

Snapper Mineral Sands Mine
ML 1621



Rehabilitation Snapper Tree Plot August 2020

Annual Environmental Management Report

1st September 2019 – 31st August 2020

Snapper Annual Environmental Management Report September 2019 – August 2020

Name of operation	Snapper Mineral Sands Mine
Name of operator	Tronox Mining Australia Limited ACN 009 247 858 (formerly Cristal Mining Australia Limited)
Development consent / project approval	Development Consent DA 06-0168
Name of holder of development consent / project approval	Tronox Mining Australia Limited ACN 009 247 858 (formerly Cristal Mining Australia Limited)
Mining lease(s)	ML 1621
Name of holder of mining lease	Tronox Mining Australia Limited ACN 009 247 858 (formerly Cristal Mining Australia Limited)
Water licence	WAL27918
Name of holder of water licence	Tronox Mining Australia Limited ACN 009 247 858 (formerly Cristal Mining Australia Limited)
MOP/RMP start date	30 November 2015
MOP/RMP end date	30 November 2020
Annual Review start date	1 st September 2019
Annual Review end date	31 st August 2020
I, Brendan Isaacs, certify that this audit report is a true and accurate record of the compliance status of Snapper Mineral Sands Mine for the period 1 September 2019 to 31 August 2020 and that I am authorised to make this statement on behalf of Tronox Mining Australia Limited. Note. a) The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, \$1 million and for an individual, \$250,000. b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or \$22,000, or both).	
Name of authorised reporting officer	Brendan Isaacs
Title of authorised reporting officer	Environmental Lead
Signature of authorised reporting officer	
Date	17 September 2020

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1 STATEMENT OF COMPLIANCE

1.1 Statement of Compliance

Table 1- Statement of compliance

Were all conditions of the relevant approval(s) complied with?	
Development Consent (DA 06-0168)	Yes
Mining Lease (ML 1621)	Yes
Environment Protection Licence (12799)	Yes
Mining Operation Plan (2015-2020)	Yes
Exploration Licence (EL8503)	Yes

1.2 Non-compliances

Table 2- Non-compliances

Relevant approval	Condition #	Condition description (summary)	Compliance status	Comment	Where addressed in Annual Review

Compliance status key for Table 2.

Risk level	Colour code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non-compliant	Non-compliance with: - potential for serious environmental consequences, but is unlikely to occur; or - potential for moderate environmental consequences, but is likely to occur
Low	Non-compliant	Non-compliance with: - potential for moderate environmental consequences, but is unlikely to occur; or - potential for low environmental consequences, but is likely to occur
Administrative non-compliance	Non-compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions)

2 INTRODUCTION

2.1 Scope of AEMR

This Annual Environmental Management Report (AEMR) refers to the environment and community performance of Tronox Mining Australia Ltd (Tronox) Snapper Mineral Sands Mine operation on Mining Lease 1621. Figure 1 shows the general location of the project. This report has been prepared in accordance with the “Annual Review Guideline 2015” published by the NSW Department of Planning, Industry and Environment. This AEMR describes the environment and community performance for the September 1st 2019 – August 31st 2020 reporting period, and is intended to satisfy requirements of:

- Snapper Mineral Sands Project Development Consent (DA 06_0168) conditions issued by the Department of Planning, Industry and Environment (DPIE) under Part 3A of the *Environmental Planning & Assessment Act*, and,
- Mining Lease (ML1621) conditions set by the Department of Mining, Exploration and Geoscience (MEG) under the *Mining Act 1992*.

This report is distributed to:

- NSW Department of Mining, Exploration and Geoscience (MEG)
- NSW Department of Planning, Industry and Environment (DPIE);
- NSW DPIE Biodiversity Conservation Division (BCD)
- NSW Land Registry Services (LRS)
- NSW DPIE Water
- NSW Environment Protection Authority (EPA)
- Wentworth Shire Council (WSC); and
- Local Leaseholders.

2.2 Key Statutory Approvals

The key statutory approvals that apply to operations of the Snapper Mineral Sands Mine are shown in Table 3.

Table 3- Development Approvals and Licences

Statutory Approval	Granted	Expires	Approval Authority
Mining Lease ML 1621	July 2008	2029	Department of Mining, Exploration and Geoscience
Development Consent DA 06_0168	August 2007	10 July 2026	NSW Department of Planning, Industry and Environment
• Modification 1	June 2009		
• Modification 2	December 2009		
• Modification 3	October 2010		
• Modification 4	October 2014		

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• Modification 5	March 2015		
• Modification 6	December 2014		
• Modification 7	March 2020		
Environment Protection Licence - No. 12799	December 2007	Renewed Annually	NSW EPA
Groundwater Bore Licences 60WA582837	January 2018	January 2025	DPIE Water
Mining Operations Plan Revision B	November 2015	November 2020	DPIE Resources Regulator

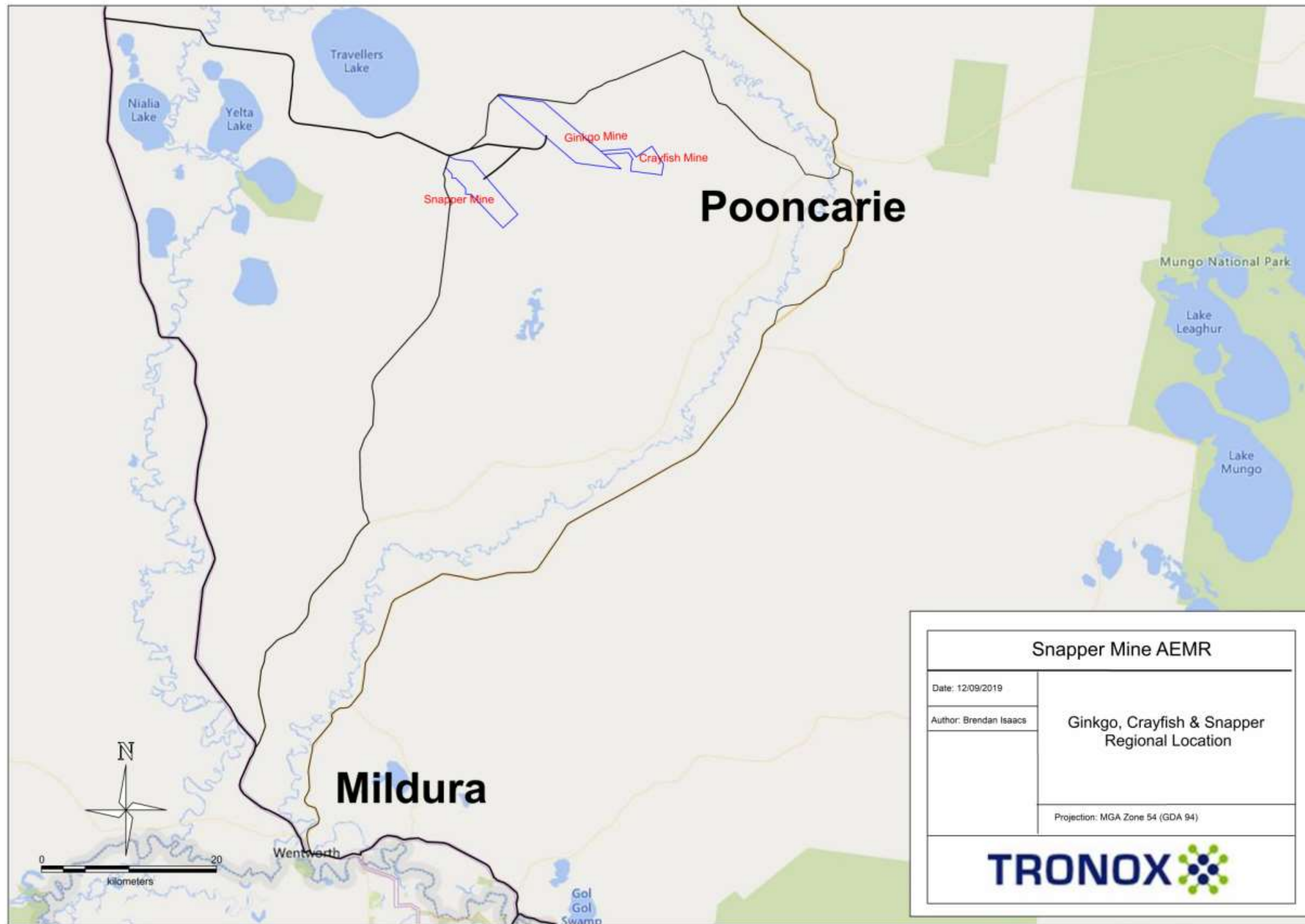


Figure 1- Regional Location

2.3 Amendments to Development Consent

Development Consent for the Snapper Mineral Sands Project was granted by NSW DPIE in August 2007. Since the issue of the consent seven amendments have been approved for the development.

June 2009 Modification (Mod 1)

During 2009, the project was modified to incorporate minor changes to the approval consent. The key aspect of the modification was to modify the Snapper mine Vegetation Offset Area. An alternative to part of the previous Snapper Mine offset area was identified which was considered to have more attractive ecological attributes than the approved Snapper Mine offset.

The modified Snapper Mine offset area allows the objectives of the offset to be met, whilst providing for several advantages over the previous offset area. In particular, the majority of the modified Snapper Mine offset is considered to be in good to moderate condition and does not contain any areas of cleared land that would require revegetation.

December 2009 Modification (Mod 2)

During 2009, the project was modified to incorporate changes to the approved consent. The key aspects of the modification included trucking of approximately 2 Mt of high-grade ore from the Snapper Mine to the Ginkgo Mine, along a private road section of the approved haul road.

The modification works are short-term in nature and would be undertaken for approximately 12 months. The approximate 2 Mt of ore represents less than 2% of the total ore to be mined from the Snapper Mine (of a total of approximately 117 Mt).

October 2010 Modification (Mod 3)

During 2010 the project was modified to incorporate changes to the current approved consent.

The key aspects of the 2010 DA variation include;

- an increase in the total amount of ore mined from approximately 117 million tonnes (Mt) to approximately 122Mt and a minor change to the extent of the mine path;
- an increase in the annual ore mining rate from approximately 8.2 million tonnes per annum (Mtpa) to approximately 9.1Mt;
- a decrease in the total amount of mineral concentrates from approximately 5.9Mt to approximately 5.2Mt, as a result of decreased average ore grades;
- an decrease in the life of the Snapper Mine from approximately 16 years to approximately 15 years, to reflect the decrease in total amount of mineral concentrates and increase in maximum annual mineral concentrate production rate;
- a change to a double-pass mining operation commencing approximately 4km from the southern end of the ore body;
- an increase in operational mining areas (including: an increase in the active mining area; an increase in the areas of the overburden emplacement from approximately 145

- to 215 hectares (ha); an increase to the HMC treatment facility and soil stockpile areas; and an addition of a temporary HMC stockpile area adjacent to the mine path);
- an increase of the final mine path landform height from approximately 2 to 4.5 metres (m) to approximately 10m;
- use of an electric conveyor system and/or dry mine fleet for dry overburden replacement instead of overburden slurring;
- a change in the alignment of the electricity transmission line (ETL) to the Snapper Mine;
- trucking of Heavy Mineral Concentrate (HMC) between the Snapper and Ginkgo Mines, dependant on the location of the HMC treatment facility, and treatment of Ginkgo Mine HMC at the Snapper Mine and disposal of Ginkgo Mine HMC treatment waste at the Snapper Mine and vice versa;
- an increase in processing rate capacity of the Wet High Intensity Magnetic Separator (WHIMS) circuit from approximately 450,000tpa to approximately 844,000tpa;
- an increase of the water supply capacity of the reverse osmosis (RO) plant;
- supply of groundwater from the deeper, higher yielding, saline Lower Olney Formation aquifer instead of the shallow Loxton-Parilla aquifer; and
- as a contingency for potential delays associated with the Snapper Mine dredge construction and commissioning, continued trucking of an additional approximate 2 Mt of high-grade ore from the Snapper Mine to the Ginkgo Mine (and associated activities) on a temporary basis (ie 12 months)

October 2014 Modification (Mod 4)

The need for the proposed modifications has arisen as a result of the Minister's approval of the Atlas-Campaspe mine as it would:

- allow concentrate from this project to be processed at the MSP; and
- allow the additional MSP process waste generated by the Atlas-Campaspe project to be emplaced at Snapper and Ginkgo mines for the first 12 years of the project, after which the waste material would be taken to the Atlas-Campaspe site for disposal.

March 2015 Modification (Mod 5)

The modifications related to road transport, minor increases in extraction, production and transportation rates of the mine.

Increasing the extraction rate of ore from 9.2 million tonnes per annum (Mtpa) to 14 Mtpa with no change to the overall total ore extracted of 122Mt;

- changing the sequence of mining involving three extraction options;
- installing an overburden slurry pipeline;
- increasing the total haulage rate of mineral concentrate from the Snapper and Ginkgo mines to the Broken Hill MSP from 780,000 to 975,000 tpa; and
- changing the trucking fleet from 80% AB-triples to 100% AB-triples to facilitate the increase in production.

December 2014 Modification (Mod 6)

The modification increases the approved ore extraction rate for the Snapper mine from

9.1 Mtpa to 9.2 Mtpa and the cumulative limit for mineral concentrate haulage from the Snapper and Ginkgo mines to the Broken Hill MSP, from 735,000 tonnes per annum to 780,000 tonnes per annum.

March 2020 Modification (Mod 7)

The Snapper Mine Northern Extension Modification includes an extension to the existing/approved mine path to extend operations at the Snapper Mine within the approved mine life and without increasing the size of the approved surface development area.

The Modification includes:

- extension of the existing/approved mine path and associated supporting infrastructure into Mining Lease Application (MLA) 1;
- development of temporary off-path overburden emplacements;
- additional soil stockpile areas;
- re-alignment of Nob Road around MLA 1;
- reduction in the number of final depressions from two to one;
- increased size of the remaining final depression; and
- relinquishment of approved surface development areas no longer required, resulting in a net reduction in surface development area.

2.4 Amendments to Mining Operations Plan

2009 – 2014: The first Snapper mine Mining Operations Plan (MOP) was accepted by the Industries and Investment NSW in December 2009. A MOP variation was lodged in December 2010 to accommodate the changes approved in the 18 October Notice of Modification for DA 06_0168. The amendment submission was never followed up by the Division of Resources and Energy.

2014 – 2020: The Snapper MOP was accepted by Industries and Investment NSW in August 2014. This MOP accommodated the changes required by the 2010 Modification for DA 06_0168. The structure and content of the MOP have been formulated in accordance ESG3: Mining Operations Plan (MOP) Guidelines September 2013 and advice given by Michael McFadyen, General Manager Environmental Operations, Environmental Sustainability Unit, Mineral Resources Division of Resources and Energy.

2015 – 2020: The current Snapper MOP was accepted by Industries and Investment NSW in November 2015. The structure and content of the MOP have been formulated in accordance ESG3: Mining Operations Plan (MOP) Guidelines September 2013. This new MOP was completed to amend the 3 mining method directions that were approved under Snappers development consent.

2015-2020 Revision A: An amendment to the current MOP was approved on July 2019 to allow exploration activities within ML1621 outside of the approved project disturbance boundary. The current MOP is expiring 31 August 2020.

2015-2020 Revision B: An amendment to the current MOP was approved in June 2020 to incorporate changes to the approved disturbance boundary within ML1621 due to Modification 7 of the Development Consent. The MOP period was also extended to 30 November 2020.

2.5 Statutory Compliance

2.5.1 Independent Environmental Audits

The last independent environmental audit was undertaken in November 2017 on the Snapper Development Consent (DA) and the Environment Protection Licence (EPL) in November 2019. The three yearly DA audit was conducted by Telford Environmental Consulting Services whose appointment was endorsed by the Secretary of Department of Planning, Industry and Environment. The DA audit assessed compliance over the previous three years of operation.

The audit returned a 100% compliance with the requirements outlined in the Development Consent and Environment Protection Licence. A summary of the audit results is provided in Table 4.

Table 4- Summary of audit findings 2017

Audit finding	Number of Project Approval audit findings	Number of EPL audit findings
Compliant	52	35
Non-compliant	0	0
Opportunity for improvement	3	1
Not applicable	7	15

There were three opportunities for improvement identified in the DA audit and one identified in the 2017 EPL audit, these are detailed in Table 5.

Table 5- Opportunities for improvement 2017

Identifier	Condition †	Opportunity for improvement
Ofi-1	PA Sched 3-17	During the next revision of the Offset Management Plan, amend s 4.1 of the Plan to read “triennial (third-yearly)” rather than “triannual”.
Ofi-2	PA Sched 3-20	Identify a specific process for action to be taken following discovery of human skeletal remains and incorporate it into the Cultural Heritage Management Plan.
Ofi-3	PA Sched 4-10	Upload December 2016 environmental monitoring results to the Cristal Mining website.
Ofi-4	EPL M4.1	Amend cross-referencing with the Community Consultation Plan during the next revision so that section 3.5.1 refers to Appendix B rather than G

Table 6- Environment Protection Licence audit summary November 2019

Finding	Number of audit findings			Broken Hill MSP
	Atlas-Campaspe Mine	Ginkgo Mine	Snapper Mine	
Non-compliant	1	0	0	2
Opportunity for improvement	2	1	0	2

Three of the four opportunities for improvement identified in the 2017 audit have been addressed during the reporting period. Changes to the Offset Management Plan have been made to reflect the correct terminology for “third yearly”. Environmental monitoring results have been uploaded to the company website for the December 2016 period. References to Appendix G were corrected to Appendix B in the Community Consultation Plan. Further discussion is required for changes to the Cultural Heritage Management Plan as Tronox believe procedures outlined in the Cultural Heritage Management Plan are sufficient should skeletal remains be discovered at the site.

No non-compliances or opportunities for improvement were identified in the November 2019 audit of the Snapper Environment Protection Licence. A summary of the audit findings is shown in Table 6.

The next Independent Environmental Audit of the Snapper DA and applicable licences and plans will take place in November 2020 in line with regulatory compliance.

2.5.2 Non-Compliances

No non-compliances were identified during the reporting period.

2.5.3 Notices

No notices were issued during the reporting period.

2.6 Mine Contacts

Table 7- Mine Contacts

Personnel	Position	Contact No.
Peter Collins	Site Director	(03) 5074 8948
Paul Blume	Operations Manager	(03) 5074 8994
Debra Stokes	SHEQ Manager	(03) 5074 8902
Brendan Isaacs	Environmental Lead	(03) 5074 8904

2.7 Action Required at Previous AEMR Review

Table 8- Actions from the previous Annual Review

Actions required from the Previous Annual review	Requested by	Action taken by the operator	Where discussed in Annual Review
None requested	DPIE		
None requested	Resources Regulator		
None requested	EPA		

2.8 Environmental Incidents

During the reporting period there was one environmental incident reported internally via the Tronox incident reporting system and one incident that was reported to DPIE.

