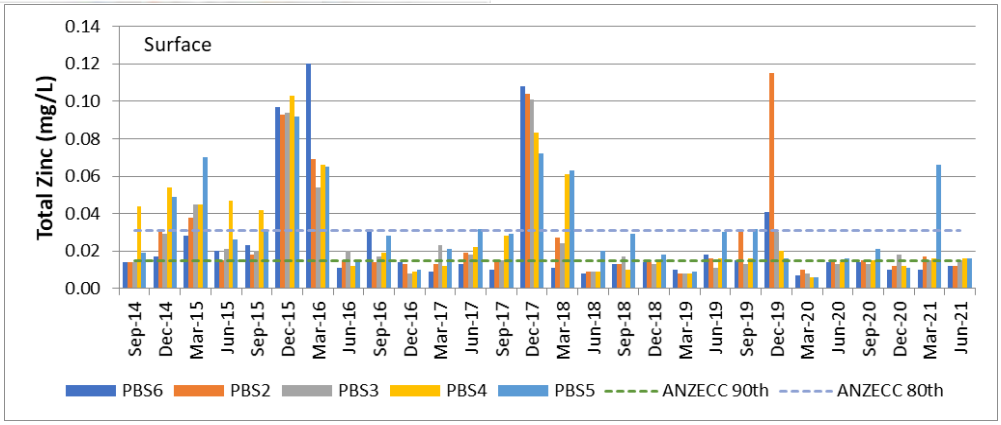
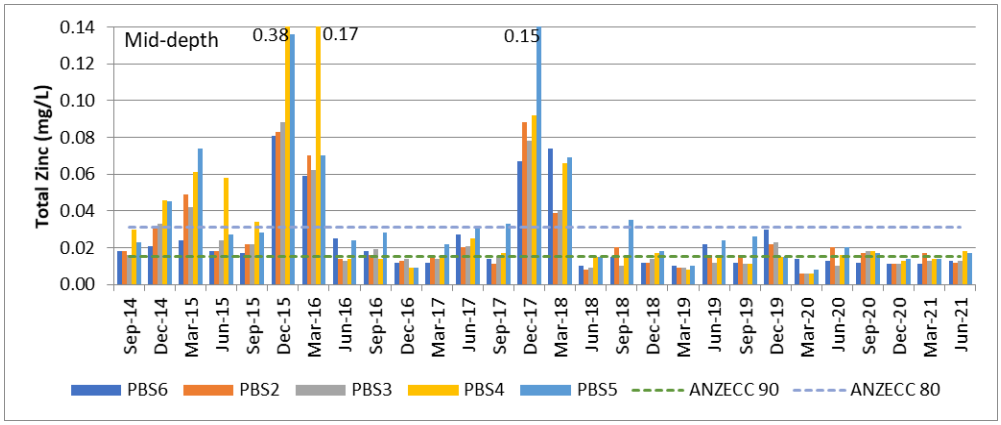


Figure 11-3. Total zinc concentrations in surface, mid-depth and bottom water samples in Lake Pieman in 2020-2021.





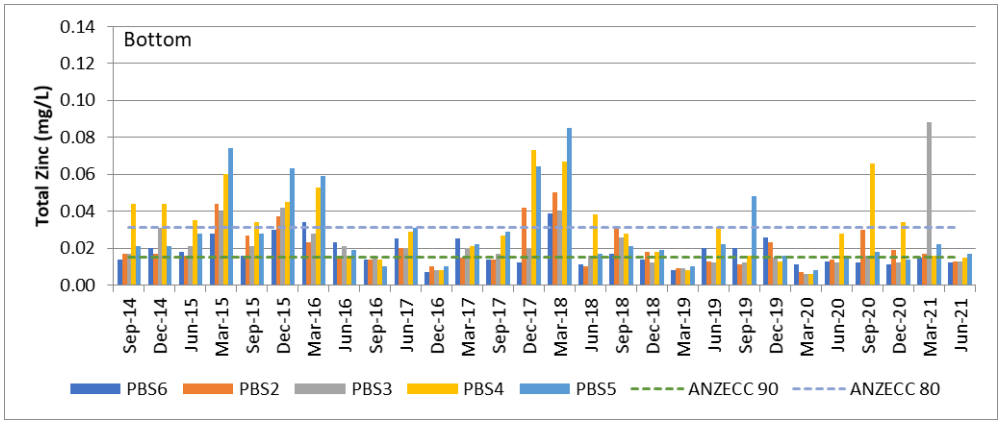
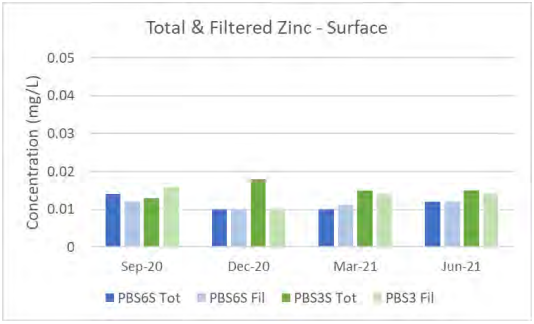
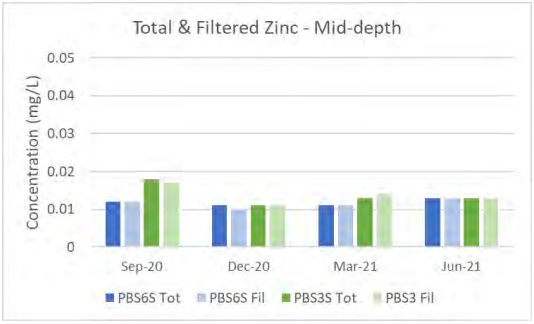


Figure 11-4. Total zinc in surface (top), mid-depth (middle) and bottom water (bottom) samples from September 2014 to June 2021. Labels indicate concentrations that extend beyond the limit of the graph.





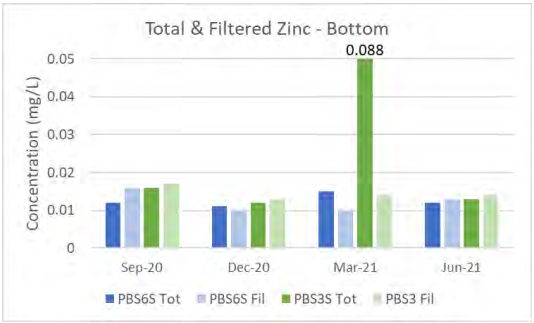


Figure 11-5. Comparison of total and filtered zinc results from PBS6 (upstream BO inflow) and PBS3 (downstream BO inflow) between Sept 2020 and Jun 2021.

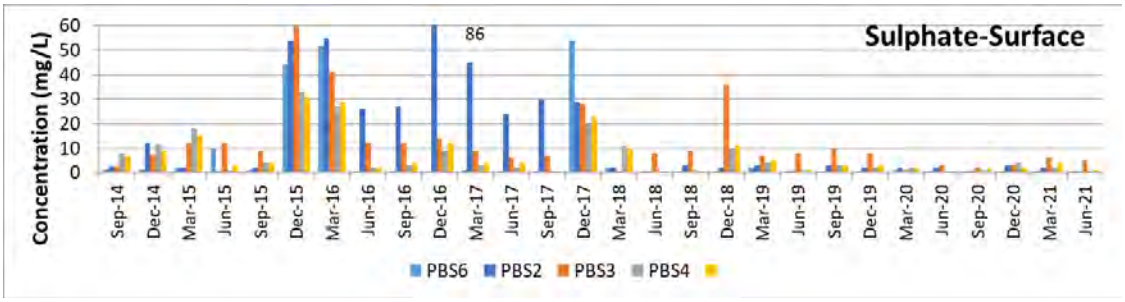


Figure 11-6. Sulphate concentrations in Lake Pieman surface water samples 2014 – 2021.

12 Review of Sampling Procedures and QA/QC of water quality monitoring

Item 2.6 under part G7 of the EPN contains a requirement that the Annual Review include a review of field monitoring procedures, and accuracy of analytical procedures. MMG Rosebery has provided the information upon which the summary in Table 12-1 is based.

Monitoring information provided by MMG Rosebery includes Surface Water and Ground Water Monitoring Procedures that clearly outline the roles and responsibilities of each team member involved in monitoring, data management and reporting, and provides references to the standard methods that are to be adopted for the collection of samples and reporting of results. The procedures include timelines for completing tasks to ensure that reporting requirements under the EPN can be met, and to ensure that management is aware of potential environmental issues as they arise.

No site visit was completed as part of this review, but procedures have remained unchanged since the last site auditing visit in 2018 when all sites listed in the EPN were visited with the exception of the underground sites. All monitoring locations have remained unchanged since the last site visit, except for the inclusion of some new sites associated with the 2/5 TSF and Stitt River. The staff have confirmed that there has been no change in monitoring procedures in the 2020-2021 year.

Based on information provided by the company, a new QA/QC program was implemented in 2019/2020 to ensure consistency between all environmental field technicians. The program consists of a series of field task observations to verify both technician competency and compliance with site procedures. Results are recorded and analysed with feedback provided to improve sampling consistency.

No laboratory visit or audit has been included as part of this review, but all results included in this review were completed in a NATA certified laboratory (ALS) which is subject to ongoing review and QA/QC checks under the NATA certification process.

Table 12-1. Summary of field monitoring practices, applicability of monitoring sites and monitoring frequency, and analytical methods used by MMG Rosebery during the 2020-2021 monitoring year.

Requirement	Findings
Accuracy of the Sampling Procedures	• Water quality samples are collected by trained environmental contractors or the professional environmental staff at MMG Rosebery according to the standard monitoring procedures established by MMG. Samples required for EPN compliance are collected and submitted to a NATA approved lab using appropriate CoC procedures (ALS Melbourne). Field duplicates are collected at a rate of 1 per 20 samples and are also submitted to the primary lab with the locations selected on a random basis. The Relative Percent Difference (RPD) between the primary and duplicate sample results are tracked, and all discrepancies greater than 50% are noted in the data base. • A comparison of the weekly compliance results with field duplicates for a total and filtered metal (total and filtered zinc), nutrient (total nitrogen) and a 'general' parameter (total calcium) collected at BO are shown in Figure 12-1 through Figure 12-3). The compliance and duplicate total zinc values

	show some discrepancy (Compliance = 0.109 mg/L, Duplicate = 0.132 mg/L). Both samples returned filtered values below the LoR and indicated the total zinc is associated with particulates, and it is not surprising the presence of particulates will vary between samples. • The Compliance and Duplicate samples for filtered zinc were all below the LoR. TN values differed by up to 0.6 mg/L, which is also likely due to different amounts of fine particulates in the samples. Calcium showed good agreement between the Compliance and Duplicate data sets. • Field probes are calibrated weekly as part of the routine monitoring by monitoring personnel according to the established procedures. Backup field instruments are calibrated and maintained on site. • The MMG Rosebery Mill is responsible for maintenance of the pH and EC probes used for continuous monitoring. MMG contract Entura to manage the water level probe at BO, the water level probe at the clean water diversion at 2 / 5 dam and the water level and water quality probes at Hercules.
Applicability of sampling schedule and monitoring locations	• The sampling schedule at the BO outfall is suitable for capturing the water quality variability at the point of discharge. The continuous pH measurements at BO guides management of the ETP and provides an accurate indicator of the discharge water quality. • The monitoring plan and supplementary monitoring carried out by MMG for 2/5 dam is adequate to capture environmental releases from the dam to the environment should they occur, and to guide internal management. • There are inconsistencies within the EPN with respect to monitoring frequency at a number of sites, with parameters required to be monitored on both weekly and monthly, or monthly and 6-monthly basis. These should be reviewed and corrected. • The monitoring schedule and parameters required to be determined at all sites should be reviewed to ensure the information gained is relevant to present operations and providing useful information. During this review parameters at BO which are consistently below the discharge limits could be considered for less frequent monitoring.
Accuracy of analytical test methods	All field and analytical methods used in the determination of water quality parameters are consistent with established and appropriate methods. Analytical results are determined by independent NATA registered laboratories, and all water quality results provided by the labs incorporate QA/QC information, including results for blanks and replicates. The results from all internal and laboratory duplicate analyses are maintained within the water quality database along with the primary sample results enabling comparison of results. NATA registered labs only report results which are within the internal QA/QC limits of the lab, so the laboratory analyses are considered accurate within the context of NATA testing.

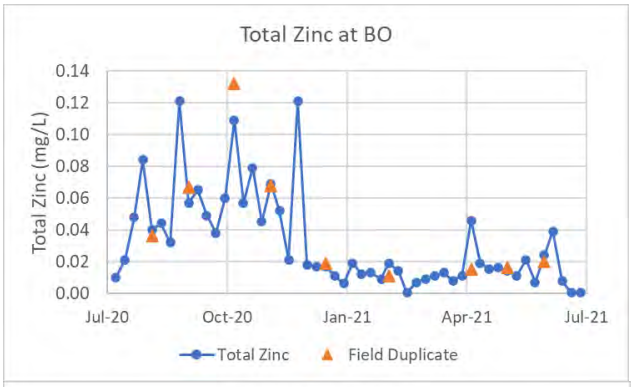
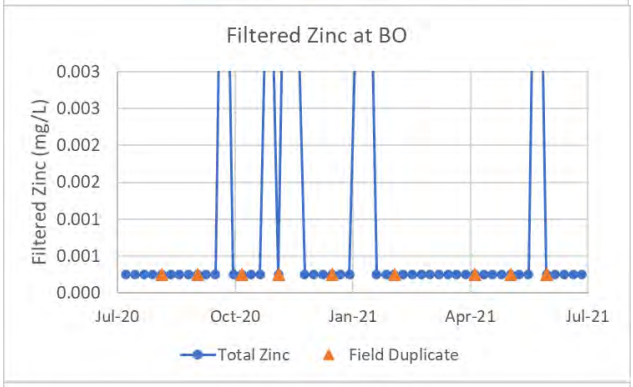


Figure 12-1. Comparison of weekly compliance sampling with field duplicates in (top) total zinc and (bottom) filtered zinc results collected at BO 2020-2021.



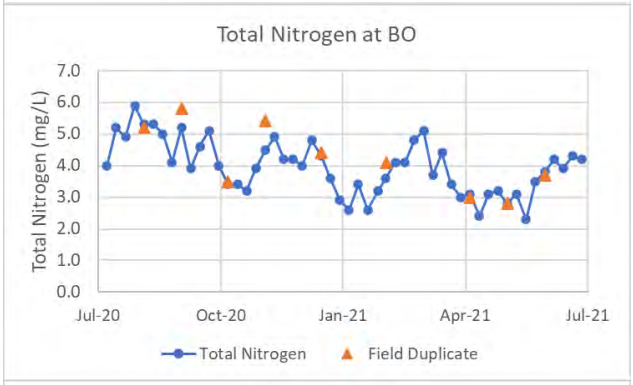


Figure 12-2. Comparison of total nitrogen results at BO in weekly compliance monitoring and Field duplicate samples collected in 2020-2021.

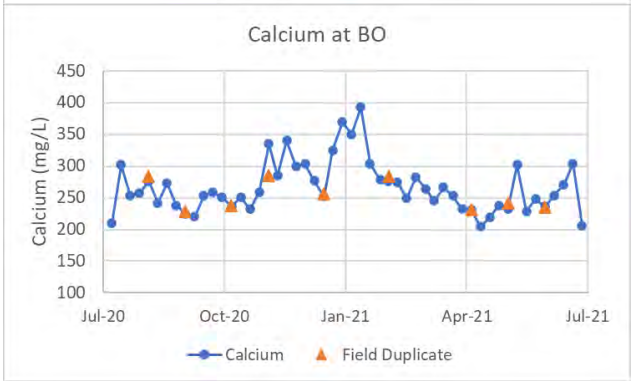


Figure 12-3. Comparison of total calcium at BO in weekly compliance monitoring and in field duplicate samples collected in 2020-2021.

13 3 Level Waste Rock Dump (EPN 8815/2)

During the 2020 – 2021 monitoring year, no additional waste rock was added to the 3 Level waste rock dump.

13.1 Surface water monitoring

A summary of the monitoring results collected from surface water sampling sites is contained in Table 13-1.

Table 13-1. Summary of surface water monitoring results for 3 Level WRD in 2020-2021.

Requirement	Findings
Monitoring Frequency and Parameters	Surface water monitoring is required to be completed on a quarterly basis as the 2015 EPN specifies monthly monitoring for 3-years, followed by quarterly thereafter. Monitoring was completed as required at all sites for all parameters when water was present.
Compliance with EPN – Assessment of surface water impacts from the 3 Level WRD	The EPN requires an assessment of surface water impacts associated with 3 Level WRD. • Surface water impacts beyond the immediate area of the WRD are minimal as all surface runoff from the 3 Level WRD is collected at the 4 Level settlement pond and directed to the ETP for treatment and discharge via the Bobadil TSF. There were no discharges from the settlement pond to Rosebery Creek during the 2020-2021 monitoring year. • pH and zinc results from OC3, OC4 and OC5 are consistent with previous results, with OC3, located at the toe of the WRD having the lowest pH and highest zinc values (Figure 13-1, Figure 13-2). In 2020-2021 zinc in OC3 has ranged from 66 mg/L to 128 mg/L with the quarterly results reversing what had been an apparent decreasing trend. At OC4 and OC5, total zinc ranged up to 11 and 3 mg/L. • OC5 continues to have the highest pH values and generally the lowest zinc concentrations consistent with this site being the clean water diversion. Three of the four results collected at the site had total zinc of <1 mg/L. • There is no clear relationship between 5-day rainfall totals and zinc concentration at OC3, with low rainfall associated with both high and low concentrations. However, higher rainfall in winter does tend to be associated with higher zinc concentrations, and could reflect higher saturation levels in the dump in winter leading to the flushing out of oxidation products that accumulated over the summer (Figure 13-3). • Average zinc and sulphate concentrations in Rosebery Creek are consistent with historic results, and increase with distance downstream, reflecting diffuse inputs rather than surface discharge from the WRD or open cut as all runoff is collected and directed for treatment (Figure 13-4, Figure 13-5). The results show substantial increases between RC1 and RC1820, reflecting inputs

	from the 3L WRD and open cut area and other diffuse sources, and between RC1820 and RC2, due to additional diffuse inputs. • The increase in zinc between the sites upstream and downstream of the 3L WRD area is shown in more detail in (Figure 13-6). Concentrations at RC2 are about 100-fold higher than RC1. RC1 shows relatively uniform zinc concentrations since 2014, whereas RC2 shows episodic elevated zinc values, although none were recorded in 2020-2021. • Other metals at the site recorded concentrations within the range of previous monitoring (Figure 13-7).
Significant trends - longer period	All surface runoff from the 3L WRD continues to be collected and directed to the ETP for treatment. The increase in zinc and sulphate in Rosebery Creek is attributable to diffuse sources entering the waterway. There continues to be a large increase in zinc at RC1820 as compared to RC1 (10-fold) but only a small increase in sulphate (<10 mg/L) suggesting the zinc may be derived from sources other than sulphide oxidation.

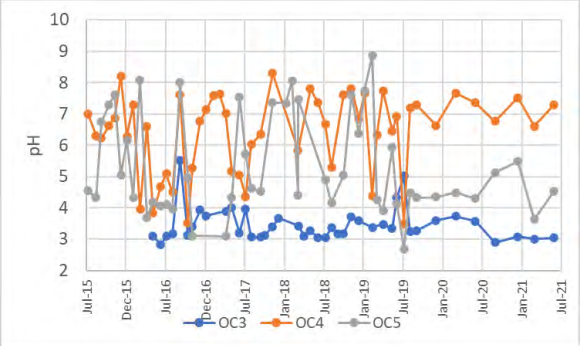


Figure 13-1. Time-series of pH in OC sites June 2015 – June 2021.

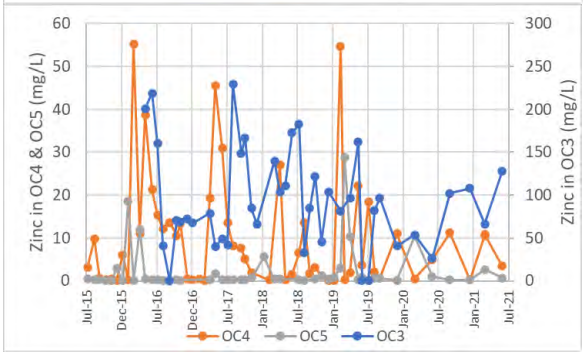


Figure 13-2. Time-series of total zinc in OC sites June 2015 – June 2021.

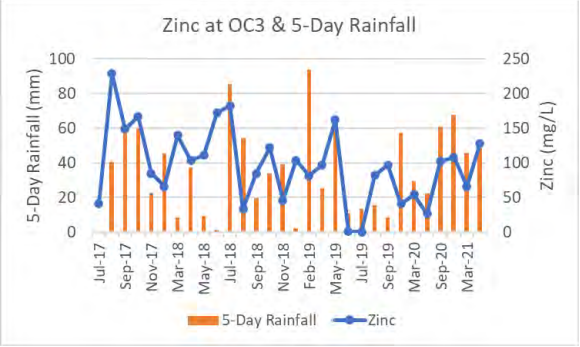


Figure 13-3. Comparison of total zinc concentrations in OC3 and rainfall total for 4 days prior to sampling and sampling day from Jul 2017 to Jun 2020.

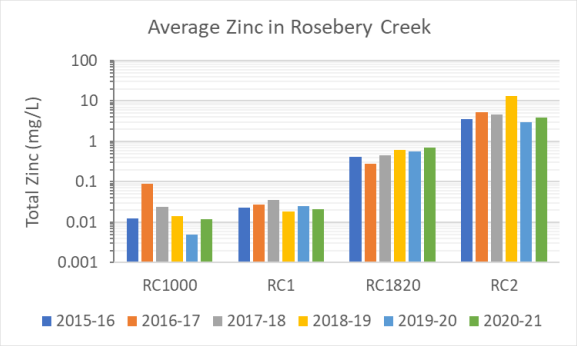


Figure 13-4. Average total zinc concentrations in Rosebery Creek in 2015 – 2021 monitoring years RC1000=background, RC1=upstream of WRD and open cut, RC1820 downstream of 3L WRD and open cut, RC2=upstream of confluence with Stitt River below all mine inputs.

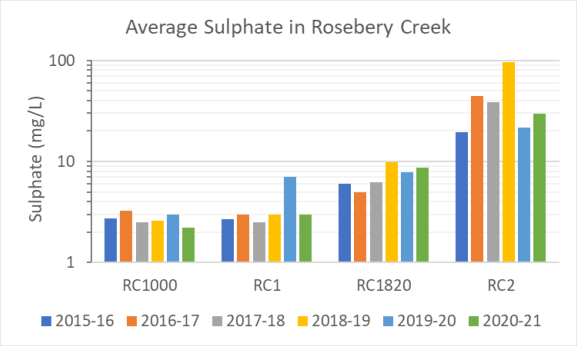


Figure 13-5. Average sulphate concentrations in Rosebery Creek in 2015 – 2021 monitoring years.

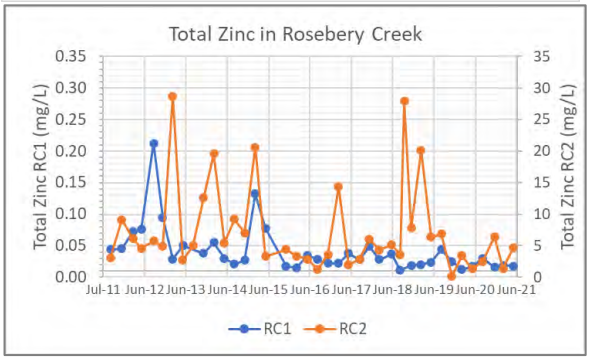


Figure 13-6. Comparison of total zinc concentrations at RC1 and RC2 from July 2011 to June 2021.

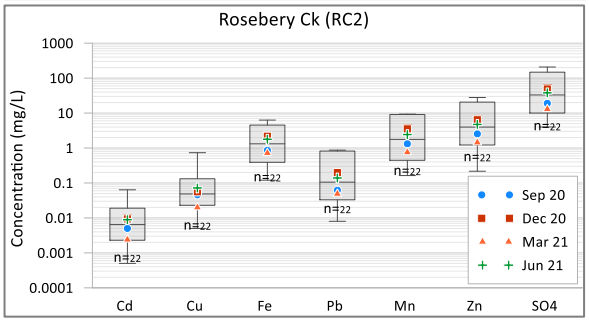


Figure 13-7. Total metals and sulphate at RC2 in 2019-2020 compared to results from Jan 2015 – Jun 20.

13.2 Groundwater monitoring

A summary of the monitoring results collected from ground water sampling sites is contained in Table 13-2.

Table 13-2. Summary of groundwater monitoring results at 3 Level WRD 2020-2021.

Requirement	Findings
Monitoring Frequency and Parameters	Groundwater sampling at the 3 Level WRD was completed on a six-monthly basis as required. Parameters were determined as required. • GB25D is no longer monitored as it was difficult to sample and the EPA approved removal of the site from the monitoring schedule in September 2020.

	Additional parameters are reported for the ground water bores that are not listed in the EPN.
Compliance with EPN – Assessment of groundwater impacts from the 3 Level WRD	The EPN requires an assessment of groundwater impacts associated with 3 Level WRD. The relative position of the groundwater bores is shown in Figure 13-8. • Monitoring results were within the range of previous results for pH, zinc, sulphate (Figure 13-10 to Figure 13-14) and other metals. • The results were generally similar in each bore for each monitoring period except in bore GB27 where total zinc in April 2021 was 1,920 mg/L, considerably higher than record in October (1,120 mg/L) and equivalent to the highest concentration recorded at the site. • Bores near the top of the valley (GB21-GB25) continue to have higher pH and lower zinc and sulphate concentrations as compared to bores located downslope of the WRD and open cut; • The bores at the base of the WRD (GB27, GB36, GB44, GB46) are characterised by low pH and elevated zinc and sulphate concentrations (Figure 13-10 to Figure 13-14). Bore GB27, located within the PAF material in the WRD has consistently recorded the highest concentrations with lead, manganese and zinc levels of almost 1-2 g/L and sulphate concentrations of ~10 g/L (Figure 13-15), and the lowest pH values. • Water levels in the bores at sites upslope of the WRD (GB21, GB22, GB23) showed decreases between Oct/Nov and Apr/May of between 0.8 m and 1.1 m. Lower on the slope water level in GB24 and GB27 increased by 0.9 m and 0.2 m between the two sampling dates, respectively. At the base of the WRD bores GB36 and GB44 increased by <0.2 m. The largest change occurred in GB46 which increased by 1.24 m between Oct 2020 and April 2021. The water level results are consistent with regional groundwater in elevated areas decreasing over the summer months. The increase in level in the lower bores may reflect the higher than average rainfall which occurred in March and April 2021.

Figure 13-8. Vertically exaggerated view of 3L WRD showing approximate relative position of groundwater bores.

Significant trends - longer period	Bores GB23 continues to record elevated zinc (11-14 mg/L) and sulphate (103-126 mg/L) concentrations even though it is located well above the open cut and WRD. Identifying the source of this groundwater would be useful for understanding diffuse inputs to Rosebery Creek.

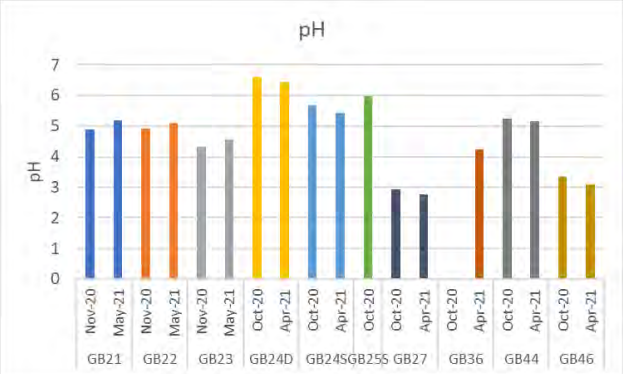


Figure 13-9. pH in groundwater at 3 Level WRD in 2020-2021. Colours indicate different groundwater bores as labelled on the x-axis.

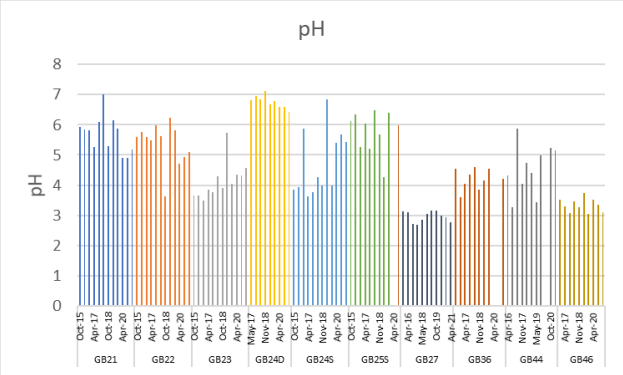


Figure 13-10. pH in groundwater bores since 2015. Colours indicate different groundwater bores as labelled on the x-axis.

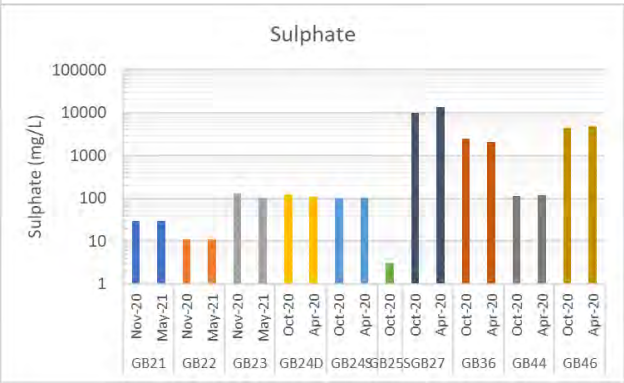


Figure 13-11. Sulphate in groundwater at 3 Level WRD in 2020-2021. Colours indicate different groundwater bores as labelled on the x-axis.

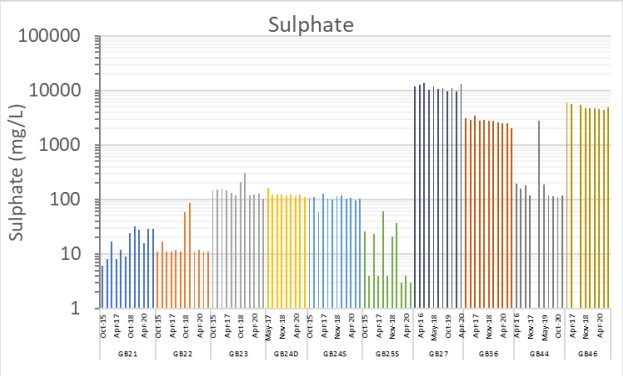


Figure 13-12. Sulphate in groundwater since 2015. Colours indicate different groundwater bores as labelled on the x-axis.

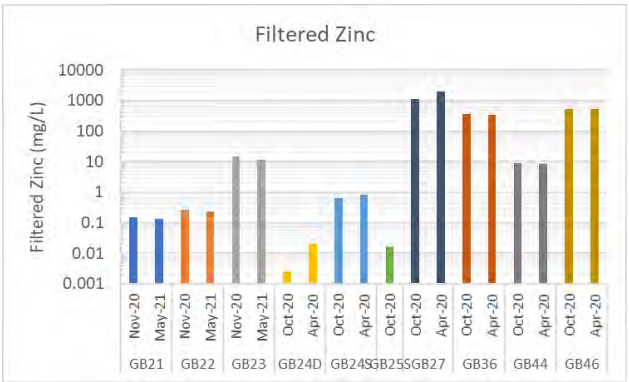


Figure 13-13. Dissolved zinc in groundwater at 3 Level WRD in 2020-2021. Colours indicate different groundwater bores as labelled on the x-axis.

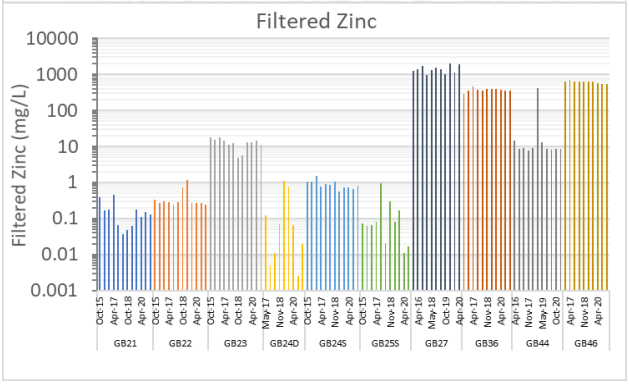


Figure 13-14. Dissolved zinc in groundwater since 2015. Colours indicate different groundwater bores as labelled on the x-axis.

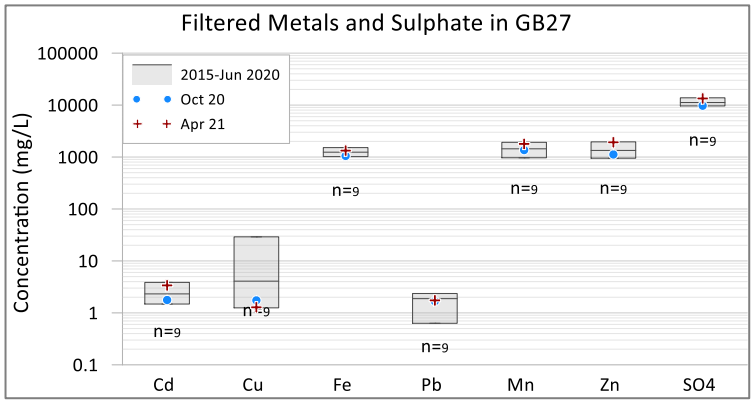


Figure 13-15. Filtered metals in GB27 Oct 2015 to Jun 2020. Box encompasses the 5th to 95th percentile vales. Data points show values in October 2021and April 2021.

13.3 Lysimeter Gas Sampling

A summary of the gas monitoring results collected from the lysimeters in the 3 Level WRD is presented in Table 13-3.

Table 13-3. Summary of lysimeter gas monitoring results from 3 Level WRD in 2020-2021.

Requirement	Findings
Monitoring Frequency and Parameters	Gas monitoring is required to be implemented at six horizontal gas monitoring pipes over the full construction of the WRD. Only the Stage 2 gas lysimeter has been installed. There are gas lysimeters installed in the Test Pads, but they do not reflect what is occurring within the main dump. Monitoring of the Test Pad ceased in October 2020, and the results until that date are only included here to provide an indication of changes over time within the material.

	Monthly monitoring for O_2, CO_2 and SO_2 was completed at all sites as required.
Compliance with EPN	The EPN sets a Preliminary Performance Objective of <3% *in situ* O_2 for the gas lysimeters. • All reported O_2 concentrations at the Stage 2 G1 lysimeter exceeded this value during the July 2020 – June 2021 monitoring period (Figure 13-16) indicating oxygen is not being excluded from the waste rock dump. The concentration in the lysimeter is similar to the atmospheric value of 20.95 %. Sulphide oxidation is not inhibited at these oxygen levels. • Oxygen levels in the test pads between July and September 2020 were also similar to atmospheric concentrations; • CO_2 levels in the Stage 2 gas lysimeter varied from 0% to 0.03% over the 12-months (Figure 13-17).
Significant trends	The results are consistent with the WRD not being fully constructed and capped.

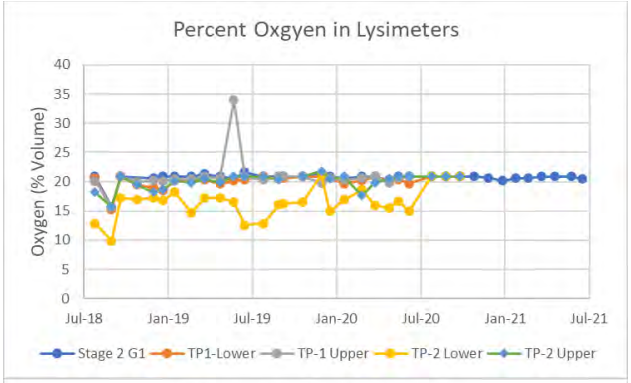


Figure 13-16. Oxygen results from the lysimeters installed in the 3L WRD July 2018 to June 2021.

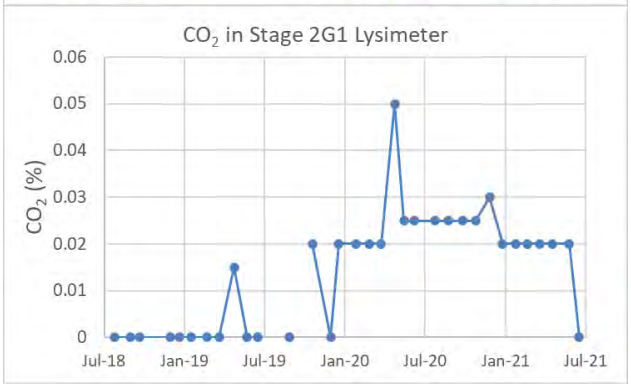


Figure 13-17. Carbon dioxide concentration in Stage 2 gas lysimeter, July 2018 to Jul 2021.

13.4 Lysimeter Water Sampling

A summary of the water quality monitoring results collected from the lysimeters installed in the 3 Level WRD is presented in Table 13-4.

Table 13-4. Summary of water quality results from lysimeters in 3 Level WRD in 2020 - 2021.