Table 9 provides a summary of the Snapper Environmental incidents:

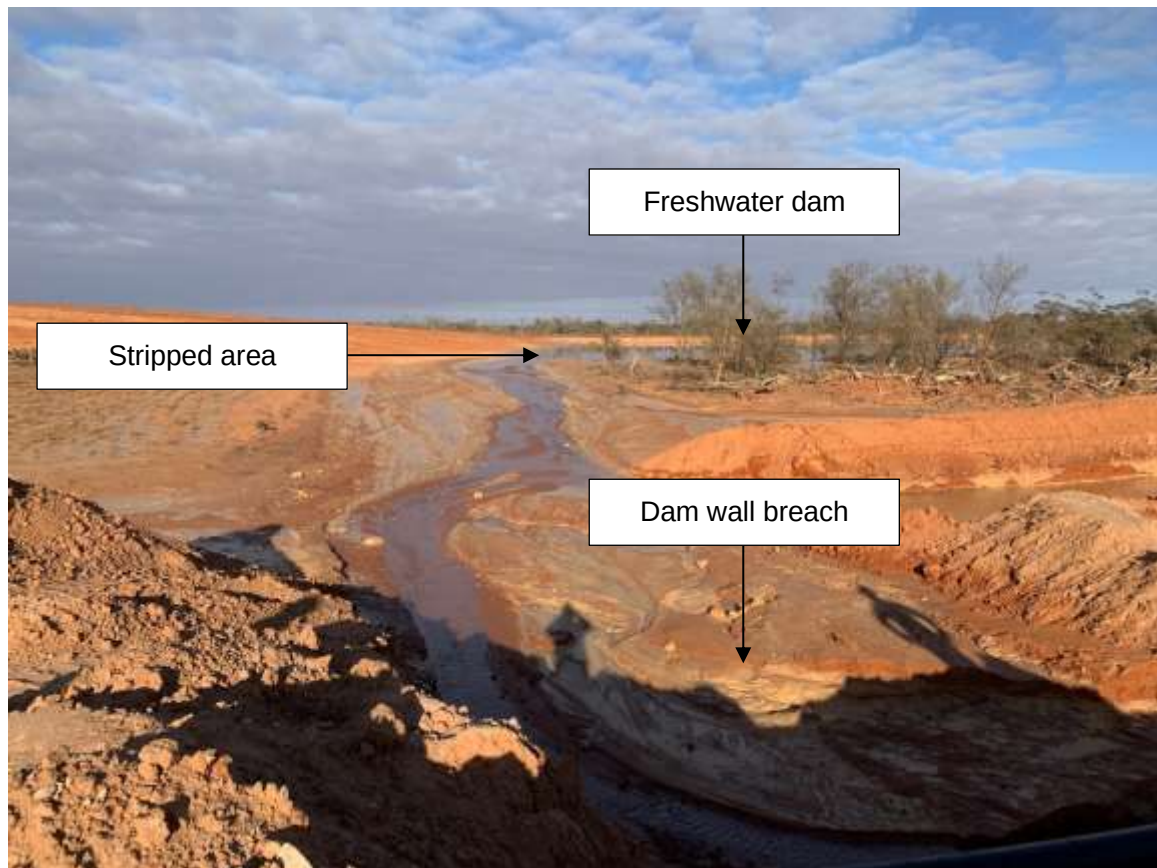
Table 9- Environmental Incidents

Date	Description	Actions completed	Risk Rating
17/4/20	Saltwater dam overflow	Contained, pumped out.	Low
26/8/20	Fire in waste rubber pipes	Investigation report conducted. Remedial actions to be made. Reported to DPIE and EPA.	Med

Saltwater dam overflow

A saltwater dam filled by a groundwater bore for dust suppression overflowed and inundated areas within the approved disturbance boundary. The areas effected had been previously stripped of topsoil. Saline water discharged from the dam was contained by a nearby freshwater dam used for dust suppression on topsoil areas. The saline water from the freshwater dam was pumped back into the saltwater dam once repairs had taken place.

The release was due to a breach in the dam wall where the water level exceeded the required freeboard allowing water to erode the earth bank and escape. The bore pump is operated remotely and a breakdown in communication between the operator of the bore pump and the supervisor of the dam resulted in the bore pump being left running on night shift. Controls were put in place to limit the amount of time the bore pump could run for before cutting out and requiring a re-start.



Fire in waste rubber pipes

During a planned burn of waste timber products in a designated and bunded area at the Snapper laydown yard, nearby scrap rubber pipes became hot and combusted due to excessive radiant heat from the fire.

The 2 attendees of the fire tried to cool the fire with a nearby fire trailer and water truck when they noticed the pipes beginning to smoke.

When it was evident that the fire was uncontrollable, one of the operators phoned the Emergency Response Team for assistance.

The ERT deployed the fire truck located at Ginkgo to the Snapper site (10km) and applied water and foam to the fire which brought the fire under control.

The fire was fully extinguished and fire watch was initiated for the next 24 hours.

3 OPERATIONS DURING THE REPORTING PERIOD

3.1 Exploration

A drilling program was conducted during Q2 and Q3 of 2020 at the northern end of the Snapper ML, a total of 100 holes for 7,732m was drilled. The drilling was designed to test the Snapper North extension. The results were favourable and further mineralisation was recorded, albeit deep. An assessment has indicated that the Snapper North extension is economic. A new block model has been developed and forwarded to Mine Planning and several mineralogical composites have been submitted for analysis. Further drilling is required during the next reporting period.

3.2 Land preparation

A 3.2Ha area of open Chenopod shrubland was cleared for additional stockpile areas required for topsoil stripping.

3.3 Construction

No construction that disturbed vegetation took place at the Snapper site during the reporting period.

3.4 Mining

Mining activities commenced at Snapper in late December 2009 with the construction of the Snapper High Grade pit. In January 2010 the first of the Snapper High Grade (HG) ore was transported to Ginkgo for treatment through the Ginkgo Dredge and process system. The mine now utilises conventional wet dredge mining techniques to recover the valuable heavy minerals from the ore deposit. The dredge and primary gravity concentration unit operates in a dredge pond, while overburden is moved via conventional mobile equipment haulage. The Dry Titan Mining Unit (DTMU), constructed in 2012, was decommissioned in May 2016 and replaced with a diesel powered Mini Dredge. The Mini Dredge is now used alongside this process to provide feed from areas where the ore-body sits above the natural water table level.

The current methods of mining overburden at Snapper are primarily using a truck and shovel fleet. Overburden is removed from the front of the pit and replaced over tailings at the back of the pit or stockpiled in temporary waste dumps for closing out final voids.

Modification 7 was approved in March 2020, the extension of the Snapper mining pit will result in an additional 12 months of production, with expected cessation in mid-2022.

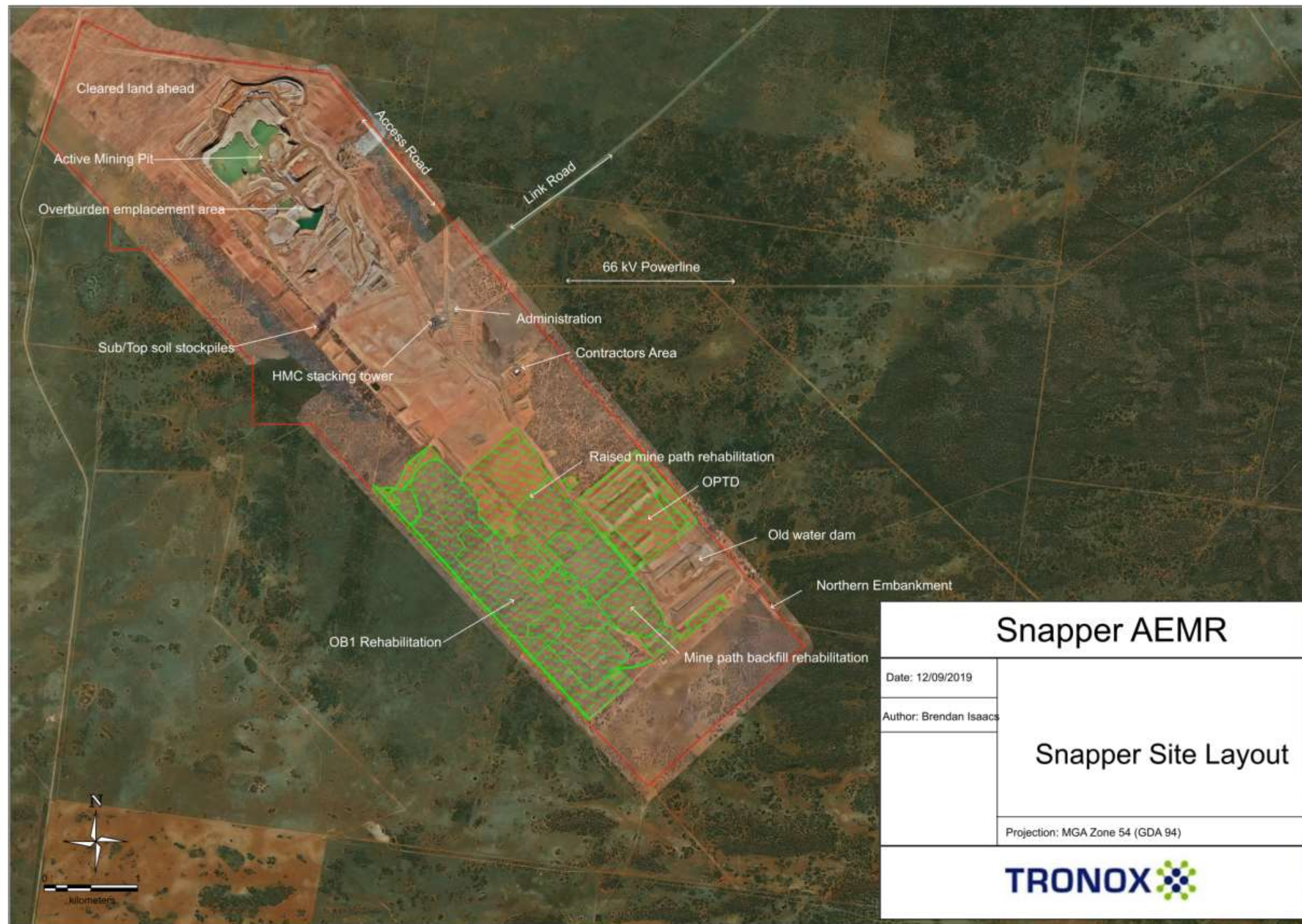


Figure 2- Site layout



Figure 3- Snapper mining pit arrangement

3.4.1 Topsoil Management

A total of 205,000 BCM of topsoil and subsoil was removed and stockpiled on the Snapper site during the reporting period.



Tractor and scoops used for topsoil and subsoil stripping and replacement

3.4.2 Production

Current production statistics detailing overburden stripping and ore mining are provided in Table 10. The Snapper MOP Plan 3c shown below as Figure 4 illustrates the mine layout at 78Mt. Ore mined at the 31st August 2020 was a total of 105Mt since the start of production in December 2009.

Table 10- Production Statistics - AEMR Period

Material	Units	78Mt Ore mined MOP	Aug-2019 to Aug 2020 Actual
Topsoil / Subsoil Stripped	Kbcm	522	205
Topsoil / Subsoil Replacement	Kbcm	300	555
Overburden Removal	Kbcm	32,470	18,479
Ore	Kt	78,000	5,910
Heavy Mineral Concentrate	Kt	331.5	164.4
Sand Residues	Kt	10,270	5,743

Differences in figures provided in the 2015 – 2020 MOP can be attributed to an evolving mine plan as mining conditions and the global environment in which Snapper operates changes over time. Additionally, the MOP is calculated on ore mined not an annual basis.

3.4.3 Dredge Mine Description

Dredge mining has been selected as the most efficient method of mining the Snapper mineral deposit.

On 25 May 2020 Snapper production was reduced to 50% on stream time, that is 5 days on and 5 days off. The reduction of on-stream time is a result of the volatile economic climate and low market demand due to the COVID-19 world epidemic.

3.4.4 Main Dredge

The floating dredge is approximately 50m long, 10m wide and has a draft of approximately 1.5m deep. The dredge consists of a rotating bucket wheel to cut and collect the ore and pumps it via the dredge pump across the float line into the concentrator. The dredge pump throughput design is 1,500 tonnes per hour. The dredge delivers the ore slurry at approx. 45% solids which comprises unconsolidated sands with a 2-3% very fine particle content (clay slimes) and minimal oversize materials.

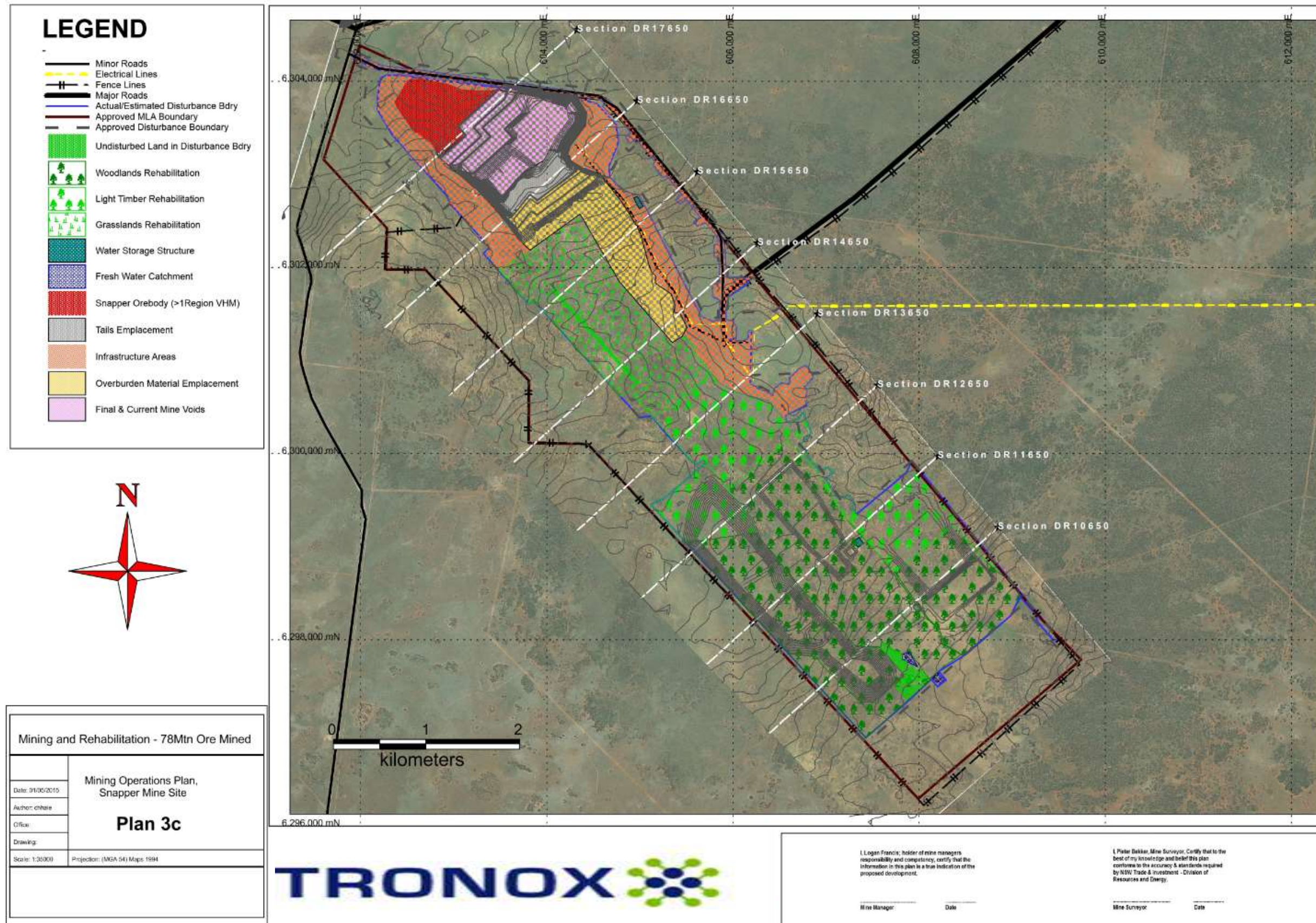


Figure 4- Snapper Mining Schedule

3.4.5 Mini Dredge

The mini dredge is a floating structure like the main dredge. The dimensions are approximately 26.8m long and 7.5m wide. The draft is approximately 0.8m deep.

The dredge has a rotating bucket wheel to cut and collect the ore and pumps it via the dredge pump across the float line to the concentrator, in parallel with the main dredge.

The dredge is powered by a 597kW diesel engine designed to mine 420t/h and pump slurry at a density of 30% by weight.

Both dredges pump slurry over a screen to reject coarse materials (.3mm) and into a surge bin. The surge bin is used to provide consistent feed to the plant. From the surge bin the slurry is pumped to the gravity separation circuits inside the plant. Twin conventional gravity separation concentration circuits separate the valuable minerals from the sand residues. Valuable heavy minerals are pumped as a heavy mineral concentrate (HMC) to a land-based tower stacker (HMC Tower).

The Snapper HMC is currently transported to the Ginkgo site for further treatment through the WHIMS plant prior to being trucked to the MSP in Broken Hill. The Snapper and Ginkgo HMC's are blended as required through the WHIMS plant.

The back-loaded MSP waste component from the Snapper HMC is currently deposited at the Ginkgo site.

3.4.6 Mineral Processing

During the period September 1st September 2019 to August 31st 2020 a total of 164,401 tonnes of Heavy Mineral Concentrate was produced through the Snapper dredge and wet plant. The Snapper MOP estimates that 331,540 tonnes of heavy mineral concentrate will be produced at the period of 78Mt of mined ore.

3.5 Waste Management

3.5.1 Sand Residue (Tailings)

Snapper produced 5.74 Million tonnes of sand residues during the period September 1st 2019 to August 31st 2020, this was pumped out via the plant boom stacker and the land based cannon to form a beach for the overburden backfill to be dumped over. The Snapper MOP estimates that 10.27 Mt of sand residues will be produced at the period of 78Mt of ore mined.



Boom stacking tails directly from the concentrator

3.5.2 Overburden

During the period September 1st 2019 to August 31st 2020 a total of 18.479 BCM of overburden had been removed and placed behind the dredge as backfill. Once placed on the backfill the overburden contractor must cap the backfill area with clean clay/sand overburden in preparation for the rehabilitation phase.



Overburden being removed by truck and shovel

3.5.3 Back-loaded Broken Hill MSP Waste

No waste material was transported from the Broken Hill MSP to the Snapper Mine during the reporting period.

The portion of the MSP waste that is attributable to Snapper is transported back to the Ginkgo site and disposed of in the mine void as per the Mines Waste Management Plan and requirements of the Ginkgo Environment Protection Licence.

3.5.4 Rubbish & Recycling

The objective of the waste management program is to minimise the production and impact of general waste (all waste other than process waste) produced at Snapper through the implementation of the waste minimisation hierarchy:

Avoid/Reduce ⇒ Reuse/Recycle ⇒ Treat ⇒ Dispose

Avoiding waste is the priority, followed by reuse and recycling/reprocessing, with disposal as the last resort. The vast majority of waste that is recyclable is either reused or recycled (100% of metal, cardboard, oil filters/rags, tyres, sewerage, grease/cooking oil, waste oil is recycled

or reused), with only small amounts of recyclable material getting mixed into the refuse system (i.e. some office paper, compost etc).