<table>
<tr><th>Requirement</th><th>Findings</th></tr>
<tr><td>Monitoring Frequency and Parameters</td><td>Water testing is required to be completed at six lysimeters across the completed footprint of the 3 Level WRD. To date, two lysimeters have been installed and are monitored on a monthly basis with samples collected if water is present. In 2020-2021, 12 monthly samples were collected in Stage 1 L1 and 9 field measurements and 8 water samples from Stage 2 L1. The months when results are absent at Stage 2 L1 is due to the lysimeter being dry. All parameters were analysed as required.</td></tr>
<tr><td>-Compliance with EPN</td><td>The EPN sets Preliminary Performance Objectives for pH, EC, Acidity and Alkalinity as indicated in Table 13-5.
pH values are within Performance Objectives in both lysimeters.
All EC values exceeded the Performance Objective at the Stage 1 L1 lysimeter. EC values in the Stage 2 L1 lysimeter were all well below the target.
Acidity values are below the Performance Objective threshold for both sites.
Alkalinity values were above 1 mg/L at both sites.
Sulphate in Stage 1 L1 ranged from 847 mg/L to 1,100 mg/L, but in Stage 2 L1 were all <5 mg/L, suggesting oxidation is occurring at the Stage1 L1 site.
The pH and alkalinity values in the Stage 1 lysimeter combined with the elevated sulphate concentrations at the site are consistent with the dump creating neutral mine drainage. The generated sulphate contributes to the elevated EC value.
Table 13-5. Summary of water quality in lysimeters measured between July 2020-June 2021. L= lab result, F = Field reading<table><tr><th></th><th>Min pH</th><th>Max EC</th><th>Max Acidity</th><th>Min Alkalinity</th><th>Comment</th></tr><tr><td>Prelim. Perf Target</td><td>>4.5 pH unit</td><td><600 µS/cm</td><td><50 mg$CaCO_3$</td><td>>1 mg$CaCO_3$</td><td></td></tr><tr><td>Stage 1-L1</td><td>6.5 L
6.4 F
n=12</td><td>2096 F
1860 L
n=12</td><td>31
n=10</td><td>13
n=12</td><td>Max alkalinity =33 mg/L</td></tr><tr><td>Stage 2-L1</td><td>6.1 L
6.4 F
n=9</td><td>133 F
20 L
n=9</td><td>18
n=8</td><td>2
n=9</td><td>5 acidity values<1 mg/L</td></tr></table>
Metal concentrations in the Stage 1 and Stage 2 lysimeters are relatively low. Maximum zinc concentrations were 0.07 in Stage1 L1 and 0.09 in Stage1 L2. All other metals except iron had median values below 0.01 mg/L (Figure 13-18).</td></tr>
<tr><td>Significant trends</td><td>The water quality results are similar to previous years and consistent with sulphide oxidation occurring within the waste rock dump and being neutralised by carbonate to produce ‘neutral rock drainage’.</td></tr>
</table>

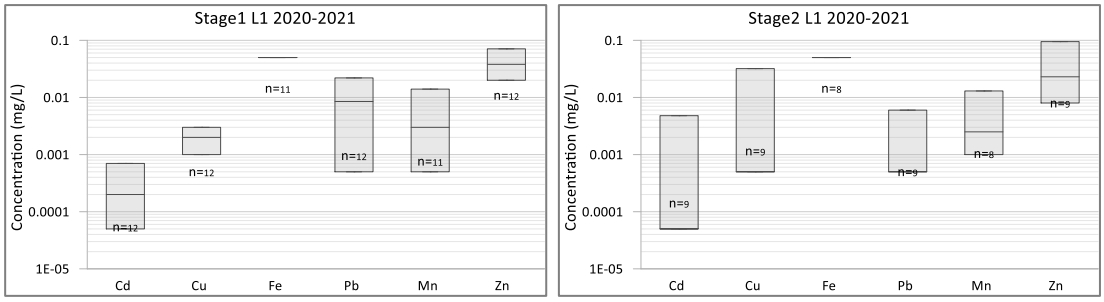


Figure 13-18.Filtered metal concentrations the Stage 1 and Stage 2 lysimeters, July 2020 – June 2021.

14 South Hercules Mine Phase 1 (EPN 8034/1)

The South Hercules mining lease is managed by MMG Rosebery under a Care and Maintenance Plan approved by the EPA Tasmania in May 2015. No mining activity was undertaken within the July 2020 to June 2021 reporting period.

14.1 Surface water monitoring

A summary of the monitoring results collected from surface water sampling sites is contained in Table 13-1.

Table 14-1. Summary of surface water monitoring results for South Hercules July 2020 to June 2021.

Requirement	Findings
Monitoring Frequency and Parameters	MMG monitored surface water on a monthly basis at sites MPW and BC2 consistent with the Closure Plan (GHD 2015). All parameters were monitored on a monthly basis as required.
Compliance with EPN – Assessment of surface water impacts from S. Hercules	• The only compliance criteria in the Closure Plan is monitoring. • pH values are consistent with previous monitoring with pH values at BC2 lower than at MPW due to the influx of acidic water from the Hercules mine site (Figure 14-1). • Zinc and sulphate increase by about 10-fold between the two sites. Manganese is consistently about 6 mg/L at MPW, but ranges from 6 to 14 mg/L at BC2, suggesting that groundwater is contributing about 6 mg/L on a regional scale. (Figure 14-2, Figure 14-3). • The MPW results show small seasonal changes, while the seasonal variability at the downstream site is much higher, due to the inflow of surface and groundwater from the Hercules mine site. • There is a substantial increase in metal concentrations between the MPW and BC2 monitoring sites due to inflows from the decommissioned Hercules site, which enter Baker Creek downstream of the South Hercules site (Figure 14-4).
Significant trends - longer period & comments	The water quality results are consistent with previous results since the site entered care and maintenance. The monitoring requirement should be reviewed as many parameters have shown long-term stability and could be eliminated from the monitoring schedule or reduced in monitoring frequency (e.g. mercury, nutrients, major ions).

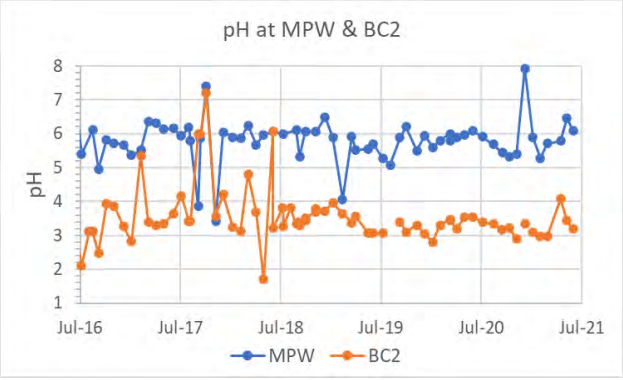


Figure 14-1. pH at the South Hercules surface water monitoring sites MPW and BC2, July 2015 to June 2021.

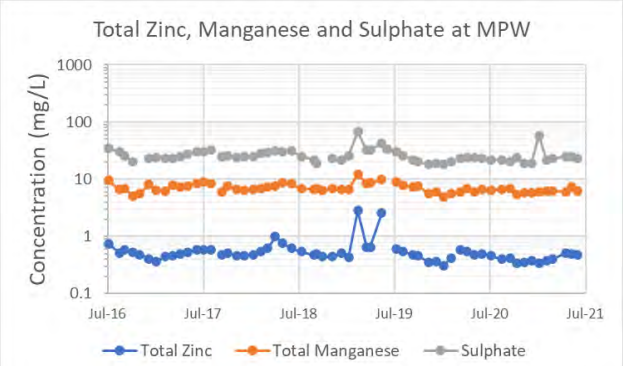


Figure 14-2 total zinc, manganese and sulphate concentrations in the Mine Pit Water at the South Hercules 2015 to June 2021. Note log scale.

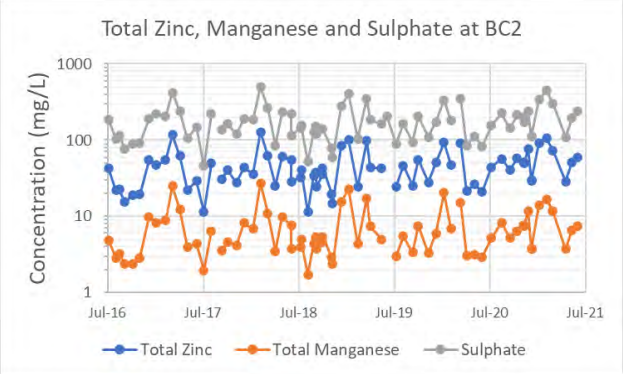


Figure 14-3 Total zinc concentrations at Bakers Creek above Ring River (BC2), July 2015 to June 2021. Note log scale.

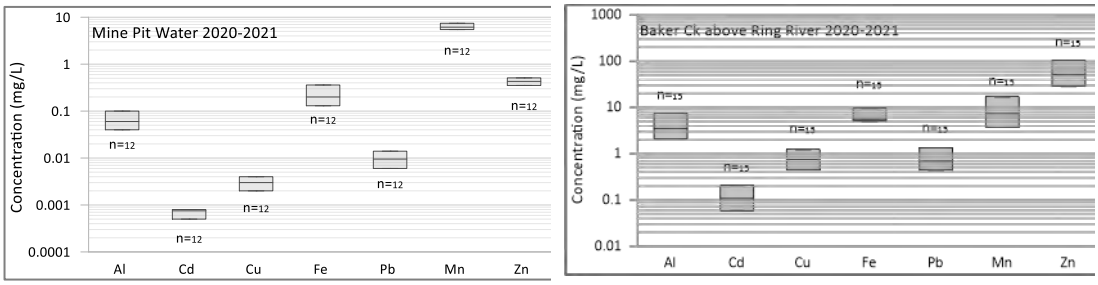


Figure 14-4. Total metal concentrations in the (left) Mine Pit Water at South Hercules and (right) Baker Creek above Ring River. Note difference in log scales with Baker Creek scale 100-times higher than MPW.

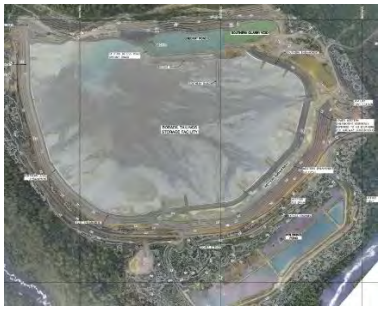
APPENDIX J: ENVIRONMENTAL PROTECTION NOTICE NO: 7153/3 THIRD PARTY COMPLIANCE AUDIT (INTEGRATED ENVIRONMENTAL SYSTEMS, 2021)

INTEGRATED ENVIRONMENTAL SYSTEMS PTY LTD

MMG Rosebery

Environmental Protection Notice No: 7153/3
Third Party Compliance Audit





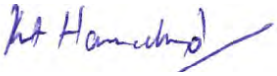
December 2020

Report Version: 13th February 2021 (with Observations)

Version	Date	Prepared by
Final Version	13th February 2021	Kurt Hammerschmid M.Sc. Principal Auditor Integrated Environmental Systems Pty Ltd PO Box 662, Paddington NSW 2021

Document History

Version Number	Revision Date	Description
Draft A	4th February 2021	First Draft Report for MMG Rosebery review and comment
Final Version (with observations)	13th February 2021	Final Report submitted to MMG Rosebery

Issued by:  (Kurt Hammerschmid)

Date: 13th February 2021

2020 Environmental Protection Notice Compliance Audit
Scope and Limitations

The scope of this December 2020 Environmental Protection Notice (EPN) Compliance Audit was limited to reviewing how the Principal Holder and Operator (MMG Australia Limited) owner of EPN No. 7153/3 (issued by EPA Tasmania on the 26th October 2011) are maintaining legal compliance against all relevant conditions defined in the EPN.

This is the eighth EPN compliance audit conducted by Integrated Environmental Systems Pty Ltd of the MMG Rosebery site. The seven previous EPN compliance audits were completed in October 2012, May 2014, May 2015, July 2016, June 2017, September 2018 and September 2019 against this same version of the Environmental Protection Notice No. 7153/3.

This compliance audit was conducted via a) direct verification of compliance against relevant conditions in the field and b) "sampling" a representative cross section of relevant documents, records and data associated with the mine and related activities. The nature of sampling during any form of legal compliance audit is such that it may not necessarily identify everything that the operation is, or is not doing, in relation to an individual EPN Condition or specific legal requirement.

This independent third-party audit and associated audit report was commissioned by MMG Rosebery. No other warranty, expressed or implied, is made as to the professional advice indicated in this report. Note that it may not contain sufficient information for the purposes of other parties or for other uses.

The content of this report applies only to matters which were available to and/or evident to the auditor at the time of this EPN compliance audit and within the scope of the audit. The status of legal compliance can change in a limited time, which may be important if the report is used after any protracted delay.

The content of this report is based on the observations made during field inspections and the associated documents and records reviewed, that were provided by MMG Rosebery during the audit. At the mine field inspection sites were targeted in accordance with EPN conditions and also selected at random by the auditor to ensure that a representative sample of MMG Rosebery's field activities could be inspected/audited against relevant EPN conditions.

No analytical samples were collected during this audit to verify any former or current monitoring programs or monitoring data collected.

This report does not, and does not purport to, give legal advice on the actual or potential liabilities of the operation, or draw conclusions as to whether any particular circumstances constitute a breach of relevant legislation. Only qualified legal practitioners can provide this advice.

2020 MMG Rosebery Environmental Protection Notice Audit (7153/3) - Details

MMG Operation Audited:	MMG Rosebery, Tasmania
Date(s) of the December 2020 EPN Compliance Audit:	14th – 17th December 2020
Audit Contact:	Mr Adam Pandelis, Senior Advisor – SHEC Delivery, MMG Rosebery
EPN Compliance Auditor	Mr Kurt Hammerschmid B.App.Sc. (Chem), M.Sc. MEIANZ Principal Environmental Auditor Integrated Environmental Systems Pty Ltd PO Box 662 Paddington NSW 2021
Scope of the December 2020 EPN Audit:	1. All relevant conditions specified in the MMG Rosebery Environmental Protection Notice No. 7153/3 (issued by EPA Tasmania) on the 26th October 2011, inclusive of Schedules 1, 2, 3 and 4 and Attachments 1 – 7. 2. The scope being limited to MMG Rosebery's operations on their mining lease (28M/1993) in Western Tasmania. Note: This December 2020 EPN audit excluded any related mining or milling operations associated with a) Hercules, b) Avebury or c) former legacy sites at Zeehan.
MMG Rosebery Personnel interviewed during this December 2020 EPN Audit:	• Mr Adam Pandelis – Senior Advisor – SHEC Delivery • Ms Tania Blake – Administration and Community Assistant • Mr Jon Crosbie – MMG Manager – Closure • Mr Ben Osgerby - Closure Study Lead (by email) • Ms Wendy Hodgetts – Superintendent SHEC

Report Summary

Overview

This EPN compliance audit and related field inspections of MMG Rosebery's EPN No. 7153/3 was conducted at the operation in western Tasmania from the 14th to 17th December 2020.

This audit was originally scheduled to be completed in August 2020, but interstate travel restrictions to Tasmania were in force for most of 2020 because of COVID-19.

MMG Rosebery EPN 7153/3 Schedule 2 - General Condition G7 (2) 2.3 requires "a review of site compliance and annual external compliance audit against EPN requirements"

This December 2020 EPN compliance audit included:

- all relevant conditions specified within MMG Rosebery's EPN No. 7153/3; and
- field visits and the sighting of requested/available representative examples of environmental and operational documentation, records, monitoring data etc provided by MMG Rosebery, relating to the operation of the mine and associated activities.

This December 2020 EPN compliance audit did not directly audit any "additional" legislative or regulatory requirements that were not directly included as existing conditions within MMG Rosebery's EPN No. 7153/3.

This 2020 EPN audit was originally scheduled for completion in August 2020. As a result of Tasmanian state border restrictions at the time, the completion of this audit was delayed to December 2020. A letter of approval to postpone the audit from August 2020 to December 2020 was secured from the Tasmanian EPA in writing on the 16th September 2020.

Context and Scope

This EPN compliance audit was completed against MMG Rosebery's Environmental Protection Notice No. 7153/3 issued to the operation on the 26th October 2011.

This audit essentially targeted and audited completed work and field practices associated with the MMG Rosebery operation within the last 16 months (i.e. since the previous EPN audit was completed in early September 2019).

EPN Audit Findings - Classifications

Definitions of the audit classifications used within this December 2020 EPN audit report are as follows:

- **Compliance** – Sufficient evidence was provided during the audit to demonstrate compliance with a specific condition or sub-condition of the EPN.
- **Major Non-compliance** – A major (systemic) audit finding against a condition of the EPN.
- **Minor Non-compliance** - A minor (isolated) audit finding against a condition of the EPN.
- **Historical Minor Non-compliance –** A non-compliance of a historical nature, that was applicable during the audit period but unable to be rectified by MMG Rosebery.
- **Partial Non-compliance** – The operation could not provide sufficient evidence to demonstrate compliance with "all sub-sections" of a specific Condition of the EPN.
- **Observation** – An opportunity for improvement identified during the audit from discussions/field observations. These are either raised directly (as an isolated finding) or is indirectly linked to a non-compliance, to assist in addressing the non-compliance.

Overall EPN Audit Findings

The key overall findings from this Environmental Protection Notice (EPN) Compliance Audit of MMG Rosebery in December 2020 identified that:

- as observed during the previous annual EPN audits, the level of statutory compliance against MMG Rosebery's current EPN (No. 7153/3) remains high;
- during this and the eight former EPN audits, there was no evidence of any "significant" environmental impact/harm occurring or being demonstrated as a result of the operation's current (not historical) activities (*Note: "significant" defined as "resulting in long-term, widespread, irreversible environmental harm with substantial impairment of ecosystem function*");
- no "major" non-compliances, one (1) minor non-compliance and one (1) partial non-compliance were identified during this December 2020 audit;
- a total of thirty-eight (38) "Observations/Opportunities for Improvement (OFI)" were also identified during this December 2020 EPN audit. These are provided in the context of continuous improvement for MMG Rosebery, to directly improve levels of statutory compliance (and also to indirectly improve site environmental management systems and environmental practices and performance in the field); and
- finally, a total of seven (7) conditions of the EPN were considered to be non-applicable as of December 2020. These continue to apply to final rehabilitation and decommissioning related conditions.

Specific

The key actual, potential and historical non-compliances and observations identified during this December 2020 audit against MMG Rosebery's EPN conditions included:

General Conditions

- **General Condition G8 – Complaints Register - Partial Minor Non-compliance No. 1** – No information, prompt or separate field exists in MMG Rosebery's Boreal-is database defining if the Director/Tasmanian EPA was notified of a complaint.

Atmospheric Conditions

- Nil

Blasting Conditions

- Nil

Decommissioning and Rehabilitation Conditions

- Nil

Effluent Disposal Conditions

- Nil

Hazardous Substances Conditions

- Nil

Monitoring Conditions

- **Monitoring Condition M4 – Discharge Limits and Investigation Trigger Levels for Bobadil Tailings Pond to the Pieman River – Minor Non-compliance No. 1** – Isolated exceedances in effluent discharge limits defined in the EPN 7153/3 occurred in 2019/20. None of these exceedances were of a magnitude or duration to have a potential or actual adverse environmental impact on the receiving waters of the Pieman River.

Noise Control Conditions

- Nil

Waste Management Conditions

- Nil

Legal Obligations Conditions

- Nil

Table 1 – Summary Status of the December 2020 MMG Rosebery's EPN Compliance Audit

The following table provides a summary of the number of compliances, non-compliance and observations that were identified in December 2020 against each schedule listed within MMG Rosebery's EPN 7153/3.

Schedule	Compliances	Major Non-compliances	Minor Non-compliances	Partial Non-compliances	Historical Non-Compliances	Observations	Not Applicable in December 2020
Schedule 1 – Definitions	Not audited/applicable in December 2020						
Schedule Q – Maximum Quantities	1	0	0	0	0	0	0
Schedule G – General	17	0	0	1	0	4	0
Schedule A - Atmospheric	20	0	0	0	0	13	0
Schedule B – Blasting	2	0	0	0	0	3	0
Schedule DC – Decommissioning and Rehabilitation	9	0	0	0	0	2	6
Schedule E – Effluent Disposal	9	0	0	0	0	4	0
Schedule H – Hazardous Substances	4	0	0	0	0	2	0
Schedule M – Monitoring	0	0	1	0	0	1	0
Schedule N – Noise Control	15	0	0	0	0	6	1
Schedule W – Waste Management	8	0	0	0	0	1	0
Schedule L – Legal Obligations	16	0	0	0	0	2	0
Attachments	Not audited/applicable in December 2020						
Total	**101**	**0**	**1**	**1**	**0**	**38**	**7**

EPN Audit Findings – Classifications (December 2020)

Definitions of the audit classifications used within this December 2020 EPN audit report are as follows:

- **Compliance** – Sufficient evidence was provided during the audit to demonstrate compliance with a specific condition or sub-condition of the EPN.
- **Major Non-compliance** – A major (systemic) audit finding against a condition of the EPN.
- **Minor Non-compliance** - A minor (isolated) audit finding against a condition of the EPN.
- **Historical Minor Non-compliance** – A non-compliance of a historical nature, that was applicable during the audit period but unable to be rectified by MMG Rosebery.
- **Partial Non-compliance** - The operation could not provide sufficient evidence to demonstrate compliance with "all sub-sections" of a specific Condition of the EPN.
- **Observation** – An opportunity for improvement identified during the audit from discussions/field observations. These are either raised directly (as an isolated finding) or is indirectly linked to a non-compliance, to assist in addressing the non-compliance.

Table 2 : Status of Compliances/Non-compliances

This section of the report provides information relating to the status of compliance and non-compliance in December 2020 against each of the individual conditions that are listed in the MMG Rosebery Environmental Protection Notice No 7153/3. Observations are provided for consideration by MMG Rosebery to enable continuous improvement to be demonstrated.

Environmental Protection Notice Schedule & Condition	Status	Supporting Evidence/Comments/Photographs
Schedule 1 – Definitions		
Schedule 1 – Definitions	**Not applicable**	The definitions defined in EPN 7153/3 were not included in the scope of this December 2020 EPN audit.

Environmental Protection Notice Schedule & Condition	Status	Supporting Evidence/Comments/Photographs
Maximum Quantities		
Schedule 2 – Maximum Quantities - Q1 "The activity must not exceed the following limits without the prior written approval of the Director. 1.1 1,000,000 tonnes/year of raw material processed. (Annual fees are derived from this figure)."	**Compliant**	On the 5th September 2018 MMG Rosebery were formally granted permission by the Tasmanian EPA to process up to 1,100,000 tonnes/year of raw material (i.e. an increase from the former limit of 1,000,000 tonnes/year of raw material). The anniversary date for EPN 7153/3 remains the 21st September each year (i.e. Permit 1904). The annual ore production at MMG Rosebery for the past eight years has been: • 2012/2013 - 881,078 dry tonnes; • 2013/2014 – 859,448 dry tonnes; • 2014/2015 – 895,441 dry tonnes; • 2015/2016 – 968,137 dry tonnes; • 2016/2017 – 996,013 dry tonnes; • 2017/2018 – 1,002,991 dry tonnes; • 2018/2019 – 1,023,375 dry tonnes; • 2019/2020 – 991,548 dry tonnes.

Environmental Protection Notice Schedule & Condition	Status	Supporting Evidence/Comments/Photographs
General Conditions		
General Conditions G1 – Compliance with EMP and BPEM The land must be developed and used, and the activity on the land must be carried out and monitored, in accordance with the environmental management measures set down in the Environmental Management Plan (EMP), and in accordance with best practice environmental management, unless otherwise specified in these conditions or contrary to EMPCA.	**Compliant**	2011 – 2016 Environmental Management Plan (EMP) The most recent review and update of MMG Rosebery's EMP was completed and issued in November 2016 (for the 5-year period from 1st July 2011 to the 30th June 2016). The plan was updated utilising internal MMG staff resources from the Rosebery and the MMG Corporate Melbourne office. The November 2016 EMP is 28 pages, inclusive of appendix A – Monitoring Program Review, by Koehnken (Technical Services in Water), 2016. The next update of the EMP is scheduled to be completed in Q1/Q2 2021 and issued before the 30th November 2021. During the audit period, MMG Rosebery have accepted increased ownership in relevant areas of environmental management and control, in comparison to previous years where environmental personnel from the MMG Corporate office in Melbourne provided significant levels of assistance and support. The number of MMG personnel employed in the Corporate Melbourne office has significantly reduced in recent years (inclusive of SHEC support). ISO14001/Environmental Management System It was stated that MMG Corporate no longer maintains and requires formal implementation of the former MMG Corporate Environment standard. This has been replaced by one MMG Corporate SHEC Assurance Standard, that was recently released and is the only MMG Group SHEC Standard that now applies to the MMG Rosebery site. It was stated that MMG operations in Australia are working towards improved standards of environmental compliance, based on the overall environmental programs applicable to each site (i.e. based on previous Gap Assessments against the former MMG Environmental Standard). In 2020, gap assessments were being progressed and completed against the ICMM Standard. It was stated that this will also encompass some EPN obligations, in addition to the relevant ICMM requirements. MMG Rosebery no longer retain third-party certification to the ISO14001 Environmental Management System (EMS) Standard or the ISO45001 OHS Management System Standard. It was stated that MMG Corporate require MMG Rosebery to generally follow and comply with the requirement of these two ISO standards.

Environmental Protection Notice Schedule & Condition	Status	Supporting Evidence/Comments/Photographs
		The scope of this December 2020 EPN audit did not formally include any direct assessment of the status of MMG Rosebery's EMS, but there was clear evidence of ongoing use of critical elements of the system. It was stated that the representatives from the Tasmanian EPA did not visit the Rosebery site during the audit period (i.e. partially as a result of COVID). The next scheduled visit is expected to occur in Q2 2021 (i.e. to also view relevant aspects of Bobadil Stage 10 lift and monitoring instrumentation).
General Conditions G2 – Access to and awareness of conditions and associated documents A copy of these conditions and any associated documents referred to in these conditions must always be held in a location that is known and accessible to the person responsible for the activity. The person responsible for the activity must ensure that all persons who are responsible for undertaking work on the land, including contractors and sub-contractors, are familiar with these conditions to the extent relevant to their work.	**Compliant**	MMG Rosebery previously submitted a request for an EPN amendment to the Tasmanian EPA in February 2016. This was provided as a table of suggested changes (i.e. not as a formal submission for an EPN amendment). To date, no formal correspondence has been received from the EPA regarding this request and no additional formal requests for EPN amendments were submitted to the Tasmanian EPA by MMG Rosebery in the last 16 months. In December 2020, the existing EPN 7153/3 remained in place. MMG Rosebery managers and relevant employees continue to have electronic access to the current 20th October 2011 version of the 7153/3 EPN via the MMG Rosebery Library (i.e. it can be easily located using a search function on the system). Hard and electronic copies of existing site EPNs are retained and utilised as required by the MMG Rosebery Environment Team. The original signed copy of relevant MMG Rosebery EPNs continue to be held with the site General Manager. All MMG Rosebery's EPNs continue to be available via the organisation's subscription to Envirolaw. In addition, relevant MMG Rosebery personnel continue to receive monthly updates from Enviroessentials, which is used to communicate relevant regulatory changes (i.e. both state and federal changes). Monthly updates are sent by this service provider and the information is disseminated as required by relevant MMG Rosebery personnel. MMG Rosebery's new employee/contractor inductions remain the key communication forum for MMG Rosebery's EPN. The MMG Rosebery Induction Module includes a high-level reference to EPN 7153/3 and its 103 Conditions.
General Condition G3 – Incident Response If an incident causing or threatening environmental nuisance, serious environmental harm or material environmental harm	**Compliant**	During the 2019/20 audit period, no environmental incidents occurred that are considered to have caused or threatened environmental nuisance, serious environmental harm or material

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from pollution occurs in the course of the activity, then the person responsible for the activity must immediately take all reasonable and practicable action to minimise any adverse environmental effects from the incident.		environmental harm from pollution in the course of mining, mineral processing and related activities. During the audit period, MMG Rosebery experienced the following types of environmental incidents that were reported to EPA Tasmania: • a high rainfall event occurred at Rosebery from the 18th to the 22nd August 2019. During this period a number of incidents arose, including: – overflow of the Filter Plant Pond (offsite discharge of dirty water); – overflow of a railway culvert at Bobadil (offsite discharge of dirty water); – acidic inflow to the Polishing Ponds; and – overflow/short-circuiting of the Polishing Ponds. • an exceedance of the trigger level for PM_{10} concentrations at all HVAS locations was recorded on the 15th January 2020. The exceedance was reported to EPA Tasmania which concluded that the elevated concentrations were the result of a smoke haze event; • a number of dust triggers during the winter months of 2019 and 2020 as a result of household wood smoke within the Rosebery township (relevant under PCE 9084); • a 2/5 TSF decant water spill that occurred between Thursday 9:20pm and Friday 7:40am on the 22nd and 23rd August 2019, resulting from intentional (i.e. vandalism) removal of a breather; • a 2/5 Dam water discharge to the Stitt River in February 2020 relating to required 2/5 dam liner repairs; and • four notifications were in relation to lost or missed sample events during 2019/20. MMG Rosebery were able to demonstrate that suitable corrective actions, and where relevant and applicable, suitable preventable actions were completed relating to the above incidents. IEM continues to be used by MMG Rosebery for managing and closing out safety, environmental and property damage incidents and licence exceedances. Reportable incidents and associated incident investigation reports continue to be submitted to Mr John Langenberg of EPA Tasmania. The number of reportable incidents, EPN licence exceedances and reportable exceedances of EPN licence trigger limits were reported in MMG Rosebery's September 2020 AMRMR. MMG Rosebery Environmental Responsibilities (2019/20)

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		In 2019/20, the management of: • water and tailings remained the responsibility of MMG Rosebery's Surface Operations Department; and • mineral waste/waste rock dumps remain the responsibility of MMG Rosebery's Mining Department.
General Condition G4 – No changes without approval The following changes, if they may cause or increase the emission of a pollutant which may cause material or serious environmental harm or environmental nuisance, must only take place in relation to the activity if such changes have been approved in writing by the EPA Board following its assessment of an application for a permit under the Land Use Planning and Approvals Act 1993, or approved in writing by the Director: (a) a change to a process used in the course of carrying out the activity; or (b) the construction, installation, alteration or removal of any structure or equipment used in the course of carrying out the activity; or (c) a change in the quantity or characteristics of materials used in the course of carrying out the activity.	**Compliant**	Since the previous 7153/3 EPN audit in September 2019, no significant (i.e., only minor) environment related capital projects were approved and/or progressed. Since 2015, MMG Rosebery's capital and major projects (i.e. that required external regulatory approval) included: • 5 Dam Causeway Amendment Approval (Reference H351410) in January 2015; • EPN 8815/2 – For construction and operation of 3 Level PAF Waste Rock Dump in February 2015; • Polishing pond redesign for EPN 8814/1 (February 2015, original EPN issued in November 2012). • Approval for the 7 Level Fuel Relocation – Installation of a new 120,000L-capacity, self-bunded fuel bay and decommissioning of the existing fuel bay site (Approval Reference H396478) in May 2015; • Expansion/construction of 2/5 Dam – EPN 9084 in February 2016; • Filter Plant Cell 2 Retention Pond (dated November 2015), which required the issuing of EPN 9360/1. It was stated that the construction of the required dam was not required to proceed as a result of changes in operational practices that were presented to the Tasmanian EPA and adopted; • Dust abatement at Bobadil dam (sprinkler systems) early 2019; • 2/5 dam groundwater seepage abatement works in 2019, inclusive of investigative studies by consultants relating to this issue; • Radio links/3G for the Dustracks and weather stations were installed in 2019;. • Cell 2 Filter Plant modifications;

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		• Installation of the Bobadil TSF Geo-tubes, as part of the de-silting of the Bobadil polishing ponds (i.e. requiring EPA approval); • Extensive dredging of the Bobadil polishing ponds during the audit period; and • Murchison Highway mitigation works relating to 2/5 Dam. <u>Planned 2021 Capital Projects for Environment</u> As of December 2020, MMG Rosebery's Capital Plan for 2021 had been completed and approved. PFS related closure studies will continue to be progressed during 2021. <u>EPA Approvals during the 2019/20 Audit Period</u> The following projects applicable to EPN 7153/3 were approved by the Tasmanian EPA during the audit period (as defined in Table 7 of the 2019/20 AMRMR): • November 2019 – Bobadil Polishing Ponds De-sludging works - Over time the Bobadil Polishing Ponds have built up with considerable metal hydroxide sludges. To improve environmental performance of the system MMG Rosebery proposed to de-sludge the polishing ponds utilising a floating dredge pumping the slurry into Geo-tubes. The works are currently still underway; • December 2019 – Tailing Deposition into Bobadil TSF - A tailing capacity assessment was completed at the Bobadil TSF that identified additional space in the centre of the Dam. To mitigate the risk of metal hydroxide sludge at the discharge co-disposal of hydroxide rich water and tailings has been utilised periodically since approval was granted; • July 2020 – Trial at Bobadil TSF - MMG gained approval to trial Geo-tubes to manage ongoing sediment deposition as a result of ongoing accumulation of metal hydroxides since the permanent cessation of tailings deposition at the Bobadil TSF; • Q3/Q4 2020 - New groundwater monitoring network at Bobadil (MMG Rosebery decommissioned some bores that required EPA approval and installed an additional 8 bores for the PFS/Mine Closure study. The new monitoring bores are operational; • 2020 – The purchase and use of a DRX unit to measure dust particle size, to demonstrate that the exceedances being recorded did not arise from fugitive dust from the mine/TSFs, but were attributed to woodfire/bushfire smoke; and

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		• The 2020 Dust Mitigation Plan Review - An external review of MMG Rosebery air quality network was completed in February 2020. The outputs of the review were utilised to update the sites Dust Mitigation Plan. <u>EPA Approval Requests during the 2019/20 Audit Period (i.e. Awaiting Approval)</u> The following project, applicable to EPN 7153/3, was requested and awaiting approval by the Tasmanian EPA as of September 2020 (as defined in Table 7 of the 2019/20 AMRMR): • Awaiting Approval - Non-Mineral Waste Management Procedure review - A review of the Rosebery Mine Waste Management Procedure was completed during the 2019/20 reporting period. In accordance with Condition WM4 the procedure when revised should be submitted to the Director EPA for approval.
General Condition G5 – Change of Ownership If the person responsible for the activity is not the owner of the land upon which the activity is carried out and the owner of the land changes or is to change, then, as soon as reasonably practicable but no later than 30 days after becoming aware of the change, the person responsible must notify the Director in writing of the change of ownership.	**Compliant**	There has been no change of ownership of the operation from MMG Rosebery since the current EPN was issued on the 26th October 2011. MMG Rosebery continues to be owned by MMG Australia Limited, with the MMG Corporate head office located in Melbourne.
General Condition G6 – EMP Review Unless otherwise specified by the Director in writing: 1.1 the next comprehensive EMP review for the period from 1 July 2008 to 30 May 2011 must be submitted to the Director for approval by 30 November 2011, and thereafter by the fifth yearly anniversary, which must include but is not limited to: 1.1.1 site and operational history, particularly where it relates to the environmental performance of the activity; 1.1.2 short, medium and long term strategic, management, and planning issues, and production and process changes that are likely to impact on production efficiency, the	**Compliant**	<u>2011 – 2016 Environmental Management Plan</u> An Environmental Management Plan (EMP) Review report (28 pages, plus Appendix A: Monitoring Program Review (Koehnken, 2016) was completed for the period 1st July 2011 to 30th June 2016. This EMP was issued on the 20th November 2016. The 2011 to 2016 MMG Rosebery EMP essentially meets the requirements specified in EPN General Condition G6. At the time of this December 2020 EPN audit, the 2011 – 2016 EMP was publicly available through the centralised MMG Rosebery Community Liaison office, located in Agnes Street, Rosebery. It was stated that as of mid-December 2020, this office has been shut since April 2020 because of COVID.

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quantities produced, and environmental performance of the activity: 1.1.3 information required under Condition G7(2) of this Notice; 1.1.4 any specific information required by the Director in writing; and 1.1.5 any other environmentally relevant matters relating to the period of the EMP. 2. The finalised version of the 5 yearly EMP review must be made publicly available by the person responsible for the activity.		 **Photo No. 1** – MMG Community Office in Rosebery (shut for most of 2020 due to COVID restrictions) (December 2020) MMG Rosebery stated that a copy of the current September 2016 EMP is also available to any external stakeholders on request. The next EMP for the period from 2016 to 2021 is expected to be completed and issued by MMG Rosebery in Q3 2021.
General Condition G7 (1) – Annual Monitoring Review and Management Report Unless otherwise specified by the Director in writing, an Annual Monitoring Review and Management Report, covering a 12-month review period from 1 July of the preceding year to 30 June of the following year, must be submitted to the Director by 30 November 2011 and every subsequent year by September 30 thereafter. The Annual Monitoring Review and Management Report must be made publicly available by the person responsible for the activity.	**Compliant**	<u>2019 - 2020 AMRMR (September 2020)</u> In August/September 2020, the 7153/3 2019-2020 MMG Rosebery Annual Monitoring Review and Management Report (AMRMR) collation was the responsibility of site personnel and not the responsibility of MMG corporate. The 2019-2020 MMG Rosebery AMRMR was completed and issued on the 22nd September 2020, inclusive of endorsement of the contents of the report by MMG Rosebery's General Manager. The report was submitted by MMG Rosebery to the Tasmanian EPA on the 22nd September 2020 by email. It was stated that a hard copy of the report was also submitted to the Tasmanian EPA. It was stated that the 2019/20 AMRMR would be made available to any member of the public on request. It was stated that a hard-copy version of the 2019/20 AMRMR is available at the MMG Rosebery Community Liaison Office, located in the main street of Rosebery.

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		It was stated that in the future, the Tasmanian EPA will potentially make submitted AMRMR's available on the Tasmanian EPA website (i.e. given that EPNs are already publicly available through this source).
General Condition G7 (2) – Annual Monitoring Review and Management Report The Annual Monitoring Review and Management Report must be compiled using the sites ISO14001 Environmental Management System (EMS) Framework to demonstrate continual improvement and compliance with legal requirements (including this Notice) and must include, but not be limited to: 2.1 an Executive Summary; 2.2 a review of site environmental aspects and impacts register against environmental controls and documentation; 2.3 a review of site compliance and annual external compliance audit against EPN requirements; 2.4 environmental planning, including objectives and targets relating to the review period and details of the forward environmental planning and forecasting process, including strategic issues for the site, for, but not limited to, the management period; 2.5 a review of environmental commitments and process changes (including annual tonnage), for, but not limited to the management period; 2.6 a review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations, including discharge and ambient monitoring points that illustrate significant trends. Include a review of the accuracy of the sampling procedures, sampling schedule, sample locations and test methods applied;	**Compliant** **Observation**	At the time of this December 2020 EPN audit, the 2019/20 AMRMR had been finalised and issued to the Tasmania EPA on the 22nd September 2020. No formal independent review of the compliance status of the September 2020 AMRMR (i.e. by MMG Rosebery's independent EPN compliance auditor) was completed prior to its finalisation and issue. <u>MMG Rosebery 2019/20 AMRMR</u> The MMG Rosebery 2019/20 AMRMR was completed and submitted to the Tasmanian EPA on the 22nd September 2020. This report was 25 pages in length (inclusive of 12 tables, 2 figures and 7 appendices). The appendices (i.e. primarily consultant reports) submitted with the MMG Rosebery 2019/20 AMRMR included: • Appendix A: Location maps • Appendix B: Rosebery water quality review (Koehnken, 2020) – including surface water and groundwater monitoring results and review for 3 level waste rock dump • Appendix C: Annual Air Quality Review (ERM, 2020) • Appendix D: Annual Meteorological Review (ERM, 2020) • Appendix E: Annual Noise and Vibration Review (Tarkarri, 2020) • Appendix F: Biological Condition of the Ring and Stitt Rivers: Spring 2019 and Autumn 2020 - (Freshwater Biomonitoring 2020) • Appendix G: Biological condition of Lake Pieman: Spring 2019 (Freshwater Biomonitoring 2020) In September 2020, MMG Rosebery were able to demonstrate that their September 2020 AMRMR included the following content as required by EPN Condition No. G7 (2) 2.1 an Executive Summary; 2.2 a review of site environmental aspects and impacts register against environmental controls and documentation (Section 4.1); 2.3 a review of site compliance and annual external compliance audit against EPN requirements (Section 7.1);

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2.7 environmental performance on site, including incident management and community complaints and the corrective and preventative processes implemented; 2.8 any approvals or written notifications received in relation to this Notice; 2.9 a summary of any rehabilitation works carried out during the period and an estimate of current remediation liabilities; and 2.10 an inventory of wastes disposed of on The Land during the previous 12 months, including details of the quantity of each waste and the location of its disposal.		2.4 environmental planning, including objectives and targets relating to the review period and details of the forward environmental planning and forecasting process, including strategic issues for the site, for, but not limited to, the management period (Sections 3.2 and 4.3); 2.5 a review of environmental commitments and process changes (including annual tonnage), for, but not limited to the management period (Sections 3.1 and 4.4); 2.6 a review of the monitoring requirements contained within Attachment 2 of this Notice for the review period, including a detailed comparative review of monitoring locations, including discharge and ambient monitoring points that illustrate significant trends. Include a review of the accuracy of the sampling procedures, sampling schedule, sample locations and test methods applied (Appendix A); 2.7 environmental performance on site, including incident management and community complaints and the corrective and preventative processes implemented (partially in Sections 5.2 and 6.7); 2.8 any approvals or written notifications received in relation to this Notice (Section 5.1); 2.9 a summary of any rehabilitation works carried out during the period and an estimate of current remediation liabilities (Section 5.3); and 2.10 an inventory of wastes disposed of on The Land during the previous 12 months, including details of the quantity of each waste and the location of its disposal (Section 5.4). **General Condition G7 (2) – Annual Monitoring Review and Management Report - Observation No. 1** – For transparency and completeness, MMG Rosebery are encouraged to tabulate each incident and the date of occurrence within Section 6.7 of its AMRMR. In addition, the summarised text that was included in the September 2020 AMRMR does not define the corrective and preventative actions implemented for each incident. Ideally, the information presented in Section 6.7 should be tabulated with a) date of occurrence; b) nature of the incident; c) planned corrective and preventative actions and d) the status of completion of these actions as of September each year. <u>MMG Rosebery ISO14001 Environmental Management System (EMS)</u> The annual risk profile review for Rosebery's Material risks was completed internally in February 2020. As identified during previous EPN audits, MMG Rosebery were able to demonstrate the use of specific elements of an ISO14001 based EMS, but no formal EMS is maintained by the operation in its entirety.