Tronox continues to deposit general waste from Snapper to the Ginkgo landfill, located approximately 10km to the north east of the Snapper site. All other waste materials i.e. metal, batteries and oils/filters are collected and transported off site for recycling.

Printer cartridges are collected onsite and delivered to Planet Ark for recycling.

Aluminium cans, plastic bottles and glass bottles are separated and recycled for a 0.10c return per item. The contractor donates 10% of proceeds back to the Tronox Mining community fund where the money is used for local community events, donations and sponsorship.

Dry cell batteries are recycled at all Tronox sites. Buckets are placed in selected locations for staff to dispose of un-wanted batteries, batteries are transferred into larger 200L drums and transported to a battery recycling centre.

Fluorescent light tubes are also collected and transported to a licenced facility for recycling, avoiding the need to landfill the potentially harmful element mercury.

Table 11 provides a summary of recyclable materials that were processed during the reporting period.

Table 11- Recycling – Reporting period

Item	BSL Snapper Contractor	Tronox
Cardboard (m ³)	215	372.5
Waste Oil (L)	99,500	58,000
Rags & Filters (m ³)	0	48
Sewerage (L)	169,500	30,000
Scrap Metal (kg)	104,000	10,125
Tyres/Rubber (t)	12.8	192.6

3.6 Water Management

As a result of the limited and well dispersed annual rainfall, the sandy soils, limited topographical relief and high evaporation rates, there are no well-defined drainage channels within the ML area, which limits the potential for fluvial erosion and sedimentation. Notwithstanding this point, the water management Plan (WMP) has been designed to contain and control waters generated from project development and operational areas, while diverting other runoff water around such areas.

The WMP is based on the containment and reuse of mine site waters and on the control of sediment that may be potentially carried with runoff from disturbed areas such as the

overburden emplacement area prior to rehabilitation. This also works to prevent clean water runoff entering disturbance zones.

Dams have been constructed to capture freshwater runoff from the overburden storage areas. These freshwater dams are utilised during topsoil stripping and replacement for dust suppression, they are also used for the watering of newly planted trees in rehabilitation areas. The use of bunds, drains and dams works effectively to keep clean, dirty and contaminated waters separate.

The Reverse Osmosis plant at Snapper produces approximately 50 L/min of fresh desalinated water when in operation. The water produced is stored in six 22,500L tanks, the overflow from the storage tanks is directed into a nearby dam eliminating the need for the plant to shut down. The surplus water keeps the dam topped up and prevents it from drying completely during the summer months, where it is used for dust suppression on topsoil areas.

One of the three Snapper production bores (SB1) was decommissioned in 2016 due to the reduced demand in water needed to raise the mining pond level. The power supply lines from this area have been moved north to extend supply as the pit advances north.

3.6.1 Water Balance

The below table is an estimation of onsite water storage, dam levels fluctuate throughout the year depending on rainfall.

Table 12- Stored Water

	Volumes Held		
	Start of Reporting Period	At End of Reporting Period	Storage Capacity
Desalinated Process/potable Water (Kl)	135	135	135
Fresh water dams (%)	0	20	100

3.7 Hazardous Material Management

Hazardous materials on-site are managed in accordance with Material Safety Data Sheets, WorkCover and EPA requirements. Due to the free digging nature of the mining operation and the lack of reagents required in the concentrator plant, the only potentially hazardous material required in significant volume is diesel.

Diesel is classified as a combustible liquid (Class C1) for the purposes of storage and handling but is not classified as a dangerous good by the criteria of the *Australian Dangerous Goods Code for Transport by Road or Rail*. The project diesel storage tanks and bunding has been constructed and operated in accordance with the requirements of the AS 1940 – *The Storage and Handling of Flammable and Combustible Liquids*.

4 ENVIRONMENTAL MANAGEMENT AND PERFORMANCE

4.1 Dust

4.1.1 Management

Tronox maintains an extensive network of dust monitoring sites in the region. This network has been established to monitor the operations of the Snapper and Ginkgo mines. For the purposes of this AEMR the only dust monitoring data reported are those that are closest to the Snapper mining lease.

A sub-network of dust monitoring sites consists of 4 monitoring sites that are reported in this AEMR. These monitoring sites are located at the nearest residential properties. The location of the Snapper dust deposition gauge sites are listed in Table 13 below and all Ginkgo and Snapper gauges are identified in Figure 5.

Table 13- Dust Deposition Gauge Location

Dust Gauge Id	Location
<i>Residential</i>	
DG01	Manilla Homestead
DG02	Woodlands Homestead
DG15	Trelega Homestead
DG16	Waukeroo Homestead



Dust deposition gauge at Manilla homestead

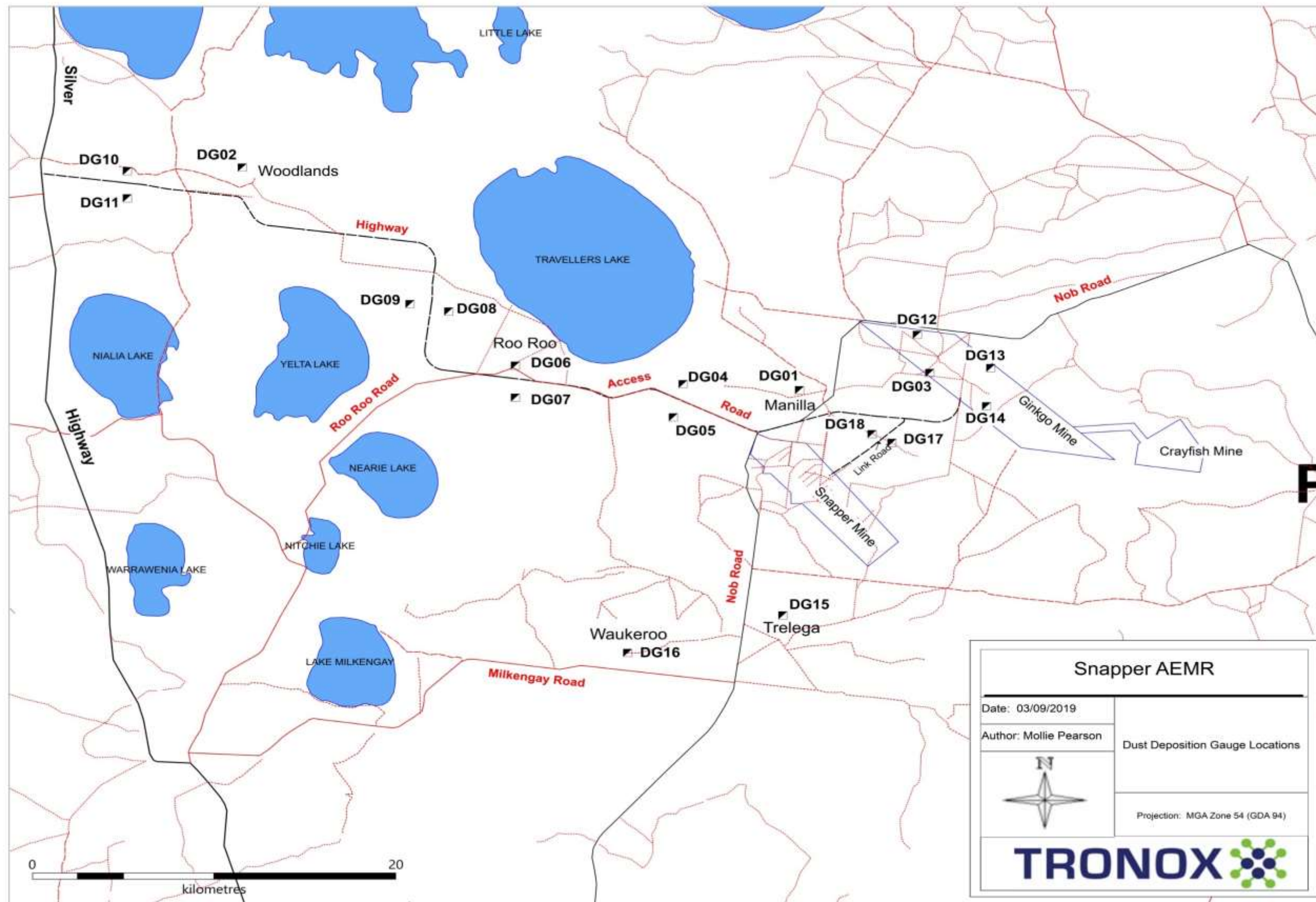


Figure 5- Dust Gauge Locations

4.1.2 Performance

The Department of Planning, Industry & Environment amenity criteria for dust deposition seeks to limit the maximum increase in the average annual rate of dust deposition from a new development to 2 g/m²/month and total dust deposition to 4 g/m²/month. The nominal background dust deposition level (as per Snapper EA 2007) was estimated to be less than 2.4 g/m²/month.

The Original Snapper EA concluded that air quality impacts would be at acceptable levels and that air quality criteria would not be exceeded at nearest residences due to the Snapper Mine operation. There could, however, be rare occasions when the maximum short-term impacts of the mine coincide with elevated background concentrations, causing exceedances of short-term air quality criteria.

There are also other activities not associated with mining operations that cause elevated levels from time to time, these include stock movement, crop harvesting and extremely dry and windy conditions. Results over the life of the project are in accordance with this original prediction as shown in Figure 7.

During the period from 1st September 2019 to 31st of August 2020, 48 dust deposition samples from residential sites were collected. Figure 6 shows that dust levels were elevated from September 2019 to April 2020 and several exceedances occurred during this period above the prescribed limit of 4 g/m²/month. Exceedances were recorded in September, October, November, December 2019 and January, February, March and April 2020, possible reasons for these exceedances are described below. All dust results for the reporting period are tabulated in Appendix 1.

September 2019 (DG01,DG16)

During the sampling period in September 2019, the maximum temperature was 31.43°C with an average minimum temperature of 8.17°C. Peak wind gusts of 79.28 km/hr were recorded during September, which is considered strong gale winds according to the Beaufort wind scale. While 3.8mm was recorded for September (Ginkgo weather station), only 57.6mm of rain had been recorded for the year, with soil conditions observed as extremely dry, bare paddocks near the dust gauges. 10,138,494 L of water was used on the haul road for haul road maintenance and dust suppression during this period.

October 2019 (DG01)

During the sampling period in October 2019, the maximum temperature was 39.36°C with an average minimum temperature of 12.29°C. Peak wind gusts of 49.7 km/h were recorded during October, which is considered strong winds according to the Beaufort wind scale. While 0.0mm was recorded for October (Ginkgo weather station), only 57.6mm of rain had been recorded for the year. Soil conditions observed as extremely dry, bare paddocks near the dust gauges. 8,534,000 L of water was used on the haul road for haul road maintenance and dust suppression during this period.

The hot and dry conditions along with multiple dust storms and minimal rainfall have contributed to the higher than average readings resulting in temporary elevated dust levels that are not directly associated with mining operations.

November 2019

(DG1, DG2,DG15, DG16)

During the sampling period in November 2019, the maximum temperature was 43.3°C with an average minimum temperature of 13.09°C. Peak wind gusts of 71 km/h were recorded during November, which is considered gale winds according to the Beaufort wind scale. While 14.4mm was recorded for November (Ginkgo weather station), only 72mm of rain had been recorded for the year. Soil conditions observed as extremely dry, bare paddocks near the dust gauges. 8,411,546 L of water was used on the haul road for haul road maintenance and dust suppression during this period. The hot and dry conditions along with multiple dust storms and minimal rainfall have contributed to the higher than average readings resulting in temporary elevated dust levels that are not directly associated with mining operations.

December 2019

(DG01, DG15)

During the sampling period in November 2019, the maximum temperature was 43.3°C with an average minimum temperature of 15.23°C. Peak wind gusts of 66.21 km/h were recorded during December, which is considered gale winds according to the Beaufort wind scale. While 3.8mm was recorded for December (Ginkgo weather station), only 72.2mm of rain had been recorded for the year. Soil conditions observed as extremely dry, bare paddocks near the dust gauges. 9,464,000 L of water was used on the haul road for haul road maintenance and dust suppression during this period. The hot and dry conditions along with multiple dust storms and minimal rainfall have contributed to the higher than average readings resulting in temporary elevated dust levels that are not directly associated with mining operations. The hot and dry weather conditions along with multiple dust storms and minimal rainfall have all contributed to the higher than average readings resulting in temporary elevated dust levels that are not directly associated with mining operations.

January 2020

(DG01)

During the sampling period in January 2020, the maximum temperature was 44.93°C with an average minimum temperature of 18.87°C. Peak wind gusts of 78.1 km/h were recorded during January, which is considered strong gale force winds according to the Beaufort wind scale. Total rainfall of 4.6mm was recorded for January (Ginkgo weather station), with soil conditions observed as extremely dry. The hot and dry conditions along with multiple dust storms and minimal rainfall have contributed to the higher than average readings resulting in temporary elevated dust levels that are not directly associated with mining operations.

February 2020

(DG01, DG15, DG16)

During the sampling period in February 2020, the maximum temperature was 43.13°C with an average minimum temperature of 18.09°C. Peak wind gusts of 59.16 km/h were recorded during February, which is considered near gale force winds according to the Beaufort wind scale. Total rainfall of 3.4mm was recorded for February (Ginkgo weather station), with soil conditions observed as extremely dry. The hot and dry conditions along with multiple dust storms and minimal rainfall have contributed to the higher than average readings resulting in temporary elevated dust levels that are not directly associated with mining operations.

March 2020

(DG15)

During the sampling period in March 2020, the maximum temperature was 37°C with an average minimum temperature of 15.78°C. Peak wind gusts of 52.06 km/h were recorded during March, which is considered near gale force winds according to the Beaufort wind scale. Total rainfall of 17.2mm was recorded for March (Ginkgo weather station), with soil conditions observed as extremely dry. The hot and dry conditions along with multiple dust storms and minimal rainfall have contributed to the higher than average readings resulting in temporary elevated dust levels that are not directly associated with mining operations.

April 2020

(DG01, DG02)

During the sampling period in April 2020, the maximum temperature was 30.8°C with an average minimum temperature of 10.95°C. Peak wind gusts of 69.81 km/h were recorded during April, which is considered gale force winds according to the Beaufort wind scale. While 40.2mm was recorded for March (Ginkgo weather station), only 62.2 mm of rain was recorded for the year. Soil conditions were observed as extremely dry, with bare paddocks near the dust gauges. The hot and dry conditions along with multiple dust storms and minimal rainfall have contributed to the higher than average readings resulting in temporary elevated dust levels that are not directly associated with mining operations.

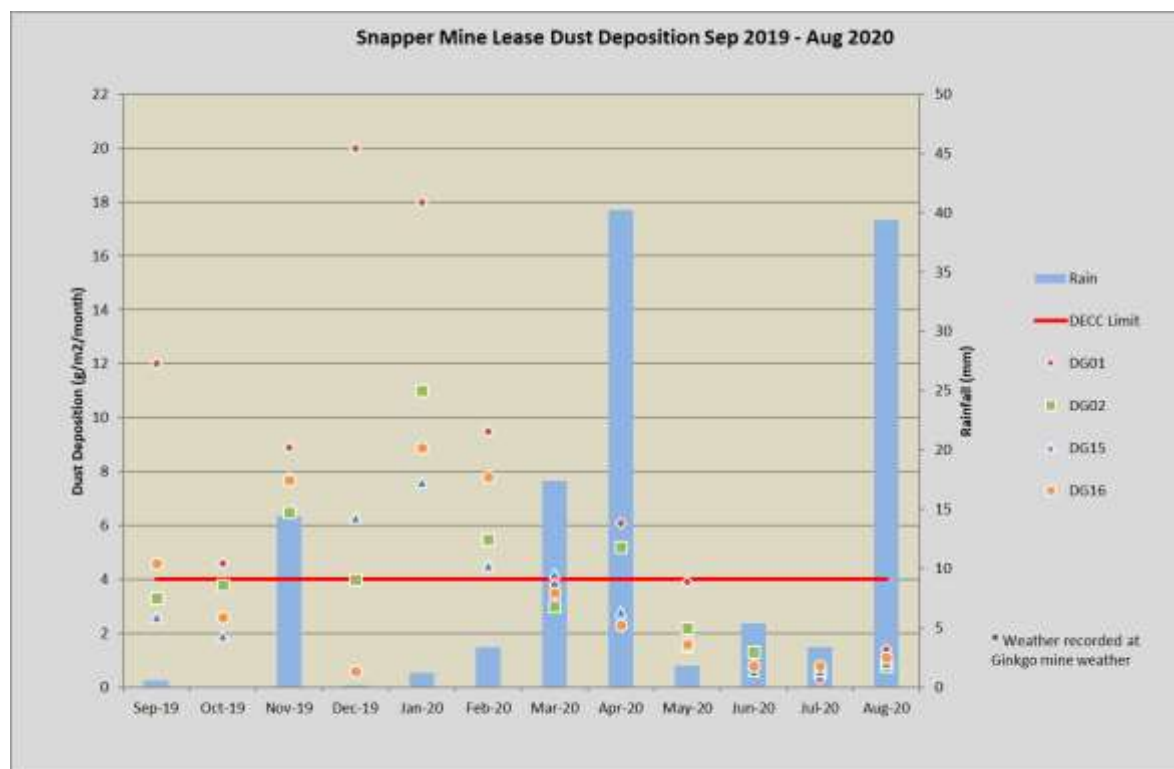


Figure 6- Snapper monthly resident site dust deposition

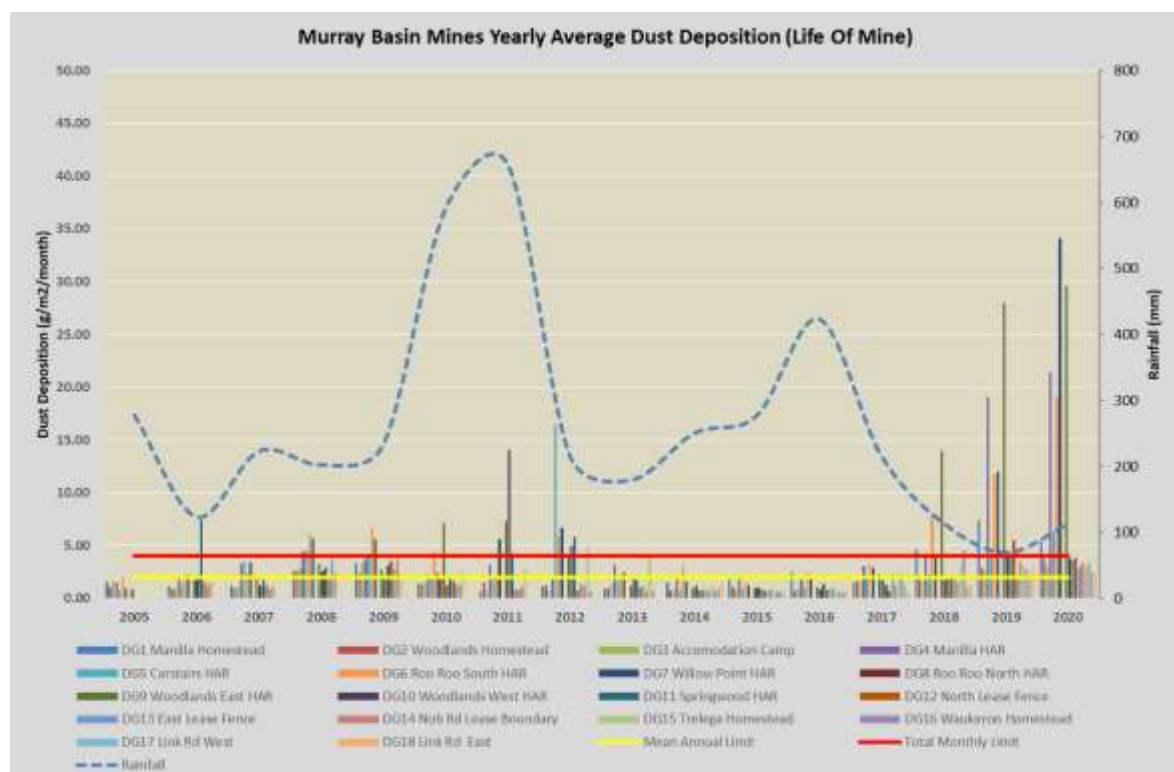


Figure 7 - Average yearly dust deposition all locations

4.1.3 Incidents

No incidents regarding dust deposition were recorded during the reporting period.

4.1.4 Improvements

The dust monitoring program will continue in the 2020 - 2021 reporting period.

4.2 Erosion and Sediment Control

4.2.1 Management

Tronox prepared a Murray Basin Mines Water Management Plan (WMP) in October 2016. The WMP details the erosion and sediment control measures and performance monitoring of controls. As a result of the limited and well dispersed annual rainfall, the sandy soils, limited topographical relief and high evaporation rates, there are no well-defined drainage channels within the Mining Lease area, which limits the potential for fluvial erosion and sedimentation.

Monitoring of sediment and erosion control is conducted after rainfall events. The monitoring is generally conducted as a visual inspection with photographs but may also involve water quality testing if saltwater contamination is believed to have occurred.

4.2.2 Performance

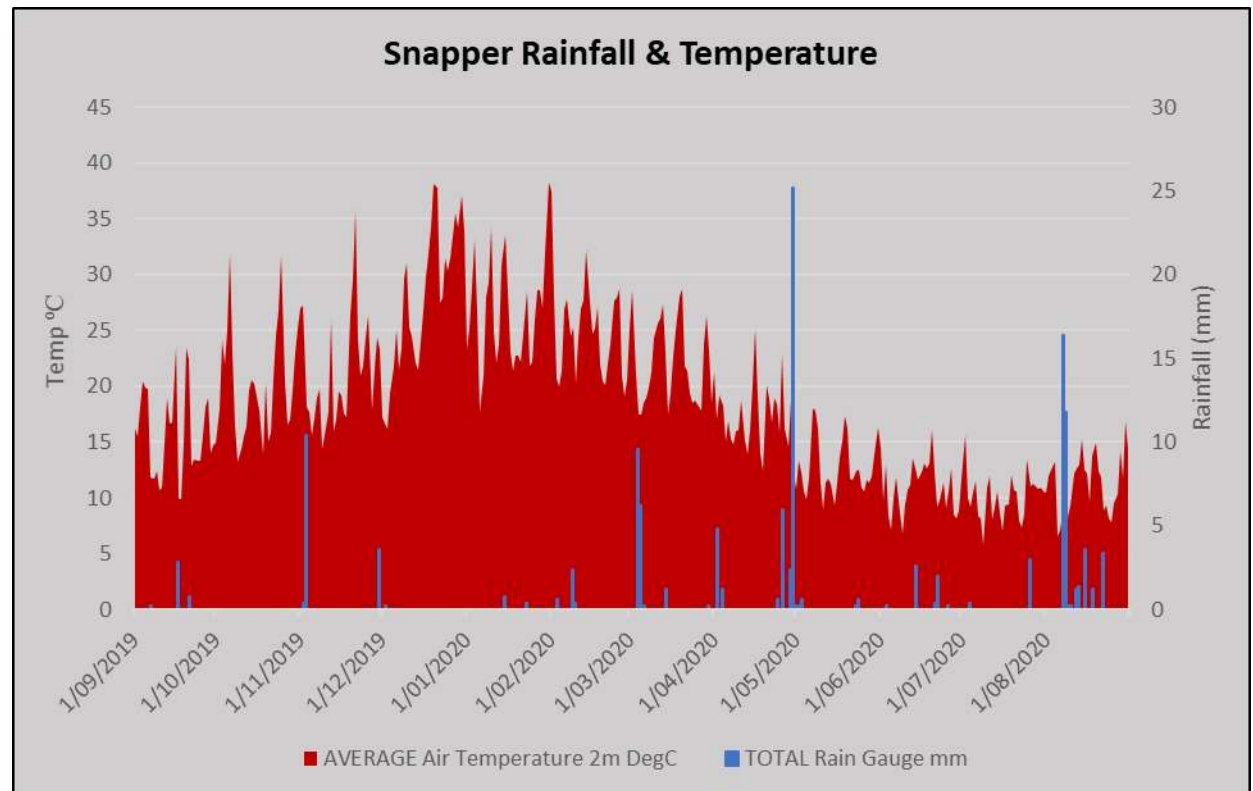


Figure 8- Weather observations (Sep 2019 to Aug 2020)

Between 1st September 2019 and 31st August 2020 Snapper received a total of 130.6 mm of rainfall, only two significant rain events were received during this period. On the 30th April 25.2mm and between the 7th and 8th of August 28.2mm.

Earthworks to maintain gutters and drains around the off-path tails dam (OPTD), freshwater site dams and roads have been ongoing during the reporting period. It is important to keep these drains free of silt to maintain the maximum catchment potential for the freshwater dams.

4.2.3 Incidents

There were no significant erosion events identified as a result of the rain events during the reporting period.

4.2.4 Improvements

Monitoring and maintenance programs consistent with 2019-2020 reporting period will be continued in 2020-2021 in accordance with statutory and WMP requirements. All erosion incidents are captured with photographic evidence.

Scheduled earthworks will continue across site to maintain existing drains and dams.

4.3 Water

4.3.1 Management

Tronox prepared a Murray Basin Mines Water Management Plan (WMP) in October 2016. The Plan describes the process water source and supply requirements, erosion and sediment management, site-water balance, storage, impact management and monitoring of groundwater in the vicinity of the mining operations.

Surface Water

Surface water run-off is generated off compacted areas such as the administration block, lay down pad, overburden stockpiles and roads etc. This run-off is managed with the construction of diversion drains and sediment sumps. These management strategies allow for dirty and potentially contaminated water to be contained on site, and not enter areas of undisturbed land. Conversely, these structures also act to prevent clean runoff from undisturbed land entering the site.

During 2012 a design engineer was utilised to ensure the current erosion and sediment control measures which are required under the Snapper Project Approval 06_0168, schedule 3, Condition 3 are acceptable and comply with condition 3a) and the *Managing Urban Stormwater: Soils and Construction* manual.

Site drainage is shown in Figure 9. These structures are constantly being modified and extended as mining and rehabilitation progresses.

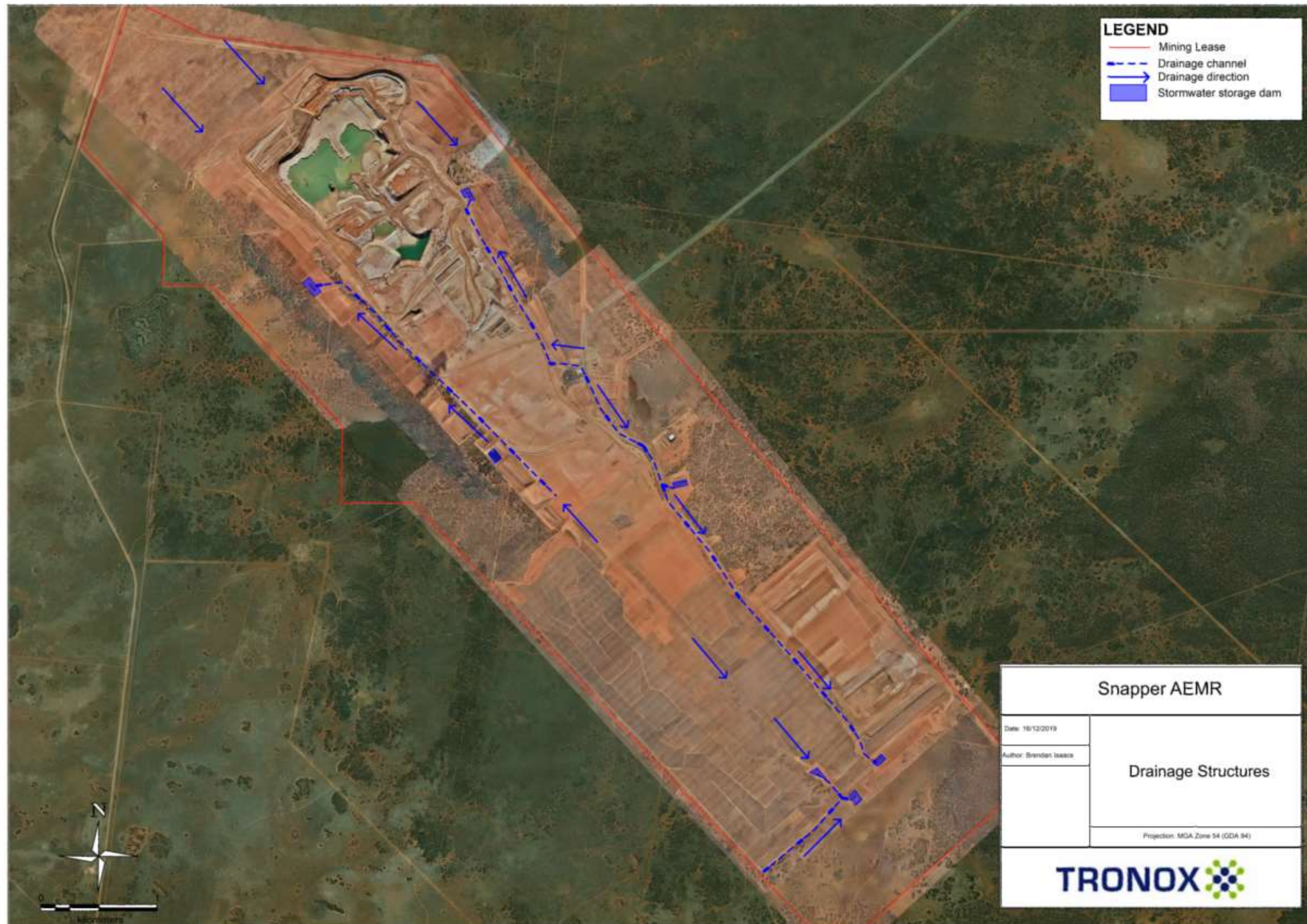


Figure 9- Site Drainage

Groundwater

A network of groundwater monitoring sites consisting of twenty monitoring bores is reported in this AEMR. The monitoring sites consist of existing landholder owned bores/wells, OEH regional monitoring bores and mining bores. The location of the existing and proposed groundwater monitoring sites are listed in Table 14 and identified in Figure 10 (Figure 11 shows regional bores).

Monitoring bores PW1 and PW1-2 located to the north of the mining pit are within the path of mining and were mined out by the overburden fleet during August 2018.

Tronox advised the NSW EPA prior to the bores being mined out as per section 3.62 (Consultation with EPA, other regulatory authorities and landholders) of the Murray Basin Mines Water Management Plan.

The remaining monitoring bores will be used to measure groundwater performance for the remainder of the project.

Table 14- Monitoring Bore Locations

Borehole/ Well ID	Description	Locality
PW1	Northern end of mine path	Local
PW1-2	Northern end of mine path	Local
SM2-1	Snapper Administration	Local
SM2-2	Snapper Administration	Local
SM3	South-western boundary fence	Local
SM4	Southern corner of lease	Local
SM5-1	4 km SW of site	Local
SM5-2	4 km SW of site	Local
GW36669	5 km NE of site	Local
GW36670	30 km WNW of site	Local
GW36820	17 km SSW of site	Regional
Trelega Bore	5km SE of site	Local
South Tank Bore	5 km NW site	Local
Court Nareen	22 km NNW of site	Local
Chalky Well	18 km N of site	Local
Greenvale	16 km NW of site	Local
M27-2	NW Corner of Ginkgo lease	Local
Bunnerungee	Bunnerungee Bridge, Silver City Highway	Regional
Coomba	Coomba Station, Silver City Highway	Regional
Karpa Kora	North East of Pooncarie	Regional

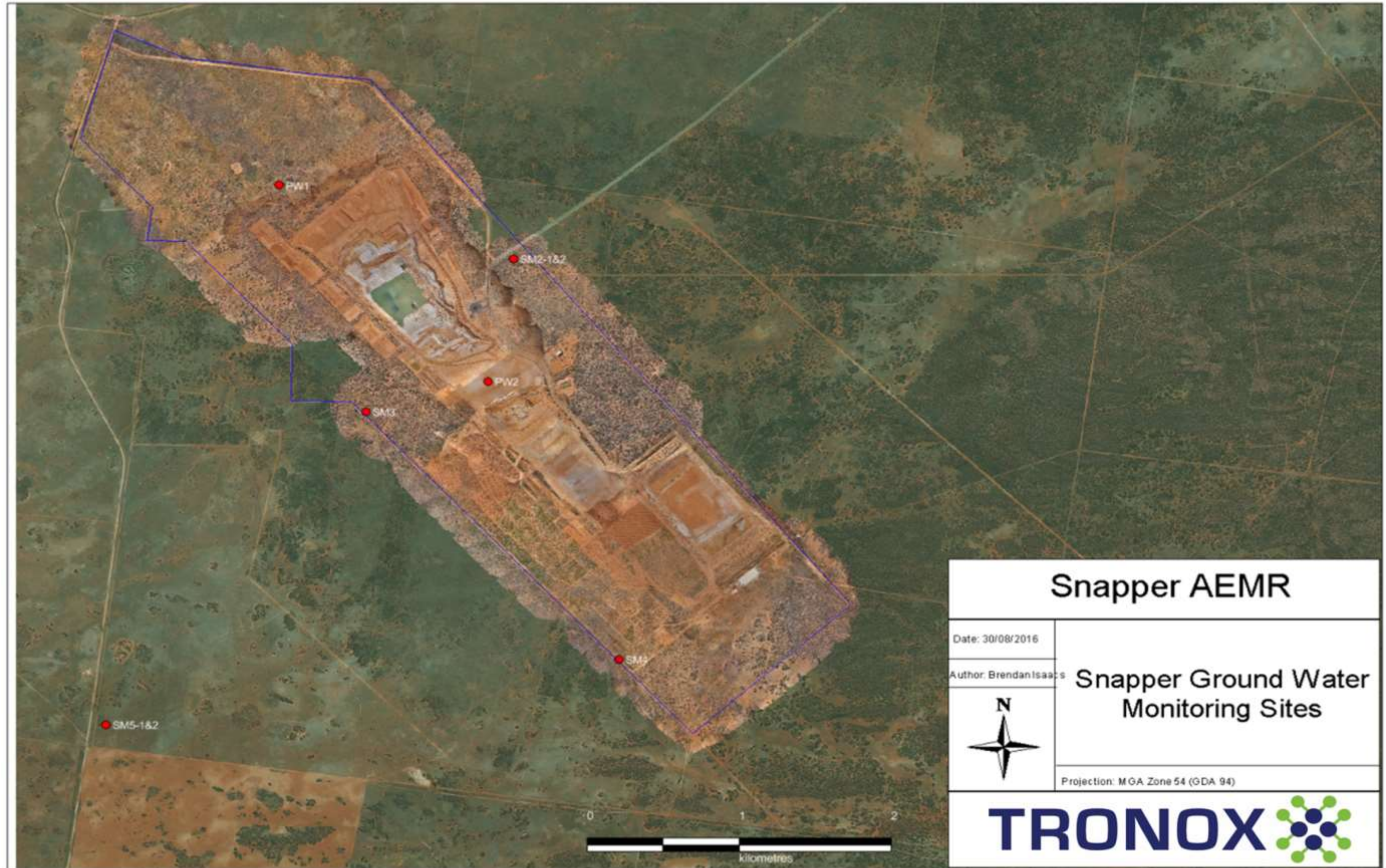


Figure 10- Local Groundwater Sites

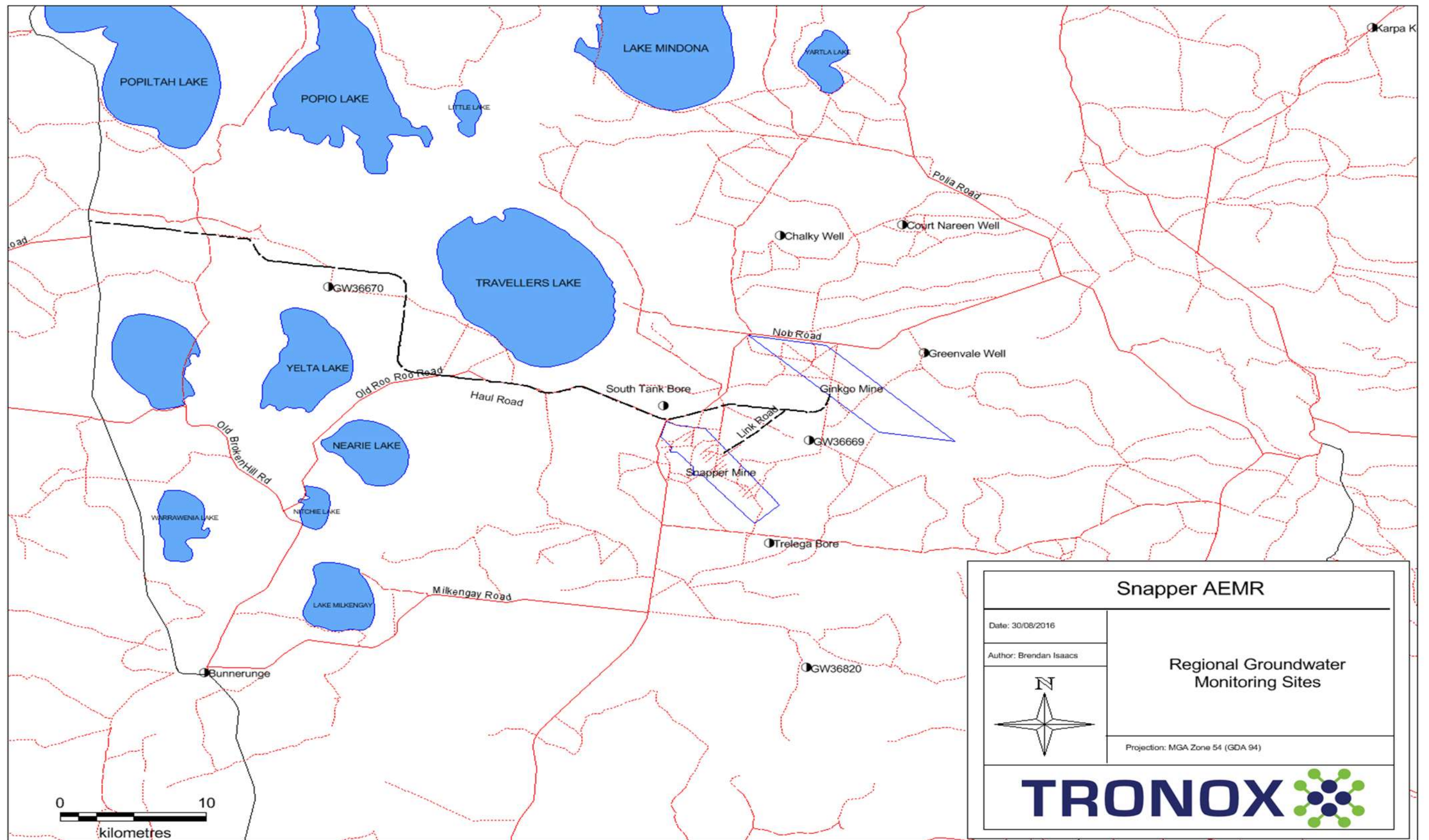


Figure 11- Regional Ground Water Sites

4.3.2 Performance

4.3.2.1 Groundwater Level

The monitoring wells intersect a large saline aquifer that extends west to the Great Darling Anabranch, east to the Darling River and south to the Murray River. Tabulated groundwater depths are provided in Appendix 2.