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		Third-party ISO45001 safety management system certification (by LQRA) is no longer maintained by the operation for self-insurance purposes.
General Condition G8 – Complaints Register A record of public complaints must be recorded using MMG Rosebery Mine's internal reporting system and must be made available for inspection by an authorised officer upon request. The public complaints register must, at a minimum, record the following detail in relation to each complaint received by MMGRM, in which it is alleged that environmental harm (or environmental nuisance) has been caused by the activity: (a) the time at which the complaint was received; (b) contact details for the complainant; (c) the subject-matter of the complaint, including if the Director has been notified: (d) any investigations undertaken with regard to the complaint; and (e) the manner in which the complaint was resolved, including any mitigation measures implemented.	**Partial Minor Non-compliance** **Observation**	In the last 12 months, MMG Corporate utilised the Borealis program/database for formal complaints management. Borealis requires that complaints are recorded as either an a) issue (i.e. low-level complaint) or b) grievance (i.e. high-level complaint). Several Rosebery SHEC personnel are responsible for entering, tracking and closing out of community complaints within Borealis. During the audit period, MMG Rosebery only received a total of 4 external community complaints (i.e. of which three of the four were valid environment-related complaints). These included: • 17th August 2019 (Water-related complaint) - A phone call was received by EPA Tasmania informing MMG of ongoing community concern regarding overtopping events at the Murchison highway seepage collection system. MMG responded to EPA with an update to the mitigation works plan; • 3rd December 2019 (Noise-related complaint) - A community member informed MMG Rosebery of nuisance noise from the ROM, 3L and/or 4L areas. Upon initial investigation the likely cause was excessive use of the mobile and pedestal rock breakers; • 4th February 2020 (Non-environment-related complaint, so not applicable to this EPN Condition); and • 4th February 2020 (Noise-related complaint) -Ongoing Noise complaint (original complaint 3rd December 2019). Upon receiving the complaint MMG staff engaged an external noise specialist to better understand the noise source and provide short, mid and long-term abatement measures. Immediate actions included a) weekly meetings with the complainant; b) reduced use of the mobile rock breaker and c) reduced hours of operation of the pedestal rock breaker between the hours of 0700 and 2100. Long term abatement measures are progressing through the design phases. No community complaints were received by MMG Rosebery for the period September to December 2020. Finally, MMG Rosebery are now responsible for collating and submitting a monthly Social Performance report for the site to the MMG Corporate office in Melbourne.

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		MMG Rosebery were able to demonstrate that the Borealis database incorporates the following content (as required by EPN General Condition G8 – Complaints Register): (a) the time at which the complaint was received (Yes); (b) contact details for the complainant (Yes); (c) the subject-matter of the complaint, including if the Director has been notified (Partial): (d) any investigations undertaken with regard to the complaint (Yes); and (e) the manner in which the complaint was resolved, including any mitigation measures implemented (Yes). **General Condition G8 – Complaints Register - Partial Minor Non-compliance No. 1** – No information, prompt or separate field exists in MMG Rosebery's Boreal-is database defining if the Director/Tasmanian EPA was notified of a complaint. **General Condition G8 – Complaints Register - Observation No. 2 –** The above non-compliance could be addressed by either a) attaching the notification email to the EPA in Boreal-is or b) recording the details of relevant calls to EPA Tasmania under the communications (engagement) thread section within Boreal-is. The current version of Boreal-is has the functionality to effectively record this information.
General Condition G9 – Land Management All persons responsible for the activity must be aware of and implement the relevant plans for the control of *Phytophthora cinnamoni*, weeds, and wild fires, as specified in the Quarry Code of Practice 1999, Mineral Exploration Code of Practice 1999 and recommendations in the West Coast Weed and Fire Management Strategy, October 2001.	**Compliant**	<u>2018/19 Weed Surveys</u> The most recent weed survey was undertaken across two days on 20th and 21st November 2018 by a GHD Ecologist and a weed contractor, using a combination of mainly vehicular and then targeted on-foot assessments. The report for this weed survey was completed and submitted by GHD to MMG Rosebery on the 17th December 2018. <u>2019/20 Weed Surveys</u> No weed surveys were completed at MMG Rosebery during the last 16 months. It was stated that a weed survey is scheduled to be completed in September 2021 (i.e. whilst the weeds are flowering) after MMG Rosebery commences using the borrow areas at Bobadil (i.e. given that most of the tree felling has been completed for Bobadil Stage 10).

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		 **Photo No. 2** – Entrance to the MMG Rosebery Bobadil 2021 Borrow Area (December 2020) 2019/20 Weed Eradication Programs MMG Rosebery continue to budget and implement annual strategies for weed management. Over the last few years, improvements to weed management across the operation was able to be demonstrated. The 2019/20 annual weed spraying program occurred as scheduled and involved one main weed spraying program and one follow up weed spraying program). It was stated that all sprayed weed waste is transported and disposed at the Zeehan landfill. Weed spraying is also scheduled and completed annually for the Hercules and South Hercules mine areas. In November 2020, MMG Rosebery developed scopes of work (i.e. CPORTS) for the a) late 2020/April 2021 weed spraying program and b) the 2021 Pampas Grass Eradication Program (i.e. for external service provider, GBE Maintenance Services Pty Ltd, based in Zeehan). Weed Procedures and Data Management As of December 2020, MMG Rosebery continue to maintain a: • Weed and Pathogen Washdown Procedure (last issued 6th August 2019). • Weed Management Procedure (last issued 10th April 2019) Both above procedures are current and available on the MMG Rosebery Library.

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		MMG Rosebery continue to utilise an existing MapInfo database/ArcGIS system. It was stated that MMG Rosebery may plan for a QGIS system in the future (i.e. as a MMG wide GIS database). It was stated that MMG have uploaded the former 2017 Weed Survey data into their GIS. No weed spraying data was able to be secured from the weed-spraying contractor in 2018 (i.e. this data is not available). It was stated that the 2019 weed survey data was supplied by the contractor. A tablet will be used for the 2021 weed survey enabling the data to be directly held by MMG Rosebery.
General Condition G10 – Stockpiling of raw materials The raw materials must only be stockpiled at 7 Level ROM and on 4-Level with any contaminated stormwater runoff as a result of that stockpile must be managed in accordance with condition E2.	**Compliant** **Observation**	<u>7 Level ROM and 4 Level</u> During 2019/20, raw (ore) materials are only stockpiled on the 7 Level ROM and on 4 Level. Material from the Assay Creek waste rock dump has not been consumed underground in the last few years as backfill. No material has been removed from this waste rock dump in the last 16 months. Drainage from the 7 level ROM, 4 Level waste rock dump and 3 Level waste rock dump continues to be diverted to MMG Rosebery's Effluent Treatment Plant (ETP) for treatment. <u>Level 3 PAF Waste Rock Dump</u> As a result of former changes in mine planning, no additional waste rock from underground is expected to be transported to the surface for the remainder of the life-of-mine. No new waste rock from underground has been transferred to the Level 3 WRD in the last four years. As of late December 2020, only 150,000 m^3 of waste rock had been placed on the Level 3 PAF, when the original design involved the placement of 1,000,000 m^3 (i.e. insufficient volumes of waste rock are available to fill the Level 3 PAF dump to its original design capacity). Some drill core waste was correctly deposited in this location during the audit period in January 2020. As defined in previous EPN audit reports, the 3 Level PAF waste rock dump was constructed with layers of waste rock, limestone, waste rock etc (i.e. this facility constructed correctly as per required design). Six-monthly construction audits of the 3 Level PAF waste rock dump were last completed in May and November 2020 by SGM Environmental. These six-monthly audits are essentially no longer relevant as no waste rock material has been placed on the 3 Level PAF waste rock dump since September 2016 (i.e. to demonstrate that the

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		waste rock dump was constructed/closed in accordance with design requirements specified by the consultant) Feedback and approval of the MMG Rosebery Closure Plan is anticipated from EPA Tasmania in 2021 (i.e. a copy of this plan was submitted to the Tasmanian EPA in October 2018). If approved, it is likely that the frequency of these six-monthly audits will be reduced to annual). In addition, the Conceptual Closure Plan for the 3 Level WRD was completed by external consultants Golder Associates and submitted by MMG Rosebery to the Tasmanian EPA on the 31st October 2018. As of December 2020, no feedback has been provided from the regulator.  **Photo No. 3** – 3 Level Waste Rock Dump (15th December 2020) **General Condition G10 – Stockpiling of raw materials - Observation No. 3** – During the audit period, MMG personnel/contractors have gained access to the 3 Level WRD for the deposition of a) waste concrete; b) minor volumes of waste "shotcrete fibres" and c) contaminated soil. MMG Rosebery are required to restrict access to this site, conduct monthly inspections and investigate/remove any unauthorised material that is being deposited at this location.

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		  **Photos No. 4 and 5 –** Unauthorised deposition of waste concrete, minor volumes of waste "shotcrete fibres" and contaminated soil at 3 Level WRD (December 2020)
General Condition G11 – Groundwater Monitoring Bore Planning and Construction A groundwater monitoring bore program must be submitted by the person responsible to the Director for approval within 6 months of the date on which these conditions take effect, or by a date otherwise specified by the Director.	**Compliant**	<u>MMG Rosebery's Groundwater Monitoring Bore Program</u> As identified in previous EPN audit reports, the MMG Rosebery groundwater monitoring bore program was submitted to the Director of the Tasmanian EPA on the 26th March 2012 and approved in writing on the 22nd June 2012. External consultants, GHD, were commissioned to develop and submit this 2012 program on behalf of MMG Rosebery. Additional groundwater monitoring bores 21 to 36 were installed on the 3 Level waste rock dump by GHD in 2012. The 2/5 Dam groundwater monitoring bores were installed in 2016/17. These are administered under a separate EPN for the operation of the 2/5 Dam. MMG Rosebery received approval from EPA Tasmanian to decommission groundwater monitoring bores GB2, GB9, GB32, GB42, and GB25D in correspondence dated 28th September 2020. <u>Decommissioning of Bobadil Groundwater Monitoring Bores</u> To date, no groundwater monitoring bores have been removed or decommissioned, but this is potentially planned for early 2021. A total of six existing bores are designated to be grouted and abandoned to restore the aquifer isolation that existed before each bore was drilled and constructed. The bores to be decommissioned include a) GB42 (bent casing, replaced by GB52S), b) GB09 (location to be

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		compromised by future borrow pit excavations), c) GB25D, d) GB32, e) GB02 and f) BP97 (which is 358 m deep and will potentially installation of a plug and grout in the upper section only). 2020 Installation of Bobadil Groundwater Monitoring Bores Additional groundwater monitoring bores have been installed in the last 16 months in the following locations at sites 1b, 2, 3, 4 and 5: • GB55, GB43D, GB51S, GB51D, GB52S, GB52D, GB53S and GB52D. No survey of the casing of these new wells has been completed to date. It was stated that a number of the new monitoring bores listed above replaced former monitoring bores that were not operational (i.e. bores at sites 3, 4, 5). The monitoring bores installed at sites 1b and 2 are new and not listed on the site EPN, as these were installed primarily to progress closure prefeasibility studies. The drilling program and installation works were approved by MRT (i.e. not EPA Tasmania) on the 12th June 2020.

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		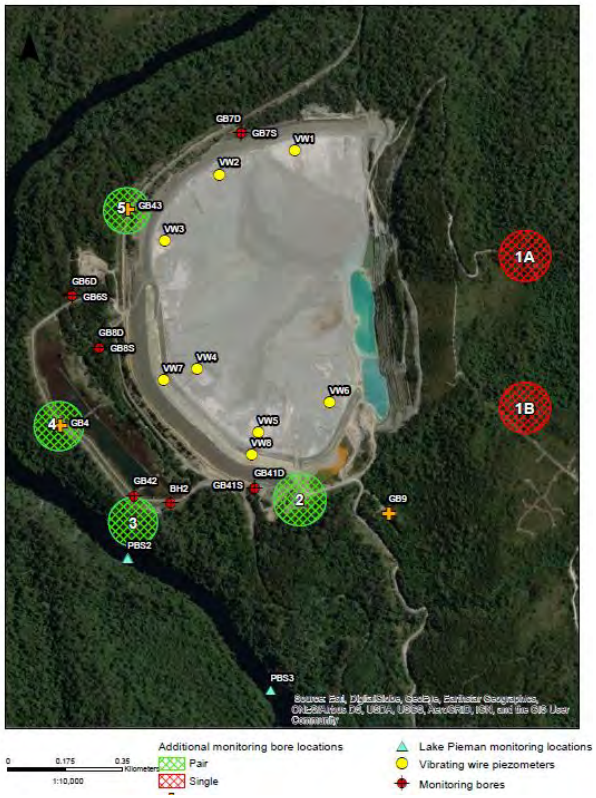 **Photo No. 6** - Bobadil Groundwater Monitoring Bore Installation Program (2020) These 10 new groundwater monitoring bores were installed in two phases in June and December 2020. The final installation report is scheduled to be completed and issued after these bores are surveyed in March 2021. <u>General Rosebery Groundwater Monitoring Program</u> During the audit period, MMG Rosebery maintained a formal program of scheduled groundwater monitoring at six monthly intervals. Sampling continues to be conducted by external service providers, ES&D for approximately 50 groundwater monitoring bores at six monthly intervals. For

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		the foreseeable future, it was stated that the recently installed Bobadil TSF monitoring bores will be sampled at monthly intervals by ES&D. The most recent six-monthly groundwater monitoring was completed by ES&D in October/November 2020 (i.e. over a period of approximately 45 days). Prior to this, the previous six-monthly groundwater monitoring program was completed in April/May 2020. Groundwater samples continue to be freighted to external commercial laboratories, ALS in Melbourne for analysis.
General Condition G11 – Groundwater Monitoring Bore Planning and Construction The groundwater monitoring bore plan must be prepared by a suitably qualified person.	**Compliant**	As identified in previous EPN audit reports, Peter Topliss, Manager - Contaminated Sites & Geoscience from external consultants GHD, was responsible for preparing MMG Rosebery's groundwater monitoring bore plan in 2012. Groundwater bores installed for the 3 Level waste rock dump and the 2 & 5 dam are administered under separate EPNs and are not included in the scope of this current December 2020 audit.
General Condition G11 – Groundwater Monitoring Bore Planning and Construction The groundwater monitoring bore plan must: 3.1 describe the location and design of groundwater monitoring bores to be constructed or which have already been constructed to detect groundwater contamination caused by the activity; 3.2 include a map of the Land on which the location of existing and proposed bores are marked; 3.3 provide reasons as to why the location and design of proposed bores is appropriate for the purpose of detecting groundwater contamination caused by the activity; 3.4 provide reasons as to why the location and design of existing bores are appropriate for the purpose of detecting groundwater contamination caused by the activity	**Compliant**	As identified in previous EPN audit reports, in March 2012, GHD provided MMG Rosebery with a review and recommendations regarding the development of a Groundwater Monitoring Network and Monitoring Plan for the MMG Rosebery Mine Site. The review report was received and described a) the location and design of groundwater monitoring bores to be constructed or which have already been constructed to detect groundwater contamination caused by the activity; b) included a map of the Land on which the location of existing and proposed bores are marked; and c) provided reasons as to why the location and design of proposed and existing bores is appropriate for the purpose of detecting groundwater contamination caused by the activity. The report received by MMG Rosebery from GHD Hobart on the 26th March 2012 enables compliance with this condition of the EPN to be demonstrated. Groundwater monitoring bores and related plans that have been installed since 2012 have met the requirements specified and in accordance with Condition G11.
General Condition G11 – Groundwater Monitoring Bore Planning and Construction	**Compliant**	2012

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Where the groundwater monitoring bore plan requires the construction of bores, those bores must be constructed within 6 months of the date on which the Director approves the groundwater monitoring plan.		As identified in previous EPN audit reports, MMG Rosebery/GHD's former proposals for the construction and installation of groundwater monitoring bores have generally occurred in accordance with a documented program, which considers and incorporates the requirement for bores to be constructed within 6 months of the date that the Director approves the final submitted groundwater monitoring plan. 2020 The 2020 Groundwater Monitoring Well Drilling Program for the 10 additional groundwater monitoring bores (i.e. constructed on 6 well pads) at Bobadil was developed by external consultants SRK and approved by MRT's Manager Scientific Services. The 2020 drilling work was supervised by a qualified and experienced hydrogeologist employed by consultants SRK. Drilling of the monitoring bores was completed by Tas Drilling Services, a Class 1 licensed well driller registered with the Tasmanian Department of Primary Industries, Water and Environment.
General Condition G11 – Groundwater Monitoring Bore Planning and Construction At the time of construction of any bore required by the groundwater monitoring bore plan, the following information must be recorded and compiled into a Bore Installation and Development Record: 5.1 a description of the materials used for construction; 5.2 initial field measurements of the groundwater for conductivity, total dissolved solids, pH and temperature; 5.3 details of slot screens installed, and the depth to which they were installed; 5.4 depth of gravel packing; 5.5 depth of bentonite cap; 5.6 details of bore development during pumping (removal of drilling contamination); 5.7 results of pump tests; 5.8 aquifer levels; and	**Compliant**	2012/13 As identified in previous EPN audit reports, on the 3rd April 2013, MMG Rosebery submitted documentation that fulfilled the operation's commitment under EPN Condition G11, relating to the submission of groundwater monitoring bore information. This included groundwater monitoring bore information from the December 2012 bore installation campaign. Prior to this, the previous submission to the EPA occurred from the bore plan submission dated 30th March 2012. Site Monitoring Well Network Installation All installed groundwater bores are held within a "MMG Rosebery - Site Monitoring Well Network Installation" Records database. Each bore listed in the Site Monitoring Well Network Installation" Records database, includes a record of: • Site layout; • Photo log; • Geological log; • Chip tray; and

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5.9 a detailed geological log		• Bore Development Record (linked to second database). MMG Monitoring Well – Development Record ESdat is used for the retention of data relating to a) SWLs and b) physical water quality parameters for all monitoring wells that were previously installed in December 2012. Bore Hole Logging The template prepared by GHD that is utilised for logging MMG Rosebery bore holes was identified to address all the requirements specified in Conditions 5.1 – 5.9 of the EPN, as described below: 5.1 A description of the materials used for construction (Yes); 5.2 Initial field measurements of the groundwater for conductivity, total dissolved solids, pH and temperature (Yes); 5.3 Details of slot screens installed, and the depth to which they were installed (Yes); 5.4 Depth of gravel packing (Yes); 5.5 Depth of bentonite cap (Yes); 5.6 Details of bore development during pumping (removal of drilling contamination) (Yes) 5.7 Results of pump tests (Yes, provided as an Annex – Pump Test Set-up Sheet to each Borehole Log in accordance with AS2368- 1990). 5.8 Aquifer levels (Yes); and 5.9 A detailed geological log (Yes) 2020 A total of 10 groundwater monitoring bores (i.e. located on 6 well pads) were constructed and installed in 2020 at the Bobadil TSF. A suitable Lithology/Construction Log template for the Bobadil GW Monitoring Bore Installation project was observed to be used by SRK Consulting. The Bobadil Bore Installation and Development Records for these additional bores were recorded and compiled by a professional hydrogeologist employed by SRK Consulting. These records will be collated and supplied to MMG Rosebery by the consultant post March 2021 in their issued report.

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General Condition G11 – Groundwater Monitoring Bore Planning and Construction The Director must be notified of construction of the bores required by the groundwater monitoring bore plan within 1 month of their construction. The Bore Installation and Development Record for each newly constructed bore must be provided with the notification.	**Compliant** **Observation**	2012/13 As identified in previous EPN audit reports, the MMG Rosebery groundwater monitoring bore program was submitted to the Director of the Tasmanian EPA on the 26th March 2012 and approved in writing on the 22nd June 2012. Bore Installation and Development Records were logged and completed by GHD during the original drilling program. These records are retained by MMG Rosebery. 2020 The new groundwater monitoring bores around the Bobadil TSF were constructed in June and December 2020. It is acknowledged by the auditor that these monitoring bores will be utilised primarily for the Pre-Feasibility Study. The Manager Scientific Services at MRT received the MMG Rosebery Groundwater Drilling Application - ML 28M/1993 on the 21st May 2020. It was stated that a number of the new monitoring bores replaced former monitoring bores that were not operational (i.e. bores at sites 3, 4, 5). The monitoring bores installed at sites 1b and 2 are new and not listed on the site EPN, as these were installed primarily to progress closure prefeasibility studies. The drilling program and installation works were approved by MRT (i.e. not EPA Tasmania) on the 12th June 2020. **General Condition G11 – Groundwater Monitoring Bore Planning and Construction - Observation No. 4** – Even though approval was granted by MRT in June 2020 for the installation of the additional 10 Bobadil groundwater monitoring bores, MMG Rosebery are required to a) notify EPA Tasmania of the construction of these 10 monitoring bores and b) supply EPA Tasmania with a copy of the Bore Installation and Development Records once received from SRK Consulting post March 2021 (i.e. given that some existing monitoring bores listed on the EPN were replaced). Information relating the planned 2021 decommissioning of the 6 existing monitoring bores would also be expected to be supplied to EPA Tasmania.
General Conditions G11 – Groundwater Monitoring Bore Planning and Construction The groundwater bores required by this condition must be established by a suitably qualified person in accordance with the Minimum Construction Requirement for Water Bores in Australia.	**Compliant**	2012/13 As identified in previous EPN audit reports, within GHD's March 2012 proposal, Peter Topliss was identified to manage the groundwater bore installation program, to ensure that all MMG Rosebery groundwater bores are established in accordance with the Minimum Construction Requirement for Water Bores in Australia

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		In addition, the drilling contractor, Tasdrill, has been used on previous occasions by both GHD and MMG Rosebery and were conversant in the required bore construction methods. 2019/20 The 2020 Groundwater Monitoring Well Drilling Program for the 10 additional groundwater monitoring bores (i.e. constructed on 6 well pads) at Bobadil was developed by external consultants SRK and approved by MRT's Manager Scientific Services. The 2020 drilling work was supervised by a qualified and experienced hydrogeologist employed by consultants SRK. Drilling of the monitoring bores was completed by Tas Drilling Services.

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Atmospheric		
Atmospheric Condition A1 – Dust Management The person responsible for the activity must employ formalised operational procedures for concentrate and fugitive dust management to the extent necessary to prevent environmental nuisance occurring, which include but are not limited to dust management measures such as: (i) sealing of roads and hard stand areas where appropriate; (ii) routine dust suppression by watering and dust sweeping at locations that produce excessive dust; (iii) the enclosure of crushing and screening plant: (iv) dust suppression and enclosure of the rail loadout facility (v) minimisation of fugitive dust sources and point source emissions by means that include where practicable, the installation and maintenance of dust extraction equipment, skirtings, dust filters and coverings on conveyors, transfer points, and discharge points; and (v) minimisation of fugitive dust through best practice environmental management in relation to dust generation in dust generating work areas (e.g. crusher, ROM).	**Compliant**	Fugitive Dust Sources, Controls and Abatement In the last 16 months, sources of intermittent fugitive dust at MMG Rosebery included, but was not limited to: • Bobadil TSF; • Operational activities on the ROM, using heavy machinery; • 3 level WRD; and • Assay Creek WRD. Dust Mitigation Plan Review (March 2020) In early 2020, MMG Rosebery requested ERM to review the Rosebery mine's dust mitigation plan and, based on data collected at site (air quality and weather), define when dust mitigation measured should be applied to sources on site. A review report was completed and submitted by ERM on the 20th March 2020. This report was submitted to the Tasmanian EPA on the 31st March 2020. The March 2020 report concluded that: • based on the consultant's site visit to MMG Rosebery on the 27th November 2019 and the review of the air quality data, the dust mitigation controls were stated to follow good housekeeping and best practice for dust management. This is also supported by the annual air quality reports as there have been a low number of non-compliances against the EPN and PCE requirements. • it is recommended that Rosebery mine continue its current mitigation management and mitigation measures. It is also recommended that the proposed mitigation and inspection trigger levels, are applied for the site. A review of these trigger levels should be completed within three years to understand if they are sufficient to assist in the continued control the dust from site. Tailings Dam Dust Impact Assessment (2020)

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		A Tailings Dam Dust Impact Assessment - Phase 1: Identification of Dust Generating Conditions was prepared for the MMG Rosebery Mine in August 2020. This assessment was initiated relating to the proposed conversion from sub-aqueous deposition to sub-aerial deposition of tailings within the tailings dam. The objectives of the assessment were to: 1. Assess the current baseline for dust impact in the local area through an analysis of data from their dust and meteorological monitoring network. 2. Identify specific events that cause elevated dust emissions and/or impacts through an analysis of: i. Observed PM_{10} data from the monitoring network ii. Observations by MMG staff in the Bobadil Tailings Storage Facility (TSF) area of significant dust emissions iii. Complaint information from the local community relating to dust emissions. 3. Investigate and identify the meteorological conditions during significant dust emission events at the TSFs that contribute to the dusty conditions. The consultants stated that the identification of high dust emission conditions will be used to inform a dust control and management plan for the TSFs. It will also be used in Stage 2 of the project, the dust dispersion modelling and impact assessment for the DPEMP. <u>2018/2019 Dust Abatement/Controls</u> MMG Rosebery received several community complaints in the summer of 2018/19, relating to fugitive dust emissions from the Bobadil TSF. In March 2019, a sprinkler system was installed at the Bobadil TSF to reduce fugitive dust emissions from the surface of the dam during the latter months of the 2018/19 summer period. It was stated that during the 2019/20 summer period the dust levels from the Bobadil TSF were acceptable. With the construction of the Stage 10 Bobadil TSF embankment lift, a water truck with a hose is used to assist in reducing fugitive dust from the surface of the dam during adverse weather conditions.

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		 **Photo No. 7** – Existing sprinkler system at the Bobadil TSF (December 2020) MMG Rosebery recommenced the discharge of tailings to Bobadil in late 2019 for fixed periods of time every 2nd or 3rd day for the last 12 months (i.e. as the dam capacity is restricted until the Stage 10 embankment is complete). It was stated that no dust complaints have been received from the operation of the 2/5 dam in the last 16 months (i.e. given few vehicle movements occur at this location). Some vegetation has commenced growing on the vacant area located near the spillway (i.e. this area is utilised for flood control). In addition, preliminary planting of vegetation was completed on the screening wall between the Murchison Highway and 2/5 dam.

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		 **Photo No. 8** – Vegetation growth on previously disturbed land near the 2/5 dam (December 2020) 2019/2020 During the 2019/20 audit period, no additional improvements or capital were committed for fugitive dust abatement in the last 16 months (i.e. only the purchase and installation of the DRX dust monitoring units). No additional sealing works have occurred within or around the operation in the last 16 months, with the objective of reducing dust emissions. It was stated that MMG Rosebery are considering additional resealing of roadways around the warehouse in 2021 (i.e. for safety reasons). Dust suppression systems utilising sprays continue to be used at the crusher and coarse ore bins (i.e. these are automatically triggered when truck movements are detected). All conveyors across the Rosebery operation remain covered to reduce fugitive dust emissions from these sources.

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		 **Photo No. 9** – Covered conveyor systems within the MMG Rosebery Processing Plant (December 2020) If needed, water carts remain available at the operation (i.e. normally utilised underground) for dust abatement of unsealed surfaces (i.e. ROM area, waste rock dumps/mining areas). These would typically be used if a community complaint was received or if adverse weather conditions were forecast. This is the dedicated water truck for underground and can be used on the surface as required. For the last 16 months, MMG Rosebery Pit Ram receive the dust alerts and can respond as required to try and target and address the source of any adverse dust emissions. MDG also have a registered water truck that can be utilised for areas around MMG Rosebery's processing area as and when needed. Gradco also utilise a water cart to minimise construction related dust during the Stage 10 lift in 2020/21 at the Bobadil TSF.

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		  **Photos No. 10 and 11** – Stage 10 Embankment Construction at Bobadil TSF (December 2020) Apart from the above, few additional opportunities existed for dust abatement across the operation in 2019/20.
Atmospheric Condition A2 – High Volume Air Sampling 1 Unless otherwise approved in writing by the Director, High Volume Air Sampling (HVAS) must be undertaken at the locations, frequency and parameters specified in columns 1-5 of Table 12 of Attachment 2 and locations shown on Attachment 6. These measurements must be to the standard of AS/NZS 3580.9.3:2003, Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method and AS/NZS 3580.9.6:2003, Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - PM_{10} high volume sampler with size-selective inlet - Gravimetric method.	**Compliant** **Observation**	2019/20 Ambient Dust Monitoring No changes or alterations were made to MMG Rosebery's ambient air/dust monitoring program during the 2019/20 audit period. It was stated that MMG Rosebery did not review their air quality monitoring program to eliminate their depositional dust monitoring program (i.e. given that erroneous results continue to be generated during periods of wet weather for approximately 6 months of the year). A letter relating to this matter was drafted by MMG Rosebery on the 30th September 2020, but was not submitted to the Director of the Tasmanian EPA. Dust monitoring stations associated with the 2/5 dam continue to be administered under a separate EPN. High Volume Air Sampling (HVAS) HVAS units are utilised at four locations (AD3, AD2.1, Alec Street and Giblin St) to measure a) 24 hr averages for PM_{10} and TSP, Lead as TSP, and Cadmium and Zinc as PM_{10}, b) a 90 day average for Lead as TSP and c) annual averages for TSP. These units are utilised to monitor compliance against trigger and compliance limits defined in the EPN.

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		External contractors, ES&D schedule and conduct two monthly flow checks of this instrumentation. In addition, Ecotech conduct preventative maintenance of ambient dust monitoring units on an annual frequency, which was last completed in October 2019 (COVID) and is next scheduled in January 2021. It was stated that MMG Rosebery did not experience any significant downtime for their HVASs in 2019/20. One HVAS unit required replacement on the 19th June 2020 (this was reportable to the Tasmanian EPA on the 22nd June 2020). All HVAS units (i.e. 4 x TSP unit and 4 x PM_{10} units) continue to be calibrated bi-monthly (i.e. flow-calibrations) in the field by service provider ES&D and annual calibrations are completed by Ecotech. If required, one spare unit remains available on site (which was utilised in June 2020 when the installed unit was not operational, so only one sampling event was not determined as scheduled). As a result of the spare HVAS unit being placed into service, MMG Rosebery no longer retain a spare unit on site. It was stated that this will be discussed with external service providers, Ecotech in January 2021 when Ecotech personnel are next scheduled to be on site. It was stated that quality control programs have been established by MMG Rosebery for their HVAS filters (i.e. 1 in 16 samples). <u>TSI DRX DustTrak units</u> As of Q2 2020, MMG Rosebery purchased and utilise two TSI DRX DustTrak units (i.e. utilised to measure dust particle size). The two DRX's units are located in Alec street and Giblin Streets (i.e. amongst sensitive receptors). These are calibrated by EPA Tasmania's Air Quality Division in Hobart, inclusive of being calibrated in a manner that eliminates the recording of smoke related dust. <u>MMG Rosebery Environmental Equipment Calibration Register</u> MMG Rosebery continue to utilise an Environmental Equipment Calibration Register to schedule their calibration program for environmental monitoring equipment. Any calibrations that are overdue are identified and colour coded within this register (i.e. given that some calibrations were impacted by COVID restrictions, for which an exemption was requested and granted from the Tasmanian EPA). **Atmospheric Condition A2 – High Volume Air Sampling - Observation No. 5** – Within the ROS Environmental Equipment Calibration Register, MMG Rosebery could retitle "Column H" currently

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		titled "Calibration Date" to "Last Calibration Date", to clearly distinguish between the most recent and the next scheduled calibrations.
Atmospheric Condition A2 – High Volume Air Sampling 2 The concentration levels, attributable to activities within the site boundary, must not exceed the limits specified in column 2 of Table 1.	**Compliant**	The MMG Rosebery Annual Air Quality Review for 2019/20 was completed and issued on the 31st August 2020 by external consultants, ERM. This report was provided to the Tasmanian EPA in the September 2020 AMRMR (as Appendix C). In relation to EPN conditions, within their August 2020 report, ERM concluded: • there were no deviations from the air sampling schedules for FY20; • there were exceedances of the trigger level for PM_{10} concentrations (24 hr average) at all HVAS locations (i.e., at AD3, AD2.1, Giblin St, Alec St) on the same day in which they were reported to EPA Tasmania. The cause of the exceedance was identified as woodfire smoke from the nearby residents. In response to the exceedances, an additional DRX DustTrak unit, able to provide information on smaller particle size fractions, was purchased; • no exceedances of the compliance limits were reported; • the results indicate that MMG's Rosebery mine is a low environmental risk and that the current dust mitigation controls are appropriate; and • based on this review, it is recommended that the air quality monitoring network be reviewed and consolidated.
Atmospheric Condition A2 – High Volume Air Sampling 3 The person responsible for the activity must investigate each exceedance of the high-volume air sampler trigger levels, specified in column 3 of Table 1, as soon as it is reasonably possible to do so after becoming aware of the event. The investigation must determine the likely cause(s) of the exceedance and identify and implement any reasonable remedial actions required to prevent it from reoccurring. A record must be kept of these actions and must be made available to the Director upon request.	**Compliant**	As identified by ERM in Section 3.3 of this consultant's 31st August 2020 report, investigations into exceedances of HVAS 24 hr average PM_{10} trigger levels were conducted for results on the 15th January 2020. Investigations by the consultants into exceedances in trigger limits defined in EPN Table 1 – HVAS Compliance Limits and Trigger Levels concluded: • exceedances of the HVAS 24 hour PM_{10} trigger limit were reported for all four HVAS locations on 16 January 2020. The exceedances were reported to EPA Tasmania via email, which concluded that these exceedances were due to woodfire smoke from the nearby residences. This was also confirmed through visual observations by site staff and the BLANkET monitoring at Queenstown operated by EPA Tasmania. The DustTrak data for this period were observed for the 24 hour period with a peaks observed at all four locations overnight, at 10:30 am and between 5 and 6 pm; • peaks were also observed with the Queenstown BLANkET monitoring location. The day of the exceedance was 15 January 2020; and

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		• in response to these exceedances, one additional TSI DRX DustTrak unit was purchased. The new and existing units provide information on smaller size fractions. As the particles generated from combustion sources are much smaller than particles generated from site activities (i.e. mechanically generated from crushing), it would be expected that the $PM_{2.5}$ concentrations would contribute to a higher proportion of the total dust concentrations. These units have been used to identify several alerts of the real-time monitoring network that relate to woodfire smoke since installation in early 2020.
Atmospheric Condition A2 – High Volume Air Sampling 4 Subject to the Director's approval in writing, the HVAS at AD2.1 may be discontinued once a yearly pattern is able to be established without compliance or trigger levels being exceeded.	**Compliant**	The operation's HVAS site, located at AD2.1 (Coreshed), continues to be utilised in 2019/20. It was stated that there has been no request or discussions with the Tasmanian EPA in the last 16 months to negotiate the potential discontinuation of this monitoring site and any potential future removal of this site from the EPN. It was stated that the AD2.1 (Coreshed) is a valuable monitoring site to assess potential operational and community impacts applicable to dust.
Atmospheric Condition A3 – Dust Deposition Sampling 1 Unless otherwise approved in writing by the Director, a network of dust deposition samplers must be established and maintained at the locations specified in columns 1 - 4 of Table 12 of Attachment 2 and locations shown on Attachment 6. Monthly deposition samples must be collected and analysed in accordance with the requirements of column 6 of Table 12 of Attachment 2. Depositional measurements and analysis must be consistent with the requirements of AS/NZS 3580.10.1:2003.	**Compliant** **Observation**	<u>2019/20 Dust Deposition Sampling</u> The collection of monthly dust deposition gauge (DDG) samples originally commenced across the MMG Rosebery operation in May 2012. Over the last 9 years, a significant data set has been generated. In the future, MMG Rosebery plan to secure approval from the Tasmanian EPA to cease monitoring the "additional dust deposition sites" listed in EPN Condition A3 (4). During the 2019/20 audit period, dust deposition monitoring continued for total solids/TIM and select heavy metals at monthly intervals at 11 locations, inclusive of the Rosebery Golf Course background site (which was identified to generate erroneous results prior to the current audit period). The overfilling of DDG sampling bottles continues to occur during periods of wet weather. Generally, this indicates minimal ambient dust during these periods, given the occurrence of high rainfall. The June 2019 environmental monitoring audit identified that some of MMG Rosebery's dust deposition sites are not located/constructed in accordance with the required Australian Standard AS/NZS 3580.10.1:2003. As of December 2020, this has not been addressed, but it was stated that MMG plan to rectify this in 2021 (i.e. prior to the next scheduled environmental monitoring audit).

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		Atmospheric Condition A2 – High Volume Air Sampling - Observation No. 6 – For MMG Rosebery to continue to collect representative data from their dust deposition monitoring program, locations of dust deposition gauges should be installed in accordance with requirements specified in the Australian Standard. The analysis of dust deposition samples from MMG Rosebery continues to be completed and reported by ALS in Melbourne.
Atmospheric Condition A3 – Dust Deposition Sampling 2 Monthly deposition measurements must be adjusted to account for the background deposition rate. For each sampling month, the background is defined as the minimum of the dust loadings recorded at all of the sites in the network during that month.	**Compliant** **Observation** **Observation** **Observation**	The collected dust deposition samples at MMG Rosebery require the background dust result to be subtracted (i.e. based on the location with the lowest detectable result, which is the designated background site for any specific month). There was evidence (i.e. via calculation spreadsheets) that background dust deposition results are being subtracted every month as required (i.e. when valid and representative dust deposition samples are collected). **Atmospheric Condition A3 – Dust Deposition Sampling - Observation No. 7** – The Environmental Monitoring Quality Assurance and Quality Control checklist should have exceedances listed in the column of Comments (i.e. as a retitled “Comments/ Exceedances” in column F). **Atmospheric Condition A3 – Dust Deposition Sampling - Observation No. 8** – MMG Rosebery could request that ERM provide additional information and context relating to the background DDG site(s) and results that are used to determine compliance with EPN Atmospheric Condition A3 (2) – Dust Deposition Sampling, as this was not clear in their most recent Annual Air Quality Review report FY20, issued 31st August 2020. **Atmospheric Condition A3 – Dust Deposition Sampling - Observation No. 9 –** As identified in September 2018, MMG Rosebery are required to utilise a text field to record exactly which dust deposition monitoring site was used in the data spreadsheet to determine the required Minimum Value/Background Site. This could be identified and recorded every month and the information retained.
Atmospheric Condition A3 – Dust Deposition Sampling 3 Monthly deposition measurements must be made at the 'core sites' (AD1.1, AD2.1, AD3, AD4 and AD5), unless otherwise approved in writing by the Director.	**Compliant** **Observation**	It was stated that monthly dust deposition measurements continue to be sampled and determined by MMG Rosebery at the 'core sites' of AD1.1, AD2.1, AD3, AD4 and AD5 listed in EPN Condition A3 (3). These sampling sites were originally installed in October 2012 for the collection of monthly dust deposition samples.

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		Monthly dust deposition sample collection at the core sites in 2019/2020 was achieved as follows: • AD1.1 – Not defined by MMG Rosebery/ERM; • AD2.1 - Not defined by MMG Rosebery/ERM; • AD3 - 4 valid and 8 invalid overflow monthly samples; • AD4 - 4 valid and 8 invalid overflow monthly samples; and • AD5 - Not defined by MMG Rosebery/ERM. **Atmospheric Condition A3 – Dust Deposition Sampling - Observation No. 10** – MMG Rosebery's consultants ERM did not list the status of monthly monitoring in 2019/20 of all of the five 'core sites' (AD1.1, AD2.1, AD3, AD4 and AD5) in their 31st August 2020 Annual Air Quality Review report (i.e. data was only provided for cores sites AD3 and AD4 and not for the remaining three core sites at AD1.1, AD1.2 and AD5). Additional text and commentary are required by the consultants to explain the reason for this. Quality control programs adopted for MMG Rosebery's dust deposition monitoring program involve the inclusion of one field blank per quarter.
Atmospheric Condition A3 – Dust Deposition Sampling 4 Measurements at the 'additional sites' (BG3, AD11, AD21, AD22, AD23 and AD25) are to continue until such time as an annual pattern can be established and a full 12-month dataset is compiled. This data is to be analysed in a report presented to the Director, containing recommendations and a request for approval to remove specific 'additional sites' from the monitoring network. Monthly monitoring must continue at all of the 'additional sites' until the Director provides approval to remove individual sites.	**Compliant** **Observation** **Observation**	Monthly dust measurements at the 'additional sites', BG3, AD11, AD21, AD22, AD23 and AD25 continued to be determined over the last 16 months. It was stated that monitoring at these locations is expected to continue until authorisation is formally requested and provided by the Tasmanian EPA for the operation to discontinue monitoring at these locations. No request was received from EPA Tasmania in this regard in the last 16 months. **Atmospheric Condition A3 – Dust Deposition Sampling - Observation No. 11** – MMG Rosebery's consultants ERM did not list the status of monthly monitoring in 2019/20 of all of the six 'additional sites' (BG3, AD11, AD21, AD22, AD23 and AD25) in their 31st August 2020 Annual Air Quality Review report (i.e. data was only provided for four sites BG3, AD11, AD21, AD22 and AD25 and not for the remaining additional site at AD23). Additional text and commentary are required by the consultants to explain the reason for this. **Atmospheric Condition A3 – Dust Deposition Sampling - Observation No. 12 –** As identified in September 2018, MMG Rosebery are encouraged to secure written approval from EPA Tasmanian to remove the additional dust deposition sites AD11, AD21, AD22, AD23 and AD25 from the ongoing dust deposition monitoring program.

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		The dust deposition reference site (BG3) located at the Rosebery Golf Course remains in use. This site generated suitable monthly dust deposition data for the 12 months in 2019/20 (i.e. not elevated as identified in previous years). Only three valid monthly samples were collected in 2019/20, with the remaining nine monthly samples impacted by high rainfall.
Atmospheric Condition A3 – Dust Deposition Sampling 5 The person responsible for the activity must investigate each exceedance of the dust deposition trigger levels, specified in column 3 of Table 2, as soon as it is reasonably possible to do so after becoming aware of the event. The investigation must determine the likely cause(s) of the exceedance and identify and implement any reasonable remedial actions required to prevent it from reoccurring. A record must be kept of these actions and must be made available to the Director upon request.	**Compliant**	2019/20 In their 31st August 2020 Air Quality Review report, external consultants ERM identified that no exceedances of the trigger level or compliance limit were reported for any deposition gauges at or beyond the site boundary for FY20.
Atmospheric Condition A3 – Dust Deposition Sampling 6 The level of dust fallout attributable to activities on The Land must not exceed the limit specified in column 2 of Table 2.	**Compliant**	As defined in EPN Atmospheric Condition A3 – Dust Deposition Sampling (5).
Atmospheric Condition A4 – Meteorological Monitoring 1 The meteorological monitoring station that was originally established near the HEC electrical substation may be relocated to a location approved by the Director.	**Compliant**	Three meteorological stations remained fully operational for the last 16 months at the MMG Rosebery main carpark, the 2/5 Dam and at Bobadil. These meteorological stations continue to be linked to WeatherMation to allow for instantaneous access to current weather conditions (i.e. as actually recorded at the station in the MMG Rosebery main carpark). All three weather stations were originally installed with modems in June 2017 to allow data to be held on WeatherMation with the external service provider.
Atmospheric Condition A4 – Meteorological Monitoring 2 The meteorological monitoring station shall continue to monitor hourly readings of: 2.1 temperature;	**Compliant** **Observation**	All three existing meteorological monitoring stations at MMG Rosebery (located in the MMG Rosebery carpark, 2/5 Dam and at Bobadil) collect data for a) temperature; b) relative humidity; c) rainfall (tipping bucket); d) wind speed; e) wind direction and f) based on a calculated figure, the standard deviation of wind direction (sigma-theta). Data for the above continues to be collected and reported on a 10 minute, hourly and daily basis.

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2.2 relative humidity; 2.3 rainfall (tipping bucket); 2.4 wind speed; 2.5 wind direction; and 2.6 standard deviation of wind direction (sigma-theta).		These three meteorological stations remain operational, with > 99% availability of data being generated from those stations in 2019/20. During the audit period in FY20, an error was observed with the wind direction sensor at the Carpark monitoring station and therefore the consultants excluded the carpark monitoring station wind direction and wind speed analysis from the August 2020 meteorological data review. From March 2013 to August 2020, the data from the MMG Rosebery main carpark meteorological station has been stored within a web-interface (WeatherMation) which is also held on SCADA. All three meteorological stations were last serviced on the 23rd and 24th July 2020 by external service providers Envirodata (i.e. after an extension was granted from EPA Tasmania resulting from COVID restrictions). **Atmospheric Condition A4 – Meteorological Monitoring - Observation No. 13** – MMG Rosebery should locate and/or request the three July 2020 meteorological station calibration certificates from the service provider, Envirodata, which were unable to be located during this audit.
Atmospheric Condition A4 – Meteorological Monitoring 3 An analysis of the yearly climate is to be included in the Annual Monitoring Review and Management Report for each year.	**Compliant**	The analysis of MMG Rosebery's annual meteorological data (1st July 2019 to 30th June 2020) and submitted report was completed and issued on the 4th August 2020 by external consultants ERM. This report was included as an appendix by MMG Rosebery in their 2019/20 AMRMR. These report reviews include data collected in relation to a) wind speed and direction; b) temperature; c) relative humidity and d) rainfall. Annual meteorological review reports completed by ERM on behalf of MMG Rosebery effectively discuss a) availability of data; b) data quality and c) variability of data between the three meteorological stations. The above was included in Table 3.1 on the 4th August 2020 Report from ERM.
Atmospheric Condition A4 – Meteorological Monitoring 4 The data is to be regularly downloaded and checked for instrument performance, and faults must be quickly rectified. The data is to be stored in a suitable database so as to be available in a useful form for any future modelling or investigation of incidents.	**Compliant**	In mid-2017, MMG Rosebery completed the uploading of historical meteorological data onto a cloud site by Envirodata from the 2/5 Dam meteorological station. Since June 2017, no downloading of meteorological data has been required as all data is available in real-time on WeatherMation. As a result, there is no requirement for MMG Rosebery to conduct manual downloads of meteorological data.

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		The analysis of MMG Rosebery's annual meteorological data (1st July 2019 to 30th June 2020), compiled by ERM, was included as an appendix in MMG Rosebery's 2019/20 AMRMR. 4th August 2020 report.
Atmospheric Condition A5 – Reporting of Monitoring Any non-compliance or exceedance of trigger levels is to be reported to the Director within 24-hours of the data becoming available.	**Compliant**	One exceedance of EPN trigger levels occurred in the 2019/20 audit period that was reported to the Tasmanian EPA. Within their September 2020 air quality review report, ERM stated: • exceedances of the HVAS 24 hour PM_{10} trigger limit were reported for all four HVAS locations on the 15th January 2020 (i.e. attributed to woodfire/bushfire smoke). The above exceedance was reported to EPA Tasmania within the required 24 hours of the data becoming available.
Atmospheric Condition A5 – Reporting of Monitoring 2 Monthly internal reports must be compiled, and must be made available to the Director upon request, providing the most up-to-date monitoring data including: 2.1 tabulated meteorological, high volume air sampler, and dust and metal deposition results for the month; 2.2 running annual averages of the deposition increment above background; 2.3 monthly deposition isopleths or graphs of total deposition and increment above 'background'; and 2.4 any supporting data analysis necessary to aid interpretation of the dataset.	**Compliant**	Monthly reports relating to air/dust quality data continue to be compiled by external service provider, ES&D (i.e. in a spreadsheet format). This data is provided weekly to MMG Rosebery and then extracted and reviewed as a summary spreadsheet by MMG Rosebery personnel as a monthly report. No monthly reports were missed during the audit period and these remain available on request to the Tasmanian EPA. It was stated that if this data is requested by the Tasmanian EPA, this would be extracted from MMG Rosebery's air quality spreadsheet as required. During the audit period, MMG Roseberry were able to demonstrate compliance with Atmospheric Condition A5 – Reporting of Monitoring 2.1 to 2.4 as follows: 2.1 tabulated meteorological, high volume air sampler, and dust and metal deposition results for the month - In 2019/20, MMG Rosebery did not include the tabulated meteorological data, as this is available from WeatherMation as needed; 2.2 running annual averages of the deposition increment above background – This continues to be provided within the MMG Rosebery Dust Deposition Gauge (DDG) sheet in the spreadsheet; 2.3 monthly deposition isopleths or graphs of total deposition and increment above 'background' – This is provided within the DDG spreadsheet (i.e. using a bar/line graph to meet this requirement) within the ROS Air Quality Monitoring Data Summary spreadsheet and is also provided in Section 3.2 and Figure 3.1 of the ERM August 2020 Air Quality Review report; and 2.4 any supporting data analysis necessary to aid interpretation of the dataset – This is provided by ES&D as and when required.

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Atmospheric Condition A5 – Reporting of Monitoring 3 The Annual Environmental Report must provide: 3.1 tabulated high-volume air sampler, and dust and metal deposition results for the entire year, showing intermediate values as well as final monitoring results; 3.2 tabulated annual averages of the deposition increment above background, supported by deposition isopleths or graphs; 3.3 monthly deposition isopleths or graphs of total dust and metal deposition and increment above 'background'; 3.4 summaries of all exceedances occurring within the reporting year, describing the results of any investigations undertaken and the mitigation measures that were adopted in response; and 3.5 any supporting data analysis or description necessary to aid interpretation of the dataset.	**Compliant** **Observation**	The MMG Rosebery Air Quality Annual Review report for 2019/20 (dated 31st August 2020) was collated by external consultants ERM and was included as an appendix in the 2019/2020 MMG Rosebery AMRMR. This 31st August 2020 review report by ERM addresses EPN Condition A5-3 (3.1 to 3.5) relating to the required: • tabulation of annual averages of the deposition increment above background, supported by deposition isopleths or graphs; • presentation of monthly deposition isopleths or graphs of total dust and metal deposition and increment above background; • tabulation of dust and metal deposition results for the 2019/20 year, defining intermediate values as well as final monitoring results; • summaries of all exceedances occurring within the 2019/20 reporting year (i.e. against EPN trigger levels and compliance limits); and • supporting data, analysis and interpretative text to aid in the interpretation of the dataset. **Atmospheric Condition A5 – Reporting of Monitoring – Observation No. 14** – External consultants ERM are not providing "intermediate" values (i.e. only final HVAS monitoring results) in their annual review reports. It is unclear why this EPN condition requires intermediate values to be provided, which could be clarified with the Tasmanian EPA. The planned 2020/21 MMG Rosebery Air Quality Annual Review report by ERM could state the reasoning for not providing "intermediate" results as defined by EPN Atmospheric Condition A5 (3.1) – Reporting of Monitoring.
Atmospheric Condition A6 – Dust Mitigation Plan A real-time dust mitigation plan (The Plan) must be submitted to the Director for approval within four months of the issue of this Notice. The Plan must include, but is not necessarily limited to, details of the following: 1.1 identification and description of suitable light scattering instruments for the continuous monitoring of ambient dust concentrations at sites AD2.1 and AD3; 1.2 identification and description of a system to transmit and display near real-time data from the meteorological monitoring station, and the continuous dust monitoring stations to the assigned person(s) identified in The Plan;	**Compliant** **Observation**	<u>Former Versions of the MMG Rosebery Dust Mitigation Plan</u> MMG Rosebery's original Dust Mitigation Plan (Plan) was completed and submitted to the Tasmanian EPA on the 27th February 2012. A revised and updated Plan was submitted to the Director on the 16th May 2014. This May 2014 version of the Plan was reviewed and updated on the 28th May 2015 by personnel from the MMG Corporate office. <u>2020 MMG Rosebery Dust Mitigation Plan</u> The most recent version of the MMG Rosebery Dust Mitigation Plan was issued in November 2020 (7 pages).

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1.3 description of the criteria used to identify the occurrence of dust events at either site in near real-time; 1.4 description of the response process to occur when dust events are identified at either site; 1.5 a table containing all of the major commitments made in The Plan; 1.6 an implementation timetable for key aspects of The Plan; and 1.7 a reporting program to regularly advise the Director of the results of implementation of The Plan.		The former March 2020 version of this plan was issued to the Tasmanian EPA to comply with relevant EPN conditions. It was stated that the March 2020 version is more relevant to current practices that exist across the operation (i.e. in comparison to the November 2020 version). Generally, MMG Rosebery were able to demonstrate that its 2020 Dust Mitigation Plan meets and describes the requirements defined in EPN Atmospheric Condition A6 1.1 to 1.7. It was stated that the November 2020 update of the MMG Rosebery Dust Mitigation Plan was issued with several other operational documents in support of securing approval for sub-aerial deposition of tailings at 2/5 dam. The current version of the plan describes expected practices based on sub-aerial deposition for the 2/5 dam being approved by EPA Tasmania. **Atmospheric Condition A6 – Dust Mitigation Plan - Observation No. 15 –** MMG Rosebery are encouraged to include a table in the next revision/update of its Dust Mitigation Plan that identifies how EPN Atmospheric Condition A6 1.1 to 1.7 is addressed in the plan (i.e. that clearly defines which sections of the revised plan meet each of the individual requirements specified in EPN Atmospheric Condition A6 – Dust Mitigation Plan – Sections 1.1 to 1.7).
Atmospheric Condition A6 – Dust Mitigation Plan 2 The Plan, as amended from time to time with the approval of the Director, must be implemented to the satisfaction of the Director.	**Compliant** **Observation** **Observation**	As defined above in EPN Atmospheric Condition A6 – Dust Mitigation Plan. Section 3 of the 2020 MMG Rosebery Dust Mitigation Plan broadly describes Dust Mitigation Measures implemented by MMG Rosebery, inclusive of three broad dust generating activities and eight related dust mitigation measures. **Atmospheric Condition A6 – Dust Management – Observation No. 16** – MMG could verify the requirement to have the current 2020 MMG Rosebery Dust Mitigation Plan formally approved by Director of EPA Tasmania. **Atmospheric Condition A6 – Dust Management – Observation No. 17** – MMG Rosebery's 2020 Dust Mitigation Plan could be describe in more detail the current specific mitigation measures used by the operation to reduce and control fugitive dust. It was stated that the proposed Stage 10 Bobadil embankment lift will significantly reduce the surface area of the dam. It was stated that during construction of this embankment lift, controls are able to be implemented to proactively minimise the generation of fugitive dust during construction activities. This is inclusive of the availability and use of sprinklers (Photo No. 12) and water carts.

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		 **Photo No. 12** – Operational sprinklers on the surface of the Bobadil TSF (16th December 2020)  **Photo No. 13** – High quality beaching of tailings was observed at 2/5 Dam that were not observed to be a source of fugitive dust (16th December 2020)

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		MMG Rosebery commissioned flocculant addition at the Bobadil dam in Q4 2019 (i.e. to facilitate the operation of the existing geotubes for the desilting of the Bobadil polishing ponds) (Photo No. 14).  **Photo No. 14** – Stainless steel flocculant tank in use at Bobadil (16th December 2020)

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Blasting		
Blasting Condition – B1 – Blasting Control Ground vibration due to blasting must not result in environmental nuisance occurring at any domestic residence or commercial activity in other occupation or ownership. Ground vibration management must be controlled by the combination of monitoring, at the location shown on Attachment 7 and for the parameters specified in Table 13 of Attachment 2.	**Compliant** **Observation** **Observation** **Observation**	MMG Rosebery continue to blast underground at a frequency of up to 14 times per week (6.45 – 7.00 am and 6.45 – 7.00 pm), inclusive of weekends. It was stated that at some point in the future, MMG Rosebery plan to change the location of the existing blast monitor, which continues to be located adjacent to the Rosebery Hospital. Discussions have been held with a specialist consultant relating to the purchase and use of a portable (i.e. roving) blast monitor, rather than continue to utilise the current fixed location monitor). It was stated that development blasting has been completed, with production blasting planned in the future. It was stated that if production blasting proceeds a roving blast monitor will be purchased and utilised (i.e. for risk mitigation). **Blasting Condition – B1 – Blasting Control – Observation No. 18 –** MMG Rosebery could verify if a baseline survey of the non-MMG owned houses is required, in the event that blasting commences underneath homes located in NE Rosebery (i.e. potentially located only 100 m below the surface). It was stated that the existing blast monitor, located adjacent to the Rosebery Hospital, is non-compliant with the over-pressures defined with in the relevant Australian Standard (i.e. as defined within the external June 2019 environmental monitoring audit). It was stated that an alternate location for the blast monitor exists in the main MMG Rosebery carpark, but some additional investigations are required prior to confirming the use of any planned alternate location. **Blasting Condition – B1 – Blasting Control – Observation No. 19** – MMG Rosebery are required to investigate a suitable alternate location for the fixed blast monitor by April 2021. Blast vibration data is currently being recorded at 15-minute intervals. It was stated that the blast vibration exceedances that have been recorded over the last 12 months continue to be a result of truck and vehicle traffic. Blast data continues to be downloaded at monthly intervals from the datalogger by ESD. **Blasting Condition – B1 – Blasting Control – Observation No. 20** – Given MMG Rosebery's recent audit finding stating that the existing blast monitor, located adjacent to the Rosebery Hospital, is non-compliant with the over-pressures defined with in the relevant Australian Standard, this needs to be prioritised and rectified, to ensure that representative data is always collected.

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		It was stated that no blast vibration or blast noise related complaints have been received by MMG Rosebery from residents in the last 16 months. MMG Rosebery's fixed blast vibration meter was last calibrated on the 31st August 2020 by Vipac in Port Melbourne (i.e. this service provider retains NATA Accreditation No. 1702, calibration No. 676). MMG Rosebery sourced a spare unit from a supplier in Launceston during August 2020 calibration period. No blasting was required at the Bobadil TSF site in the last 16 months. Blasting is scheduled to resume in 2021 at 2/5 Dam and at Bobadil.
Blasting Condition B2 – Blasting – Noise and Vibration Limits (a) Blasting on the land must be must be carried out in accordance with blasting best practice environmental management principles, and must be carried out such that, when measured at the curtilage of any residence (or other noise sensitive premises) in other occupation or ownership, air blast overpressure and ground vibration comply with the following criteria: (1.1) for 95% of blasts over a 12 month period, air blast overpressure must not exceed 115dB (Linear Peak); (1.2) air blast overpressure must not exceed 120dB (Linear Peak) at all; (1.3) for 95% of blasts over a 12 month period, ground vibration must not exceed 5mm/sec peak particle velocity (ppv); (1.4) ground vibration must not exceed 10mm ppv at any time; and (2) all measurements of air blast overpressure (Linear Peak) and peak particle velocity must be carried out in accordance with the methods set out in "Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration", Australian and New Zealand Environment Council, September 1990 or future revisions of this guideline.	**Compliant**	As of December 2020, blast vibration continues to be monitored at the boundary of the mining lease at a location adjacent to the Rosebery Hospital, utilising a Minimate Plus unit owned by MMG Rosebery. Blast and vibration monitoring data from this site continues to be downloaded at monthly intervals, with readings recorded at 15-minute intervals for peak particle velocity (mm/s) and peak linear sound pressure levels (dBL). This Minimate Plus unit is calibrated annually by a NATA accredited laboratory. MMG Rosebery's blast vibration data (i.e. for 2019/20) was most recently reviewed and interpreted by Tarkarri Engineering and presented in a report submitted to MMG Rosebery on the 9th September 2020. This report was included as an appendix to the 2019/20 AMRMR. In their September 2020 report, Tarkarri Engineering concluded that for the period 1st July 2019 and 30th June 2020: • the environmental noise monitoring data typically showed annual averages for the L_{Aeq}, L_{A90} and L_{A10} 15-minute levels at monitoring positions N1, N2, N3, N4 and N5 similar to those measured in the previous year except for Murchison Station which was on average 2 dB higher during the evening and night; and • ground vibration (GV) and air blast over pressure (ABO) data showed that levels recorded during blasting times at the mine were below the EPN limits.

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Schedule DC – Decommissioning and Rehabilitation		
Decommissioning and Rehabilitation Condition DC1 – Stockpiling of Surface Soil Prior to the commencement of extractive activities on any portion of The Land all surface soils must be removed and stockpiled for later use in rehabilitation of The Land. Topsoil must be kept separate from other overburden and protected from erosion or other disturbance.	**Compliant** **Observation** **Observation**	In the last 12 months, no topsoil stockpiles across MMG Rosebery have been removed, handled and/or relocated. It was stated that all MMG Rosebery's topsoil stockpiles were last surveyed on the 5th March 2019. It was stated that this survey was a baseline survey, inclusive of the 2/5 dam and Bobadil topsoil stockpiles. It was stated that not all topsoil stockpiles required surveying in March 2019. In addition to the 5th March 2019 survey, a Lidar survey was completed internally for the Karlson's Knob stockpile on the 11th March 2019. For the planned 10 ha cover trial for the Bobadil TSF, MMG Rosebery plan to trial and use a peat topsoil sourced from the moorlands, located to the east of the Bobadil TSF. The surveyed quantities of topsoil are retained in a formal MMG Rosebery Topsoil Stockpile register. This register includes 14 stockpiles, six that are located at Bobadil, six at 2/5 dam and two known additional historical topsoil stockpiles (i.e. located near Karson's Knob and the Northern Open Cut Area). **Decommissioning and Rehabilitation Condition DC1 – Stockpiling of Surface Soil - Observation No. 21 –** MMG Rosebery are encouraged to resurvey all topsoil stockpiles after April 2022, after the completion of current and planned earthworks at Bobadil and 2/5 Dam. **Decommissioning and Rehabilitation Condition DC1 – Stockpiling of Surface Soil - Observation No. 22** – Ideally, the MMG Rosebery Topsoil Stockpile register should be document controlled (or dated as a minimum) to enable its currency to be readily determined, inclusive of the dates of the last entry of any records). It was stated that hydromulch (not topsoil) was used to vegetate the TSF screening embankments at 2/5 dam. MMG Rosebery personnel also previously planted tube stock on the 2/5 visual screening wall in April 2019.
Decommissioning and Rehabilitation Condition DC2 – Notification of Cessation Within 30 days of becoming aware of any event of decision which is likely to give rise to the permanent cessation of the activity, the person responsible for the activity must notify the Director in writing of that event or decision. The notice must	**Not applicable in December 2020**	At the time of this December 2020 audit, mining operations at MMG Rosebery were not within 30 days of any decision that is likely to give rise to the permanent cessation of the activity. It was stated that as of mid-December 2020, the most recent determination for end-of-mine life at Rosebery was 2028, based on existing tailings capacity for a) Stage 2 at 2/5 Dam to 2024; b) Bobadil Stage 10 and c) the planned Marionoak TSF through until end of mine life (i.e. with a design footprint of up to 40 years storage).

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specify the date upon which the activity is expected to cease or has ceased.		
Decommissioning and Rehabilitation Condition DC3 – Mine Closure Plan 1 A Mine Closure Plan must be submitted for the Director's written approval, by 30 November 2011 and reviewed at least every five years thereafter to ensure it is consistent with MMG Rosebery Mine's current environmental liabilities. Such reviews may be incorporated with the 5 yearly EMP review;	**Compliant**	<u>Bobadil TSF Closure Plan (June 2016)</u> As of mid-December 2020, the current version of the Bobadil TSF Closure Plan was completed by Pitt and Sherry (i.e. with technical input from O'Kane Consultants) and submitted to MMG Rosebery on the 24th June 2016 (Rev 2). This plan is 183 pages in length and is limited to discussing the planned Bobadil Decommissioning and Closure process (i.e. not decommissioning and closure processes associated with the entire MMG Rosebery site). <u>Bobadil TSF Cover Trials</u> As of December 2020, the cover system design for the Stage 10 cover trial was approved. A 50 m stepped in area of the Bobadil TSF will be utilised over the next few years as the cover trial, enabling the data to confirm the proposed cover designs (or if changes are required to be made). It was stated that the current design of the cover trial has been accepted by the Tasmanian EPA.  **Photo No. 15** – Location of the cover trials to be completed on the Bobadil TSF (December 2020) <u>Closure Pre-feasibility Study (PFS)</u> It was stated that a Closure Pre-feasibility Study is scheduled to be completed in early 2022 to identify and evaluate closure options for the site.

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		Once complete, the Closure PFS will present the closure objectives for both Rosebery and South Hercules. The Closure PFS is being led by external consultants, Coffeys. It was stated that some minor delays were incurred in 2020 because of COVID. Once complete, a simplified version will be submitted to Tasmanian EPA. It was stated that this is required to be completed in late 2021 but is likely to be extended, as it was stated that it is impractical to attempt to develop/complete the updated Mine Closure Plan prior to the completion of the Closure PFS. <u>Liaison with the Tasmanian EPA</u> It was stated that the first meeting with the Tasmanian EPA, to discuss the Bobadil Extension Strategy and Bobadil TSF Closure Plan occurred on the 22nd June 2017 (i.e. inclusive of meeting minutes). During 2020, three meetings were held relating to closure and closure planning between MMG Rosebery and the Tasmanian EPA. Some additional operational and approval related meetings were also scheduled and held, with a number of these relating to the Bobadil Stage 10 embankment lift. It was stated that the closure of the Bobadil TSF is dependent on the completion of the No. 10 and possibly No. 11 planned embankment lifts. The current June 2016 Bobadil TSF Closure Plan does not incorporate the planned Bobadil TSF Lifts No. 10 and No. 11. It was stated that the planned construction completion dates for Bobadil Stage 10A is April 2021 and Stage 10B is October/November 2021. <u>MMG Rosebery Mine Closure Plan (May 2018)</u> The current MMG Rosebery Mine Closure Plan was last completed and issued in May 2018 (i.e. 106 pages inclusive of 7 appendices). This version of the Mine Closure Plan was submitted to EPA Tasmania on the 23rd May 2018 by MMG's Principal – Closure Planning. The Tasmanian EPA acknowledged receipt of the plan, even though no formal approval letter was provided by the EPA at the time. Specifically, on the 17th May 2018, MMG Rosebery submitted the following documents to EPA Tasmania: • Mine Closure Plan for the current disturbance at the MMG Rosebery operation; • Mine Closure Plan Addendum – Rehabilitation Cost Estimate; and • Rehabilitation Cost Estimate – MS Excel workbook.

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		As of the 15th December 2020, MMG Rosebery had not received any formal communication or response relating to the contents of the May 2018 MMG Rosebery Mine Closure Plan. MMG Rosebery included a table in the final version of the May 2018 MMG Rosebery Mine Closure Plan that enables the reader to cross-reference the sections of the plan that relate to specific conditions DC3 4 (4.1 – 4.14) defined in the EPN. A separate Level 3 conceptual Waste Rock Dump Closure Plan was also submitted to the Tasmanian EPA in May 2018. <u>MMG Rosebery Closure Bond</u> Written correspondence from Mineral Resources Tasmania (MRT) was received by MMG Rosebery on the 17th August 2018 relating to the Mine Closure Plan and Rehabilitation Bond Update. This is inclusive of the agreed requirement for the closure security deposit/bond to be increased from 17.1 million to 77.7 million by April 2021 (i.e. excluding costs associated with South Hercules or Hercules (Williamsford mine) site disturbance). It was stated that internal processes within MMG allowed for a phased incremental increase of the closure security deposit to 60 million through to December 2020. As of December 2020, the closure security deposit totalled 60 million and is expected to be suitably increased to 77 million by April 2021. The proposed MMG Rosebery security deposit payment schedule (through until the 1st April 2021) was previously communicated in writing to MRT and EPA Tasmania on the 24th August 2018. As of December 2020, no bond was in place or is currently required for Hercules or South Hercules, as this is a historical legacy site and not an ongoing operation. It was stated that as of the 15th December 2020, MMG Rosebery were able to demonstrate that the closure security bond of 77.7 million was in the process of being secured by April 2021, as required by Tasmanian regulators.
Decommissioning and Rehabilitation Condition DC3 – Mine Closure Plan 2 The Mine Closure Plan must be prepared in accordance with any guidelines issued by the Director, and with reference to the *Leading Practice Sustainable Development Program For The Mining Industry* series related to mine closure and completion developed by the Commonwealth Department of Resources Energy and	**Compliant**	<u>MMG Rosebery Mine Closure Plan (May 2018)</u> Section 3.1.2 of the May 2018 MMG Rosebery Mine Closure Plan states that the following guidelines were considered by the MMG Rosebery mine, in relation to mine closure planning and the development of the May 2018 Mine Closure Plan: • Decommissioning & Rehabilitation Plan (DRP). A guideline for the Tasmanian mining industry. Version 3 (EPA, 2011); • Strategic Framework for Mine Closure (ANZMEC and MCA, 2000);

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Tourism, any revisions or supplements to this series, and in accordance with the *Minerals Council of Australia Strategic Framework/or Mine Closure*;		• Leading Practice Sustainable Development Program for the Mining Industry (Australian Government Department of Industry, Innovation and Science, 2017); • Quarry Code of Practice (EPA, 2017); • Mineral Exploration Code of Practice (MRT, 2012); and • Cradle Coast Regional Weed Management Strategy (Cradle Coast Regional Weeds Advisory Group, 2010).
Decommissioning and Rehabilitation Condition DC3 – Mine Closure Plan 3 The Mine Closure Plan must include details of the financial provision for closure, determined in accordance with accepted accounting standards, and an itemised estimation of the probable costs of rehabilitation works; and	**Compliant**	On the 17th May 2018, MMG Rosebery submitted the following documents to EPA Tasmania: • Mine Closure Plan (May 2018) for the current disturbance at the MMG Rosebery operation; • Mine Closure Plan Addendum – Rehabilitation Cost Estimate; and • Rehabilitation Cost Estimate – MS Excel workbook. It was stated that as of December 2020, there had been no trigger to update the above during the audit period (i.e. where new disturbance may occur, such as a lift to 2/5 Dam). There is no additional significant disturbance planned for 2021. It was stated that the next potential modification to the MMG Rosebery security deposit/financial provision would be in relation to the potential Marionoak TSF (i.e. post 2021).
Decommissioning and Rehabilitation Condition DC3 – Mine Closure Plan 4 Unless otherwise approved in writing by the Director, the Mine Closure Plan must as a minimum include provision for: 4.1 removal of all plant, machinery or structures whether temporary or permanent, unless they are considered to be beneficial to the future use of the land and/or classified as mine heritage; 4.2 demolition and/or removal of all buildings, unless they are considered to be beneficial to the future use of The Land and/or classified as mine heritage, in accordance with permit requirements, safety requirements including the removal and appropriate disposal of waste building materials, including asbestos cladding, in accordance with the EMPC (Waste Management) Regulations 2000, or future revision of the regulations;	**Compliant**	As identified during the September 2018 and September 2019 EPN audits, Table 1 of the May 2018 MMG Rosebery Mine Closure Plan presents the relevant EPN Decommissioning and Rehabilitation conditions and provides a reference to the closure plan section where the required content is located. This includes: 1 A Mine Closure Plan must be submitted for the Director's written approval, by 30 November 2011 and reviewed at least every five years thereafter to ensure it is consistent with MMG Rosebery Mine's current environmental liabilities. Such reviews may be incorporated with the 5 yearly EMP review – Section 5.1.5 Mine Closure Plan Review; 2 The Mine Closure Plan must be prepared in accordance with any guidelines issued by the Director, and with reference to the Leading Practice Sustainable Development Program For The Mining Industry series related to the Closure and completion developed by the Commonwealth Department of Resources Energy and Tourism, any revisions or supplements to this series, and in accordance with the Minerals Council of Australia Strategic Framework for Mine Closure – Section 3.1.2 Local and International Guidelines;

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4.3 removal, treatment or appropriate disposal and remediation of remaining stockpiles of materials, including mine product (ore) located on the surface, waste rock and waste materials, including controlled wastes (e.g. chemicals, reagents, fuels and oils, explosives, radiation sources and PCBs in transformer oils), in accordance with the EMPC (Waste Management) Regulations 2000, or future revision of the regulations; 4.4 identification of remediation requirements, including the need for a site contamination survey; 4.5 making the portal entrance, the decline, ventilation shafts, and quarry wall slopes on The Land safe and stable; 4.6 erosion prevention works as may be specified in writing by the Director; 4.7 measures to mitigate the effects of mine water due to flooding of the mine; 4.8 final closure/remediation of all tailings and sediment collection dams; 4.9 measures to ensure maintenance of tailings dams (No.2, No.5 and Bobadil dams and the polishing pond), No.2 wetlands and discharge water quality; 4.10 revegetation of all disturbed areas including roads and hard stand areas to the satisfaction of the Director; 4.11 identification of opportunities for remediation works to be carried out, including a budget for those works, prior to cessation of operations; 4.12 identification of potential final land uses and required standards for mine closure and rehabilitation; 4.13 identification of the need for a monitoring and maintenance program following decommissioning and rehabilitation; and 4.14 any other detail requested in the Director.		3 The Mine Closure Plan must include details of the financial provision for closure, determined in accordance with accepted accounting standards, and an itemised estimation of the probable costs of rehabilitation works – Section 5.1.4 Closure Cost Estimate; 4 Unless otherwise approved in writing by the Director, the Mine Closure Plan must as a minimum include provision for: 4.1 removal of all plant, machinery or structures whether temporary or permanent, unless they are considered to be beneficial to the future use of the land and/or classified as mine heritage – Section 5.6.6 Infrastructure and Services 4.2 demolition and/or removal of all buildings, unless they are considered to be beneficial to the future use of The Land and/or classified as mine heritage, in accordance with permit requirements, safety requirements including the removal and appropriate disposal of waste building materials, including asbestos cladding, in accordance with the EMPC (Waste Management) Regulations 2000, or future revision of the regulations – Section 5.5.4 Hazardous Materials Management Plan and 5.6.6 Infrastructure and Services 4.3 removal, treatment or appropriate disposal and remediation of any remaining stockpiles of materials, including mine product (ore) located on the surface, waste rock and waste materials, including controlled wastes (e.g. chemicals, reagents, fuels and oils, explosives, radiation sources and PCBs in transformer oils), in accordance with the EMPC (Waste Management) Regulations 2000, or future revision of the regulations – Sections 5.5.4 Hazardous Materials Management Plan, 5.6.3 Waste Rock Dumps and 5.6.5 Run of Mine and Ore Stockpiles; 4.4 identification of remediation requirements, including the need for a site contamination survey – Sections 5.5.5 Contaminated Land Assessment Plan; 4.5 making the portal entrance, the decline, ventilation shafts, and quarry wall slopes on The Land safe and stable – Sections 5.6.1 Underground Workings and Associated Infrastructure and 5.6.4 Mining Pits and Quarries; 4.6 erosion prevention works as may be specified in writing by the Director – Sections 5.5.1 Rehabilitation Plan and 5.5.2 Water Management Plan; 4.7 measures to mitigate the effects of mine water due to flooding of the mine – Sections 5.5.2 Water Management Plan and 5.6.1 Underground Workings and Associated Infrastructure; 4.8 final closure / remediation of all tailings and sediment collection dams – Sections 5.6.2 Tailings Storage Facilities and 5.6.7 Water Management System;

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		4.9 measures to ensure maintenance of tailings dams (No.2, No.5 and Bobadil dams and the polishing pond), No.2 wetlands and discharge water quality – Sections 5.6.2 Tailings Storage Facilities; 4.10 revegetation of all disturbed areas including roads and hard stand areas to the satisfaction of the Director – Sections 5.5.1 Rehabilitation Plan; 4.11 identification of opportunities for remediation works to be carried out, including a budget for those works, prior to cessation of operations – Section 5.5.1 Rehabilitation Plan; 4.12 identification of potential final land uses and required standards for mine closure and rehabilitation – Section 3.2 Closure Framework and Relinquishment Pathway; 4.13 identification of the need for a monitoring and maintenance program following decommissioning and rehabilitation – Section 5.7 Post Closure Management; and 4.14 any other detail requested in writing by the Director – Not applicable.
Decommissioning and Rehabilitation Condition DC4 – Suspension of Activity 1. During temporary suspension of the activity: 1.1 The Land must be managed and monitored by the person responsible for the activity to ensure that emissions from The Land do not cause serious environmental harem material environmental harm or environmental nuisance; and 1.2 If required by the Director, the person responsible must prepare and implement a Care and Maintenance Plan to the satisfaction of the Director. 2. Unless otherwise approved in writing by the Director, if the activity on The Land has substantially ceased for 2 years or more, rehabilitation of The Land must be carried out in accordance with the requirements of these conditions as if the activity has permanently ceased.	**Not applicable in December 2020**	This EPN condition was not applicable in December 2020 as there has been no temporary or permanent suspension of mining activities at MMG Rosebery in the last 16 months (i.e. to the 14th December 2020).
Decommissioning and Rehabilitation Condition DC5 – Mine Rehabilitation	**Compliant**	<u>Rehabilitation (September 2019 to December 2020)</u> Very minimal progressive rehabilitation of operational areas occurred in the last 16 months.