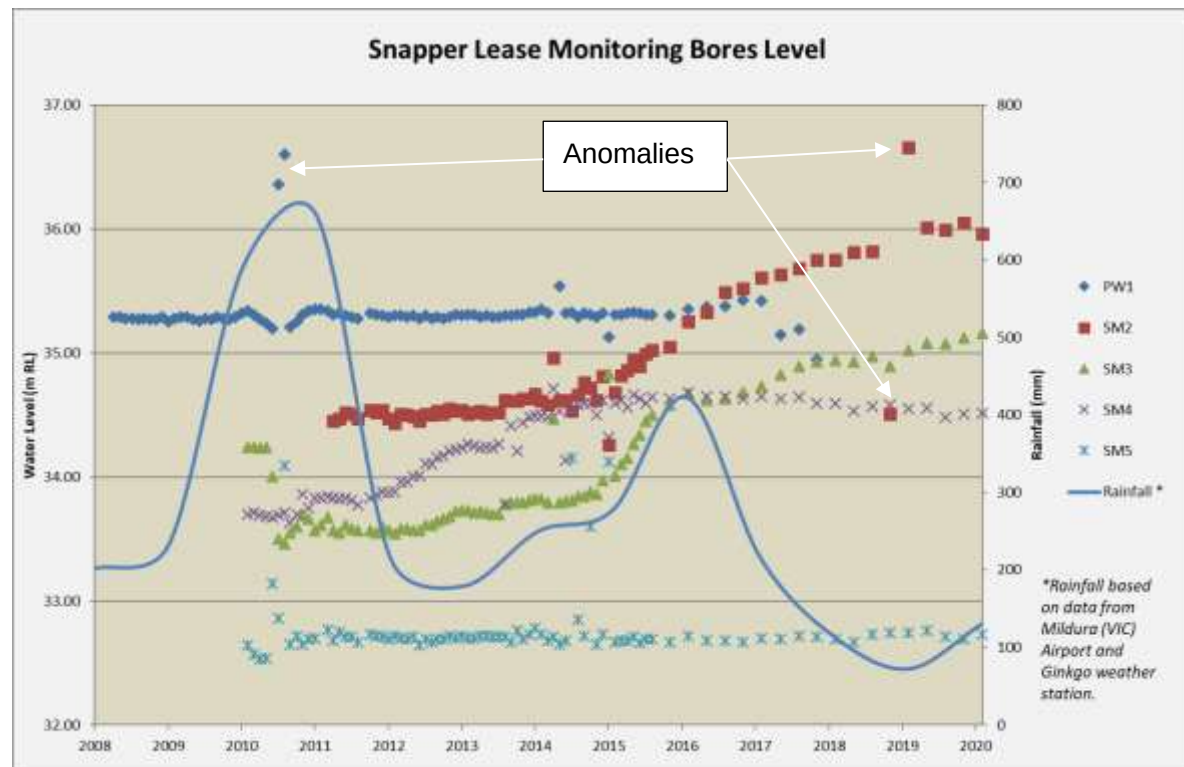


Figure 12- Snapper Lease Monitoring Bores

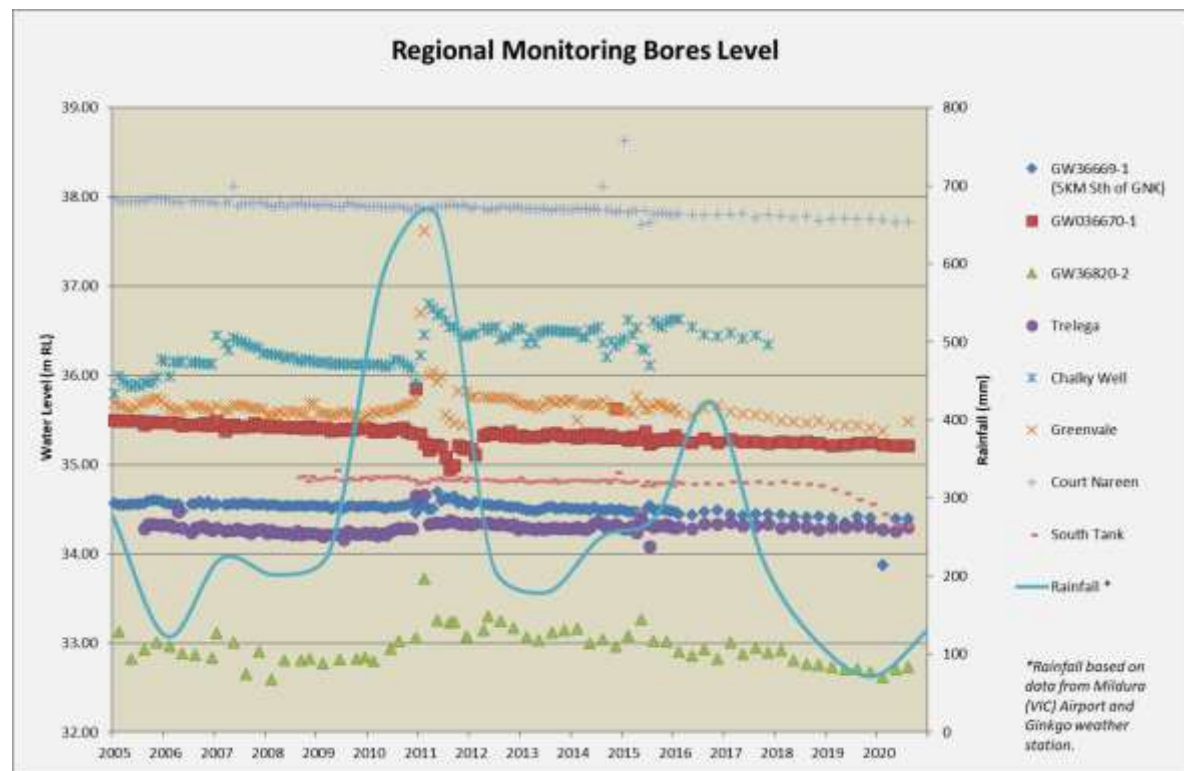


Figure 13- Regional Monitoring Bore Level

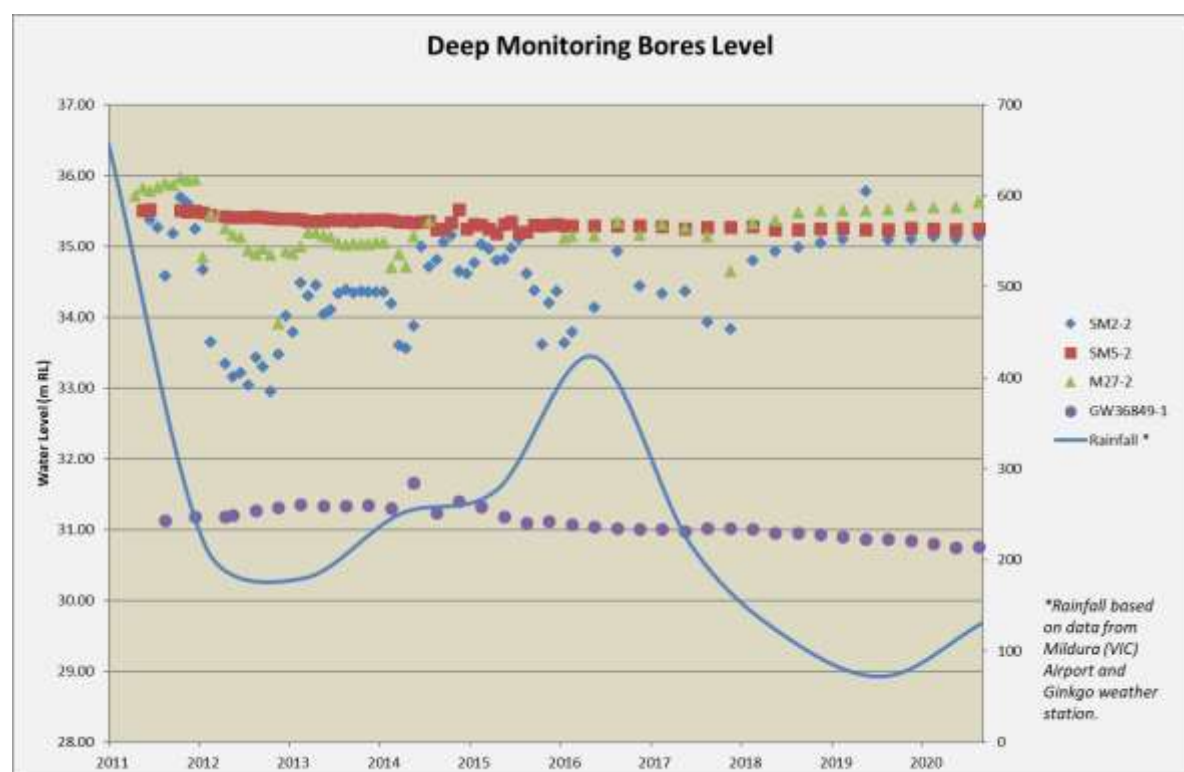


Figure 14- Deep Monitoring Bore Level

The Snapper site and regional groundwater levels have been generally stable since the start of mining, indicating little if any impact from mining operations. Bores SM2, SM3 and SM4

have shown an increase in level of between 1m to 1.5m since mining began, this rise in the water table occurs as the mining pit moves in closer proximity to these locations. As the mining pit advances past these locations the water level seems to stabilise.

A downward trend in “South Tank” can be observed from 2019 to 2020, localised lowering of the water table from mining operations as the pit advances north is the likely contributing to the drawdown in this region. Predicated drawdown at this location is 1m with South Tank being around 0.5m below pre-mining levels, well within predicated levels of modelling in the EIS.

Levels recorded at SM2 in May and August are anomalies, it was identified that there may have been an error with the monitoring equipment when taking the measurements.

Movement in the water table at Greenvale and Chalky Wells is most likely due to the fact they are shallow aquifers with wide openings and are therefore more influenced by rainfall. Furthermore, the water is of good quality and can be pumped for watering stock; this will also influence the water level. High rainfall in the area early in 2011 appears to have played a part in the brief rise of the water table at several other points as well. Bores 36820, Trelega and 36670 are located in low lying areas where water will gather. This rise hasn't been observed at sites where the bores are situated on slopes or higher in the landscape.

Figure 14 shows groundwater levels taken from deep monitoring bores located around the Snapper lease (SM2-2 and SM5-2) and further afield (M27-2 and Bunnerungee). The data shows they have been generally stable, however levels in SM2 have been quite variable since the start of mining. Given this well's proximity to the production bores and the fact they are located in the same deep aquifer, it is quite likely the trend observed is drawdown during times of high water extraction from the production bores.

4.3.2.2 Water Quality

Salinity (TDS) analysis is undertaken on a quarterly basis as per the required frequency described in the Snapper Environment Protection License 12799 for all the local monitoring bores and most of the regional bores. Tabulated groundwater TDS results are provided in Appendix 3. Figure 15, Figure 16 and Figure 17 show no significant changes in salinity levels since monitoring began. The slight upward trend in salinity levels at bore SM4 stabilises in late 2012 until 2018 where it has returned to levels similar to that of pre-mining. All other monitoring bores are relatively stable.

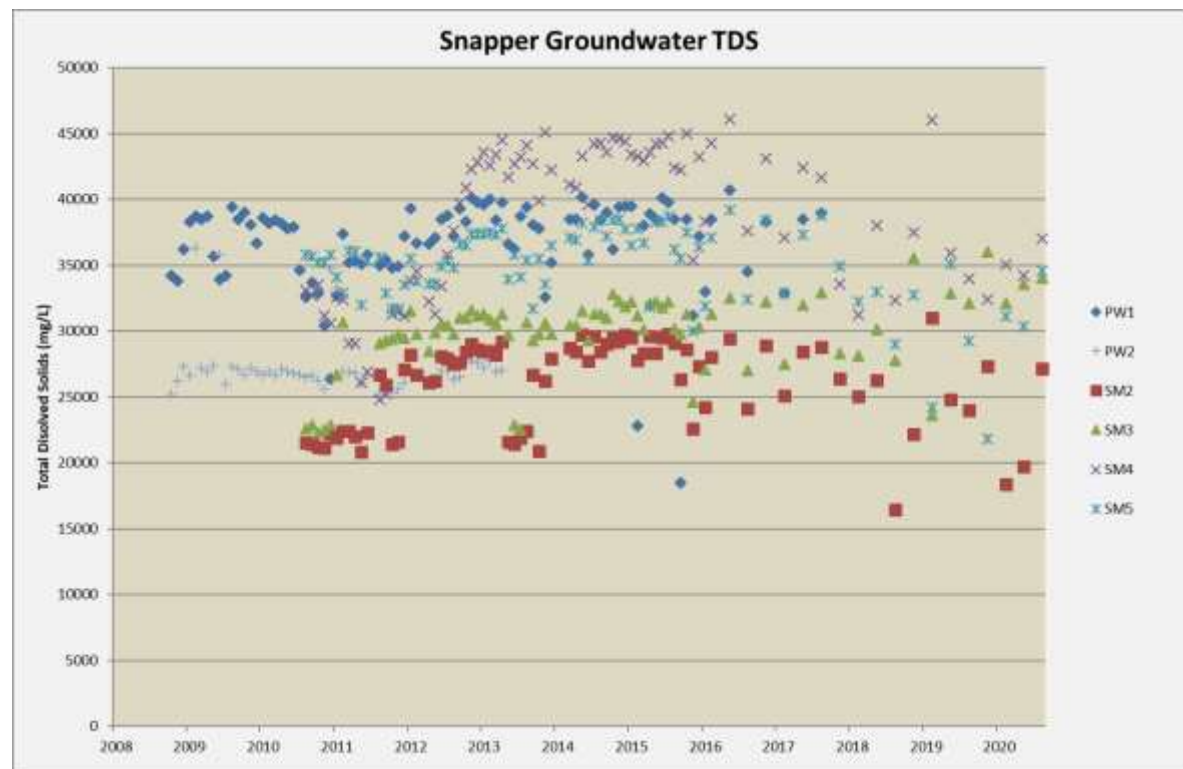


Figure 15- Snapper Groundwater TDS

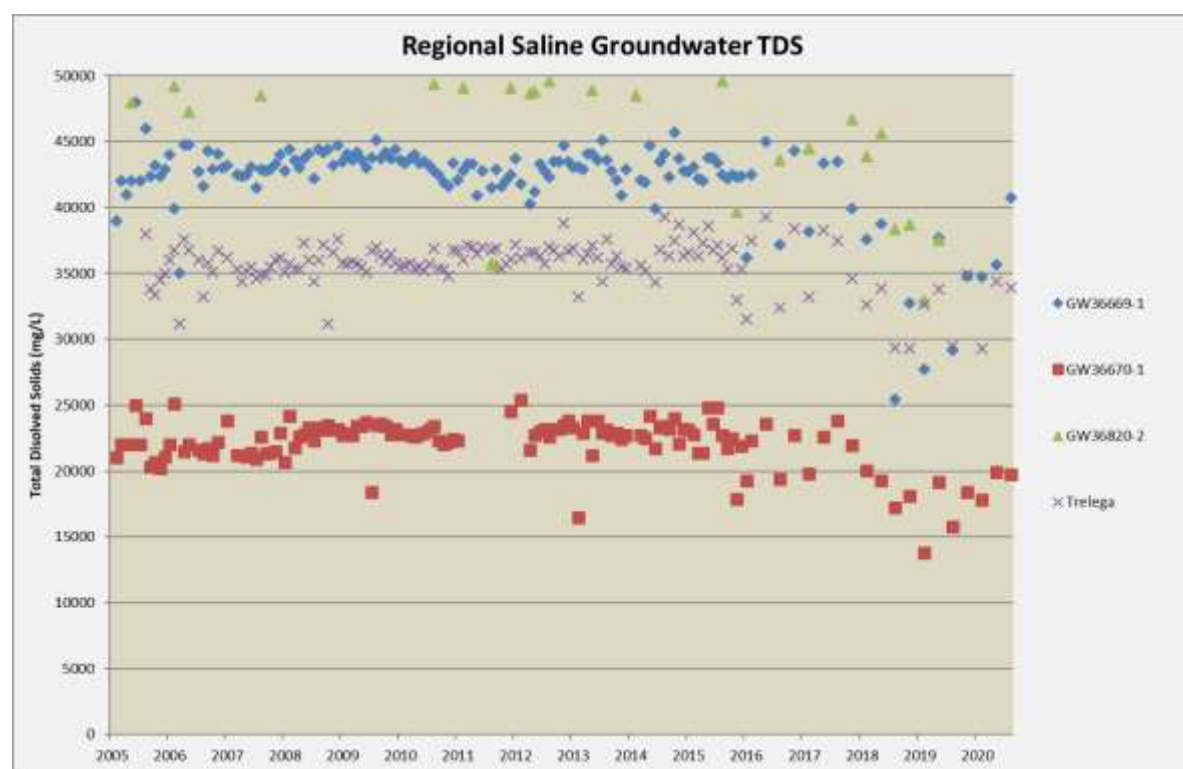


Figure 16- Regional Groundwater TDS

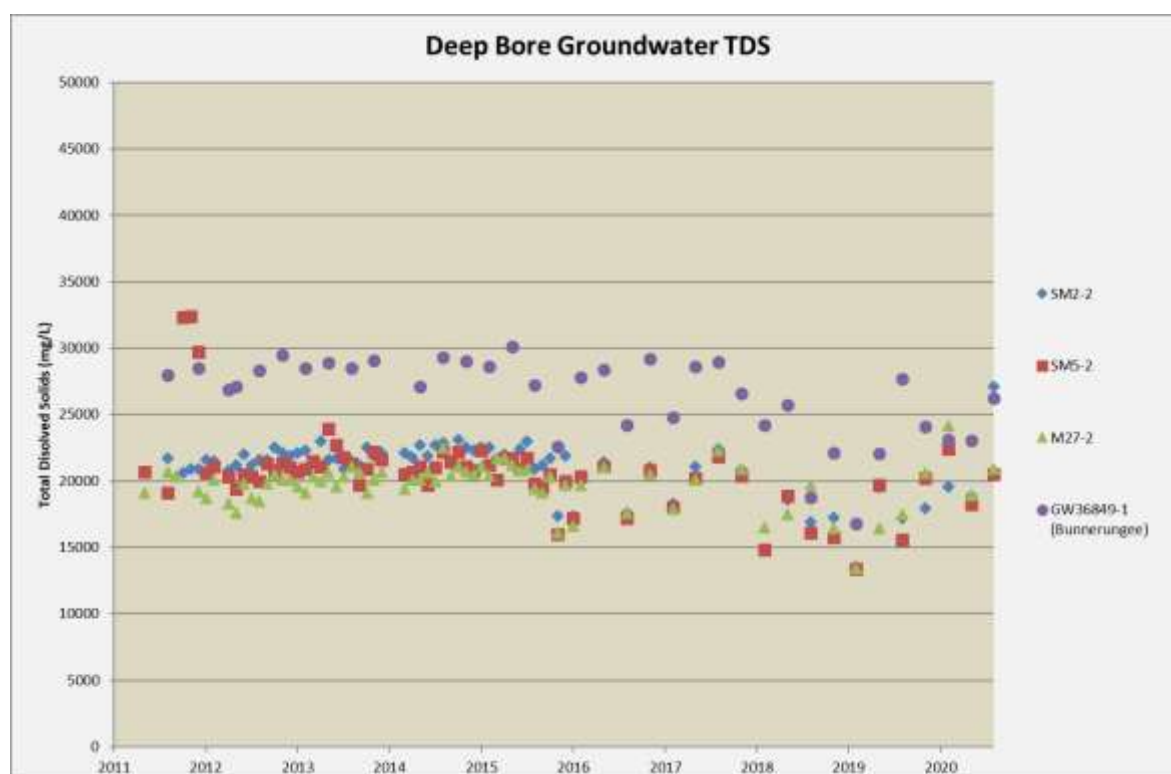


Figure 17- Deep Bore Groundwater TDS

4.3.2.3 Groundwater Extraction

The authorised extraction volume for water access licence (WAL27918) is 14000 ML per year. Table 15 lists the volume extracted for the production bores for the reporting period.