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Rehabilitation works on the land must be carried out concurrently with the operational phase of the activity to the satisfaction of the Director.		Prior to the audit period, a project was initiated in 2018 in conjunction with EPA and MRT to close out minor legacy workings throughout ML 28M/1993. Closure work that was completed related to additional studies, inspections and some very minor works some legacy sites at both Rosebery and Hercules. It was stated that these were risk assessed with regards safety to the local community. It was stated to be a significant exercise to validate and inspect these sites, which was validated by MRT. It was stated that minimal progressive rehabilitation is scheduled to be completed in 2021 until the Closure PFS has been completed, to ensure that any planned rehabilitation is completed correctly. MMG Rosebery retain a budget of approximately 100k to progress some additional minor legacy sites in 2021. It was stated that the Zeehan site may receive some attention in 2021, but this would require approval from the Tasmanian EPA, but may be of lower priority. No EPN exists for this site. It was stated that the planned progressive rehabilitation (10ha) associated with the Bobadil TSF cover trails is scheduled to be fully installed and completed in April 2021. Approval has been secured from EPA Tasmania and seed mixes, lysimeters etc have been sourced. As of December 2020, MMG Rosebery continue to utilise an on-line GIS database for their legacy sites. In the last 12 months, the number of identified legacy sites increased from approximately 100 sites to 173 sites. It was stated that landforms that are scheduled to be progressively rehabilitated need to be, once completed, acceptable to the Tasmanian Parks and Wildlife and Sustainable Timbers (i.e. as future landholders). <u>Bobadil TSF Rehabilitation</u> A capping design for the Bobadil TSF was previously completed in 2016 by O'Kane consultants. The consultants recommended a store and release cover, inclusive of utilising an impervious lined barrier etc. Apart from the above design, no progressive or final rehabilitation trials or surface capping studies have been completed at the Bobadil TSF to date. There was evidence during this audit that the preparation work for these studies was progressing. Instrumentation for is scheduled to be installed in late January 2021.

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		During this December 2020 audit, successful natural rehabilitation of the quarry site at the Bobadil TSF was able to be demonstrated. Soil testing has been completed and a rehabilitation expert utilised in 2019 investigate and determine the reason for the rehabilitation success. <u>MMG Rosebery Site</u> Only minor areas of completed progressive rehabilitation currently exist around the MMG Rosebery site. As identified in previous EPN audit reports, there have been minimal opportunities available to conduct any progressive rehabilitation works at the MMG Rosebery site. As of December 2020, this position/situation had essentially not changed. <u>Hercules/South Hercules Rehabilitation</u> In the last 16 months, no physical rehabilitation work was completed at South Hercules. Relevant studies, investigations and data collection occurred in 2020. In addition, qquarterly meetings were held with the Tasmanian EPA relating to the Closure PFS (i.e. with meetings minutes retained by MMG Rosebery in Borealis). It was stated impounded water is still held in the South Hercules pit. As part of the 2021 budget, MMG Rosebery plan to pump out this water and refill the pit with suitable earthen/rock material (<500k). <u>Closure Expenditure</u> It was stated that approximately 2 million of expenditure occurred on closure studies during 2020 (i.e. 50/50 expenditure on Hercules and Rosebery). It was stated that may potentially increase to a 10 million expenditure, requiring approval by MMG ExCo and the Rosebery General Manager (i.e. the operation is waiting for board approval by MMG in China for the 2021 operational budget). If approved, expenditure in 2021 is likely to be 80% Rosebery and 20% Hercules. <u>Assay Creek Waste Rock Dump</u> The Assay Creek Waste Rock Dump (WRD) reached dumping capacity in early May 2014. The operation physically barricaded further access to this facility, to prevent overfilling the dump beyond design capacity. The Assay Creek waste dump partially contains Potentially Acid Forming (PAF) material. NAF material from the decline was placed on the Assay Creek WRD from 2008 – 2011 and then PAF material was placed over this. No changes have occurred at this facility in the last 16 months. No material has been reclaimed and transported underground, as this has been delayed to later phase of the mine life.

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		No further technical studies are planned for the Assay Creek WRD, as all waste rock stored within this dump is anticipated to be taken underground prior to final mine closure. It was stated that some initial soil testing investigations were completed in 2020, to determine the reason for some natural rehabilitation occurring on the surface of this waste rock dump. <u>Level 3 Waste Rock Dump</u> On the 13th February 2015, this storage facility was approved by the Tasmanian EPA for the storage of PAF waste rock, inclusive of the issuing of a separate EPN (i.e. EPN 8815/2). Until September 2016, waste rock previously hauled to the surface was placed in the 3 Level waste rock dump site. It was stated that no additional material has been dumped at this location in the last four years. No physical rehabilitation works were completed in the last 16 months (i.e. only the required six monthly audits of this facility). Closure planning for this facility is described in Table 14 - 3 Level Waste Rock Dump within the May 2018 Mine Closure Plan. A separate Concept Closure Plan for this facility was completed and issued on the 31st October 2018. This plan was developed by external consultants, Golder Associates. No feedback has been received from the Tasmanian EPA to date relating to this October 2018.
Decommissioning and Rehabilitation Condition DC5 – Mine Rehabilitation Unless otherwise approved in writing by the Director, rehabilitation of the land must be undertaken upon permanent cessation of the activity. Without limitation, rehabilitation works must include: 2.1 stabilisation of any land surfaces that may be subject to erosion; 2.2 removal or mitigation of all environmental hazards and land contamination that has the potential to cause environmental harm; and 2.3 decommissioning of any equipment that has not been sold.	**Not applicable in December 2020**	This EPN condition is not applicable until 2025 at the earliest.

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Decommissioning and Rehabilitation Condition DC5 – Mine Rehabilitation Where a Mine Closure Plan (MCP) or Decommissioning and Rehabilitation Plan (DRP) has been approved by the Director, rehabilitation must be carried out in accordance with the requirements of the MCP or DRP, whichever was approved most recently by the Director.	**Compliant**	As of December 2020, the MMG Rosebery 2018 Mine Closure had not formally approved in writing by the Tasmanian EPA. In addition, as of December 2020, no Decommissioning and Rehabilitation Plan (DRP) had been prepared for the MMG Rosebery site. The only exception to this was a historical DRP for the Bobadil TSF. It was stated that the earliest that a DRP will be developed for MMG Rosebery will be after the completion of the 2022 PFS and the planned Mine Closure Plan (i.e. at the earliest a DRP for MMG Rosebery will be issued is early 2024). This timeline will enable the DRP to be submitted to EPA Tasmania in Q1 2024. It was stated that a site wide End Land Use Plan will form the basis of the proposed MMG Rosebery Rehabilitation Plan. Progressive rehabilitation for some areas is planned to commence once relevant precincts become available prior to the end of the mine life. For most of the site however, rehabilitation will occur following the end of the mine life. As of September 2019, MMG Rosebery appointed one additional professional employee (Closure Study Lead) in a mine closure planning/pre-feasibility role (i.e. under an extended two-year contract). This role has responsibility for coordinating the completion of the PFS. <u>Assay Creek Waste Rock Dam (WRD)</u> It was stated that the Tasmanian EPA verbally communicated that the progressive rehabilitation of the Assay Creek WRD is required, but as of September 2019, MMG Rosebery have not formally committed to this activity. It was stated that MMG Rosebery are progressing the PFS which the site considers to be of a higher priority than the progressive rehabilitation of the Assay Creek WRD.
Decommissioning and Rehabilitation Condition DC5 – Mine Rehabilitation Unless otherwise approved by the Director, rehabilitated areas must be monitored and maintained for a period of at least three years after rehabilitation works have been substantially completed.	**Compliant**	As defined in Decommissioning and Rehabilitation Condition DC5 – Mine Rehabilitation within this audit report. Section 5.3.2 of 2019/20 MMG Rosebery's September 2020 AMRMR defines the status, as of this date, of progressive rehabilitation completed at the a) Hercules mine and b) the Bobadil Tailings Storage Facility (TSF). Monitoring of revegetation at the Hercules site was last completed in December 2017 and is next scheduled in December 2021.

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		As of September 2020, no monitoring had commenced of any completed progressive or final rehabilitation for the Bobadil TSF, but extensive monitoring programs are scheduled to commence in 2021 relating to the cover trials.
Decommissioning and Rehabilitation Condition DC5 – Mine Rehabilitation After the period referred to in the above sub-clause, the Person responsible for the activity may apply in writing to the Director for a written statement that rehabilitation has been successfully completed.	**Not applicable in December 2020**	This condition is not applicable in December 2020 given that no major rehabilitation works have been undertaken at the Rosebery mine to date.
Decommissioning and Rehabilitation Condition DC6 – Decommissioning and Rehabilitation Plan 1 Unless otherwise approved in writing by the Director, a Decommissioning and Rehabilitation Plan (DRP) must be submitted to the Director within 30 days of any decision that is likely to give rise to the permanent cessation of the activity.	**Not applicable until at least 2028**	At the time of this December 2020 audit, mining operations at MMG Rosebery were not within 30 days of any decision that is likely to give rise to the permanent cessation of mining activities.
Decommissioning and Rehabilitation Condition DC6 – Decommissioning and Rehabilitation Plan 2 The DRP must: 2.1 set out detailed prescriptions for carrying out the rehabilitation works identified in the most recent Mine Closure Plan approved by the Director; and 2.2 contain information as outlined with the document, 'Decommissioning and Rehabilitation Plan (DRP) - a guideline for the Tasmanian Mining Industry, version 1, May 2006' or any subsequent version of this document.	**Not applicable until at least 2024**	As of December 2020, no Decommissioning and Rehabilitation Plan (DRP) had been prepared for the MMG Rosebery site. The only exception to this was a historical DRP for the Bobadil TSF. It was stated that the earliest that a DRP will be developed for MMG Rosebery will be after the completion of the 2022 PFS and the planned Mine Closure Plan (i.e. at the earliest a DRP for MMG Rosebery will be issued is early 2024). This timeline will enable the DRP to be submitted to EPA Tasmania in Q1 2024.
Decommissioning and Rehabilitation Condition DC6 – Decommissioning and Rehabilitation Plan 3 The DRP must be prepared in accordance with any reasonable guidelines provided by the Director.	**Compliant**	Section 3.1.2 of the MMG Rosebery May 2018 Mine Closure Plan references the Tasmanian EPA (2011) Decommissioning & Rehabilitation Plan (DRP) - A guideline for the Tasmanian mining industry (Version 3. December 2011) as a key guideline considered by MMG Rosebery in relation to mine closure planning and the development of its May 2018 Mine Closure Plan.

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		The planned 2024 DRP is also expected be developed in accordance with relevant requirements specified in the Tasmanian Environment Protection Authority (EPA) (2011) Decommissioning & Rehabilitation Plan (DRP) - A guideline for the Tasmanian mining industry (Version 3. December 2011). The current mine life of the MMG Rosebery operation is 2028. MMG Rosebery acknowledged that in its preparation, the DRP is required to outline the full costs, the works schedule, approval requirements and post closure maintenance and monitoring. It is required to be inclusive of any stakeholder consultation commitments.

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Effluent Disposal		
Effluent Disposal Condition E1 – Nominated Discharge Locations Unless otherwise specified by the Director in writing, potentially contaminated wastewater must only be discharged from the land from the following nominated discharge points, as shown on Attachment 4 of this Notice: (a) Bobadil dam decant discharge to Lake Pieman (BO); and (b) No.2 Tailings Dam decant to Stitt River (WL1).	**Compliant**	As defined in EPN 7153/3, the only approved permanent water discharge point for MMG Rosebery continues to be the Bobadil dam decant discharge to Lake Pieman (BO). Weekly water quality sampling continues to be scheduled and conducted at this location. A spillway at the 2/5 dam was constructed in 2017/18 in the extremely unlikely event of any emergency overtopping occurring from the 2/5 dam. This was not utilised during the audit period. <u>2020 Discharge to the Stitt River</u> During a 13 week period in 2020, the Stitt River was approved as an authorised discharge point when unexpected liner repairs were required on the 2/5 Dam. Specifically, seam defects in the bituminous geo-membrane (BGM) liner, located on the eastern embankment of the 2/5 Dam Tailings Storage Facility required repair. To secure approval to conduct the above discharge for the nominated period, the operation submitted the following to the Tasmanian EPA for their approval: • MMG Rosebery PCE 9084 – Temporary Discharge from 2/5 Dam TSF to the Stitt River", dated 11th March 2020; and • Discharge Plan – Trigger Action Response Plan (TARP), dated 18th March 2020. An approval letter, dated 23rd March 2020, was received from the Tasmanian EPA. Specific conditions were incorporated into this approval, inclusive of the collation and submission of weekly update reports to the Tasmanian EPA, which occurred over a 13 week period.

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		 **Photo No. 16** – Location of the eastern embankment of the 2/5 Dam Tailings Storage Facility that required liner repairs (16th December 2020).
Effluent Disposal Condition E2 – Discharge Water Management Polluted water that will be discharged from the land must be collected and treated prior to discharge to the extent necessary to prevent serious or material environmental harm or environmental nuisance.	**Compliant** **Observation**	<u>Effluent Treatment Plant (ETP)</u> The MMG Rosebery Effluent Treatment Plant (ETP) was originally constructed and commissioned in the 1970s. A dedicated team of trained and competent operators (and Shift Supervisor) from the mill continue to operate the ETP 24/7. This is maintained and overseen by MMG Rosebery's Mill Maintenance Team. In the last 16 months, it was stated that no incidents occurred at the ETP which required reporting to the Tasmanian EPA.

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		 **Photo No. 17** – MMG Rosebery ETP (December 2020) <u>Filter Plant</u> One environmental incident occurred at the MMG Rosebery filter plant in the last 16 months. This involved one accidental release of stormwater to the environment that coincided with a high rainfall event between the 18th and 22nd August 2019. The event resulted in a spill of water from the Filter Plant Cell #2 that contained copper and lead in excess of the 95th percentile investigative values and zinc in excess of the discharge limit at BO. This event was reported to the EPA and a summary report was provided in September 2019.

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		 **Photo No. 18** – MMG Rosebery Filter Plant (December 2020) <u>4 Level Surge Pond</u> No incidents occurred at the 4 Level Surge Pond in the last 16 months. <u>8 Level Surge Pond</u> No incidents occurred at the 8 Level Surge Pond in the last 16 months. The Level 8 surge pond continues to be utilised as required during periods of mill shutdown and during high rainfall events. This surge pond facility includes a functional level sensor, which continuously displays pond levels in the mill control room. This facility has never overtopped since its construction.

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		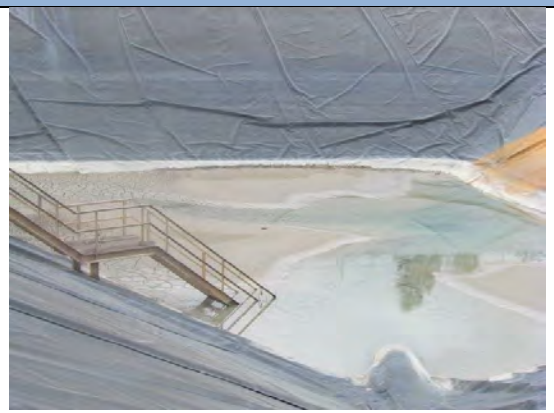 **Photo No. 19** – Level 8 Surge Pond (16th December 2020) <u>Polishing Ponds (Bobadil)</u> As of December 2020, the Bobadil Polishing Ponds were in the process of being desilted. Desilting operations commenced in January 2020 and is expected to be completed by mid-2021. Settled material from these ponds is being deposited in Geo-tubes located on the surface of the Bobadil TSF. 

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		Photo No. 20 – Geo-tubes in use at the Bobadil TSF (16th December 2020) Water quality samples taken during this project identified no detrimental reduction in water quality at the Bobadil outfall as a result of the ongoing desludging activities (i.e. no evidence of reduced water quality within the polishing ponds from remobilising suspended sediment/sludge from the base of these ponds). MMG Rosebery processing personnel continue to conduct daily inspections of the Bobadil TSF and 2/5 Dam. <u>2/5 Dam</u> No incidents occurred in the last 16 months from 2/5 Dam that had the potential to cause serious or material environmental harm or environmental nuisance MMG Rosebery secured approval from EPA Tasmania on the 23rd March 2020 for the temporary discharge from the 2/5 Dam TSF to the Stitt River in order to repair seam defects in the bituminous geomembrane (BGM) liner, located on the eastern embankment of the 2/5 Dam TSF. Approval was only granted for a fixed period during the liner repairs (i.e. over a 13 week period, requiring the preparation of weekly progress reports).  **Photo No. 21** – Location of the 2/5 sump adjacent to the Murchison Highway (16th December 2020) **Effluent Disposal Condition E2 – Discharge Water Management - Observation No. 23** – The 2/5 sump adjacent to the Murchison Highway should be formally placed on a regular maintenance

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		schedule, to remove settled sediment (i.e. to prevent this facility becoming blocked and overtopping). *Auditors Note – The status of compliance with conditions of PCE 9084 relating to 2/5 dam have not been included in the scope of this December 2020 EPN audit report (i.e. PCE 9084 was not audited in December 2020).*
Effluent Disposal Condition E2 – Discharge Water Management All stormwater runoff from areas on the land, (including haul roads, and hard standing areas), and contaminated areas (e.g. Mill and mine processing areas, ROM pad, fuel refilling station) which is subject to contamination due to disturbance by the activity, must be collected by means of diversion drains, catch drains, settlement ponds or detention ponds and delivered to the effluent treatment plant for treatment to remove sediment, metals, oil and grease or discoloration prior to discharge to Lake Pieman via the Bobadil dam decant.	**Compliant**	All potential or actual contaminated stormwater runoff, site drainage and the outflows from the 4 Level and 8 Level surge ponds continue to be directed to the site Effluent Treatment Plant (ETP). The operation continues to utilise significant quantities of lime to treat/improve water quality (i.e. to increase pH levels for metal reduction). Any discharges from the 3 Level WRD to the 4 Level storm surge pond continue to be directed to the ETP for treatment. The 8 Level surge pond remains double lined with a storage capacity of approximately 8,000 m^3. The 4 Level surge pond has 1,000 m^3 capacity to service a small on-site catchment. Suitable v-notch weirs on clean water diversion drains are utilised for both flow monitoring and water quality sampling, primarily at 3 Level. In September 2020, Technical Advice on Water summarised the stormwater flows across MMG Rosebery to comprise: • all flow in upper Filter Plant Creek (FPC1 and FPC2) and Primrose Creek (PC1 and PC2) is collected and directed to the ETP for treatment. Site FPC3 is located downstream of the Filter Plant ponds and collects predominantly runoff from the residential area, including inflows from historic waste rock located around the residential area. Filter Plant Creek ultimately enters Lake Pieman in the flooded arm of the Stitt River; and • water diverted away from the 4L WRD area by Assay Creek is discharged from site and enters the Stitt River between Rosebery Creek and Stitt Falls. Water that has come in contact with the WRD area is collected and directed to the ETP for treatment and discharge via Bobadil.
Effluent Disposal Condition E2 – Discharge Water Management Uncontaminated stormwater must, as a minimum standard, be monitored at the locations specified in columns 1 and 2 of	**Compliant**	<u>Stormwater Management and Treatment</u> A major unlined diversion drain continues to be utilised around the MMG mine/mill area to facilitate the diversion of clean/uncontaminated water around the site. This drainage system restricts the volume of uncontaminated water directed into areas of contaminated drainage (i.e. that would otherwise enter the footprint of the operation and require treatment within the ETP).

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Table 9 of Attachment 2 and for the parameters specified in column 3 of Attachment 2 of this Notice.		The 3 Level waste dump has been utilised for the storage of PAF material sourced from underground. It was stated that no additional waste rock material is scheduled to be transported to the surface and placed within this facility in the future. For the 150,000 m^3 of material that was previously placed in this location up until September 2016, layers of limestone were utilised to increase the neutralising capacity of the 3 Level WRD. <u>Stormwater Monitoring</u> Stormwater monitoring is conducted at a) two water quality monitoring sites on Assay Creek (upstream and downstream); b) three sites on Filter Plant Creek (cell 1, cell 2 and off-site location); c) four sites on Rosebery Creek and d) two sites on Primrose Creek. These locations are sampled on a quarterly frequency by personnel from ES&D when field and climatic conditions allow. In September 2020, Technical Advice on Water summarised the stormwater monitoring that was completed during the audit period, stating that: • all sites were monitored for the required parameters at the required frequency; • during the year there was one accidental release of stormwater to the environment that coincided with a high rainfall event between the 18th and 22nd of August 2019. The event resulted in a spill of water from the Filter Plant Cell #2 that contained copper and lead in excess of the 95th percentile investigative values and zinc in excess of the discharge limit at BO. This event was reported to the EPA and a summary report was provided in September 2019; and • due to improvements in storm water management the water monitored at sites FPC1, FPC2 and PC1 and PC2 do not enter the environment, so do not reflect runoff from the MMG operation. The data from samples collected at these locations is retained in ESdat hosted cloud-based server. External service providers, Entura continue to monitor water flows at select telemetry monitoring sites around the operation at quarterly intervals.
Effluent Disposal Condition E3 - Water Quality Monitoring Program of the Stitt River and Lake Pieman An annual biological survey and ambient water quality monitoring program of the Stitt River and Lake Pieman must be undertaken in accordance with columns 1 to 4 of Table 6	**Compliant** **Observation**	<u>Aquatic Biological Surveys (2019/2020)</u> Since 2004, biannual aquatic biological surveys continue to be scheduled and completed by Hobart based external consultants, Freshwater Biomonitoring Consulting Service on the Stitt River and Ring River. These were most recently completed in spring 2019 and autumn 2020, involving seasonal sampling events for macroinvertebrates and fish. The report “Biological Condition of the

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of Attachment 2 and columns 1 to 6 of Table 7 of Attachment 2 to document on-going environmental conditions, increase the understanding of temporal, spatial and seasonal biological and chemical changes within the lake, and progress the development of site specific toxicity guidelines for sulphate and zinc in Lake Pieman.		Ring and Stitt Rivers: Spring 2019 and Autumn 2020" by SA Mallick was issued to MMG Rosebery in April 2020. In April 2020, key conclusions determined by the consultants included: • the Ring River remains in a severely degraded condition; • diversity and abundance in the Ring River remain severely depressed downstream of Williamsford, • both Bakers and Dolcoath Creeks remain in a highly degraded condition; • the primary reason for poor condition of river fauna communities in the Ring River continues to be pollution from the Hercules mine area; • overall, the Stitt River is in a better ecological condition than the Ring River; • the results of the present survey confirm an ongoing improvement in the condition of the lower Stitt River. This improvement is now apparent at all three sites in the Stitt River downstream of the 2/5 tailings storage facility (TSF), with all three downstream sites now supporting a range of clean-water macroinvertebrate taxa; and • two of the three downstream sites (S3 and S4) now also support an apparently self-sustaining population of brown trout. The primary aims of this biannual monitoring continue to a) describe the status of macroinvertebrate and fish assemblages in the Ring and Stitt Rivers and b) evaluate changes over time and relate these to environmental conditions (especially habitat and water quality) and management actions associated with the MMG mine operations. <u>Annual Aquatic Biological Surveys (2019/20)</u> Annual aquatic biological surveys (i.e. annual survey of shore biota) in Lake Pieman are also scheduled and completed by the same consultants. The most recent Lake Pieman Bobadil discharge zone biomonitoring field work was completed in October 2020. As of mid-December 2020, this report was in draft and expected to be issued by the consultants in January 2021. Sampling was conducted at 15 sites along the eastern shore zone of the lake on the 16th October 2019 and the results presented in a report issued in November 2019. The next annual survey is scheduled to be completed in October/November 2021 with the survey report to be completed and submitted in January 2022. This biological monitoring program continues to assess the ecological status of the area in Lake Pieman influenced by the discharge from the MMG Rosebery mine Bobadil settling pond facility.

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		Effluent Disposal Condition E3 - Water Quality Monitoring Program of the Stitt River and Lake Pieman - Observation No. 24 – Neither the existing program of a) biannual aquatic biological surveys on the Stitt River and Ring River or the b) Lake Pieman Bobadil Discharge Zone Biomonitoring completed by external consultants, Freshwater Biomonitoring Consulting Service incorporate the development of site-specific toxicity guidelines for sulphate and zinc in Lake Pieman (i.e. as required by this EPN Condition). If not applicable, or unable to be achieved, this EPN condition could be changed/updated to reflect what is required.
Effluent Disposal Condition E4 – Water Quality Unless otherwise approved in writing by the Director, water quality monitoring must take place at the locations, frequencies and for the parameters specified in the site discharge and ambient water quality monitoring program committed to in Tables 3 and 4 and Tables 5-11 of Attachment 2 of this Notice and at the locations indicated on Attachments 3-5.	**Compliant**	MMG Rosebery continue to demonstrate that water quality monitoring is scheduled and conducted at the locations, frequencies and for the parameters specified in the site discharge and ambient water quality monitoring program committed to in EPN Tables 3 and 4 and Tables 5-11 of EPN Attachment 2 and at the locations indicated on EPN Attachments 3 – 5. The most recent 2019/20 Rosebery Water Quality Review of collected data was completed by Dr Lois Koehnken from Technical Advice on Water. The review report was submitted to MMG Rosebery on the 2nd September 2020 and was included as an appendix in the September 2020 AMRMR. The 2019/20 MMG Rosebery Water Quality Review from Technical Advice on Water included a formal review of water monitoring results from a) Bobadil Tailings Storage Facility Discharge; b) Internal Bobadil TSF Monitoring (BI and BF); c) Bobadil TSF Seeps; d) Bobadil TSF Groundwater Monitoring; e) 2 and 5 Dam Monitoring Results; f) Stitt River upstream of 2 and 5 Dam; g) Hercules Monitoring; h) Stormwater monitoring; i) Underground Mine Water Monitoring; k) Lake Pieman Monitoring; l) Review of Sampling Procedures and QA/QC of water quality monitoring; m) 3 Level Waste Rock Dump and n) South Hercules Mine – Phase 1. <u>Compliance with EPN Discharge Limits – Water (2019/20)</u> In the MMG Rosebery Water Quality Monitoring Review 2019/2020, Technical Advice in Water (2nd September 2020) summarised compliance with EPN Discharge Limits to be: • rainfall during the 2019 to 2020 monitoring year was above average, with 2,261 mm recorded at the Bobadil rain gauge compared with the long-term average of 2,224 mm. Maximum discharge from BO coincided with a period of high rainfall in August 2019. During this period pH levels in the TSF declined, recording pH values <6.5 with a minimum hourly aggregated reading of 6.2 at 8pm on 20th August 2019. The weekly sample collected earlier in the day on 20th August had a field pH of 10.3 and a lab pH of 8.73. An additional sample collected on 21 August had a lab pH of 6.73, consistent with the continuous pH readings increasing from <6.5 over the previous 24 hours.

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		• The 20th August weekly sample contained a total zinc concentration of 1.4 mg/L (filtered = 1.1 mg/L), exceeding the EPN discharge limit of 1.0 mg/L. The same sample had elevated concentrations of total manganese (5.7 mg/L), but did not exceed the discharge criteria. • This event was reported to the Tasmanian EPA and a review of the incident was submitted to the EPA on 19th September 2019. Contributing factors to the elevated discharge included high rainfall, reduced capacity in the Bobadil TSF and short-circuiting between the cells in the polishing pond system due to an accumulation of sludges. • All metals except the one zinc value were below the EPN discharge limit in the compliance monitoring samples during the year. The low metal concentrations are attributable to the maintenance of the pH in the TSF at values consistently above pH 8.5. Similar to previous years, laboratory pH values are lower than in-situ measurements suggesting that the pH declined in the samples following collection. This decline does not affect metal concentrations as the metals have already been removed and captured in the TSF. • All other parameters were within the discharge criteria except for the following: – EC values in March 2020 exceeded the 2,000 us/cm EPN limit. On 10th March, the field EC results were 2,051 us/cm and the lab result was 2,060 us/cm. During the same day the continuous readings ranged from 1,590 to 1,638 us/cm. From 7pm on 13th March to 1 pm on the 15th March the continuous probe recorded values over 2,000 us/cm, ranging from 2,004 to 2,082 us/cm. The elevated EC values did not coincide with elevated sulphate levels, but rather reflect higher than usual calcium and carbonate concentrations. Alkalinity in the BO discharge during March ranged from 117 mg/L to 177 mg/L, considerably higher than the average of 35 or median of 21 mg/L for the year. This event was reported to the EPA. – Total suspended solids: The field duplicate for TSS collected on 3 December 2019 was 217 mg/L which is substantially above the discharge limit of 50 mg/L. The compliance sample had a concentration of <5 mg/L. The laboratory has investigated the duplicate result and indicated it may be a laboratory error as all other duplicate results were similar to the compliance sample. – Total Petroleum Hydrocarbons: Five TPH results, based on the sum of C_{10} – C_{40} values, were above the EPN discharge limit of 0.05 mg/L. These exceedances were reported to the EPA and an investigation was conducted that demonstrated that the elevated values were false positives attributable to interference from a milling reagent, Magnafloc 1011. The investigation found that after a silica gel clean-up of the sample prior to analysis by

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		gas chromatography, the TPH values were below the EPN limit. MMG submitted a report summarising the investigations to the EPA on 14th April 2020. <u>Comparison with EPN Investigation Trigger Levels (2019/20)</u> In the MMG Rosebery Water Quality Monitoring Review 2019/2020, Technical Advice in Water (2nd September 2020) summarised comparison with EPN Investigation Trigger Levels to be: • EC was the only parameter for which the 95th percentile investigative level was exceeded for the 2019-2020 monitoring year. The field and laboratory 95th percentile values were 1710 us/cm and 1854 us/cm, which exceeded the 1,700 us/cm target. The 95th percentile value of the continuous recording results was 1,594 us/cm. • There was a discrepancy between lab, field and continuous EC values collected on the same day. This may be due to different instruments, or could indicate the continued dissolution of carbonates or other compounds in the BO discharge between collection and laboratory analysis of the sample. In the first half of the monitoring year the field EC values were generally higher than the continuous results, but during the second half of the year there was better agreement between the two data sets. • During the monitoring year, the rolling 95th percentile of the preceding 12-month data set for total nitrogen exceeded the investigative trigger value and MMG submitted reports describing the conditions in December 2019 and Jan 2020. • The 95th percentile value for TN over the 2019-2020 monitoring set is 5.36 mg/L if all samples (compliance and field duplicates) are included, and 5.54 mg/L if only the weekly compliance samples are included. MMG undertook an internal investigation to identify the likely cause for the elevated concentrations and identified underground explosives and hydrated lime as potential sources, with the concentrations exacerbated by prolonged periods of low rainfall. • In 2018 – 2019 three Total CN concentrations exceeded the 95th percentile trigger value, but in 2019-2020 the 95th percentile value of Total Cyanide was 0.0089 mg/L, well below the trigger level of 0.1 mg/L.
Effluent Disposal Condition E4 – Water Quality The water quality monitoring program specified in Attachment 2 (Tables 5-11) must be reviewed in accordance with the requirements of Condition G7 (2.6) of this Notice. Implementation of the monitoring program and or any subsequently amended program, must be implemented for a	**Compliant** **Observation**	External service providers, ES&D continue to be contracted by MMG Rosebery to conduct water quality monitoring in accordance with a) a predefined schedule specifying the locations, frequencies and parameters to be monitored and b) requirements specified in the operation's August 2018 procedures for surface water and groundwater monitoring, which still reflect current and required practice in December 2020.

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5-year period, with a review of the results, any identified impacts on the Pieman and Stitt River receiving environments and any further recommended amendments to the program to be included in the five yearly EMP reviews.		It was stated that no changes were required to the ES&D contract or contractual arrangements in the last 16 months. During the 2019/20 audit period, improvements to MMG Rosebery's water quality monitoring program included: • increasing the competency assessments of ES&D staff responsible for monitoring and collecting samples; and • actioning recommendations/omissions defined in annual review reports received from Technical Services in Water. The program is inclusive of scheduled water quality monitoring at a) Lake Pieman at five locations on a quarterly frequency; b) the Stitt River on a weekly frequency and c) monthly monitoring of the decommissioned Hercules Mine at Bakers Creek, above the Ring River. Additional water quality monitoring sites were recommended by Technical Services in Water in December 2020 (i.e. within Lake Pieman and monitoring within specific creeks entering Lake Pieman). In December 2020, ESdat continued to be utilised for the retention of water chemistry, groundwater level and quality data, HiVol air sampling and all associated laboratory data (i.e. except for time-series/logger data). Daily task sheets are required to be completed by personnel from ES&D (i.e. using a tablet in the field) to record completed monitoring/sampling. Monthly monitoring schedules are completed for the following month by ES&D and verified by MMG Rosebery. Water quality monitoring data, trend analysis and interpretation continue to be reported annually in the MMG Rosebery AMRMR, inclusive of comparisons made against relevant limits specified in the EPN. Both chemical and biological monitoring is incorporated into the monitoring program for a significant number of years, to generate a statistically robust dataset. If any samples are not collected in accordance with the agreed monitoring schedule, this is detailed in the AMRMR (i.e. mainly defining missing water quality parameters by ALS, rather than failing to collect a scheduled sample). **Effluent Disposal Condition E4 – Water Quality - Observation No. 25 –** Additional commentary /interpretation could be provided by Technical Advice on Water in their annual water quality review reports relating to any "identified impacts" on the Pieman and Stitt River receiving environments (i.e. this could be included in a) Section 7 - Table 7-1. Summary of monitoring results from the Stitt River and b) Section 11 - Table 11-1. Summary of monitoring results from Lake Pieman).

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Effluent Disposal Condition E5 – Groundwater Monitoring 1 Unless otherwise approved in writing by the Director, groundwater quality monitoring must: 1.1 take place at the locations, frequencies and for the parameters specified in the groundwater monitoring program committed to in Table 11 of Attachment 2 and Location Plans shown on Attachment 5.	**Compliant**	As of September 2019, MMG Rosebery's external service provider ES&D continue to monitor approximately 60 groundwater monitoring bores (including those installed and utilised at the 2/5 dam and new bores at Bobadil) at six monthly intervals. This sampling is typically scheduled for April and October each year (i.e. for 50 compliance bores only). A total of 10 additional groundwater monitoring bores were installed around the Bobadil TSF/polishing ponds in 2020, which are sampled at monthly intervals.  **Photo No. 22** – Recently installed 2020 groundwater bores at the Bobadil TSF (December 2020) The 2020 monitoring of groundwater bores across the operation was completed using low flow sampling in both April/May and in October/November 2020. It was stated that groundwater monitoring scheduled at six monthly intervals typically requires a sampling period of up to 6 weeks, given that low flow sampling methods continue to be utilised. Each six-monthly groundwater sampling campaign includes relevant field duplicates (i.e. inclusive of 3 duplicates from the 50 groundwater monitoring bores sampled). With some minor exceptions in 2019/20, MMG Rosebery were able demonstrate that they sample/monitor the required groundwater locations, frequencies and for the parameters specified in EPN Table 11 of Attachment 2. Groundwater quality data continues to be reviewed annually in July/August by "Technical Advice on Water". These annual review reports are provided to MMG Rosebery and included as an appendix to MMG Rosebery's AMRMR.

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Effluent Disposal Condition E5 – Groundwater Monitoring 1.2 Monitor the level of groundwater contamination (mass load of pollutants), due to seepages from the Bobadil, No. 2, No. 5 and rehabilitated No. 1 tailings storage facilities (TSFs) on the Stitt River and Lake Pieman. Monitoring results must be reported in the Annual Monitoring Review and Management Report.	**Compliant** **Observation**	Groundwater monitoring continues to be scheduled and completed at six monthly intervals as described in EPN Schedule E - General Conditions E5 – Groundwater Monitoring. Monthly monitoring of the recently installed Bobadil TSF bores progressed in 2020. A brief review, analysis and interpretation of the results for groundwater bores at a) the Bobadil TSF; b) the 2/5 Dam and c) the 3 Level Waste Rock Dump was completed by "Technical Advice on Water" for groundwater monitoring for the period 2019/20. <u>Bobadil TSF Groundwater Bore Monitoring (2019/20)</u> The August 2020 Annual Water Quality Review report from Technical Advice on Water concluded the following for 2019/20 for the Bobadil TSF groundwater bores: • the pH in GB4 increased in April 2020 relative to the previous two monitoring periods. In general, pH in GB4 and in the surface (S) sample of GB6, 7, and 8 were lower than in the deeper sample, which may reflect the ingress of naturally acidic surface waters into the shallow aquifers; • the same bores (GB4, GB6S, 7S, and 8S) generally have higher concentrations of zinc, manganese and sulphate as compared to the deeper bores; • GB9 and GB8D showed large decreases in acidity relative to the previous monitoring period. This may reflect higher alkalinity addition to the TSF in March. The results from bore GB9 should be treated with caution as it is difficult to sample owing to the water level being lower than the screen level. The groundwater network at Bobadil is being reviewed and compromised bores are being re-drilled and re-established; • zinc concentrations in Bore GB9 decreased relative to the 2018/2019 monitoring year when the highest values at this site were recorded; • Bore GB7, located between the dam and Lake Pieman continues to record the highest total zinc levels. • the groundwater results show there are substantial differences between shallow and deeper groundwater. The shallow aquifer, which is likely composed of glacial till, appears to be hydraulically connected to the dam, with elevated zinc, manganese and sulphate. <u>2/5 Dam Groundwater Bore Monitoring (2019/20)</u> The August 2020 Annual Water Quality Review report from Technical Advice on Water concluded the following for 2019/20 for the 2/5 dam groundwater bores:

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		• Similar to previous years the groundwater results vary on different sides of the TSF and reflect regional groundwater flow combined with impacts from historic and present operations; • GB23H, located near the western embankment continues to record relatively low pH and the highest zinc and sulphate concentrations. This is consistent with the bore intersecting water that is similar in composition to the seepage being discharged along the Murchison Highway; • the lowest concentrations of sulphate and zinc are found in bores GB21H, GB15, GB16 and GB14 which are located either upslope or away from the TSF and reflect more local groundwater conditions; and • all TPH and BTEX values were below the LoR except in bore GB14S where toluene was 0.012 mg/L and 0.01 mg/L in November 2019 and April 2020, respectively. GB14 is located at the toe of the northern embankment and the source of the hydrocarbons is unknown. <u>2/5 Dam Groundwater Bore Monitoring (2019/20)</u> The August 2020 Annual Water Quality Review report from Technical Advice on Water discussed the results of 2/5 Dam Groundwater Bore Monitoring for 2019/20. This relates to EPN 8815/2 and is therefore outside of the scope of this audit report. <u>Monthly Groundwater Field Data</u> Monthly groundwater field data (e.g. phreatic surface, seeps etc.) continues to be collected by personnel from ATC Williams. **Effluent Disposal Condition E5 – Groundwater Monitoring - Observation No. 26 –** For ease of understanding and interpretation, the column headings in MMG Rosebery's FD Tracker could be made clearer (i.e. define in the column headings if the dates relate to either scheduled or completed monitoring, as this is not clear).

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Hazardous Substances		
Hazardous Substances Condition H1 – Storage and Handling of Hazardous Substances Unless otherwise specified by the Director in writing, all environmental hazardous materials, including all chemicals, fuels, and oils held on The Land in volumes exceeding 250 litres must be stored and handled in accordance with the following: 1.1 any storage facility must be contained within a spill collection bund with a net capacity of whichever is the greater of the following: 1.1.1 at least 110% of the combined volume of any interconnected vessels within that bund; or 1.1.2 at least 110% of the volume of the largest storage vessel; or 1.1.3 at least 25% of the total volume of all vessels store in that spill collection bund; or 1.1.4 the capacity of the largest tank plus the output of any firewater system over a twenty-minute period. 1.2 All activities that involve a significant risk of spillages, including the loading and unloading of bulk materials, must take place in a bunded containment area or on a transport loading apron. 1.3 Bunded containment areas and transport vehicle loading aprons must: 1.3.1 be made of materials that are impervious to any environmentally hazardous material stored within that bund; 1.3.2 be graded or drained to a sump to allow recovery of liquids;	**Compliant** **Observation** **Observation** ***Also as per Schedule 3 – Legal Obligations - Condition L03 – Storage and Handling of Dangerous Goods and Dangerous Substances***	It was stated that in the last 16 months, no major chemical spillages or major changes to chemical storage practices/use has occurred (i.e. requiring notification to the Tasmanian EPA). The bulk fuels and chemicals that are stored in bulk storage tanks on site include a) diesel, b) waste oil and c) cyanide. Most of MMG Rosebery's processing reagents continue to be stored in bunded 1000L IBC containers within the mill reagent storage shed. In 2020, compliance with chemical storage and management practices remained the responsibility of the individual area owners across the operation. In late 2019, MMG Rosebery's Metallurgist Superintendent was formally appointed as the site Chemical Controller. MMG Rosebery Chemical Representative (x9) were also suitably trained in November 2020 using the on-line training package for Chemalert 5.0 from RMT (i.e. over a 12 hour period). The training certificates were issued in December 2020 by Chemalert. Finally, discussions have commenced relating to the internal appointment of a trained employee to conduct a 6-to-8-week audit against specific requirements defined in Chemalert. This individual is still to be appointed and the audit approved for completion in 2021. <u>2019 MMG Rosebery Dangerous Goods Audit</u> A Dangerous Goods Storage Audit was completed, and a report prepared, by external consultant, Environmental Initiatives in June 2019, with the audit report issued in August 2019. This June 2019 audit identified a range of improvements required to improve compliance against relevant Australian Standards and Tasmanian Guidelines. A total of eight grouped actions from this audit were entered into IEM in mid-2019 for formal actioning and close-out. It was stated that some MMG Departments have also progressed and closed out audit actions not utilising IEM. In addition, it was stated that the Site Chemical Controller commissioned some additional investigations to clarify the detail relating to some of the June 2019 audit findings. In addition to the above, some operational improvements were also progressed in 2020. In the absence of installing an oil/water separator underground, it was stated that monitoring of mine water is occurring monthly for TPH (i.e. three TPH fractions) at 8 Level adit (i.e. before the mine water enters the ETP). As of December 2020, average mine water flows are approximately 80

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1.3.3 be chemically resistant to the environmentally hazardous substances stored or transferred; 1.3.4 be designed and managed such that any leakage or spillage is contained within the bunded area (including where such leakage emanates vertically higher than the bund wall; 1.3.5 be designed and managed such that the transfer of materials is adequately controlled by valves, pumps and meters and other equipment wherever practical. The equipment must be adequately protected (for example, with bollards) and contained in an area designed to permit recovery of any released chemicals. 1.3.6 be designed such that chemicals which may react dangerously if they were to come into contact have measures in place to prevent mixing; and 1.3.7 be managed such that the capacity of the bund is maintained at all times (e.g. by regular inspections and removal of obstructions).		L/sec, which is discharged to the ETP and mixed with mill water, filter plant water and return decant water.  **Photo No. 23** - Mine dewatering at the 8 Level adit (December 2020) <u>Chemalert</u> MMG Rosebery's Chemalert licence (i.e. site licence) remains current and the on-line version of Chemalert remains accessible to all site personnel with a MMG computer log in. MMG Rosebery's Site Chemical Controller remains the key custodian for the management and maintenance of Chemalert. <u>Chemical Risk Assessments</u> It was stated that RMT plan to develop a site specific New Chemical Substances Form for the MMG Rosebery site (i.e. within Chemalert). A "New Chemical Substances Form" is currently stored and accessible from the MMG Library. The MMG Rosebery "New Chemical Risk Assessment Form" is available and required to be completed for all new chemicals requested by site personnel. As part of the workflow, MMG Rosebery environment personnel are required to be included in the review process for the purchase/use of a new chemical. **Hazardous Substances Condition H1 – Storage and Handling of Hazardous Substances - Observation No. 27** – Given MMG Rosebery's current access and use of Chemalert, MMG

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		Rosebery's New Chemical Substances Form should be the version that is currently available in the Chemalert workflow (i.e. not a separate or modified version). **Hazardous Substances Condition H1 – Storage and Handling of Hazardous Substances - Observation No. 28 –** MMG Rosebery could ensure that their December 2020 procedure for Hazards Material Management (i.e. that was drafted from a MMG corporate procedure) is site specific and relevant to required practices at the MMG Rosebery site.
Hazardous Substances Condition H2 – Hazardous Materials (< 250 Litres) Unless approved in writing by the Director, each environmentally hazardous material including chemicals, fuels and oils held on The Land in discrete volumes not exceeding 250 litres but not including discrete volumes of 25 litres or less, must, as far as practical and to reasonable satisfaction of the Director, be located within bunded areas or spill trays which are designed to contain at least 110% of the volume of the largest container.	**Compliant**	See Hazardous Substances Condition H1 – Storage and Handling of Hazardous Substances. The Dangerous Goods Storage Audit that was completed, and a report prepared, by Environmental Initiatives in August 2019 reviewed and assessed the status of secondary containment of on-site environmentally hazardous materials. Upgrades and improvements to chemical storage facilities and practices across MMG Rosebery in the last 16 months included: • some minor improvements based on the recommendations defined in the June 2019 audit; • some minor roof repairs in relevant areas; and • the reagent mixing shed was reviewed and assessed by an external consultant, relating to specific compliance requirements. In addition, only minor quantities of chemicals, lubricant and diesel continue to be stored underground, inclusive of explosive/detonation products held in the underground magazine.
Hazardous Substances Condition H3 – Spill Kits Spill kits appropriate for the types and volumes of materials handled on the land, must be kept in appropriate locations to assist with containment of spilt environmentally hazardous materials.	**Compliant**	Spill kits continue to be available across the operation and primarily include a) numerous 240L spill kits and b) two jumbo spill kits. These were observed to be suitably stocked and are available as needed.

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		 **Photo No. 24** – Example of jumbo spill kit near the chemical reagent shed (December 2020) MMG Rosebery's warehouse retains adequate stocks of spill kit contents, which are replaced as needed. The availability and maintenance of spill kits was stated to be the responsibility of area owners (i.e. to ensure that these are correctly maintained and sufficiently stocked). Relevant mining personnel are responsible for managing the availability and restocking of spill kits underground. It was stated that only minor spills have occurred across the operation and underground in the last 16 months, inclusive of some minor diesel spills in 2019/20 that required the use of some stocks from these kits. It was stated that the on-site MMG Rosebery MDG and off-site Veolia vacuum truck remain available for any major spill clean-up, which was not required for any spill or emergency situation in the last 16 months.
Hazardous Substances Condition H4 – Inventory of Hazardous Materials An inventory must be kept of all environmentally hazardous materials stored and handled on the land. The inventory must specify:	**Compliant**	MMG Rosebery's inventory of hazardous substances continues to be retained by MMG Rosebery warehouse personnel in SAP (i.e. as a requirement of chemical stock management/inventories). It was stated that this inventory is not linked to or managed in Chemalert. As of December 2020, MMG Rosebery also utilise and maintain Chemalert version 5.0.0.349 (Oracle).

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- the location of the storage facilities; - the maximum quantities of each environmentally hazardous material likely to be kept in storage; and - must include Safety Data Sheets for those environmentally hazardous materials.		Relevant aspects of MMG Rosebery's Chemalert system were audited during the recent June 2019 Dangerous Goods audit. All the SDS's for the site are held and generated by Chemalert. MMG Rosebery Area Chemical Representatives and Supervisors are responsible for reissuing and maintaining updated hard copy SDSs in relevant areas across the site.

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Monitoring		
Monitoring Condition M1 – Dealing with Samples Obtained for Monitoring Any sample or measurement required to be obtained under these conditions must be obtained in accordance with the following: 1.1 samples must be tested in a laboratory accredited by the National Association of Testing Authorities (NATA), or a laboratory approved in writing by the Director, for the specified test, 1.2 measurements must be made and samples must be collected and analysed in accordance with relevant Australian Standards, NATA approved methods, the "American Public Health Association Standard Methods for the Analysis of Water and Waste Water" or other standards approved in writing by the Director 1.3 noise measurements must be taken in accordance with the Tasmanian Noise Measurement Procedures Manual; 1.4 results of measurements and analysis of samples and details of methods employed in taking measurements and samples must be retained for at least three years after the date of collection; and 1.5 samples and measurements must be obtained and transported by a person with appropriate training and experience.	**Compliant**	<u>External Laboratory Analysis</u> Since the 1st January 2015, the majority of MMG Rosebery's environmental monitoring samples have been submitted to and analysed by an external commercial laboratory, ALS in Melbourne (or potentially in any of ALS's Sydney, Newcastle or Brisbane environmental laboratories). ALS remain accredited by the National Association of Testing Authorities (NATA) for all chemical and biological tests that are requested by MMG Rosebery for their EPN compliance monitoring program. <u>Contracted Environmental Monitoring Services</u> Routine environmental monitoring and sampling services required by MMG Rosebery continue to be contracted (annually) to Environmental Services and Design (ES&D) for an average of 6 to 8 days a fortnight. It was stated that up to three ES&D personnel are being utilised for environmental monitoring at MMG Rosebery (i.e. three stated to be suitably trained and competent, with two of these personnel tertiary qualified). ES&D is responsible for the following environmental monitoring tasks in accordance with an agreed MMG Rosebery environmental monitoring schedule: • sampling approximately 50 groundwater monitoring bores six monthly in April and October each year; • sampling approximately 10 additional groundwater monitoring bores monthly (i.e. recently installed around the Bobadil TSF); • weekly and monthly surface water monitoring; • daily and weekly monitoring of water quality in the Bobadil polishing ponds during the 2020 dredging of settled sediment within these ponds (with results reviewed by an external specialist); dredging commenced in early 2020 and is continuing in December 2020. Monitoring program was approved by the EPA (see letter) – See USB. • collection of ambient monitoring data from HiVols, Dustracks and dust deposition gauges; • ambient noise monitoring; • blast vibration monitoring (monthly downloads); and

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		• meteorological station monitoring (automatic telemetry downloads). Additional responsibilities of ES&D personnel include monitoring data uploading and management, trend analysis, reporting, data quality checks etc. It was stated that in 2019/20 MMG Rosebery's environmental monitoring and analytical budgets were similar to the previous budget in 2018/19. ES&D continue to utilise MMG Rosebery's environmental monitoring equipment and monitoring procedures. For the main routine environmental monitoring program, these procedures were last updated in August 2018 by both site and ES&D personnel. It was stated that MMG Rosebery's Surface and Groundwater Monitoring Procedure is scheduled to be reviewed in 2021. At weekly intervals, ESD utilise a formal Environmental Monitoring Quality Assurance and Quality Control Checklist to verify the correct continuation of all environmental monitoring programs. The pH and EC meters at the Bobadil Outfall continue to be maintained by MMG Rosebery electricians. The routine calibration of these instruments is scheduled internally, and records retained. MMG Rosebery flow monitoring and related instrument maintenance/servicing continues to be conducted at quarterly intervals by external service providers, Entura. Continuous flow monitoring data continues to be collected and transferred by telemetry for the operation from a) Rosebery Creek (above Still River); b) Bobadil Outfall; c) Bakers Creek; d) Ring River and e) the Williamsford settling pond to Entura's offices in Hobart. Additional closure related flow monitoring sites were also installed in 2019/20. ESdat continues to be utilised for MMG Rosebery's environmental monitoring database, incorporating environmental data collected at the operation since 1992. <u>Bobadil Polishing Pond Desludging (2020/21)</u> Tasmanian EPA approval for the removal of accumulated metal hydroxide sludges from the Bobadil Polishing Ponds was secured in writing on the 26th November 2019. As of December 2020, the removal of settled sludge from the Bobadil TSF polishing ponds was continuing. Desludging of the ponds utilised dredging and dewatering of dredged material via geotextile containment technology.

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		This project is being closely monitored, inclusive of the monitoring and review of water quality data from the Bobadil outfall (i.e. to ensure that no deterioration in water quality occurs during desludging operations). 2/5 Dam Environmental monitoring activities associated with 2/5 dam are not included in the scope of EPN 7153/3, but under the scope of PCE9084.
Monitoring Condition M2 – Reporting of Monitoring Results Unless otherwise approved in writing by the Director, the results of monitoring specified in Tables 3 and 4 and Tables 5-11 of Attachment 2 must be reported quarterly to the Director and submitted no later than 30 days after the end of the monitoring period.	**Compliant**	To comply with relevant statutory obligations, MMG Rosebery complete a data download from ESdat and collate the required quarterly report. This quarterly report is provided to EPA Tasmania in MS Excel format. No interpretative commentary is provided with these quarterly environmental monitoring data reports, which is forwarded to the Tasmanian DPIPWE EPA Division Data Analyst for uploading to their database. The dates that these quarterly reports were submitted to the Tasmanian EPA in the last 12 months included a) 29th October 2019; b) 21st January 2020; c) 27th April 2020; d) 22nd July 2020 and e) 22nd October 2020. MMG Rosebery were able to demonstrate that this information/data is being submitted to the Tasmanian EPA within the required 30 days of the end of each quarter, as specified in Condition M2 of the EPN. The next scheduled submission of a quarterly report is 30th January 2021 (i.e., for Q4 2020).
Monitoring Condition M3 – Monitoring Audit Once every 5 years an external monitoring audit must be undertaken. The audit needs to assess compliance in relation to conditions M1 and M2 of this Notice and whether the current monitoring program is adequately measuring the discharge water quality from The Land. The audit report must be incorporated into the next 5 yearly EMP Review due in 2016.	**Compliant** **Observation**	MMG Rosebery Environmental/Water Quality Monitoring Audit (April 2018) MMG Rosebery engaged Environmental Initiatives (TAS) to conduct an on-site environmental monitoring audit from the 9th and 12th of April 2018 (i.e. as required by EPN Condition M3. This audit focused on EPN Condition M1 (i.e. Table 1). A report for this environmental monitoring audit was received by MMG Rosebery on the 7th May 2018, identifying six non-conformances and five opportunities for improvement. It was stated that these were formally entered into IEM for actioning and close-out. The audit report was previously presented to EPA Tasmania as Appendix I in the September 2018 AMRMR. The above audit met the requirements of EPN Condition M3 – 5 yearly Monitoring Audit. It was stated that the completion of this audit would next be scheduled in early 2021 (i.e. to allow MMG

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		Rosebery to align with the next scheduled EMP review). This will be scheduled for March/April 2021. **Monitoring Condition M3 – Monitoring Audit - Observation No. 29** – The updated 2019/2020 QA/QC program for water quality monitoring could be included for independent review as part of the scope of the proposed early 2021 Environmental Monitoring Audit (i.e. potentially as a brief desk-top review, prior to the commencement of the on-site audit). In addition to the above April 2018 monitoring audit, two former water quality monitoring audits were completed in October 2011 and September 2016 by Technical Advice in Water. It is recognised that Technical Advice in Water continue to conduct an annual water quality review for MMG Rosebery (for the preceding 12 months of collected water quality data), which is submitted annually to the Tasmanian EPA as an appendix to the AMRMR.
Monitoring Condition M4 – Discharge Limits and Investigation Trigger Levels for Bobadil Tailings Pond to the Pieman River 1 Monitoring of the Bobadil Tailings Dam end-of-pipe discharge must be completed weekly, with results summarised and reported to the Director quarterly. 2 The concentrations in effluent of parameters listed in Column I of Table 3 must comply with the limits specified in Column 3 and Column 4 of Table 3 at the point at which it is discharged into the Pieman River when measured in the units specified in Column 2 of Table 3. 3 If the concentration of effluent of parameter listed in Column I of Table 3 do not comply with levels specified in Column 5 of Table 3 (Investigation Trigger Level) at the point at which it is discharged to the Pieman River when measured in the units specified in Column 2 of Table 3, then, an investigation into the possible reason for the exceedance must be conducted and a report summarising the outcomes of all such investigations submitted to the Director in MMG Rosebery Mine's Annual Monitoring Review and Management Report in compliance with Condition G7:	**Minor Non-compliance**	MMG Rosebery's external contractor ES&D continues to collect water samples of the Bobadil Outfall discharge on a weekly frequency. <u>Compliance with EPN Discharge Limits (2019/20)</u> A comparison of the 2019/20 Bobadil outfall monitoring results with EPN maximum limits (i.e. discharge and trigger limits) was completed in September 2020 by external consultant, Technical Advice on Water. The consultant concluded in their 2nd September 2020 report: • Rainfall during the 2019 to 2020 monitoring year was above average, with 2,261 mm recorded at the Bobadil rain gauge compared with the long-term average of 2,224 mm (1911 – 2018 at Renison Bell, Tasmania). Maximum discharge from BO coincided with a period of high rainfall in August 2019. During this period pH levels in the TSF declined, with the continuous pH meter recording pH values <6.5 with a minimum hourly aggregated reading of 6.2 at 8pm on 20 August 2019. The weekly sample collected earlier in the day on 20 August had a field pH of 10.3 and a lab pH of 8.73. An additional sample collected on 21 August had a lab pH of 6.73, consistent with the continuous pH readings increasing from<6.5 over the previous 24 hours. • The 20th August weekly sample contained a total zinc concentration of 1.4 mg/L (filtered = 1.1 mg/L), exceeding the EPN discharge limit of 1.0 mg/L. The same sample had elevated concentrations of total manganese (5.7 mg/L) but did not exceed the discharge criteria. • This event was reported to the EPA and a review of the incident was submitted to the EPA on 19th September 2019. Contributing factors to the elevated discharge included high rainfall, reduced capacity in the Bobadil TSF and short-circuiting between the cells in the polishing

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		pond system due to an accumulation of sludges. Remedial actions have included dredging the ponds and cleaning and repairing stormwater drains. • All metals except the one zinc value were below the EPN discharge limit in the compliance monitoring samples during the year. The low metal concentrations are attributable to the maintenance of the pH in the TSF at values consistently above pH 8.5. Similar to previous years, laboratory pH values are lower than in-situ measurements suggesting that the pH declined in the samples following collection. This decline does not affect metal concentrations as the metals have already been removed and captured in the TSF. • All other parameters were within the discharge criteria except for the following: – EC values in March 2020 exceeded the 2,000 uS/cm EPN limit. – On 10th March, the field EC results was 2,051 uS/cm and the lab result was 2,060 uS/cm. During the same day the continuous readings ranged from 1,590 to 1,638 uS/cm. From 7pm on March 13 to 1 pm on March 15 the continuous probe recorded values over 2,000 uS/cm, ranging from 2,004 to 2,082 uS/cm. The elevated EC values did not coincide with elevated sulphate levels, but rather reflect higher than usual calcium and carbonate concentrations. Alkalinity in the BO discharge during March ranged from 117 mg/L to 177 mg/L, considerably higher than the average of 35 or median of 21 mg/L for the year. This event was reported to the EPA. – Total suspended solids: The field duplicate for TSS collected on 3rd December 2019 was 217 mg/L which is substantially above the discharge limit of 50 mg/L. The compliance sample had a concentration of <5 mg/L. The laboratory has investigated the duplicate result and indicated it may be a laboratory error as all other duplicate results were similar to the compliance sample. – TPH: Five TPH results, based on the sum of C_{10} – C_{40} values, were above the EPN discharge limit of 0.05 mg/L. These exceedances were reported to the EPA and an investigation was conducted that demonstrated that the elevated values were false positives attributable to interference from a milling reagent. The investigation found that after a silica gel clean-up of the sample prior to analysis by gas chromatography, the TPH values were below the EPN limit. The milling reagent Magnafloc 1011 was identified as the likely source of the false positives. MMG submitted a report summarising the investigations to the EPA on 14 April 2020.

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		Comparison with EPN Investigation Trigger Levels (2019/20) A comparison of the 2019/20 Bobadil outfall monitoring results with EPN Investigation Trigger Levels (i.e. discharge and trigger limits) was completed in September 2020 by external consultant, Technical Advice on Water. The consultant concluded in their 2nd September 2020 report: • Electrical conductivity was the only parameter for which the 95th percentile investigative level was exceeded for the 2019-2020 monitoring year. The field and laboratory 95th percentile values were 1710 uS/cm and 1854 uS/cm, which exceeded the 1,700 uS/cm target. The 95th percentile value of the continuous recording results was 1,594 uS/cm. • There is a discrepancy between lab, field and continuous EC values collected on the same day. This may be due to different instruments, or could indicate the continued dissolution of carbonates or other compounds in the BO discharge between collection and laboratory analysis of the sample. In the first half of the monitoring year the field EC values were generally higher than the continuous results, but during the second half of the year there was better agreement between the two data sets. • During the monitoring year, the rolling 95th percentile of the preceding 12-month data set for total nitrogen exceeded the investigative trigger value and MMG submitted reports describing the conditions in December 19 and January 20. • The 95th percentile value for TN over the 2019-2020 monitoring set is 5.36 mg/L if all samples (compliance and field duplicates) are included, and 5.54 mg/L if only the weekly compliance samples are included. MMG undertook an internal investigation to identify the likely cause for the elevated concentrations. The company identified underground explosives and hydrated lime as potential sources, with the concentrations exacerbated by prolonged periods of low rainfall. • In 2018 – 2019 three Total CN concentrations exceeded the 95th percentile trigger value, but in 2019-2020 the 95th percentile value of Total CN was 0.0089 mg/L, well below the trigger level of 0.1 mg/L. **Monitoring Condition M4 – Discharge Limits and Investigation Trigger Levels for Bobadil Tailings Pond to the Pieman River – Minor Non-compliance No. 1** – Isolated exceedances in effluent discharge limits defined in the EPN 7153/3 occurred in 2019/20. None of these exceedances were of a magnitude or duration to have a potential or actual adverse environmental impact on the receiving waters of the Pieman River.

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Monitoring Condition M5 – Discharge Limits for No. 2 Tailings Dam to the Stitt River 1 Unless otherwise approved in writing by the Director, the discharge from the No.2 Tailings Dam can be directly discharged into the Stitt River when the following conditions are achieved: 1.1 the flow rate in the Stitt River is 100 times or greater than the dam discharge flow rate (using automatic flow monitoring); 1.2 for the purpose of demonstrating compliance with 1.1 above, the person responsible must continuously measure and record the flowrate of the Stitt River; and 1.3 the concentrations in effluent of parameters listed in column 1 of table 4 must comply with the limits specified in column 3 and column 4 of table 4, at the point at which it is discharged into the Stitt River when measured in the units specified in column 2 of Table 4.	**Not applicable in December 2020**	This EPN condition was superseded with the construction, commissioning and use of MMG Rosebery's 2/5 dam (i.e. this condition was no longer applicable in December 2020).

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Noise Control		
Noise Condition N1 – Continuous Noise Monitoring Unless otherwise approved in writing by the Director: 1.1 Noise emissions from the activity must be monitored applying the MMG Rosebery Mine (MMGRM) continuous monitoring program, at the locations specified in Table 13 of Attachment 2 and locations shown on Attachment 7, based on equivalent continuous (Leq) and L10 and L90 A-weighted sound pressure levels measured over a period of 15 minutes or an alternative time interval specified by the Director. 1.2 noise level measurements must be taken in the presence of ambient noise normally existent in the area; 1.3 measured noise levels are to be adjusted for tonality and impulsiveness in accordance with the Tasmanian Noise Measurement Procedures Manual 2004, or any future revisions of this manual, issued by the Director. 1.4 all methods of measurement must be in accordance with the Tasmanian Noise Measurement Procedures Manual 2004; 1.5 noise from the activity must not cause an environmental nuisance, at any domestic residence or commercial activity in other ownership; 1.6 an indicator of whether environmental noise nuisance has occurred will be based on the record of any noise complaints received by MMG Rosebery Mine; and 1.7 If a noise complaint is received, the person responsible must.: 1.7.1 address the complaint including the use of appropriate dispute resolution if required; or if necessary; and	**Compliant** **Observation** **Observation** **Observation**	MMG Rosebery's Air, Vibration and Noise Management Plan – Revision 2 was last issued on the 31st March 2017. As of December 2020, this version of the plan was under revision. The above management plan is supported by MMG Rosebery's Noise and Vibration Procedure – Revision 4 last issued on the 18th March 2015. This version of the plan is under revision. **Noise Condition N1 – Continuous Noise Monitoring Observation No. 30** – MMG Rosebery are encouraged to final the review and updating of their a) Air, Vibration and Noise Management Plan (March 2017) and b) Noise and Vibration Procedure (March 2015) given the extended period since these documents were last reviewed and updated and to ensure that the plan and supporting procedure remain current and reflect current/required operating practices. Noise Monitoring (2019/20) Noise and vibration data for the 2019/20 FY identified that the annual averages for the L_{Aeq}, L_{A90} and L_{A10} 15-minute levels at monitoring positions N1, N2, N3, N4 and N5 were similar to the previous 2018/19 reporting period for all monitoring locations, except for Murchison Station which averaged 2 dB higher during evening and night periods. All ground vibration monitoring results for 2019/20 FY identified that all levels recorded during blasting times at the mine were below the EPN limits. Air blast overpressure monitoring results for 2019/20 FY identified a few occasions during blasting times at the mine which were above the EPN limits. However, these exceedances are not likely to be breaches of the EPN conditions with levels likely controlled by gusty weather conditions and or precipitation. It was stated that there have been no changes to the operation's noise monitoring program in the last 16 months. Annual Noise Monitoring Review (2019/20) The MMG Rosebery mine Environmental noise, ground vibration and air blast overpressure annual monitoring data review (2019-2020) were completed in September 2020 by external noise specialist Tarkarri Engineering Pty Ltd (Tarkarri). **Noise Condition N1 – Continuous Noise Monitoring - Observation No. 31** - External noise specialist Tarkarri Engineering Pty Ltd provided several valid recommendations in their September 2020 annual review report relating to a) adjusting the recorded noise monitoring intervals; b) the potential installation of directional noise monitoring systems where practicable (i.e. allowing for

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1.7.2 implement noise abatement measures so that nuisance noise emissions from the activity do not result in ongoing environmental nuisance occurring 1.8 Results of the continuous noise monitoring program and noise related complaints must be reported in the Annual Monitoring Review and Management Report.		operational noise from the mine to be differentiated from ambient noise sources in the area; c) remote access connection to the noise monitors is considered by the mine and d) improved measures to minimise the loss of data and inconsistencies in the data records. Given the recent extension to the mine life for the operation, these recommendations should be planned, budgeted and implemented (i.e. given that noise monitoring will be required for the remaining years of operation and during mine closure and rehabilitation). To meet the requirements defined in Schedule B – Conditions N1 – Continuous Noise Monitoring, MMG Rosebery: 1.1 were able to demonstrate that pre-existing noise monitoring sites continue to be used in 2019/20 in accordance with the monitoring sites listed in Table 13 – Noise and Vibration Monitoring of the EPN. The five permanent noise monitoring locations utilised are located at a) N1 – Police House; b) N2 – Cohen Street; c) N3 - Clemons Street; d) N4 - Alec Street and e) N5 - Murchison Street. At these locations, noise monitoring data is collected continuously and converted to 15-minute intervals (i.e. held as CSV/Excel format). It was stated that a total of seven Ngara noise measurement units currently exist. For the last 24 months, five units remain operational in the field and two calibrated spare units are available as required (i.e. when existing units are being calibrated or erroneous data is detected). When required, noise loggers are replaced for calibration and/or repair. Annual noise data reviews (from continuously installed noise recording instrumentation at five locations) is conducted by an independent noise consultant, Tarkarri Engineering. The most recent 2019/20 review report was submitted to MMG Rosebery on the 9th September 2020. From 2014 to 2020 contracted personnel (i.e. ES&D) responsible for noise monitoring conduct weekly downloads of noise data from the five installed Ngara noise monitoring units (i.e. to minimise the risk of any potential data loss). It was stated that MMG Rosebery are considering the potential live streaming of this data in 2021 (i.e. this will require a LTE/communication upgrade to occur). 1.2 Noise measurements are completed at these locations on a continuous basis, in the presence of ambient noise, that typically occurs in these areas. All five noise monitoring stations utilise the same instrumentation, with data being recorded at 15-minute average intervals.

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		The five environmental noise monitoring stations are in general accordance with requirements of section 4 and section 5.2 of the Tasmanian Noise Measurement Procedures Manual (July 2008). 1.3 Noise is measured in accordance with the updated MMG Rosebery Noise and Vibration Monitoring Procedure (Version 4 March 2015). 1.4 As for sections 1.2 and 1.3 above. 1.5, 1.6 and 1.7 – MMG Rosebery received only two noise complaints during the 2019/20 audit period on the: a) 3rd December 2019 relating to nuisance noise from the ROM, 3L and/or 4L areas, which upon initial investigation the likely cause was excessive use of the mobile and pedestal rock breakers; and b) 4th February 2020, which was an ongoing noise complaint that was reviewed and assessed by a specialist noise consultant to understand the noise source and provide short, mid and long-term abatement measures. Immediate actions conducted by the operation included; weekly meetings with the complainant, reduced use of the mobile rock breaker and reduced hours of operation of the pedestal rock breaker between the hours of 0700 and 2100. Long term abatement measures are progressing through the design phases. 1.7 If any noise complaints are received by MMG Rosebery, these continue to be entered into Borealis (as of December 2020) and Incident Event Management System (IEMS) for formal investigation and actioning. Proactive investigation and follow-up of external noise complaints was able to be demonstrated by MMG Rosebery, with corrective actions being identified and implemented to address the source/root cause of valid noise complaints. 1.8 Results of the Continuous Noise Monitoring Program were last collated and formally reviewed by a noise consultant, Tarkarri Engineering for the period 1st July 2019 to 30th June 2020. This was included in the report titled "MMG – Rosebery mine environmental noise, ground vibration and air blast overpressure annual monitoring data review 2019/2020." dated 9th September 2020. This report was submitted to EPA Tasmania in Appendix D of the 2019/20 AMRMR. The results from the three yearly MMG Rosebery noise monitoring survey, last completed in September 2018 (i.e. report issued 22nd October 2018), was submitted to EPA Tasmania on the 9th January 2019.

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		Noise Condition N1 – Continuous Noise Monitoring - Observation No. 32 – In 2021, MMG Rosebery are encouraged to consider the purchase (or long-term hire) of a new blast monitor given that a) no spare blast monitor is retained on site and b) the blast monitor is 10 years old.
Noise Condition N2 – Noise Survey Requirements Unless otherwise approved in writing by the Director, a noise characterisation and modeling survey must be carried out and reported: 1.1 by 30 November 2011; 1.2 at such other times as may reasonably be required by the Director; and 1.3 recurrently, with no longer than 3 years since the previous survey.	**Compliant**	2008, 2011, 2015 and 2018 - 3 Yearly Noise Surveys The most recent noise survey completed across MMG Rosebery was conducted between the 23rd and 25th September 2018 by Tarkarri Engineering and a final survey report was submitted to MMG Rosebery by the consultant on the 22nd October 2018 and EPA Tasmania on the 9th January 2019. As identified in the previous EPN audit report, a total of nine noise measurement locations were utilised during this September 2018 noise survey (inclusive of one control site). The results of this September 2018 three yearly noise survey indicated: a) At noise sensitive measurement positions 1 and 2 the noise environment was controlled by emissions from the MMG Filter Plant and Train Loading area. At the remaining noise sensitive positions, the day noise environment was controlled by local noise sources external to the MMG operations, typically traffic noise. During the evening and night, as local ambient noise decreased, sources from the MMG Concentrator and Portal areas of the mine and the MMG Southern Upcast Fan were audible. b) Where the noise environment was controlled by noise emissions from MMG operations or MMG operational noise was a significant component of the environment, LAeq,10min levels adjusted for intrusive characteristics, typically complied with environmental indicator levels provided in The Tasmanian Environment Protection Policy (Noise) 2009. The exception is at position 2 where measured noise level were controlled by noise emissions from the Filter Plant and Train Loading area. The dominant component of the noise emissions from this area of MMG's operations is a tone in the 100 Hz 1/3-octave band (109 Hz narrow band). It was stated that the next three yearly noise survey will potentially be scheduled between July to September 2021 (i.e. three years after the most recent September 2018 survey). It was stated that this will include a full update of the MMG Rosebery noise model.
Noise Condition N3 – Noise Survey Methodology and Reporting Requirements Prior to undertaking a noise survey as required by these conditions, a proposed noise survey methodology must be submitted to the Director for approval.	**Compliant**	The required noise survey methodology was defined in a Technical Memo received from Tarkarri Engineering dated 26th July 2018. An email with the attached 26th July 2018 methodology was forwarded to EPA Tasmania on the 15th August 2018 to secure approval for the noise survey methodology to be utilised in September 2018.

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		It was stated that no approval letter/email was received from EPA Tasmanian verifying agreement and approval of the submitted three yearly noise survey methodology to be used in September 2018 by Tarkarri Engineering. Section 7.1.1 of the January 2019 noise survey report states that "Under the site EPN an environmental noise survey is required on a tri-annual basis and the survey methodology requirements under the EPN call for a 10-minute measurement interval (condition N3 3.3.). Tarkarri Engineering recommended that loggers at the 5 monitoring locations are changed to record 10-minute intervals rather the current 15-minute intervals to bring survey and unobserved monitoring data in line. Approval for this change should be sought from Director of the EPA as per condition N1 1.1 of the mine's EPN".
Noise Condition N3 – Noise Survey Methodology and Reporting Requirements Without limitation, the survey methodology must address the following: 2.1 measurements must be carried out at day, evening, and night times (where applicable) at each location; and 2.2 measurement locations and the number thereof, must be specified, with one location established as a control location (noise)	**Compliant**	The proposed noise survey methodology was defined in a Technical Memo received by MMG Rosebery from Tarkarri Engineering dated 26th July 2018. The 26th July 2018 Technical memo relating to noise survey methodology proposed included Table A1 – Environmental Noise Survey Position Location Details, which defines the nine monitoring sites that will be utilised, including a suitable control site. The issued January 2019 Noise Survey Report clearly defines that measurements were completed day, evening and at night.
Noise Condition N3 – Noise Survey Methodology and Reporting Requirements Measurements and data recorded during the survey must include; 3.1 subjective descriptions of the sound at each location 3.2 details of meteorological conditions relevant to the propagation of noise 3.3 the equivalent continuous (Leq) and L1, L10, L50, L90 and L99 weighted sound pressure levels measured over a period of 10 minutes or an alternative time interval specified by the Director	**Compliant**	<u>Three Yearly Noise Survey – October 2018</u> The most recent noise survey completed across Rosebery was conducted from the 23rd and 25th September 2018 by Tarkarri Engineering and a final survey report was submitted to MMG Rosebery and EPA Tasmania on the 9th January 2019. Section 4. Environmental Noise Survey Methodology (dated 26th July 2018) states that the measurement approach taken by Tarkarri Engineering would be as follows: • A minimum of three sequential 10-minute observed measurements at nine locations measuring equivalent continuous (L_{eq}) and L_1, L10, L50, L90 and L99 A-weighted sound pressure levels. Measurements would be carried out during the day, evening and night. • 1-minute 1/3-octave band and narrow band measurements at each measurement location during each observed measurement. Narrow band measurements would be taken across the following range:-

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3.4 one-third octave spectra over suitably representative periods of not less than 1 minute; and 3.5 narrow-band spectra over suitably representative periods of not less than 1 minute.		• Narrow band data 0 to 1000 Hz (0.15625 Hz resolution) • Subjective description of the noise environment during each observed measurement would be made and details of meteorological conditions relevant to noise propagation noted. • Logged data from the mines 3 continuous monitoring stations (as specified in table 13 of the mines EPN) would be extracted and presented for the period encompassing the observed measurements.
Noise Condition N3 – Noise Survey Methodology and Reporting Requirements A noise survey report must be forwarded to the Director within 30 days from the date on which the noise survey is completed.	**Compliant**	<u>September 2018 - 3 Yearly Noise Survey</u> The most recent September 2018 MMG Rosebery Noise Survey report was received from the consultant (Tarkarri Engineering) on the 22nd October 2018 (i.e. approximately four weeks after the completion of the late September 2018 field survey on-site). This noise survey report was submitted to the Director of EPA Tasmania by email on the 9th January 2019 (i.e. outside of the required 30-day period defined in EPN Noise Condition N3 – Noise Survey Methodology and Reporting Requirements.
Noise Condition N3 – Noise Survey Methodology and Reporting Requirements The noise survey report must include the following: 5.1 the results and interpretation of the measurements required by these conditions; 5.2 a map of the area surrounding the activity with the boundary of The Land, measurement locations, and noise sensitive premises clearly marked on the map; 5.3 any other information that will assist with interpreting the results and whether the activity is in compliance with these conditions and EMPCA; and 5.4 recommendations of appropriate mitigation measures to manage any noise problems identified by the noise survey.	**Compliant**	The most recent noise survey completed across Rosebery was conducted from the 23rd and 25th September 2018 by Tarkarri Engineering complies with the requirements defined in Schedule B – Condition N3 – Noise Survey Methodology and Reporting Requirements. The three yearly noise survey completed in September 2018 and accompanying report (issued 22nd October 2018) was stated (in Section 1) that "This report details the results of a survey conducted between 23rd and 25th September 2018 and is written to meet the requirements of EPN condition N3(5)". 5.1 – This is provided in tabular and graphic form in Section 4 and Appendix A – MMG Rosebery Mine Environmental Noise Survey (October 2018) 5.2 – Relevant maps are provided in Figures 2.1 and 2.2 in the October 2018 survey report. Noise sensitive premises are not defined within these maps or other figures included in the October 2018 report; It is acknowledged that in mid-December 2020, MMG Rosebery were able to demonstrate that they have amended the 2021 Scope of Work with their noise consultant, in anticipation of the commencement of the Q3 2021 Three Yearly Noise Survey. 5.3 – This is provided in numerous sections, as text, tabulated data, figures and graphs within the MMG Rosebery Mine Environmental Noise Survey report (October 2018).