Production bore SB1 was decommissioned in August 2016 due to reduced demand for water required for level control in the mining pit and the need for the electrical infrastructure to progress north.

Table 15- Ground Water Extraction Volume

Bore No.	Licence No.	Licence Allocation (ML)	Volume traded	Volume Extracted (ML)
Bore 1 (SB1)	60BL216489	14000	-	Decommissioned
Bore 2 (SB2)	60BL216490	-	-	85.8
Bore 3 (SB3)	60BL216491	-	-	447.5
Total		14000	-	533.3

**The above figures for volume extracted (ML) are a total for the period 1st Sep-19 to 31st Aug-20 inclusive.*

The Snapper EA predicts the maximum drawdown in the lower aquifer to occur during year 7 of the snapper operations, with a 0.5m drawdown extending to a radius of 6km from the mine. A model of the predicted drawdown is shown in Figure 20 below.

At August 2020 (Year 11) the current draw down when compared to pre-mining levels is shown in figure 18 and Figure 19. The localised monitoring bores are within the predicted

drawdown ranges with the majority showing no change or a rise in level, the rise and fall of these monitoring bores is influenced by dredge pond and bore pumping activities and varies depending on location of the mining pit and pumping volumes.

Data from regional monitoring bores was compared from Jan 2005 to Aug 2020 (16 years) to look at any drawdown effects on groundwater from mining operations at a regional level. The regional drawdown levels are also within the predicted EIS levels with the average draw down of 0.29m recorded across bores that shown a reduction in groundwater level. Chalky well has not been monitored since the beginning of 2018 due to safety issues, therefore there is no current data for this site.

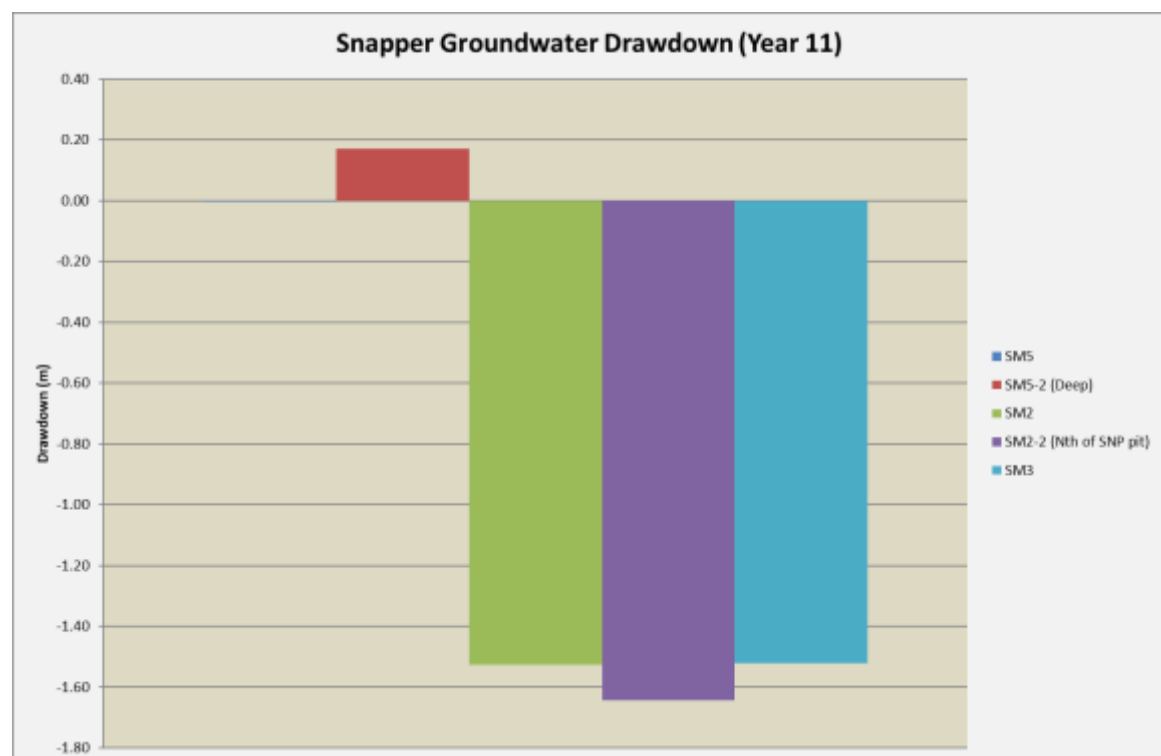


Figure 18- Snapper localised groundwater drawdown (Year 11)

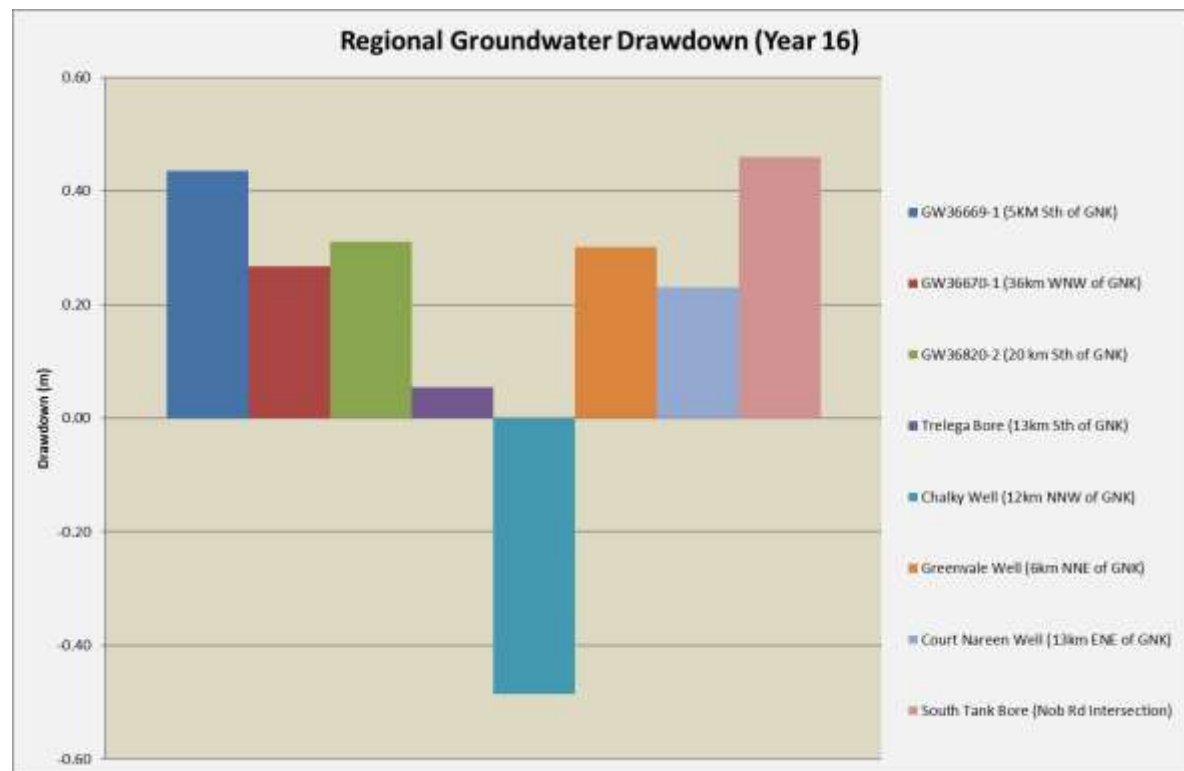


Figure 19- Regional groundwater drawdown (Year 16)

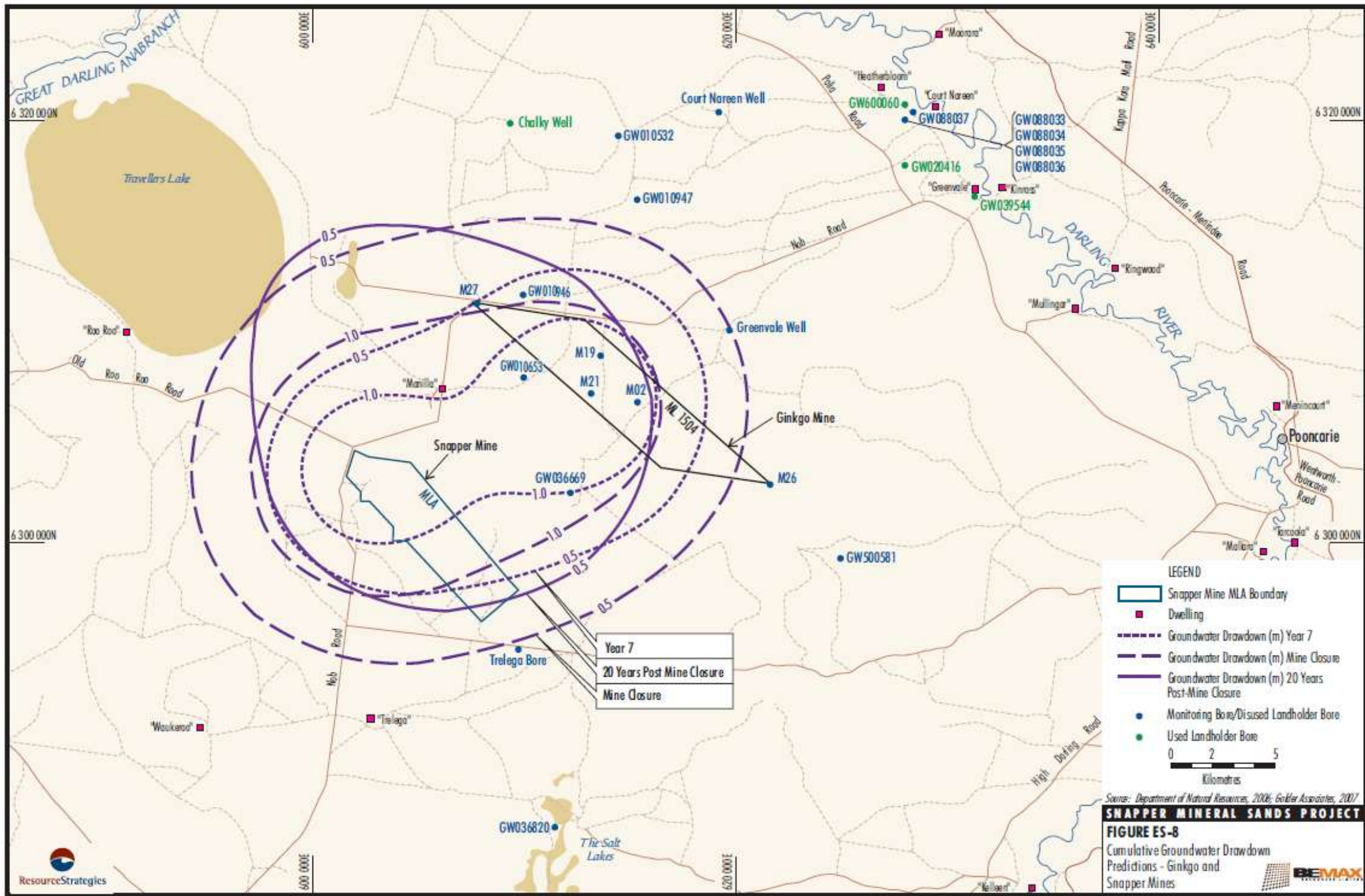


Figure 20- Cumulative groundwater drawdown predicted in EIS

4.3.3 Incidents

No incidents regarding water management were recorded during the reporting period.

4.3.4 Improvements

Monitoring programs consistent with 2018-2019 will be continued in 2019-2020 in accordance with statutory requirements.

4.4 Flora and Fauna

4.4.1 Management

A Flora and Fauna Management Plan has been prepared in accordance with Development Consent requirements for the construction and operation of the mine and associated infrastructure. The plan specifies the measures to be implemented to manage vegetation clearing activities, threatened species protocols, and reinstate, monitor and manage native flora and fauna habitat and communities.

Prior to any clearing on site a pre-clearance survey is conducted in line with the VCP (Vegetation Clearance Protocol) attached as Appendix 4 to this report.

4.4.2 Performance

4.4.2.1 Land Clearance

An area of 3.2Ha of degraded Chenopod shrubland was cleared for additional topsoil stockpiling.

As at 31st August 2020 an area of 27 ha has been stripped of topsoil for the mine-path progression in front of the dredge pit. At the end of August 2020 the topsoil stripping area was 500m on average in advance of the overburden benches and 1100m on average in advance of the ore face.

Table 16- Vegetation Clearance Schedule

Activity	AEMR Period	
	August 2020	August 2021
Clearance Area (ha)	3.2	85
Cumulative Clearance Area (ha)	1451	1536



Vegetation being pushed into windrows to be used in future rehabilitation

4.4.2.2 Biodiversity Offset 2 (Snapper Offset)

The snapper offset was setup in 2011 to account for impacts to flora and fauna as a result of disturbance activities associated with mining operations. Long term security of the offset has been established by changing the land use of the NSW Western Lands Lease from grazing to conservation for perpetuity of the lease.

An Offset Management Plan (OMP) has been developed to aid in the management and biodiversity enhancement of Tronox Offset areas.

The OMP outlines criteria that needs to be met for successful management and enhancement. Table 17 shows the status of completion criteria for the Snapper Offset at the end of the reporting period and outlines any works planned for the next reporting period. Figure 21 shows the current Tronox Biodiversity Offset areas that have been established.

Table 17- Offset Management Plan Actions

Measure/Management control	Completed	Actions taken during the reporting year	Actions planned for the following year
Fencing to exclude grazing	Yes	Complete	Maintain
Incremental destocking	Yes	Complete	Maintain
Removal of unnecessary fencing	Yes	Complete	NA
Erosion control	NA	NA for offset area	NA
Signage of offset areas	Yes	Complete	NA
Revegetation of unnecessary tracks	NA	NA for offset area	NA
Animal pest control	Yes	Fox baiting and goat control	Fox baiting, goat control
Weed management	NA	None	None
Fire management	Yes	Fire trail grading	Fire trail grading
Threatened species management	NA	None	None
Security of artificial waters	Yes		
Other actions taken	Yes	Ongoing ecological monitoring	Ongoing ecological monitoring

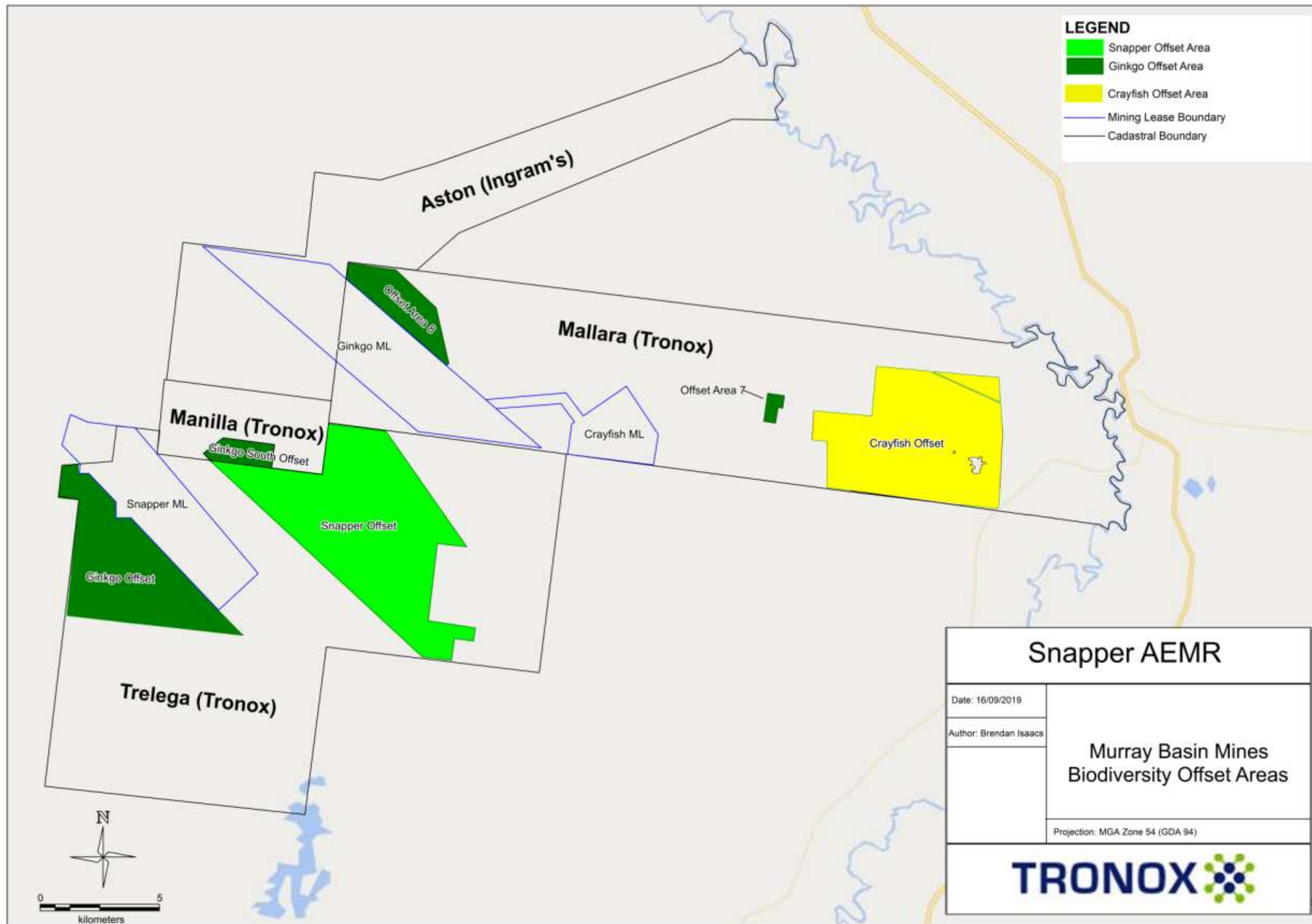


Figure 21- Murray Basin Mines Biodiversity Offset Area

Tronox's Biodiversity Offsets are monitored annually for the first three years and every three years after until the management completion criteria have been met as per the Offset Management Plan.