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		5.4 – Recommendations for additional noise abatement and control are provided in Section 6 – Conclusion in the MMG Rosebery Mine Environmental Noise Survey report (October 2018).
Noise Condition N4 – Establish and Maintain a Noise Model 1 Unless otherwise approved by the Director in writing, a noise model for the site must be established and maintained on an annual basis. The model must be based on a comprehensive site-wide survey of noise sources and must be used to predict noise levels in the neighbourhood of the site.	**Compliant**	2018/19 Noise Modelling In late 2018, Tarkarri Engineering was commissioned by MMG Limited to establish an environmental noise model of their Rosebery mine operations, to comply with EPN 7153/3, Condition N4. In 2018, MMG Rosebery commenced utilising SoundPLAN for noise modelling that was contracted to Tarkarri Engineering (i.e. the former CadnaA noise model is no longer used). 2019/20 Noise Surveys During the audit period, two specific noise assessments/surveys were completed for: • Rosebery mine Rockbreaker Environmental Noise Assessment completed on the 25th February 2020 (report from Tarkarri Engineering Pty Ltd dated 30th April 2020). This survey was completed in response to a community complaint; and • Rosebery mine 2/5 TSF diesel pump package unit (i.e. used to pump down the Rosebery mine 2/5 TSF to allow repair to the dam lining) environmental noise assessment (report from Tarkarri Engineering Pty Ltd dated 11th March 2020). Relating to the above, the environmental noise model of the MMG Rosebery mine (detailed in Tarkarri Engineering report 5185_AC_R[4]) was used to model noise emissions from the a) rockbreakers in Q1 2020 and b) diesel pump package unit. It was stated that because of the February 2020 noise survey, the MMG Rosebery rock breaker has not operated at night since March 2020. A third noise survey was completed in September 2020 for the Pre-Feasibility Studies, specific to the completion of the Rosebery Mine PSF2 attenuator performance review and PSF1 environmental noise emission assessment. This noise assessment targeted the attenuator performance for the Rosebery mine vent fan PSF2 and an environment noise assessment of potential noise emission levels in Tullah from the mine's PSF1 vent fans. It was stated that the MMG Rosebery Noise Model was updated on three occasions in 2020, after the completion of the above three noise assessments. Tarkarri Engineering continues to maintain the noise model on behalf of MMG Rosebery.

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		A written correspondence by Tarkarri Engineering on the 3rd December 2020 stated that the consultant "confirms that the model doesn't require updating. The model was utilised in the rock breaker noise investigation and PSF1 and PSF 2 investigations conducted in 2020 and has been updated to the latest version of SoundPLAN (version 8.2). As stated in 2019, dominant noise source areas should be re-measured and reviewed in the model in conjunction with the next environmental noise survey". With regards to future noise sources from the operation, only one known change is planned in the next 12 months, relating to replacing the pedestal rock breaker in 2021.
Noise Condition N4 – Establish and Maintain a Noise Model 2 The model must be updated upon replacement, repair or addition of equipment that is a significant source of noise and where replacement, repair or addition of equipment may increase or adversely alter the level and/or character of the noise emitted from the site.	**Compliant** **See N4 (1)**	As defined in EPN Condition N4 (1). Noise related monitoring and modelling work completed since October 2012 included: a) the collection of continuous background noise data; b) annual reviews of noise monitoring data from fixed noise monitoring stations; c) the September 2014, February 2015 and September 2018 noise surveys at between 9 to 13 locations across Rosebery; d) establishing and confirming noise model calibration by WGE; e) in late 2018, Tarkarri Engineering utilised SoundPLAN modelling software to enable compliance with this EPN condition to be demonstrated; f) three specific noise surveys were completed in 2020 (as defined in EPN Condition N4 (1)); and g) a noise survey was completed in 2020 in anticipation of the installation of additional pumps at the MMG Rosebery filter plant (i.e. as of December 2020, these pumps had not been installed, only the concrete pad for the pumps). In the last 12 months, no additional capital funds for noise abatement measures were approved/ implemented to further attenuate noise from the MMG Rosebery operation. Some operational changes were implemented as required (i.e. MMG Rosebery ceased using the rock breaker at night since March 2020).
Noise Condition N4 – Establish and Maintain a Noise Model 3 It is not necessary to re-measure noise sources unless their noise output has changed since a previous	**Compliant** **See N4 (1)** **Observation**	As defined in EPN Condition N4 (1) and (2). Over the last 16 months there has been no major changes or increase to noise sources from the MMG Rosebery operation. It was stated that no major capital works or upgrades occurred at the operation in the last 16 months, that would potentially increase the noise levels.

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measurement. New or modified noise sources must be measured within 6 months of commissioning or re-commissioning the sources.		In 2021, MMG Rosebery plan to install additional pumps at the filter plant. A pre-noise assessment has been completed as the noise levels from the pump(s) are required to be included within the MMG Rosebery noise model. MMG Rosebery utilise a continuous noise logger located approximately 100m from the proposed location of these pumps. It was stated that it is likely the noise generated from the new pumps will be detected by the noise logger located near this location. **Noise Condition N4 – Establish and Maintain a Noise Model – Observation No. 33** – Prior to the 2021 three yearly noise survey in mid-2021, MMG Rosebery could verify any planned 2021 capital projects to identify if any approved capital works or plant upgrades will be progressed that could increase noise emissions or trigger the reuse of the noise model.
Noise Condition N4 – Establish and Maintain a Noise Model 4 Equipment may be grouped to facilitate the measurement process. Where an item of equipment has more than one significant source of noise, each significant source of noise must be measured.	**Compliant** **See N4 (1)**	As identified during previous EPN audits, no multiple sources of noise arise from the one facility/equipment at the MMG Rosebery site, except for mobile heavy equipment (for which heavy and light vehicle traffic movements can be grouped intermittently). Mobile equipment noise referred to above relates to surface noise sources inclusive of rock breakers, reversing beepers, the idling of equipment engines etc.
Noise Condition N4 – Establish and Maintain a Noise Model 5 The survey of noise sources must include: 5.1 The identification of all significant sources of noise on site; 5.2 An estimation of the spatial location, including elevation, of each item of equipment with respect to a well-established coordinate system; 5.3 Sound pressure level measurements of each item of equipment to allow the determination of the one-octave band sound power levels being emitted; and 5.4 The determination of the one-octave band sound power level spectrum of each source. Unless details are provided to the contrary, this sound power level must represent the direction of maximum sound emission.	**Compliant** **Observation** **Observation**	The next planned triennial noise survey of MMG Rosebery is scheduled to be completed in Q3 2021. As of December 2020, MMG Rosebery has completed a draft Task Assignment (CPORT) for Tarkarri Engineering relating to this Q3 2021 triennial noise survey. As of December 2020, the requirements applicable to Noise Condition N4 – Establish and Maintain a Noise Model (5.1) to (5.4) had not been included in the draft scope, nor was this completed and included in the former September 2018 Triennial Noise Survey Report. **Condition N4 – Establish and Maintain a Noise Model – Observation No. 34 –** MMG Rosebery are encouraged to include the requirements defined in EPN Noise Condition N4 Section 5 – Subsections 5.1 to 5.4 within the 2021 scope for external services for noise modeling that is planned in mid-2021 (i.e. this content had not been included in the draft scope of work). **Condition N4 – Establish and Maintain a Noise Model – Observation No. 35 –** MMG Rosebery are encouraged to request that Tarkarri Engineering define, in a tabulated format (i.e. in Q3 2021) the location of the requested information defined in EPN Condition N4 – 5, 6, 7 and 8 as it is

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		difficult to determine how compliance with these conditions has been achieved (i.e. via three yearly noise surveys, planned maintenance of the MMG Rosebery noise model etc.).
Noise Condition N4 – Establish and Maintain a Noise Model 6 The results from this survey must be used to predict the spatial distribution of A-weighted sound pressure levels, resulting only from the activities on site, to beyond a resultant level of 25 dB(A). This prediction must be based on a method, and meteorological conditions approved by the Director.	**Compliant** **See N4 (1)**	As described in Schedule B – Condition N4 (1) of this December 2020 audit report.
Noise Condition N4 – Establish and Maintain a Noise Model 7 A report must be forwarded to the Director within six weeks of the completion of the survey detailing: 7.1 The positions of the identified items of equipment; 7.2 Que-octave band sound power spectra of all identified sources; 7.3 Details of the prediction methodology; and 7.4 Contours of the predicted sound pressure levels equal to or above 25 dB(A).	**Compliant** **See N4 (1)**	As described in Schedule B – Condition N4 (1) of this December 2020 audit report.
Noise Condition N4 – Establish and Maintain a Noise Model 8 The measured noise levels determined in surveys required by N2 must be compared to the predictions required by this condition.	**Compliant** **See N4 (1)**	As described in Schedule B – Condition N4 (1) of this December 2020 audit report.

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Waste Management		
Waste Management Condition WM1 – Mine tailings and Tailings Storage Facility (TSF) All tailings, generated from processing operations, which are not to be placed underground as backfill material, must be placed in an approved tailings storage facility.	**Compliant**	<u>2/5 Dam TSF</u> Tailings commenced being discharged into the 2/5 dam TSF on the 3rd April 2018. During the last 16 months, MMG Rosebery's 2/5 dam continued to receive tailings from the operation. Improved beaching of tailings was observed to have occurred over the last 16 months along the western embankment, to prevent decant water ponding along this embankment. During the last 16 months, tailings has been deposited into 2/5 dam as sub-aqueous tailings. On the 20th October 2020, MMG Rosebery provided a submission to the Tasmanian EPA requesting that the tailings deposition methods into 2/5 dam be changed to sub-aerial deposition. The Stage 2 embankment lift at 2/5 Dam is scheduled to commence in April/May 2021, subject to the recommencement of tailings placement within the Bobadil Dam, after the completion of the Stage 10 embankment lift. It was stated that the potential life of MMG Rosebery's existing 2/5 dam is 2025 (Stages 1 and 2). After the completion of the Stage 10 embankment lift at Bobadil in late 2021, it was stated that 2/5 Dam will be potentially be used for sludge treatment and involve depositing tailings every few days via co-disposal with mine water. It was stated that the rationale surrounding this has not been formally defined and confirmed. <u>Bobadil TSF</u> For the last 16 months, the Bobadil TSF has been utilised in the following capacity: • all excess water from the process and ETP continues to be pumped to the Bobadil TSF, for settling in the Bobadil polishing ponds and discharge via the Bobadil outfall; • as required, treated water from the ETP is pumped to the TSF to maintain surface tailings in a wet condition for dust suppression; and • sprinklers are utilised at the Bobadil TSF as and when needed under adverse weather conditions. Earthworks for the Stage 10 embankment lift at the Bobadil TSF was progressing in December 2020.

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		 **Photo No. 25** – Earthmoving equipment for the Stage 10 Bobadil embankment lift (16th December 2020) The management and operation of the Bobadil and 2/5 dams continue to be the responsibility of MMG Rosebery's Processing Superintendent. At the time of this audit, MMG Rosebery was in the process of appointing a Superintendent – Tailings and Water, with responsibilities for both tailings storage facilities. At the time of this December 2020 audit, no tailings generated by MMG Rosebery were being used or placed underground as backfill material.
Waste Management Condition WM1 – Mine tailings and Tailings Storage Facility (TSF) 2 All tailings dams must: 2.1 Have any associated work or operation undertaken in accordance with any requirements of the Assessment Committee for Dam Construction (ACDC); these include: 2.1.1 an Operation and Maintenance Manual covering all main aspects of the dam operation and maintenance, tailings placement, inspections, water management, monitoring and reporting;	**Compliant** **Observation**	<u>2019 TSF Surveillance Inspections</u> Annual surveillance inspections of the 2/5 Dam TSF and Bobadil TSF were scheduled and conducted by external engineers from Klohn Crippen Berger (KCB) in August 2019 (i.e. as per the two issued reports dated 16th January 2020). In August 2019, KCB stated that both the MMG Rosebery Bobadil TSF and 2/5 Dam TSF continue to be High C' consequence category facility under the Australian National Committee on Large Dams (ANCOLD) guidelines for tailings dams. <u>Bobadil TSF</u> An MMG Rosebery Bobadil TSF and Polishing Pond Surveillance Review was completed in July/August 2019 by Khone (KCB) Engineers.

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2.1.2 a Dam Safety Emergency Plan based on dam break analysis; 2.1.3 ensuring that the ongoing safe operation and maintenance of the dam is carried out under the supervision of a professional engineer with relevant experience in the design and construction of large earth and rockfill tailings dams (the 'supervising engineer'), that the routine operation and maintenance activities are carried out by suitably trained and experienced personnel in accordance with the Operation and Maintenance Manual required by Condition WMI (2.1.1) and that effective strategies are permanently in place to ensure the effective operation of the Dam Safety Emergency Plan required by Condition WMI (2.1.2); 2.1.4 generally in accordance with the publication Guidelines on Tailings Dam Design, Construction and Operation, October 1999, published by the Australian National Committee on Large Dams, the person responsible must arrange safety inspections and audits and Operation and Maintenance Manual reviews by the supervising engineer at annual intervals; and 2.1.5 When the responsible person decides that no further tailings are to be deposited in the TSF, the company shall submit for approval a dam decommissioning and site rehabilitation design report. 2.2 Be constructed and decommissioned in a manner that will maintain, on final abandonment, a cover system to ensure long term stability and minimisation of the risk of long-term AMD. 2.3 Have duplicate copies of dam safety audits supplied to the Director within one month of issue of the final audit report. 2.4 Have any environmental or stability issue identified and associated with it reported to the Director within 24 hours		On the 16th January 2020, Klohn Crippen Berger (KCB) submitted the report for the Rosebery Mine Bobadil Tailings Storage Facility – Dam Safety Review completed on the 13th August 2019. In their 16th January 2020 report, the KCB engineers concluded that "Based on the site visit and surveillance review there are some concerns with the Bobadil TSF" recommendations listed above should be actioned for the ongoing safe management of the TSF. A total of 14 recommendations were included in the 16th January 2020 Bobadil TSF Dam Safety Review KCB report. <u>2/5 Dam TSF</u> On the 16th January 2020, KCB also submitted the final report for the Rosebery Mine 2/5 Dam Tailings Storage Facility – Dam Safety Review completed from the 13th – 15th August 2019. In their 16th January 2020 report, the KCB engineers concluded that "Based on the site visit and comprehensive surveillance review there are no immediate dam safety concerns with the 2/5 Dam. The recommendations listed above should be actioned for the ongoing safe management of the TSF". A total of 11 recommendations were included in the KCB 16th January 2020 2/5 Dam TSF Dam Safety Review report. **Waste Management Condition WM1 – Mine tailings and Tailings Storage Facility (TSF) – Observation No. 36** – MMG Rosebery are encouraged to confirm if the total 25 recommendations from the two 16th January 2020 Dam Safety Review reports from KCB have been formally entered into MMG Rosebery's IEM database for formal tracking and close-out. The KCB August 2019 surveillance inspections and final January 2020 reports form part of the annual surveillance reporting program for a 'High C' consequence category facility under the ANCOLD guidelines for tailings dams. <u>2020/21 TSF Surveillance Inspections</u> It was stated that these independent reviews by Khone Engineers have been scheduled at two yearly intervals (i.e. next scheduled for Q3 2021). <u>Monthly TSF Dam Inspections</u> Personnel from engineers, ATC Williams continue to conduct monthly inspections of the Bobadil and 2/5 dam, utilising a detailed checklist that is included in the MMG Rosebery's Tailings Operating Manual.

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of becoming aware of the issue and further outlined to the Director in the Annual Monitoring Review and Management Report.		It was stated that the completion of all of the 2020 monthly inspections by personnel from ATC Williams was partially impacted by Tasmanian COVID-19 border restrictions in 2020. Bobadil TSF Operating Manual The current version of the Bobadil TSF Operating Manual was last completed and issued by ATC Williams on the 1st November 2017. As of December 2020, the November 2017 Bobadil TSF Operating Manual was in the process of being revised and updated. It was stated that this revision is required to be reviewed and reissued as part of the Bobadil Stage 10 embankment raise. It was stated that the updated manual is required to be completed and submitted to EPA Tasmania by April 2021. 2/5 Dam TSF Operating Manual An update to the 2/5 Dam Tailings Storage Facility Operating Manual was last completed by ATC Williams personnel in March 2018 (Rev E – Final Issue). Bobadil and 2/5 Dam TSF Material Risk Response Plan (January 2020) A Material Risk Response Plan – Catastrophic Failure of Tailings Storage (i.e. applicable to both the Bobadil TSF and 2/5 Dam TSF) was completed by MMG Rosebery in January 2020. This was based on completed dam break analysis assessment reports for both TSF facilities.
Waste Management Condition WM2 – Waste Management Hierarchy Wastes must be managed in accordance with the following hierarchy of waste management: 1.1 waste must be minimised, that is, the generation of waste must be reduced to the maximum extent that is reasonable and practical having regard to best practice environmental management; 1.2 waste must be re-used or recycled to the maximum extent that is reasonable and practical; and 1.3 waste that cannot be re-used or recycled must be disposed of at a waste depot site or treatment facility that has been approved in writing by the relevant planning	**Compliant**	MMG Rosebery's Non-Mineral Non-Hazardous Waste Management Procedure (8 pages) was last issued on the 12th July 2020. MMG Rosebery were able to demonstrate general conformance to the requirements and practices defined in this procedure. This procedure is supported by MMG Rosebery's Non-Mineral Waste Handling and Disposal Register that defines the handling, tracking and Inventory of all non-mineral waste on site. This procedure was submitted to the Tasmanian EPA by email on the 13th July 2020 for their records. Since September 2014, designated collection points continue to be utilised for the ongoing collection and recycling of cardboard. MDG continue to be contracted by MMG Rosebery to collect the contents of these skips at fortnightly intervals. Once collected, this material is then flat packed into a dedicated 15 m^3 skip and transported to J.J. Richards facility in Launceston.

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authority or the Director to receive such waste, or otherwise in a manner approved in writing by the Director.		Processes continue to be utilised for recycling timber pallets from designated points. Empty bulk 1 tonne copper sulphate bags continue to be bagged on-site and deposited at the Zeehan landfill, in accordance with Tasmanian EPA requirements. These are not classified as a controlled waste.  **Photo No. 26** - Empty bulk 1 tonne copper sulphate bags (16th December 2020) Used cyanide bags are removed infrequently from the operation and transported to Victoria by Cleanaway as a regulated waste. Cleanaway retain EPA Victoria Consignment Authorisation No. 231139, which was issued on the 18th August 2020 and has an expiry date of the 18th August/2021 for treatment/disposal of this waste stream.

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		 **Photo No. 27** – Empty waste cyanide boxes and bags securely stored at MMG Rosebery (16th December 2020) Comingled non-recyclable and putrescible waste continues to be transported to and disposed at the Zeehan landfill operated by the West Coast Council.  **Photo No. 28** - Recyclable steel bulk skips for subsequent off-site removal by Recycal (16th December 2020)

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		External contractor, Recycal removes segregated recyclable steel from temporary storage locations for off-site recycling.  **Photo No. 29** – Contents of recyclable steel bulk skips (16th December 2020) MMG Rosebery's off-site light vehicle maintenance contractor continues to be responsible for servicing MMG vehicles and for the removal and management of used light vehicle tyres generated under this contract.
Waste Management Condition WM3 – Waste Management System Preferentially, materials contaminated with hazardous materials from mining operations, must be disposed of underground in stopes as backfill. Only the following wastes may be buried at the contaminated landfill site within the Bobadil Tailings Storage Facility: 1.1 filter cloths; 1.2 general non-recyclable materials (redundant poly pipe, redundant hoses); (ii) reagent waste (excluding Cyanide, which must be returned to the supplier for disposal as a controlled waste);	**Compliant**	MMG Rosebery retain a "Landfill Waste Disposal at Bobadil" procedure which was last issued in December 2017. Remediation work is occurring at the landfill to stabilise some minor geotechnical issues that were apparent. MDG continue to be contracted to a) dispose of lead contaminated waste to the Bobadil landfill and b) remove incompatible waste (and placement unsuitable materials in a designated location at the landfill for subsequent removal). During the audit period, there was one example of waste being disposed at Bobadil landfill (August 2020), relating to poor waste segregation at source. This was addressed by increased number of toolboxes provided to employees and as awareness slides on communication screens available around the site.

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1.3 sulphide concentrate and tailings residues; and 1.4 any other material approved in writing by the Director.		As defined in the 2019/20 AMRMR, the total amount of waste disposed at the authorised onsite contaminated site landfill was 234.5 tonnes in 2019/2020 (as determined by load cells fitted to the bin collection vehicle and tracked by the authorised waste management contractors, by way of a docket book). This was an increase of 7% from the previous reporting year. On a monthly frequency, MDG are utilised to check, segregate and remove any material that has been incorrectly disposed within bulk waste bins on site.  **Photo No. 30** – Example of MMG Rosebery bulk waste skips (16th December 2020) Additional waste training was provided in August 2020 to the MDG truck drivers to improve the checking of the contents of waste skips prior to collection. The following waste management and disposal practices occur at MMG Rosebery for the primary waste streams specified in EPN Schedule B – Condition WM3: 1.1 filter cloths are transported to the Bobadil landfill for final disposal. 1.2 general non-recyclable materials such as redundant poly pipe, redundant hoses etc. are currently transported and disposed of at the inert landfill at Bobadil. 1.3 formal approval was secured from the Tasmanian EPA on the 10th May 2013 to transport and dispose of lead contaminated inert material at the Bobadil landfill. This includes poly pipe, conveyor waste, rubber materials from shutdowns, contaminated timber, demolished building materials, tailings waste from the flume and filter cloths from ventilation systems.

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		 **Photo No. 31** – MMG Rosebery on-site landfill (16th December 2020) 1.4 De Bruyns are responsible for transporting hydrocarbon containers and coolants to a Level 2 secure landfill in Port Latta. Waste oil is forwarded to De Bruyns in Wivenhoe and Tasoil then transport to a lime furnace. Oil contaminated rags and filters are transported to Port Latta. De Bruyns forward a monthly email to the MMG Rosebery warehouse which is received by the SHEC Department (i.e. defining the quantity of waste transported to Dulverton or Port Latta). This information is provided in an email and MMG Rosebery SHEC update and manage the spreadsheet. As defined in previous EPN audit reports, no regulated waste tracking system has been established within Tasmania to date (i.e. for the tracking of hazardous/ regulated waste). The majority of Tasmania's hazardous waste continues to be transported to Victoria for treatment or disposal within an authorised secure landfill.
Waste Management Condition WM3 – Waste Management System An inventory must be kept of all wastes disposed of on the land, including details of the quantity, nature of the waste, and locations deposited. The annual inventory of wastes disposed of on the land must be included in the Annual	**Compliant**	External contractors, MDG collate a monthly Waste Bin Register (sighted the January 2020 register in PDF and June-November 2020 register in MS Excel), which detail and define the quantities and locations of waste disposed/removed, both internally and externally (inclusive of docket numbers, bin numbers, waste volumes and weights).

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Monitoring Review and Management Report required by condition G7.		During the audit period, individual monthly waste registers are collated and retained (i.e. from September 2019 to June 2020). These are then included in a spreadsheet (i.e. by month per sheet). MDG continue to provide MMG Rosebery with monthly data for waste materials transported to Bobadil (i.e. during the audit period as a PDF and more recently as a spreadsheet). Annual waste inventory data continues to be collated and included in MMG Rosebery's National Pollutant Inventory (NPI) reporting. MMG Rosebery's data booklet was last forwarded to NPIplus on the 24th September 2020. Once received, this consultant completes the required calculations to determine emissions data. This was last completed for the period 1st July 2019 to 30th June 2020. It was stated that no asbestos removal has occurred at MMG Rosebery since 2014. The operation continues to maintain an Asbestos Register which was last updated in September 2017 and is next scheduled for review in September 2019. The most recent asbestos audit was completed at MMG Rosebery in February 2020 by Environmental Initiatives and the report issued in June 2020. Once received, this prompted the updating of the MMG Rosebery Asbestos Register.
Waste Management Condition WM3 – Waste Management System Putrescible waste must be disposed of at a site that is authorised to receive that waste.	**Compliant**	Bulk skips of putrescible/domestic waste are located on-site in the front carpark and within the mill.  **Photo No. 32** - Putrescible/domestic waste bins in the front carpark (16th December 2020)

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		These bulk skips continue to be owned by both West Coast Council and MMG Rosebery. These are collected by MDG/West Coast Council and the waste transported to the licenced municipal landfill located at Zeehan.
Waste Management Condition WM4 – Site Waste Management Procedure Unless otherwise specified in writing by the Director the person responsible for the activity must manage waste on the land in accordance with the Zinifex Rosebery Mine Waste Management Procedure, Zinifex Rosebery Mine Environmental Management Plan and 2004 Tyre Disposal Plan and/or any revision or addendum to those documents, approved by the Director in writing.	**Compliant**	MMG Rosebery continue to maintain the following procedures, plans and training guides applicable to non-mineral waste management: • MMG Rosebery Non-Mineral Non-Hazardous Waste Management Procedure (July 2020); • The Landfill Waste Disposal at Bobadil procedure (December 2017); • The MMG Rosebery Non-Mineral Waste Handling and Disposal Register; • The Non-mineral Waste Training Guide (November 2018); and • The Underground Waste Storage and Disposal Work Instruction (June 2020). In December 2020, MMG Rosebery were able to demonstrate responsible levels of waste segregation, management and disposal, as a result of mature processes that remain implemented with the use and support of external contractors.
Waste Management Condition WM5 – Controlled Waste Transport Transport of controlled wastes to and from The Land must be undertaken only by persons authorised to do so under EMPCA or subordinate legislation.	**Compliant**	<u>Q3 2020 Controlled Waste Contractor Survey</u> Required waste authorisations/certificates retained by authorised waste contractors to transport controlled waste were included in the scope of the information request survey that was completed by MMG Rosebery's Advisor - SHEC in Q3 2020 included the following waste contractors: • Cleanaway; • DeBryns; • Hagen Oil; • MDG; • Tasmanian Oil; and • Veolia. This recent survey concluded that existing waste contractors were compliant with relevant statutory/ licencing requirements. The records for the Q3 2020 survey are retained in the MMG Library and these are all hyper-linked within the Non-Mineral Waste Handling and Disposal Register that is maintained. No formal report

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		was issued as a result of the completion of this survey (i.e. only the information that was supplied by the contractors and retained by MMG Rosebery). Records of waste contractor licences/certificates continue to be stated to be retained on the MMG Library. <u>Controlled Waste Transporters</u> The key controlled waste contractors and the regulated waste products authorised to be removed and transported include: • De Bruyn's (hydrocarbon/liquid/coolant waste to a Level 2 secure landfill in Port Latta); • De Bruyn's for waste oil that is forwarded to De Bruyns facility in Wivenhoe and Tasoil, which is consumed in a lime furnace; • De Bruyn's for oil contaminated rags and filters to Port Latta; • One-stop (One-Steel) (recycling of batteries, steel); • MDG (lead/zinc contaminated waste to Bobadil); • West Coast Council (general waste to the Zeehan landfill); • JJ Richards (hazardous waste); and • External specialist contractor (asbestos waste to Dulverton, Zeehan or near Burnie) which was last removed in 2014.  **Photo No. 33 –** Oil Contaminated Waste Bins at the Waste Laydown Yard (16th December 2020)

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Legal Obligations		
Schedule 3 - Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA A person responsible for an activity that is not a Level 2 activity or a Level 3 activity must notify the relevant Council as soon as reasonably practicable but not later than 24 hours, after becoming aware of the release of a pollutant occurring as a result of any incident in relation to that activity, including an emergency, accident or malfunction, if this release causes or may cause an environmental nuisance.	**Compliant**	As identified in previous EPN audit reports, MMG Rosebery are formally approved as a Level 2 activity and as a result, the operation is not obliged to communicate or report any emergency, accident or malfunction to the Environmental Health Officer of the West Coast Council, based in Queenstown. Nevertheless, as and when needed, MMG Rosebery remain proactive and transparent in their communications with the West Coast Council, relating to drainage and roadworks applicable to the Murchison Highway near 2/5 dam. It was stated that all required authorisations and approvals relating to a) the 2020 road and culvert works associated with the clean water diversion drainage along the Murchison Highway road verges near 2/5 dam and b) pipeline installation under the Murchison Highway were conducted in accordance with requirements from the West Coast Council. <u>Environmental Emergency Exercises (2020)</u> No emergency exercises were completed by MMG Rosebery in 2020. It was stated that one exercise was planned in Q2 2020, but this was cancelled due to COVID-19. From a safety perspective, an simulated explosion underground safety emergency response exercise was completed in 2020. <u>2019 Emergency Exercise (2/5 Dam)</u> On the 17th July 2019, MMG Limited (MMG) completed Exercise Cold Rush based on their Rosebery mine in Tasmania. The exercise was a two-level exercise based on an emergency event at Rosebery Mine which required the activation of both the site-based Emergency Management Team (EMT) and the Crisis Management Team (CMT) located in the MMG corporate office in Melbourne.
Schedule 3 – Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA A person responsible for an environmentally relevant activity must notify the Director, as soon as reasonably practicable but not later than 24 hours, after becoming aware of the release of a pollutant occurring as a result of any incident in relation to that activity, including an emergency, accident or	**Compliant**	It was stated that in the last 16 months, there were no examples where a known exceedance was not reported within the required 24-hour period to EPA Tasmania. For example, MMG Rosebery was able to demonstrate that they notified EPA Tasmania on the 30th June 2020 relating to the dust alarms detected at the Alec Street location for the 60-minute trigger levels on the 29th and 30th June 2020 (i.e. within the required 24 hours).

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malfunction, if this release causes or may cause an environmental nuisance.		If a major incident or reportable event occurs that could result in potential environmental nuisance and/or harm (i.e. off-site discharge), relevant MMG Rosebery could demonstrate that these incidents would be reported to EPA Tasmania (John Langenberg) within 24 hours (verbal/voice message) and a follow-up written report submitted within 7 days. The required 24 hour reporting typically occurs via email notification or use of the 1800 number for reporting to EPA Tasmania. It was stated that relevant on-site incidents, which are contained on-site and cleaned-up, are only notifiable to the Tasmanian EPA where relevant (i.e. as a courtesy). Details of reportable environmental incidents continue to be collated and presented within MMG Rosebery's AMRMR, submitted annually to EPA Tasmania in late September.
Schedule 3 – Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA A person responsible for an environmentally relevant activity must notify the Director, as soon as reasonably practicable but not later than 24 hours, after becoming aware of the release of a pollutant occurring as a result of any incident in relation to that activity, including an emergency, accident or malfunction, if this release causes or may cause serious or material environmental harm.	**Compliant**	During the audit period, MMG Rosebery were able to demonstrate that environmental incidents are promptly reported to EPA Tasmania as per Schedule 3 – Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA. The decision to notify the Tasmanian EPA of an incident continues to be based on criteria relating to a) its severity, b) potential/actual environmental harm or nuisance and c) if the incident has the potential to or discharges off-site). The decision is typically made by MMG Rosebery's Senior Advisor – SHEC Delivery. It was stated that all reportable incidents are required to be formally signed off by MMG Rosebery's General Manager and Senior SHEC Advisor.
Schedule 3 – Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA The Director can be notified by telephoning 1800 005 171 (a 24 hour emergency telephone number).	**Compliant**	MMG Rosebery stated that the EPA Tasmania 1800 005 171 emergency number would only be utilised on the weekend (if required) or outside of normal working hours to enable the required 24-hour reporting obligation to be met. During working hours, it was stated that the operation would directly contact the relevant Tasmanian EPA representative (Mr. John Langenberg) or their delegated person.
Schedule 3 – Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA This notification can be faxed to the Director on 62 333 800 or delivered by hand.	**Compliant**	It was stated that relevant MMG Rosebery personnel continue to utilise email as the preferred method of communication and/or notification to the Tasmanian EPA (i.e. no longer by fax or any form of hand delivery of notifications).

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Schedule 3 – Legal Obligations - Condition L01 – Any notification given by a person in compliance with this section is not admissible in evidence against the person in proceedings for an offence or for the imposition of a penalty (other than proceedings in respect of the making of a false or misleading statement).	**Compliant**	The reporting culture and applicable internal MMG Rosebery requirement is not to provide any false or misleading information or statements to the Tasmanian EPA. There was no evidence during this December 2020 EPN audit to demonstrate that any false or misleading information or statements have been made to the Tasmanian EPA in the last 12 months (i.e. since the previous September 2019 EPN audit conducted by Integrated Environmental Systems Pty Ltd).
Schedule 3 – Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA A person is required to notify the relevant Council or the Director of an incident despite the fact that to do so might incriminate the person or make the person liable to a penalty.	**Compliant**	Relevant discussions continue to be held between relevant MMG Rosebery site management and the Senior SHEC Advisor when an environmental incident is required to be reported to the Tasmanian EPA and/or if required, to the West Coast Council. It was stated that relevant definitions in the EMPCA and EPN, relating to environmental harm and environmental nuisance are referenced as needed to assist in the classification of an environmental incident and/or exceedance and the requirement to potentially report an incident to the Tasmanian EPA and/or the West Coast Council.
Schedule 3 – Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA Any notification referred to in subsection (1), (2) or (3) must include details of the incident, its nature, the circumstances in which it occurred and any action that has been taken to deal with it.	**Compliant**	It was stated that information reported to the Tasmanian EPA for an incident notification is in accordance with requirements defined on the Tasmanian EPA website. No specific or dedicated form is used for incident notification, only communication of required information via email/formal letter. MMG Rosebery were able to demonstrate that incident information reported to EPA Tasmania generally includes the details of the incident, its nature, the circumstances in which it occurred and any action that has been taken to deal with the incident. In addition to the above, for the external reporting of all environmental incidents, MMG Rosebery provides a summarised overview of environmental incident statistics and a summary table in the annual submission of its AMRMR.
Schedule 3 – Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA For the purposes of subsections (1), (2) and (3): 9.1 a person is not required to notify the relevant Council of an incident if the person has reasonable grounds for believing that the incident has already come to the notice of the Council;	**Compliant**	As defined in Schedule 3 – Legal Obligations - Condition L01 – Notification of Incidents under Section 32 of the EMPCA. MMG Rosebery remain a Level 2 activity and as a result it was stated that the operation is not obligated to report any emergency, accident or malfunction to the Environmental Officer of the West Council, based in Queenstown.

Environmental Protection Notice Schedule & Condition	Status	Supporting Evidence/Comments/Photographs
9.2 a person is not required to notify the Director of an incident if the person has reasonable grounds for believing that the incident has already come to the notice of the Director.		No environmental incidents have been reported to the West Coast Council during the timeframe specified as applicable in this December 2020 EPN audit and previous annual EPN audits (i.e. October 2012 – December 2020).
Schedule 3 – Legal Obligations - Condition L02 – EMPCA The activity must be conducted in accordance with the requirements of the Environmental Management and Pollution Control Act 1994 and Regulations there under. The conditions of this document must not be construed as an exemption from any of those requirements.	**Compliant** **Observation**	It was stated that MMG Rosebery no longer reference or utilise their former Environmental Legal Register. This was essentially replaced in July 2018 with MMG's subscription to Envirolaw, inclusive of access to Commonwealth and state legislation and regulations. Access to this database is available to relevant MMG Rosebery site personnel (i.e. inclusive of a subscription to applicable Commonwealth and Tasmania legislation, and all relevant MMG Rosebery SHEC permits and licences, which were uploaded and are available). This subscription includes the receipt of monthly updates of Commonwealth and Tasmanian state legislation by email. On receipt, this information is reviewed by the Senior Advisor SHEC for relevance to the MMG Rosebery operation. An example of a monthly email communication from Enviroessentials to MMG Rosebery occurred on the 13th November 2020. MMG Rosebery's Senior Advisor SHEC communicated the relevant requirements to the SHEC Manager on the 16th November 2020. Direct access to current versions of Commonwealth, Tasmanian State legislation, regulations and relevant Code of Practice continue to available via the internet. In addition to the above, the MMG Rosebery Obligations and Consents Register (last updated in November 2018) defines the dates that all applicable EPNs and other site licences require renewal. This is inclusive of current and closed licences and permits. **Schedule 3 – Legal Obligations - Condition L02 – EMPCA - Observation No. 37** – If staff resources permit, MMG Rosebery are encouraged to maintain and update the MMG Rosebery Obligations and Consents Register at six monthly intervals. The operation could also verify if any of the recurring tasks listed in this register require entry into IEM as scheduled recurring tasks.
Schedule 3 – Legal Obligations - Condition L03 – Storage and Handling of Dangerous Goods and Dangerous Substances The storage, handling and transport of dangerous goods and dangerous substances must comply with the requirements of relevant State Acts and Regulations thereunder, including:	**Compliant**	MMG Corporate maintain a Fatal Risk Standard - Hazardous Materials Management (last issued 18th April 2018) which defines requirements for the identification, assessment and mitigation of specific fatal risks at MMG Limited and its subsidiaries (MMG). In addition, MMG Corporate previously maintained a Hazardous Materials Management procedure (last issued 4th April 2017), which applied across the MMG Group. This procedure has been revised, with minimal changes, to allow it to be applicable to the MMG Rosebery operation. This procedure generally defines the required engineering and process requirements associated with

Environmental Protection Notice Schedule & Condition	Status	Supporting Evidence/Comments/Photographs
1.1 Dangerous Goods (Road and Rail Transport) Act 2010 1.2 Dangerous Goods (Road and Rail Transport) Regulations 2010; 1.3 Dangerous Substances (Safe Handling) Act 2005; 1.4 Dangerous Substances (Safe Handling) Regulations 2009; 1.5 Workplace Health and Safety Act 1995; and 1.6 Workplace Health and Safety Regulations 1998.		the handling, storage, disposal, introduction and control of hazardous materials and dangerous goods at the operation. The operation has formally appointed and filled the role of the site Chemical Coordinator (i.e. Metallurgist Superintendent). The most recent Dangerous Goods and Hazardous Substances Audit of MMG Rosebery was completed in June 2019 by a specialist auditor from Environmental Essentials, Hobart. The audit report was received by MMG Rosebery on the 26th August 2019. It was stated that a number of the minor audit findings were progressed and completed shortly after the audit. The remainder of accepted audit actions were entered into IEM for formal progress and close-out.
Schedule 3 – Legal Obligations - Condition L04 – Aboriginal Relics Requirements The Aboriginal Relics Act 1975, provides legislative protection to Aboriginal heritage sites in Tasmania regardless of site type, condition, size or land tenure. Section 14(1) of the Act states that; Except as otherwise provided in this Act, no person shall, otherwise than in accordance with the terms of a permit granted by the Minister on the recommendation of the Director: 1.1 destroy, damage, deface, conceal or otherwise interfere with a relic; 1.2 make a copy or replica of a carving or engraving that is a relic by rubbing, tracing, casting or other means that involve direct contact with the carving or engraving; 1.3 remove a relic from the place where it is found or abandoned; 1.4 sell or offer or expose for sale, exchange, or otherwise dispose of a relic or any other object that so nearly resembles a relic as to be likely to deceive or be capable of being mistaken for a relic; 1.5 take a relic, or permit a relic to be taken, out of this State, or	**Compliant** **Observation**	It was stated that MMG's Rosebery's individual Project Owners (as relevant) continue to be responsible for ensuring that all aspects of indigenous and European cultural heritage are managed in accordance with relevant statutory obligations and the conditions of this EPN. The MMG Rosebery internal environmental approvals process/permit incorporates relevant requirements applicable to Aboriginal/cultural heritage. <u>Inventory of Historical Structures (2000)</u> An original inventory of historical structures was completed in April 2000. This was completed as part of a previous archaeological survey of historic mine sites in the Pasminco lease, Rosebery (by Parry Kostoglou). <u>GHD/AHT Strategic Heritage Values Assessment (June 2013)</u> An indigenous and European heritage desk-top survey of the MMG Rosebery lease was originally completed in April/May 2013 by GHD (in association with Aboriginal Heritage Tasmania (AHT). This information was documented in their Strategic Heritage Values Assessment Report (June 2013). As identified in former EPN audit reports, no known indigenous heritage sites exist on the Rosebery or Hercules mining leases. The April/May 2013 survey by GHD concluded that the probability of an indigenous site existing on these lease areas is low, based on the lease topography etc. In total, 109 legacy sites were identified (with cultural heritage significance) that are listed in the MMG Rosebery Legacy Site Register (last updated in 2016). A GIS map was originally developed for MMG Rosebery/Hercules in 2013 that incorporated all known cultural heritage findings. In June 2018, GIS mapping was completed for known legacy

Environmental Protection Notice Schedule & Condition	Status	Supporting Evidence/Comments/Photographs
1.6 cause and excavation to be made or any other work to be carried out on Crown Land for the purpose of searching for a relic.		sites by Coffey Engineers. This was completed on the basis of the former survey completed by a) Parry Kostoglou in 2000, b) GHD in 2013 and c) Coffey in 2016. It was stated that this database is available for referencing prior to any scheduled vegetation clearing. The MMG Rosebery Cultural Heritage Management Plan was most recently reviewed and updated in September 2018. In addition, a Critical Control Plan for Cultural Heritage Management was developed in August 2018 that remains Rosebery specific and is the responsibility of MMG Rosebery's SHEC Superintendent. <u>Bobadil TSF Borrow Area Vegetation Clearance (2020/21)</u> It was stated that no additional aboriginal heritage surveys were scheduled or completed in 2020/21 relative to the borrow areas required for the current Stage 10 Bobadil TSF embankment lift. **Schedule 3 – Legal Obligations - Condition L04 – Aboriginal Relics Requirements – Observation No. 38 –** Given the large surface area involved, MMG Rosebery are encouraged to schedule and complete an on-the-ground- aboriginal heritage field survey for the planned Marionoak TSF.
Schedule 3 – Legal Obligations - Condition L04 – Aboriginal Relics Requirements If a relic is suspected and/or identified during works then works must cease immediately and the Tasmanian Aboriginal Land and Sea Council and the Aboriginal Heritage Office be contacted for advice before work can continue. In the event that damage to an Aboriginal heritage site is unavoidable a permit under Section 14 of the Aboriginal Relics Act 1975 must be applied for. The Minister may refuse an application for a permit, where the characteristics of the relics are considered to warrant their preservation.	**Compliant**	It was stated that the relevant appointed MMG Rosebery Approvals Manager would be accountable for and expected to cease work if any Aboriginal heritage relic is suspected and/or identified during any site clearing/disturbance or construction work. As a result of limited ground disturbance and vegetation clearance in the last 16 months, no additional cultural heritage relics were located during this period on the MMG Rosebery/Hercules leases. It was stated that no additional aboriginal heritage surveys were scheduled or completed relative to the borrow areas required for the current Stage 10 Bobadil TSF embankment lift.
Schedule 3 – Legal Obligations - Condition L04 – Aboriginal Relics Requirements	**Compliant**	It was stated that due process would be applied and followed by relevant MMG Rosebery personnel for the reporting of any identified Aboriginal sites and/or relics. The MMG Rosebery

Environmental Protection Notice Schedule & Condition	Status	Supporting Evidence/Comments/Photographs
Anyone finding an Aboriginal relic is required under Section 10 to report that finding as soon as practicable to the Director of National Parks and Wildlife or an authorized officer under the Aboriginal Relics Act 1975. It is sufficient to report the finding of a relic to Aboriginal Heritage Tasmania to fulfil the requirements of Section 10 of the Act.		General Manager (or delegate) would be responsible for reporting any identified sites to relevant personnel within the Tasmanian government. Relevant aspects of cultural heritage and protection/ reporting of any identified sites are included as information to employees within MMG Rosebery's induction module(s).
Schedule 3 – Legal Obligations - Condition L05 – Change of Responsibility If the person who is or was responsible for the activity ceases to be responsible for the activity, they must notify the Director in accordance with Section 45 of the EMPCA.	**Compliant**	MMG Corporate/Rosebery appointed the current General Manager (Mr Robert Walker) in late November 2019. A formal communication was submitted to the Director of the Tasmanian EPA on the 2nd December 2019 informing the Director of the newly appointed General Manager at MMG Rosebery.
Schedule 3 – Legal Obligations - Condition L06 – Underground Storage Tanks The operation and management of underground petroleum storage systems must be in accordance with Environmental Management and Pollution Control (Underground Petroleum Storage Systems) Regulations 2010.	**Compliant**	No Underground Petroleum Storage Tanks (UPSSs) currently exist on site. It was stated that all former UPSSs were previously removed (i.e. potentially up to four underground tanks). All chemical and hydrocarbon transfer piping across the site is located above ground. Within the underground mine, approximately 10,000 L of diesel continues to be stored in self bunded tanks adjacent to the workshop. In early 2016, MMG Rosebery commissioned the surface 7 Level self-bunded 130,000 L bulk diesel fuel storage tank and decommissioned the former 100,000 L bulk tank. Tasmanian EPA approval for this infrastructure replacement was originally secured in May 2015 (Approval Reference No. H396478).

APPENDIX K: MMG ROSEBERY - ENVIRONMENTAL MONITORING AUDIT (ENVIRONMENTAL INITIATIVES, 2021)

MMG Rosebery
Environmental Monitoring Audit

23rd May 2021

PREPARED FOR: 1710

Report #: MMG Rosebery Operation

Environmental Initiatives (TAS)
A Trading arm of Jebees Holdings Pty Ltd

Version Control			
Rev No.	Authors	Status	Date
0	Jeff Ekert	Draft	29/04/2021
1	Jeff Ekert	Final	23/5/2021

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4. This report should remain together and be read as a whole.
5. The effectiveness of the management measures and recommendations provided in this report are dependent on their effective implementation and maintenance for the duration of the construction period or until such time as the site conditions are substantially stabilised.
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Jeff Ekert
Member Environment Institute of Australia and New Zealand

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Contents

Jebees Holdings Pty Ltd
Trading as Environmental Initiatives (TAS)
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Executive Summary

The MMG Rosebery mine operates under an Environmental Protection Notice (EPN 7153/3) and Permit Conditions Environmental (PCE No. 9084) issued by the Tasmanian Environmental Protection Authority. MMG Rosebery engaged Environmental Initiatives (TAS) to conduct an external monitoring audit as required by clause M3 of EPN 7153/3 and clause M5 of PCE 9084.

The audit identified good conformance with Australian Standards and other industry guidelines with respect to the collection of surface and groundwater samples. There were some areas where improvements could be incorporated to strengthen internal quality control. High volume air sampling was also found to be well managed. Contract field staff who are engaged by MMG Rosebery to collect environmental samples had a good theoretical knowledge of the sampling methodology and techniques required.

A number of non conformances were identified particularly in relation to the existing installation of depositional dust gauges, noise monitoring installations and the current location of the blast vibration/overpressure monitoring station.

This report contains a number of recommended actions and improvement opportunities in relation to the collection of environmental monitoring samples and data at the MMG Rosebery operation.

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Introduction

The MMG Rosebery mine operates under both an Environmental Protection Notice (EPN 7153/3) and a Permit Conditions Environmental (PCE No. 9084) issued by the Tasmanian Environmental Protection Authority.

Clause M3 of the EPN require that once every 5 years an external monitoring audit to be undertaken. The audit needs to assess compliance in relation to conditions M1 and M2 of this Notice and whether the current monitoring program is adequately measuring the discharge water quality from The Land. Clause M5 of the PCE requires a monitoring audit to be undertaken at the same time as this audit.

MMG Rosebery engaged Environmental Initiatives (TAS) to conduct an onsite audit between the 20th and 23rd of April 2021 as required by clause M3 of EPN 7153/3. This audit focused on the relevant clauses in EPN 7153/3 and PCE No 9084 outlined in Table 1. Compliance with clause M2 and other sections of EPN 7153/3 is assessed on an annual basis through a third party compliance audit conducted by Integrated Environmental Systems Pty Ltd, with the latest audit, originally scheduled for August however conducted in December 2020 due to Covid travel restrictions and with the agreement of the EPA for the delay. This report is referenced where compliance with EPN 7153/3 has previously been determined.

Table 1: EPN 7153/3 and PCE No 9084Clauses

EPN 7153/3 Clause	
A1 – A4	HVAS, Dust Deposition Sampling
B2	Blasting noise and vibration limits
E4	Water Quality
E5	Groundwater monitoring
M1 – M3	Samples, reporting and monitoring, monitoring audit
N1- N3	Noise monitoring
Attachments 2 -7	Monitoring location maps
PCE 9084 Clause	
M1	Monitoring
M2	Water quality monitoring
M3	Air quality monitoring
M4	Noise monitoring
M5	Monitoring audit

This audit involved a review of documentation relating to environmental sample collection, observation of and interviews with field staff collecting samples across the full range of environmental monitoring outlined in EPN 7153/3 and PCE No 9084.

The findings of the audit are outlined in section 2 of this report and include areas where the monitoring program is compliant with the requirements of the EPN, areas where the monitoring program is non-compliant with the requirements of the EPN and suggestions where though the monitoring is compliant some improvement opportunities exist.

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Audit Findings

Audit findings are coded:

- C – Activities were observed to be compliant with the requirements of EPN 7153/3 and or PCE 9084
- NC – The audit identified areas where performance is not compliant with the requirements of EPN 7153/3 or PCE 9084
- OI – Opportunity for improvement, suggestions are included where improvement opportunities are identified

High Volume Air Sampling

EPN 7153/3 Condition	C, NC, OI	Audit Findings
A2 High Volume Air Sampling **1** Unless otherwise approved in writing by the Director, High Volume Air Sampling (HVAS) must be undertaken at the locations, frequency and parameters specified in columns 1-5 of Table 12 of Attachment 2 and locations shown on Attachment 6. These measurements must be to the standard of AS/NZS 3580.9.3:2003, *Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method and ASINZS 3580.9.6:2003, Methods for sampling and analysis of ambient air· - Determination of suspended particulate matter – PM10 high volume sampler with size-selective inlet - Gravimetric method*.	C	High Volume Air Sampling (HVAS) is conducted for both PM_{10} and TSP at the two locations specified in EPN 7153/3 Attachment 6, specifically sites AD2.1 and AD 3. HVAS sampling is also conducted by MMG Rosebery at other locations not specified within the EPN. Two high volume air samplers are installed within secure locations at each site. One sampler at each location is fitted with a PM_{10} inlet. The samplers are serviced and calibrated on an annual basis by EcoTech, service reports for site visit for January of 2021 and were reviewed. A review of the calibration and service report for the visit 12-13/01/2021 stated that *"All HV3000's well maintained and in good working order".* Filters pre-weighed and supplied in paper bags, inside zip lock bags, and barcoded by the analysing laboratory ALS. MMG Rosebery have developed a work instruction titled *HVAS Operation and Calibration Work Instruction* (document #1425864) released on the 18th of March 2015, which outlines: • General principles of the methodology relating to HVAS

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		• Equipment required • Removal and replacement of filters • Sample dispatch to the analysing laboratory • Calibration of equipment
	OI	 HVAS samplers at Site AD3 Updated work instructions titled *HVAS Calibration* and *HVAS* have been developed however at the time of the audit were not issued or under document control. An opportunity exists to finalise and issue these documents in order that they can replace the existing document as intended.
		Observations during the audit indicated:

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		• Field staff have a good understanding of the principles involved an operation of the equipment • All equipment was operational and in good order • Field staff followed steps outlined in *HVAS Operation and Calibration Work Instruction* • Initial flow rates were determined and recorded for five minutes following the installation of the new filters

Dust Deposition Sampling

EPN 7153/3 Condition	C, NC, OI	Audit Findings
A3 Dust Deposition Sampling **1** Unless otherwise approved in writing by the Director, a network of dust deposition samplers must be established and maintained at the locations specified in columns 1 - 4 of Table 12 of Attachment 2 and locations shown on Attachment 6. Monthly deposition samples must be collected and analysed in accordance with the requirements of column 6 of Table 12 of Attachment 2. Deposition measurements and analyses must be consistent with the requirements of AS/NZS 3580.10.1:2003, *Methods for sampling and analysis of ambient air - Determination of particulate matter - Deposited matter - Gravimetric method*.	NC	The current dust deposition sampling does not meet the requirements of AS/NZS 3580.10.1 for the following reasons: • Installation – all of the sample bottles, aside from AD5 were supported on a single star picket. In a number of cases the start picket had rusted out at the bottom and had been attached to surrounding fences with cable ties. This has resulted in a number of the deposition gauges becoming unstable and funnels not remaining in the correct orientation. Unstable gauges were located at sites AD25, AD23, AD11, AD3, AD4 and AD22. • The standard was updated in 2016 and 5 L bottles are now required. The current 4L bottles in use remain compliant with the standard as specified in EPN 7153/3 • At two sites the top of the funnel was not at the correct height of 2.0 m $\pm$ 0.2m (site AD2 1730 mm, site AD5 1645mm) • AD22 is located within the fronds of a man fern located in a domestic garden

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		• AD5 is located next to a major site carpark with the potential for excessive dust to be resuspended by vehicle movements during dry conditions resulting in potentially higher results It is recommended that the installation of all dust deposition gauges is reviewed and: • Sites no longer required are decommissioned • New stands are constructed, in a tripod arrangement as outlined in AS/NZS 3580.10.1 to enable all gauges to be at the correct height, stable and in the correct orientation • Where current locations provide a potential for contamination such as AD 5 the location is reviewed and if a core sampling site then a case is presented to the EPA Director for a new location.
		 Site AD3 cable tied to fence and supported by rock wedged behind in an attempt to maintain the funnel in the correct orientation. Any movement of the fence however resulted in the gauge shaking violently.

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		 Site AD 21
3 Monthly deposition measurements must be made at the 'core sites' (ADI.I, AD2.l, AD3, AD4 and AD5), unless otherwise approved in writing by the Director.	NC	Monthly samples are collected at these sites however site AD4 has been moved from the original location, now situated within 2/5 dam footprint, without advice to or agreement from the EPA director.
4 Measurements at the 'additional sites' (BG3, AD11, AD21, AD22, AD23 and AD25) are to continue until such time as an annual pattern can be established and a full 12-month dataset is compiled. This data is to be analysed in a report presented to the Director, containing recommendations and a request for approval to remove specific 'additional sites' from	C OI	Monitoring at the additional sites specified in EPN 7153/3 is ongoing. Given these additional sites have been monitored from at least 2012 it is recommended that an application is made to the EPA Director to

EPN 7153/3 Condition	C, NC, OI	Audit Findings
the monitoring network. Monthly monitoring must continue at all of the 'additional sites' until the Director provides approval to remove individual sites.		discontinue monitoring at the additional sites as outlined in EPN 7153/3 A3,4.

Meteorological Monitoring

EPN 7153/3 Condition	C, NC, OI	Audit Findings
A4 Meteorological Monitoring The meteorological monitoring station that was originally established near the HBC electrical substation may be relocated to a location approved in writing by the Director. The meteorological monitoring station shall continue to monitor hourly readings of: Temperature; relative humidity; rainfall (tipping bucket); wind speed; wind direction; and standard deviation of wind direction (sigma-theta).	C	Meteorological stations have been established at the carpark, Bobadil and 2/5 Dam. These are externally calibrated on an annual basis by Environdata, certificates for calibration in 2020 were reviewed with the next calibration is scheduled for July of 2021.

Noise Monitoring

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EPN 7153/3 Condition	C, NC, OI	Audit Findings
N1. Continuous Noise Monitoring Unless otherwise approved in writing by the Director: **1.1** Noise emissions from the activity must be monitored applying the MMG Rosebery Mine continuous monitoring program at the locations specified in Table 13 of Attachment 2 and locations shown on Attachment 7, based on equivalent continuous (Leq) and LIO and 190 A-weighted sound pressure levels measured over a period of 15 minutes or an alternative time interval specified by the Director. **1.2** Noise level measurements must be taken in the presence of ambient noise normally existent in the area. **1.3** measured noise levels are to be adjusted for tonality and impulsiveness in accordance with the *Tasmanian Noise Measurement Procedures Manual 2004*, or any future revision of this manual, issued by the Director. **1.4** All methods of measurement must be in accordance with the *Tasmanian Noise Measurement Procedures Manual 2004.*	NC OI	The current noise monitoring program is not compliant with the *Tasmanian Noise Measurement Procedures Manual 2004 in* relation to the height of the microphones and the absence of the Clemons St monitoring station. The procedures manual, current version Second Edition July 2008, in Section 5 Measurement Requirements specifies that "*unless otherwise specified, the measurement microphone must be located 1.2 meters above ground level*". Microphone heights for the stations were: • Cohen St - 3.9 m • Police House – 3.1 m • Clemons St - no station has been established to date at the location indicated on Attachment 7 of EPN 7153/3 • Mt Black – 3.9 m (located at the end of Mt Black Road) Aside from the height of the microphones the noise monitoring equipment inspected during the audit was in good condition. Data was downloaded and the calibration of the microphone tested with a NATA certified acoustic calibrator at 94 db. External calibration is conducted by Acoustic Research Labs and a range of calibration certificates for 2019 and 2021 were reviewed as part of this audit There will be an ongoing technical non-compliance with the *Tasmanian Noise Measurement Procedures Manual 2004* due to the height of the microphones. These installations have been in place for a considerable time and have provided a large data set. Changes to the height of the microphones does have some

EPN 7153/3 Condition	C, NC, OI	Audit Findings
	OI	inherent risk to the quality of the data given that the monitoring equipment is located in public areas of Rosebery. The organisation could consider applying to the EPA Director for approval for the microphones to remain at their existing height, so allowing historical data to be used in comparison with ongoing measurements and for the Mt Black station to be accepted as a replacement for the Clemons St site as it provides useful data in relation to the operation of the ROM pad and associated rock breaker. The Work Instruction *Noise and Vibration Procedure* (Release 4 2015) requires review and reissue

Blasting and Vibration

EPN 7153/3 Condition	C, NC, OI	Audit Findings
B1 Blasting Control Ground vibration due to blasting must not result in environmental nuisance occurring at any domestic residence or commercial activity in other occupation or ownership. Ground vibration management must be controlled by the combination of monitoring, at the location shown on Attachment 7 and for the parameters specified in Table 13 of Attachment 2.	C	Measurement is conducted at the site shown on Attachment 7 of EPN 7153/3.
2		The station location is not situated in accordance with *Guidelines to Minimise Annoyance Due to Blasting Overpressure And Ground*

EPN 7153/3 Condition	C, NC, OI	Audit Findings
All measurements of air blast overpressure and peak particle velocity must be carried out in accordance with the methods set down in *Technical Basis For Guidelines To Minimise Annoyance Due to Blasting Overpressure And Ground Vibration*, Australian and New Zealand Environment Council, September 1990.	NC	*Vibration, namely* Section 3.3 Measurement Location which specifies that: *3.3.2 Airblast overpressure levels may be measured at any point on, 'noise sensitive sites' which is located at least 3.5 m away from any building or structure.* *3.3.3 Ground vibration levels may be measured at any point on 'noise sensitive sites' which is located at least the longest dimension of the foundations of a building or structure away from such building or structure.* The current microphone is located only centimeters away from a solid brick wall and therefore does not comply with clause 3.3.2. The existing geophone, while the dimensions of the foundations of the existing building were not available to the auditor is unlikely to comply with clause 3.3.3 given the size of the building. It is recommended that measuring equipment is relocated to another site within the hospital grounds that allows the full compliance with the guidelines. This would require the agreement of the EPA director

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		 Current noise/vibration measurement station. Of note microphone located next to brick wall and geophone located in the ground at the end of the green metal cover. Both instruments were in calibration (see below)  An application has been made to the EPA director (07/04/2021) to relocate the blast and vibration monitors to a site compliant with the standard. (see map below)

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		

Surface Water Quality Monitoring

EPN 7153/3 Condition	C, NC, OI	Audit Findings
E4 Water Quality Unless otherwise approved in writing by the Director, water quality monitoring must take place at the locations, frequencies and for the parameters specified in the site discharge and ambient water quality monitoring program committed to in Tables 3 and 4 and Tables 5-11 of Attachment 2 of this Notice and at the locations indicated on Attachments 3-5.	C	See - *Environmental Protection Notice No: 7153/3 Third Party Compliance Audit* Integrated Environmental Systems Pty Ltd 2020.
M1 1.2. measurements must be made and samples must be collected and analysed in		

EPN 7153/3 Condition	C, NC, OI	Audit Findings
accordance with relevant Australian Standards, NATA approved methods, the American Public Health Association Standard Methods for the Analysis of Water and Waste Water or other standard(s) approved in writing by the Director;	C	An observation of the collection of water samples and field parameters (pH, EC etc.) was completed at a number of sites during the audit. In general field staff demonstrated techniques that were in accordance with AS/NZS 5667.1:1998 *Water Quality Sampling Part1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples* and accepted standard industry practice. Guidance on field sampling is provided through the MMG Rosebery *Surface Water Sampling Work Instruction*, Document # 1532546 Release 1 15/12/2017. This document provides guidance in relation to sampling equipment, preparation labelling and sampling, data management etc. Calibration and operation of the YSI Pro DSS multi probe equipment is contained in the MMG Rosebery document YSI *Pro DSS Water quality meter operation and calibration work instruction*. A range of sample containers are used, supplied prepared and with preservative as required, from the analysing laboratory ALS in Melbourne. ALs also supply a sample collection guide, a copy of which is located within the environmental lab storage room, outlining the correct bottle and preservation techniques/holding time for various analytes. The required sample containers for each site are placed within an individual bag prior to sample collection. Samples for dissolved metals are filtered in the field using syringes fitted with disposable 0.45 μm filters.

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		Field duplicate samples are collected and submitted blind to the analysing laboratory. Field parameters are collected using a YSI Pro DSS multiprobe unit. Calibration status of these instruments is displayed with a sticker on each unit. Results are recorded on tablet and transmitted directly or transferred manually into departmental IT resources prior to import into into ESDAT.
	OI	Ignore second decimal place when pH is being measured in the field. It would be preferable to round either up or down to a single decimal place as two places is not realistically achievable in a field situation when field probes are in use. It is preferable to rinse filters and syringes with the sample and discard the rinsate prior to collection of a sample for filtered metals. The syringes and filters are sterile however the auditor is aware of instances of trace metal contamination being attributed to the filter medium. Incorporate a Filter Blank into every sampling run. This is a sample of de ionized water that is filtered into a sample container in the field in the same way that a sample is collected. This will aid in identifying and potential for contamination of the sample either through sample filtration technique or environmental conditions such as dust etc. It is recommended that some duplicate samples are dispatched periodically for analysis at another laboratory to allow for Interlaboratory comparison with the regular analysing laboratory.

EPN 7153/3 Condition	C, NC, OI	Audit Findings

Groundwater Monitoring

EPN 7153/3 Condition	C, NC, OI	Audit Findings
E5 Groundwater monitoring Unless otherwise approved in writing by the Director, groundwater quality monitoring must: Take place at the locations, frequencies and for the parameters specified in the groundwater monitoring program committed to in Table 11 of Attachment 2 and Location Plans shown on Attachment 5.	C	See - *Environmental Protection Notice No: 7153/3 Third Party Compliance Audit* Integrated Environmental Systems Pty Ltd 2017.
M1 1.2. measurements must be made and samples must be collected and analysed in accordance with relevant Australian Standards, NATA approved methods, the American Public Health Association Standard Methods for the Analysis of Water and Waste Water or other standard(s) approved in writing by the Director;	C	An observation of the collection of groundwater samples and field parameters (pH, EC etc) was completed at two bore locations during the audit. In general field staff demonstrated techniques that were in accordance with AS/NZS 5667.11:1998 *Water quality sampling Part 11: Guidance on sampling of groundwaters* and AS/NZS 5667.1:1998 *Water Quality Sampling Part1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples* and accepted standard industry practice. Guidance on field sampling is provided through the MMG Rosebery 3 work instructions and a groundwater sampling plan. these documents provide guidance in relation to sampling equipment,

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		preparation labelling and sampling, data management etc. and includes sections on Low Flow and Standard Purge techniques. Calibration and operation of the YSI Pro DSS multi probe equipment is contained in the MMG Rosebery document YSI *Pro DSS Water quality meter operation and calibration work instruction*. A range of sample containers are used, supplied prepared and with preservative as required, from the analysing laboratory ALS in Melbourne. ALs also supply a sample collection guide, a copy of which is located within the environmental lab storage room, outlining the correct bottle and preservation techniques/holding time for various analytes. The required sample containers for each site are placed within an individual bag prior to sample collection. SWL was monitored appropriately with field staff clearly understanding the theory behind bore purging and how to ensure samples are collected that represent the aquifer. Low flow sample tubes stored in situ within the bore casing with a visual assessment made with respect to the need for replacement with new tubing. Sufficient stocks of tubing were available on site at the environment laboratory. Samples for dissolved metals are filtered in the field using syringes fitted with disposable 0.45 μm filters. Field duplicate samples are collected and submitted blind to the analysing laboratory. Field parameters are collected using a YSI Pro DSS multiprobe unit with a flow through cell.

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		Results are recorded on tablet and transmitted directly or transferred manually into departmental IT resources prior to import into into ESDAT.
	OI	Ignore second decimal place when pH is being measured in the field. It would be preferable to round either up or down to a single decimal place as two places is not realistically achievable in a field situation where field probes are in use. It is preferable to rinse filters and syringes with the sample and discard the rinsate prior to collection of a sample for filtered metals. The syringes and filters are sterile however the auditor is aware of instances of trace metal contamination being attributed to the filter medium. As some of the groundwater samples contain fine suspended material there is a tendency for the 0.45µm filter to block resulting in the use of multiple filters to obtain sufficient volume for analysis of dissolved metals. These filters can be stacked, with a larger pore size filter (2µm) first attached to the syringe. This provides some prefiltering and can increase the volume filtered before the 0.45µm filter is blocked. Provided the final filter in the chain is 0.45µm the resulting sample remains suitable. Incorporate a Filter Blank into every sampling run. This is simply a sample of de ionized water that is filtered into a sample container in the field in the same way that a sample is collected. This will aid in identifying and potential for contamination of the sample either through sample filtration technique or environmental conditions such as dust etc.

Monitoring

EPN 7153/3 Condition	C, NC, OI	Audit Findings
Monitoring M1 Dealing with samples-obtained for monitoring Any sample or measurement required to be obtained under these conditions must be obtained in accordance with the following:		
Samples must be tested in a laboratory accredited by the National Association of Testing Authorities (NATA), or a laboratory approved in writing by the Director, for the specified test;	C	All samples are analysed at ALS laboratories who are NATA accredited for all testing conducted for MMG Rosebery. The laboratory also supplies sample containers for water samples and pre weighed filters for the high-volume air samplers
Measurements must be made and samples must be collected and analysed in accordance with relevant Australian Standards, NATA approved methods, the American Public Health Association Standard Methods for the Analysis of Water and Waste Water or other standard(s) approved in writing by the Director;	C	See comments in sections above for HVAS, Surface Water, Groundwater.
Noise measurements must be taken in accordance with the Tasmanian Noise Measurement Procedures Manual;	NC	See section above in relation to Noise Measurement
Results of measurements and analysis of samples and details of methods employed in taking measurements and samples must be retained for at least three years after the date of collection; and	C	See - *Environmental Protection Notice No: 7153/3 Third Party Compliance Audit* Integrated Environmental Systems Pty Ltd 2020.

EPN 7153/3 Condition	C, NC, OI	Audit Findings
Samples and measurements must be obtained and transported by a person with appropriate training and experience.	C	Observations of contract field staff (supplied by ES&D) identified that there was a good theoretical knowledge of the sampling and data collection undertaken for MMG Rosebery. An observation of the sampling techniques and equipment exhibited appropriate experience and training. New field staff area required by ES&D to spend a period of time working under the supervision of an experienced field officer prior to working on their own.
	OI	Groundwater sampling Work Instruction (Doc # 15325970 Release 1 2017) refers in Step 3.1.11 refers to stabilisation of physical parameters, and the resulting sample collection as being after "*2 consecutive readings are within*" and then provides pass/fail criteria. The requirement for "*2 consecutive readings "is* also repeated in the non-approved/non-document-controlled *Groundwater Sampling – Low Flow Work Instruction.* The 2013 version of the *Groundwater Monitoring Procedure* (2013) stated "*5.8.8 The parameters are considered stable when three consecutive readings are within:"* which is consistent accepted standards for groundwater sampling. It is recommended that the current Work Instructions be updated to require stabilisation by three consecutive samples within the pass/fail criteria.
	OI	MMG Rosebery could request some form of competency assessment from ES&D outlining inhouse training or other experience for all new field monitoring staff. It is recommended that MMG Rosebery environmental staff also continue to conduct periodic competency assessments/field observations during sampling events to ensure that sampling procedures/work instructions are being followed, quality

EPN 7153/3 Condition	C, NC, OI	Audit Findings
		control measures are implemented and that they remain fit for purpose and reflect current activities.

PCE 9084 Condition	C, NC, OI	Audit Findings
Monitoring **M1. Dealing with samples-obtained for monitoring** 1. Any sample or measurement required to be obtained under these conditions must be obtained in accordance with the following: 1.1 Australian Standards, NATA approved methods, the American Public Health Association Standard Methods for the Analysis of water and waste Water or other standard(s) approved in writing by the Director: 1.2 samples must be tested in a laboratory accredited by the National Association of Testing Authorities (NATA), or a laboratory approved in writing by the Director, for the specified test; 1.3 results of measurements and analysis of samples and details of methods employed in taking measurements and samples must be retained for at least three years after the date of collection; 1.4 measurement equipment must be maintained and operated in accordance with the manufacturers specifications and records of maintenance must be retained for at least three (3) years: and 1.5. noise measurements must be taken in accordance with the Tasmanian Noise Measurement Procedures Manual;	C C NC	All samples are analysed at ALS laboratories who are NATA accredited for all testing conducted for MMG Rosebery. The laboratory also supplies sample containers for water samples and pre weighed filters for the high-volume air samplers External technicians are engaged on an annual basis to perform onsite maintenance and calibrations. Records are retained and were reviewed as part of this audit. See section above in relation to Noise Measurement

PCE 9084 Condition	C, NC, OI	Audit Findings
M2 Water Quality Monitoring 1 At least three months prior to the commencement of tailings discharge into the TSF, or by a date otherwise specified in writing by the Director, the responsible person must submit to the Director for approval a water Quality Monitoring Plan. 4. Monitoring must be conducted in accordance with the Plan unless otherwise approved in writing by the Director.	C C	A monitoring plan was submitted to the EPA. Tailing's disposal commenced 12/03/2018 Water quality reviews conducted by Technical Advice on Water in 2019 and 2020 reported the following: **2017/18** Monitoring was completed at all sites listed in the Water Quality Monitoring Plan since April 2018 at the required frequency with the following exceptions: • CWDD01 (Clean water diversion): No continuous flow results are available as flow infrastructure has not been installed, WAD CN not determined. • GB2: Listed in Monitoring Plan but no results available since October 2015. Due to access issues this bore will not be included in the final monitoring strategy. • GB12D: Only monitored in May 2018 due to the bore being dry in October. • SCD01: Seepage collection drain – no flow rate recorded in April 2018. • RW01: No water quality results due to lack of return flow to ETP. • SD: Spillway- No water quality results because no water was discharged from 2 and 5 dam into the Stitt River. **2018/19** Monitoring was completed at all sites listed in the Water Quality

PCE 9084 Condition	C, NC, OI	Audit Findings
		Monitoring Plan at the required frequency with the following exceptions: • CWDD01 (Clean water diversion): No continuous flow results are recorded; • SD: Spillway- No water quality results because no water was discharged from the 2 & 5 TSF into the Stitt River **2019/20** Monitoring was completed at all sites listed in the Water Quality Monitoring Plan at the required frequency with the following exceptions: • SD: Spillway- No water quality results because no water was discharged from the 2 & 5 TSF into the Stitt River • GB22H: Only the C6-C10 fraction of TPH was reported for November 2019 due to a sampling error. Many additional parameters were reported for each of the surface water sites. See reports: *MMG Rosebery Water Quality Monitoring Review 2017 – 2018, Technical Advice on Water, 2018* *MMG Rosebery Water Quality Monitoring Review 2018 – 2019, Technical Advice on Water, 2019* *MMG Rosebery Water Quality Monitoring Review 2019 – 2020, Technical Advice on Water, 2020*
M3 Air Quality Monitoring		

PCE 9084 Condition	C, NC, OI	Audit Findings
2. One or more real time continuous air quality monitoring stations must be established and operated at a location or locations within the Rosebery township that are representative of residences that will be exposed to atmospheric emissions from The Land.	C	Site AD4, located at a residence in Giblin St contains HVAS, PM_{10} and Dust deposition gauges. Note: this site has been relocated due to construction of the new 2/5 dam and requires approval from the EPA Director for this relocation.
M4 Noise Monitoring 1 or more continuous noise monitoring stations must be established and operated for the duration of the Stage 1 construction works and Stage 2 construction works at a location or locations that are representative of residences that will be exposed to noise emissions from The Land.	NC	Noise monitoring stations are installed across the township however remain technically non compliant due to the height of the microphones. See comments in noise section above.
M5 Monitoring Audit 1 A monitoring audit must be undertaken by a suitably qualified independent consultant engaged by the responsible person 2 An audit must be conducted at the same time as any monitoring audit conducted under the requirements of Permit No 1904	C	This report meets the requirements of this section of the permit
M6 Establishment of Replacement groundwater bores	C	Extra groundwater monitoring bores have been established, as outlined in *Water Quality Monitoring Plan 2/5 Dam Tailings Storage facility, 2018*
M7 Monitoring during unanticipated discharge	C	There has been no discharge to date from the 2/5 dam.

PCE 9084 Condition	C, NC, OI	Audit Findings
M8 Blast Monitoring	N/A	Blasting has ceased following the completion of construction.

Appendix 1 Summary of Audit Recommendations

Number	NC	OI	Recommendation
1	X		It is recommended that the current installation of all dust deposition gauges is reviewed as outlined in the body of the report to bring the sampling gauges up to compliance with AS/NZS 3580.10.1:2016, *Methods for sampling and analysis of ambient air - Determination of particulate matter - Deposited matter - Gravimetric method*.
2		X	It is recommended that an application is made to the EPA Director to discontinue depositional dust monitoring at the additional sites as outlined in EPN 7153/3 A3,4 as part of the review into current installation of the depositional dust gauges.
3	X		The operation could obtain written approval for the change in location of station AD 4 from the EPA Director to remove an ongoing technical non-conformance.
4	X		Review the current height of the microphones used for continuous noise monitoring and either reduce the height to 1.2 m as specified in the *Tasmanian Noise Measurement Procedures Manual 2004* or obtain approval from the EPA Director for the microphones to remain at the current height. This would remove an ongoing technical non-conformance.
5	X		Obtain approval for the removal of the Clemons St noise monitoring station from the list of required monitoring locations by the EPA Director. This would remove an ongoing technical non-conformance.
6	X		Finalise the relocation of the existing blasting and vibration monitoring station to a site within the hospital grounds that is compliant with Section 3.3 of the *Guidelines To Minimise Annoyance Due to Blasting Overpressure And Ground Vibration* Measurement. This would remove an ongoing technical non-conformance.
7		X	Review the opportunities for improvement outlined in the body of the report, in particular the finalisation and issue of existing/new work instructions.

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Number	NC	OI	Recommendation
8		X	MMG Rosebery could request some form of competency assessment from ES&D outlining inhouse training or other experience for all new field monitoring staff provided to the operation.

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References

Environmental Protection Notice EPN 7153/3, EPA Tasmania, 2011

Permit Conditions Environmental No. 9084, The Construction and operation of the 2/5 tailings storage facility EPA Tasmania 2016

Environmental Protection Notice No: 7153/3 Third Party Compliance Audit, Integrated Environmental Systems Pty Ltd, 2020

MMG Rosebery Water Quality Monitoring Review 2017 – 2018, Technical Advice on Water, 2018

MMG Rosebery Water Quality Monitoring Review 2018 – 2019, Technical Advice on Water, 2019

MMG Rosebery Water Quality Monitoring Review 2019 – 2020, Technical Advice on Water, 2020

Water Quality Monitoring Plan 2/5 Dam Tailings Storage Facility, Pitt & Sherry, 2018

Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration, Australian and New Zealand Environment Council, 1990

Noise Measurement Procedures Manual, Environment Division, Department of Environment Parks Heritage and Arts Tasmania, 2008

AS/NZS 3580.10.1:2016, *Methods for sampling and analysis of ambient air - Determination of particulate matter - Deposited matter - Gravimetric method*

AS/NZS 3580.9.3:2003, *Methods for sampling and analysis of ambient air - Determination of suspended particulate matter - Total suspended particulate matter (TSP) - High volume sampler gravimetric method and ASINZS 3580.9.6:2003, Methods for sampling and analysis of ambient air· - Determination of suspended particulate matter – PM10 high volume sampler with size-selective inlet - Gravimetric method*

AS/NZS 5667.1:1998 *Water Quality Sampling Part1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples,* Standards Australia

AS/NZS 5667.11:1998 *Water quality sampling Part 11: Guidance on sampling of groundwaters,* Standards Australia