The Snapper Offset was monitored in 2018 by Ogyris Pty Ltd, below is a summary of the report.

Tronox Mining Australia Ltd is the owner of the Ginkgo and Snapper Mineral Sand Mines located 40km and 50km west of Pooncarie, respectively, in far southwest New South Wales. The Ginkgo Mine commenced operations in January 2006 with the Snapper Mine commencing in late 2009. As part of the Development Consent for both mines, the owner has been required to identify and protect two conservation offset sites which lie in close proximity to the Ginkgo and Snapper Mines in order to compensate for the loss of biodiversity and habitat associated with mine construction. In line with the objectives of the Offset Management Plan or OMP (Bemax 2011; GHD 2016), as well as conservation offset requirements dictated under the *Native Vegetation Act* 2003, routine monitoring of the flora and habitat values has been undertaken in May and October 2011, October 2012 and September 2015 to determine if current management of the reserve is leading to enhancement of flora and fauna values. This current report summarizes the results of vegetation monitoring as well as the status of pests and infrastructure conducted in September 2018 and compares these results with outcomes from preceding monitoring sessions extending back to 2011. In particular, emphasis is placed on the past two monitoring years (2015 and 2012) in order to provide a description of the trajectory of change over the past six years.

The Offset 2 land contains 7 plant communities described by Benson *et al.* (2006) as well as a number of modified vegetation types which have resulted from past attempts to clear the vegetation of the site by a former owner. A vegetation map has been drawn to show the location of the major vegetation communities and classes – including those areas where modified vegetation occurs. The regrowth vegetation is mostly Modified Bluebush Shrubland/Grassland Mosaic and Belah-Rosewood Woodland with reduced tree density, but appreciable areas of Open Grassland-Copperburr are also present. Seventeen permanent monitoring sites have been established across Offset 2 which sample all of the major vegetation community types.

Based on the monitoring and visual observations conducted, the following statements can be made on the condition and status of the vegetation within Offset 2 in September 2018:

- 1) Seventeen quadrat sites were assessed in early September 2018.
- 2) A total of 46 indigenous plant taxa and 0 alien plant taxa were recorded in spring 2018. This compares with 125 and 65 indigenous plant taxa and 28 and 9 alien plant taxa in spring 2015 and 2012, respectively.
- 3) The 2018 result saw a massive loss in plant diversity which in spring 2018, was at the lowest baseline ever recorded from Offset 2, after being at the highest ever recorded in spring 2015.
- 4) Indigenous plant cover across all monitored sites varied between 1-30% and averaged ~14% in spring 2018. This compares with a plant cover range of 3-44% and average of ~22% in spring 2015, and 8-36% and average of ~20% in spring 2012.
- 5) Indigenous plant cover levels in all vegetation types other than Spinifex-Mallee were extremely low, however, and varied between 1-10% with an average for Offset 2 of 5%.

- 6) Spinifex-Mallee sites maintained plant cover at average levels of 23%, but in all cases the ground flora was present in an extremely stressed state.
- 7) Weeds were not recorded in Offset 2 quadrats or transects in spring 2018.
- 8) The degraded condition of the vegetation in Offset 2 in spring 2018 can be largely attributed to sustained drought conditions, but the presence of significant numbers of Dorper Sheep within the reserve was also contributing to the problem.
- 9) The sheep were present due to the presence of numerous breaches beneath the boundary exclusion fence, including at some poorly constructed gates.
- 10) Sections of the boundary fence were also lacking top and/or bottom barbwires, consequently facilitating the task of kangaroos excavating under the fenceline.
- 11) The systematic mustering of Feral Goats which commenced in late 2014 would appear to have reduced numbers within Offset 2 judging by monitoring results which show reduced scat (dung) densities at the majority of monitoring sites.
- 12) Rabbit infestations were substantially lower in spring 2018 due to a rabbit ripping program conducted in mid-late 2017.
- 13) Kangaroo numbers were highly variable across Offset 2, but were particularly high in Belah-Rosewood, Sugarwood Woodland and some Spinifex-Mallee sites.
- 14) Consideration should be given to culling kangaroo numbers within Offset 2, especially considering the impact of the current drought.
- 15) Tronox Mining were partially compliant with criteria 1 and 2 and fully compliant with criteria 3-14 outlined in the current OMP (GHD 2016); with these criteria aimed at improving biodiversity outcomes within Offset 2.

The enhancement of flora and fauna values of Offset 2 was achieved in the period post construction of the perimeter fence in 2011 with major gains leading up to spring 2015. Recovery from a very low flora baseline in spring 2018 can be achieved in line with OMP objectives, after abatement from the current drought conditions. Currently, however, the most important measure to improve biodiversity within Offset 2 will be to provide adequate resources on an ongoing basis to fix fence breaches caused by kangaroos excavating under the existing fence. Sheep will need to be removed from Offset 2 and current pest animal reduction strategies maintained.

The next scheduled vegetation monitoring of Offset 2 should be undertaken in line with OMP directives in spring 2021.

4.4.2.3 Other Management

Fox Baiting

Fox baiting was conducted on 16 April 2020 where 200 fox baits (1080 in chicken wings) supplied by the Local Land Services were placed around the perimeters (inside the boundary fence) of the conservation offsets.

Signage was placed on all gates advising of fox baiting in these areas, mine site personnel and neighbours were notified of the activity.

Goats

A regular mustering program is in place whereby the contractor conducts the mustering and Tronox receives 20% of the profits which help fund community events and grants. Approximately 195 goats were removed from Tronox sites during the reporting period. In addition to mustering other strategies include use of traps around water points, removing un-

wanted water points and ongoing regular fence inspections. With the combination of these strategies goat numbers have been reduced to a more manageable number.

It is imperative that we continue to implement such strategies to aid in reducing grazing pressure on rehabilitated areas, offsets and surrounding farming land. Newly established vegetation in rehabilitation areas is especially vulnerable to goat attack and browsing can cause mass mortalities.



This photograph illustrates the importance of goat control and the damage goats can cause even to guarded trees. (2019)

The Black Box *Eucalyptus largiflorens* trees illustrated above sustained total foliage loss as a result of grazing during the drought. The photograph below illustrates the response of vegetation once grazing pressure from Kangaroos and feral goats is reduced or removed.



New growth on Blackbox saplings after grazing pressure removed.

Fencing

The entire Snapper mining lease boundary (26km) has a 30cm apron at the bottom of the fence to prevent kangaroos and goats from traversing under the fence and accessing rehabilitation sites. Holes are created by the scratching of kangaroos along the perimeter of the fence and eventually the holes become big enough to allow both kangaroos and goats to traverse under.

One-way spring gates and ramps are installed in selected corners of the lease with the intention that goats and possibly kangaroos would exit the lease. The gates would also be used during mustering to push both kangaroos and goats off the lease. Animal activity at the base of the spring gates and observations captured by trail cameras confirm that both Kangaroos and Goats are exiting the lease.

Since the installation of the fence apron, ramps and spring gates it is evident that the number of kangaroos and goats on the lease have decreased substantially.



One-way spring gate and ramp to allow herbivores to exit the lease



A trail camera capturing a goat exiting the lease.



Apron attached to bottom of fence

Weeds

Inspections for Bathurst Burr (*Xanthium spinosum*) were carried out but weeds have not been observed during the reporting period due the drought conditions experienced.

Autumn rains in late April have resulted in an increase in weed presence in rehabilitation sites, whilst the weeds are not noxious, or a real concern weed density will be monitored through visual inspections periodically. If weed populations become a threat to the succession of native plant species then an integrated weed management strategy will be implemented. It is difficult to control broadleaf weeds in rehabilitation areas with a chemical application as spraying will knock out native vegetation also. Mechanical removal might be a viable option, but the scale of the rehabilitation sites may limit this methodology.



Smooth mustard weed present in isolated patches throughout Snapper rehabilitation sites (Native spear grass *Austrostipa nitida* also has a high presence after recent rains)

Flora

Drought conditions from 2017 to 2020 have meant much of the rehabilitation has undergone severe moisture stress and signs of defoliation and dieback are evident. Dieback of large trees has been observed in remnant Belah woodlands, this is a true indication of how severe the drought is and the impact it is having on native flora.

In a 24 month period, from 1 January 2018 to 31 December 2019 only 210.8mm of rainfall was received. This is still 60-70mm below the average annual rainfall in the region over a 2 year period. It wasn't until April 30th 2020 that a significant rain event of 25.2mm was received and another event of 28.2mm between 7th and 8th of August. The much needed rain to the region has seen a tremendous response in revegetated areas.



Revegetation showing sever signs of moisture stress (October 2019)



Much needed rains have seen revegetation areas respond positively. (August 2020)

4.4.3 Incidents

No incidents regarding flora and fauna were recorded during the reporting period.

4.4.4 Improvements

Vegetation assessments were carried out as part of the Snapper Northern Extension (Mod 7) to assess impacts on biodiversity values. The extension area comprised mainly of heavily grazed Chenopod shrublands whilst the areas for relinquishment consisted of Belah-Rosewood open woodlands and Chenopods shrublands. The area subject to disturbance (87.4Ha) has little biodiversity value and is highly degraded whilst the other study areas (90.7Ha) for relinquishment consisted of relatively intact Belah-Rosewood woodlands. There has been a net positive outcome for biodiversity values and a net reduction in the disturbance footprint of 3.3Ha).

4.5 Noise

4.5.1 Management

Tronox has prepared a Noise Management Plan (NMP) in accordance with Development Consent requirements for the construction and operation of the mine. The NMP prescribes the frameworks to monitor, assess, investigate, mitigate, and report noise generated by the mining operation.

4.5.2 Performance

The original Snapper Environmental Assessment studies suggested that the cumulative effects of noise emissions from the Ginkgo Mine in the Snapper Mine area are considered to be small with noise levels at or below 35dB(A).

In August 2017 Tronox obtained a signed agreement with the landholder of Woodlands and Manilla station that noise monitoring will no longer be required at either residence due to the continuing excellent performance in low noise.

The Noise Management Plan was amended to include details of the agreement and was approved by the Department of Planning & Environment on 19 February 2019.

Tronox has assured residence should they have any concerns about noise related to mining activities, to contact the environmental department to have the matter investigated and any mitigation measures necessary will be adopted to minimise impacts.

4.5.3 Incidents

No incidents related to noise occurred during the reporting period.

4.5.4 Improvements

During 2020 an in principal compensation agreement for noise being generated at the Snapper mine has been reached between Tronox and nearby landowner of Manilla Station. Concerns were raised in July 2019 that noise was increasing as the Snapper mine advanced closer to the premises.

Noise generated from the Snapper mine has been confirmed by an independent noise expert to be within the 35dBA limit set by The Noise Policy for Industry (NSW EPA 2017) and the Snapper Development Consent. Notwithstanding Tronox are within the required noise limits, it is acknowledged that stakeholder relationships are important for the continuity of mining operations and therefore noise mitigation measures have been offered to minimise the impact of noise on the Manilla residence.

4.6 Indigenous and European Heritage

4.6.1 Management

Tronox has prepared a Murray Basin Mines Cultural Heritage Management Plan in accordance with Development Consent requirements for the construction and operation of the mine and associated infrastructure. The Murray Basin Mines Cultural Heritage Management Plan addresses the consultation program with the local indigenous community and identification, assessment, monitoring, conservation and management of archaeological heritage.

The plan included results from Aboriginal heritage surveys and assessments of ML 1621, the ETL and the haul road linking the Snapper and Ginkgo mines. The surveys and assessments

were undertaken in accordance with DPIE Biodiversity Conservation Division (formerly Office of Environment and Heritage) requirements and in consultation with representatives from local Aboriginal organisations. Aboriginal and European heritage sites are shown in Figure 22.

4.6.2 Performance

The objectives of the Cultural Heritage Management Plan (CHMP) were achieved in the reporting period with impacts controlled in accordance with statutory conditions.

The majority of sites identified during Aboriginal heritage surveys were isolated stone artefacts or heat retainers from hearths. During 2008, all artefact sites that will be impacted by mining operations were salvaged in accordance with the CHMP. Stone artefacts and hearthstones were collected from the exposed surfaces of nineteen Aboriginal archaeological sites located within the Snapper ML1621. Four *in situ* hearths were excavated at one of these sites.

The aims of the archaeological investigation were to examine the lithic technology and reduction strategies adopted at the Aboriginal sites and determine the ages of the hearths. This research design included an analysis of the contexts of the artefacts, in an effort to better understand and interpret local and regional patterns of past Aboriginal settlement and resource use. The program was also aimed at protecting Aboriginal cultural heritage items.

The archaeological sites are fifteen scatters and isolated finds of stone artefacts, two stone quarry/stone artefact scatter site complexes and two hearths. One of the scatters of stone artefacts also contained associated scattered calcrete hearthstones and one had four *in situ* hearths with baked clay heat retainers.

The Aboriginal archaeological sites in the Snapper study area generally contained a low density of Aboriginal stone artefacts. A total of 516 stone artefacts were recorded, with a minimum of one stone artefact and a maximum of 162 stone artefacts collected at each site. The main lithic resource was silcrete, which comprised 96 % of the assemblages and was probably derived from the two stone quarries and other known nearby silcrete outcrops. Other lithic materials represented included 10 chert artefacts, 4 quartz artefacts, 3 sandstone artefacts and 2 quartzite artefacts.

The abundance of amorphous flakes, flaked pieces, angular fragments and cores (94 %) at most of the archaeological sites in the Snapper study area is typical of stone artefact assemblages near stone sources. The large size of many of the artefacts is also diagnostic of sites proximal to stone quarries.

Two of the hearths contained preserved charcoal, which was dated to 1075 ± 105 (Wk-22900) and 380 ± 80 (Wk-22901) calibrated radiocarbon years before present (cal 14C yr BP). A heat retainer from the younger of these hearths was dated by optically stimulated luminescence to 320 ± 30 years ago. These ages, coupled with the fact that artefacts appear to be restricted to the present land surface, suggest that most of the archaeology dates to the late Holocene (ie. the past few thousand years).

Most of the artefact assemblages in the Snapper study area, particularly those at its south-western end, relate spatially and contextually to stone resource sites. These lack clear

evidence of domestic archaeological components such as grinding implements and other formal tools, hearths and organic remains. Aboriginal people probably only visited the stone quarries and associated stone artefact scatter sites for brief periods to procure lithic material.

Several sites in the north-eastern section of the Snapper study area have hearths, imported stone and artefacts such as grinding implements that reflect domestic habitation. They probably represent temporary campsites occupied for brief durations by small, mobile groups who periodically journeying into the dune field hinterland of the Lower Darling River and Darling Anabranch to collect food plants and hunt animals. Hearths and hearthstones are probably the remains of cooking ovens. Based on the radiocarbon and luminescence ages from the dated hearths and from comparison with other dated sites at similar hinterland settings elsewhere in the Murray Basin, it is probable that most of this occupation in the Snapper study area occurred within the past several thousand years.



Exclusion fencing around a cultural heritage site

Two sites are outside the disturbance area and have been fence off for protection against accidental disturbance in accordance with CHMP.

Modification 7 was approved in March 2020, as part of the approval Aboriginal heritage surveys were carried out on 5 November 2019 by archaeologist (Landscape) in areas proposed for disturbance. Local Aboriginal RAPs were invited to partake in the survey, but all were unable to attend. No Aboriginal cultural heritage items were identified in the proposed extended mining area. No RAP's objected to the proposed modification.

4.6.3 Incidents

No incidents regarding Aboriginal archaeology or European heritage were recorded during the reporting period.

4.6.4 Improvements

Tronox Mining has recently executed an agreement to support a number of programs to assist the local indigenous Barkandji people.

The following assistance programs will be funded by Tronox over the term of the agreement.

Scholarships program

Tronox Mining to provide funding to establish a scholarship fund for Barkandji People for education purposes.

Memorial fund

Tronox Mining to provide a once-off payment to BNTGAC for the establishment of a memorial fund for headstones and other funeral expenses for Barkandji persons who have passed away and whose families have not been in a position to provide a suitable headstone or memorial.

Sponsorship of NAIDOC events and sports teams

Tronox Mining to provide support to establish a sports sponsorship fund for Barkandji.

Cultural excursions fund

Tronox Mining to provide funding for use by Barkandji People in cultural camps and cultural training.

Other informal employment opportunities that Tronox may offer in the future are:

Ginkgo mining camp employment program

Contract for the operation of the mining camp to reach an employment target of 10% Barkandji employees in the Ginkgo camp.

Contract for seeding/tree planting

Tronox Mining to facilitate the employment of Barkandji persons as employees of the seasonal tree planting program.

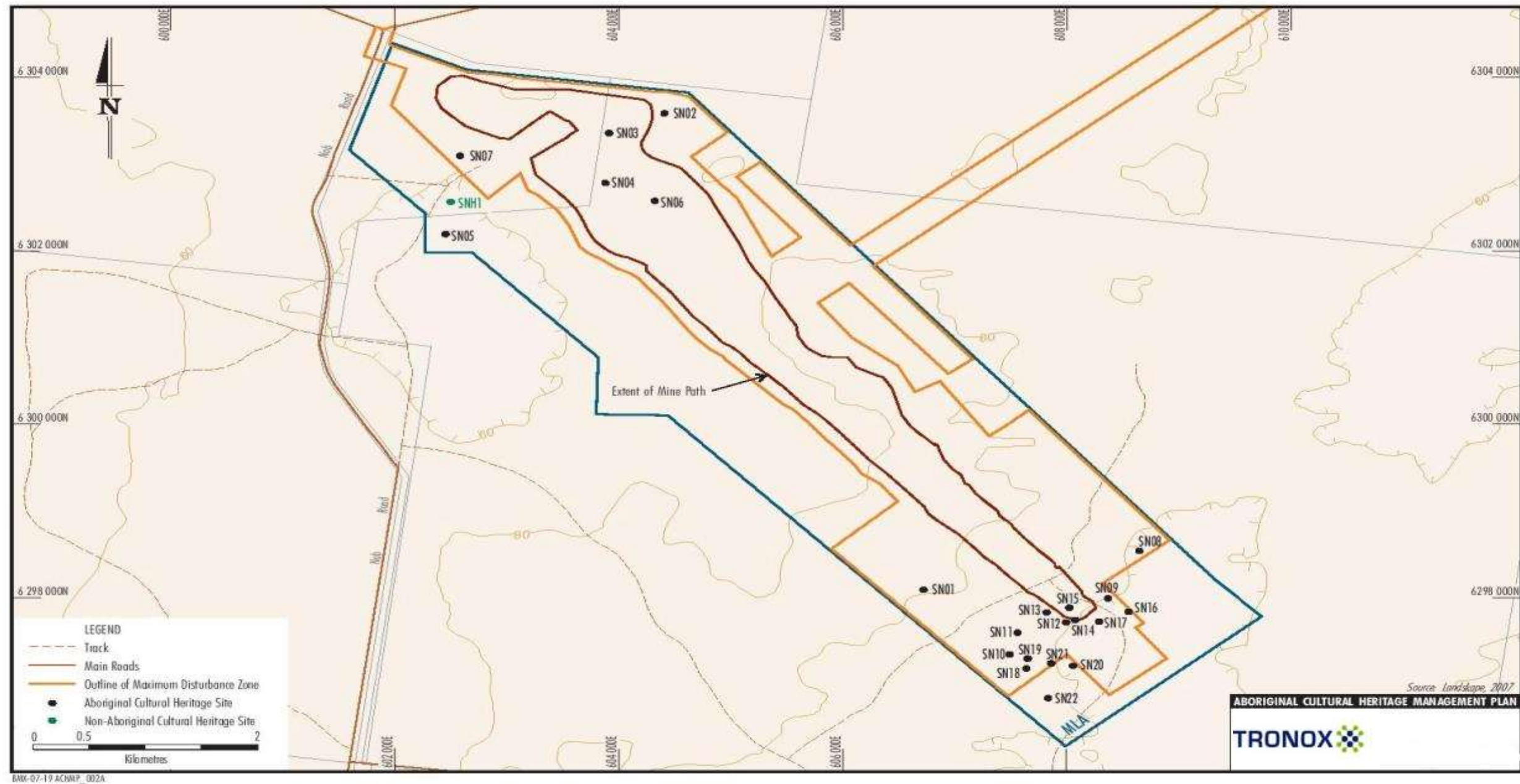


Figure 22- Location of Cultural Heritage Sites

4.7 Bushfire

4.7.1 Management

Tronox has prepared a Bushfire Management Plan (BMP). The BMP prescribes the frameworks the operation arrangements and fuel management strategies for the mining operation.

Tronox also employs an Emergency Response Coordinator as part of a cooperation agreement with Fire and Safety Australia. This adds another level of preparedness in case of fire in the region or on site.

4.7.2 Performance

During the reporting period fuel management strategies deemed appropriate was the maintenance of firebreaks around the mining lease, biodiversity offsets, Trelega homestead, power-line corridors, internal roads and maintaining access to water points.

The firebreak is designed to act as control lines for low-intensity fires and assist with safer access and egress for high-intensity fires. Firebreaks have been maintained using a grader.



Fire break along a boundary fence

4.7.3 Incidents

26 August 2020

During a planned burn of waste timber products in a designated and bunded area at the Snapper laydown yard, nearby scrap rubber pipes became hot and combusted due to excessive radiant heat from the fire.

The 2 attendees of the fire tried to cool the fire with a nearby fire trailer and water truck when they noticed the pipes beginning to smoke.

When it was evident that the fire was uncontrollable, one of the operators phoned the Emergency Response Team for assistance.

The ERT deployed the fire truck located at Ginkgo to the Snapper site and applied water and foam to the fire which brought the fire under control.

The fire was fully extinguished and fire watch was initiated for the next 24 hours.

4.7.4 Improvements

Improvements to the management of timber waste will be made to ensure excessive amounts of timber are not accumulating onsite. Alternative means of disposal will be investigated if burning is determined to be too high of risk

Monitoring of fuel loads will continue in 2020-2021. Areas for fuel reduction strategies will be selected annually considering the recent fire history, fuel hazards present and environmental considerations of the area. Appropriate fuel reduction strategies will then be selected and implemented according to the Bushfire Management Plan.

The site accommodation fire alarm system continues to be tested weekly by the camp operator.

4.8 Radiation

4.8.1 Management

Tronox prepared a Waste Management Plan in accordance with the Development Consent conditions for the construction and operation of the mine and associated infrastructure. The Waste Management Plan outlines the strategy for low level radioactive waste material from the Broken Hill MSP to be backfilled at the Snapper Mine.

No waste material was disposed of at the Snapper Mine during the reporting period.

The MSP rejects are made up of blended wastes from the 'wet' and 'dry' plants. The MSP rejects emit low levels of radiation. This is due to the fact that heavy mineral sands ore bodies contain traces of the natural radioactive elements uranium and thorium together with

their daughter nuclide. One process waste (monazite) generated at MSP has a higher level of radioactivity. The monazite fraction of the MSP rejects determines the overall radioactivity levels of the MSP rejects.

Waste is managed as follows:

- On separation from the product zircon mineral, the monazite reject stream is directed to a process sump where it is moistened and blended with other waste streams to produce MSP rejects;
- The MSP rejects are then stored as a damp (“pugged” or slurried) waste material with a total activity level of 190 Bq/g;
- The MSP rejects are then stored in a concrete storage bay fitted with overhead sprinklers;
- Each truckload of MSP rejects is sampled with a gamma radiation meter at 1 m and the reading recorded on the Shippers Declaration Form; and
- Stockpiled “pugged” MSP rejects are subsequently back loaded into mineral concentrate trucks for disposal at the Ginkgo Mine.

The MSP rejects are transported by a contractor, who is licensed by the NSW EPA to transport this material.

The MSP rejects are dense and not prone to dusting, presenting an inherently low hazard material. They do not require shielding and persons can work near it for an extended period (about 100 hours) before approaching or exceeding the Annual Radiation Dose Limit for Members of the Public as set by the *Radiation Control Regulations 2013*. If there is no dust Suspension in the air, then radiation dose by inhalation will not occur as a secondary pathway for whole body radiation exposure.

4.8.2 Performance

Prior to operations, background radiation levels were measured using a gamma dose rate meter to record background levels in the environment. The gamma radiation readings at natural ground surface were measured one metre vertically above the surface are recorded over grid pattern over the mine path. As there is no material deemed to be radioactive currently disposed of on site, no monitoring was strictly necessary, however radiation dose monitoring is conducted at various locations across the Snapper site every 3 months. The average reading recorded between September 2019 and August 2020 was 0.54 $\mu\text{Sv/h}$. All rejects from the Broken Hill MSP are currently blended into the tails at the Ginkgo mine.

4.8.3 Incidents

No incidents regarding radiation were reported during the reporting period.

4.8.4 Improvements

Radiation monitoring will continue to be undertaken in accordance with statutory requirements and the Waste Management Plan and the Environmental Monitoring Program (EMP).

4.9 Hydrocarbons

Management of hydrocarbon contaminated soils is ongoing at the Snapper Mine. The current technique involves the use of a bioremediation area that is designed and managed in accordance with Tronox safe operating procedures.

Contaminated soil material from spills are taken to the bioremediation area and placed within the plastic lined and bunded structures. The contaminated soil is spread out over the area and a layer of Enretech remediator is applied and mixed periodically to induce aeration and biological activity.

Dams are treated in 3 stages and then left for 90 days to allow for effective bioremediation of hydrocarbon contaminated soil before each dam is cleaned out and returned to the backfill in the mine void.

All treatments and clean ups are recorded on a spreadsheet so the environmental department can keep a track of which dams have been treated and cleaned out so treated material isn't contaminated with further hydrocarbon waste.

Signage has been installed stating which dams are open for use or closed for use to prevent unwanted placement of contaminated material.

During the reporting period no reportable hydrocarbon spills occurred at Snapper. Tronox Mining has a policy that any hydrocarbon spill over 10 litres will be internally reported. Spills will be externally reported if material harm to the environment is caused in line with the *Protection of the Environment Operation Act 1997*.

4.10 Public Safety

The site is closed to the public and access is via the Tronox site office. The mine site is fenced to restrict unauthorised access and warning signs are in place. Fencing consisted of a standard stock-proof fence the access gates are fitted with padlocks. A security gate has been placed at the main entrance from off the Mine Haul Road. Employees and contractors are required to be inducted to the site. All visitors are accompanied at all times whilst on the site. Card reader boom gates are installed at Snapper as a way to monitor all personnel onsite. There were no reports of unauthorised access to the mine site during the reporting period.



Snapper Boom Gates

4.11 Blasting – N/A

4.12 Spontaneous combustion – N/A

4.13 Methane drainage/ventilation – N/A

5 COMMUNITY RELATIONS

5.1 Environmental Complaints

No complaints were received during the reporting period.

5.2 Community Liaison

Due to the COVID 19 pandemic only essential workers have been permitted to site and contact with the local community has been restricted.

6 REHABILITATION

In June 2020 a revised (Revision B) Snapper Mining Operation Plan was approved by the Resources Regulator for the period 2015- 30 November 2020. The rehabilitation commitment stated in the Snapper MOP has been largely achieved. However, this is difficult to quantify as the Mining Operation Plan is based on tonnage of ore moved and not time, therefore a direct comparison of year's achievement is difficult to conclude.

A summary of the rehabilitation activities which were undertaken at Snapper during the reporting period include;

- Seeding 53ha of off path tails dam and stockpile areas
- Establishment of a two 2ha fenced and irrigated tree plots (1600 trees)
- Establishment of one 2ha fenced and irrigated direct seeding plot
- Tube stock in plots of 20 and guarded (600 trees)
- Ripping of unwanted tracks in rehabilitation sites
- Watering and maintenance of existing trees
- Seed longevity studies conducted by Swainsona Environmental Services (progress report 2020)
- Seed viability testing conducted by Swainsona Environmental Services
- Bulk earthworks and stabilisation of former water dam
- Preparation of areas with sub-soil and topsoil for seeding in 2021
- Annual ecological monitoring of scheduled sites

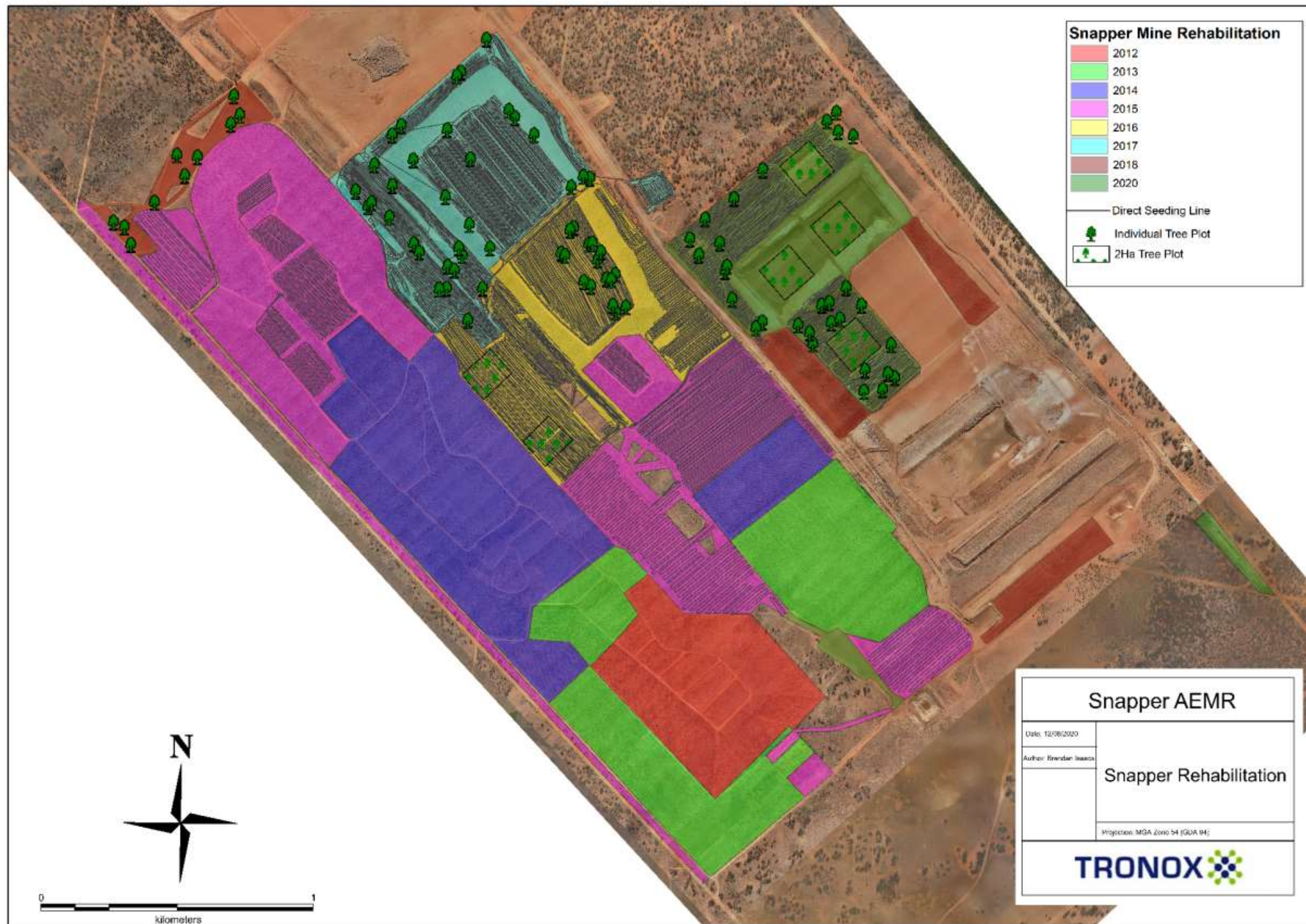


Figure 23- Rehabilitation Map

6.1 Seed Management

A range of native seed is collected by environmental contractor, Ecotypic, from local provenance or lands where native endemic seed is available subject to seasonal availability. The seed is stored onsite in a temperature controlled environment until sowing commences around May-June each year.

Each batch of seed is sampled and tested by Swainsona Seed Services for purity and viability prior to purchasing, this ensures Tronox is receiving good quality seed that has the best chance of germination in the rehabilitation environment.

A small portion of the seed used in revegetation is grown at Tronox's seed production area (SPA). Species that are difficult to collect seed from in any significant quantities in remnant areas are grown and seed is harvested and vacuumed up for storage.



Seed being vacuumed up in the seed production area

Chenopod Longevity Study of Black Bluebush (*Maireana pyramidata*)

Tronox engaged Swainsona Seed Services to investigate the storage longevity of several primary chenopod species used in seeding including silver saltbush, bladder saltbush, black bluebush and pearl bluebush. Seeds have been re-tested at approximately yearly intervals after storage to determine any loss of viability.

The latest report (February 2020) concluded that Black Bluebush can be successfully stored for 1-2 years without significant loss of viable seeds.

A summary of the current findings and current recommendations are provided below, and the full report is attached as Appendix 5.

- ONS 279 was the only *M. pyramidata* collection to show a rapid decline in viability during storage, with all other collections tested capable of storage in the Ginkgo Seed Store for at least 1-2 years. It is noted, however, that Duncan et al. (2019a, 2019b), also reported a decline of greater than 50% within 12 months of storage at 20°C for another collection of this species.
- Single collections of four other Bluebush species have also been shown to be capable of storage in the Ginkgo Seed Store for at least 3 years. However, as this study has shown variation between individual collections, it is recommended further collections of these species are added to the trial as seed becomes available.
- The ONS 279 results may have been affected by increased seed age, with seeds potentially 3 months older (or more) than other collections at each test interval. The results for this collection are also less reliable than all other collections due to the low number of replicates that were tested. These factors may have also attributed to the results by Duncan et al. (2019a, 2019b), with tests conducted on seeds with a similar age to ONS 279 (8 months old), and with low numbers of replicates and seed tested (4 replicates of 25 seeds).
- Variation in the seed longevity may also be attributed to varying seed maturity as well as environmental factors experienced by the parent plants during seed development. Both of these factors are difficult to control and will continue to vary with individual collections.
- The current Tronox seed store conditions may have reduced the potential shelf-life of individual batches or species. It is expected that improvements to the temperature and humidity would increase the shelf life of all species held within the seeds stores. As such it is recommended that at a minimum, the current air-conditioners should be upgraded so that a constant temperature is maintained year round. If possible, the RH should also be controlled and maintained at less than 15%. When further facilities are commissioned (due to increased seed volume requirements), it is recommended that they should be capable of a temperature of approximately 5°C and less than 15% RH. Improved conditions will be of particular benefit to species with short longevity under the current conditions (such as *M. sedifolia*), and allow storage of other species on a medium term basis (5-10 years), especially for species that seed infrequently.

- Current *M. pyramidata* collections should be continued to be monitored for at least 1-2 years under the current storage conditions in order to gain a better understanding of the average expected shelf-life for these species. Given the variation in results for *M. pyramidata*, additional collections of *M. sedifolia* should be added to the study (when seed becomes available) to verify existing results, as the potential lack of storage capability under the current conditions may create a 'bottleneck' in being able to return this species to the rehabilitated landscape.
- It is also recommended that, following any upgrades to the Tronox seed storage conditions, the storage performance of the above species (plus others) are monitored to ascertain changes in shelf-life. As storage space within each seed store is limited, investigations will also determine priority species that benefit the most from storage under the premium conditions (e.g. species currently with the shortest seed longevity).

Chenopod Longevity Study of Pearl Bluebush (*Maireana sedifolia*)

The latest report (July 2020) concluded that Pearl Bluebush should not be stored beyond 12 months due to rapid decline in viability. Collections should be made each year to fulfill the requirements for the following years rehabilitation program.

A summary of the current findings and current recommendations for Pearl Bluebush are provided below and the full report is attached as Appendix 6.

- The initial seed fill, viability and germination (viability adjusted) was found to vary across the 5 batches included in this study to date, with ONS 309 having the highest seed fill and ONS 443 having the lowest seed fill. Differences in seed fill and viability were likely due to the environmental conditions experienced by the parent plants prior to and during seed development, with sustained moisture across multiple months maximising initial seed fill and viability. Note that environmental conditions cannot be controlled and will continue to cause variation between individual batches.
- The longevity of all *M. sedifolia* batches tested to date (including Duncan et al., 2019) have significantly declined in viability within 2 years of storage. ONS 309 was considered to have aged at a greater rate than ONS 399, however, ONS 309 results may have been affected by increased seed age, with seeds potentially 12 months old during the initial tests. ONS 309 results are also less robust than the ONS 399 batch due to the low number of replicates that were tested. These factors may have also attributed to the results by Duncan et al. (2019), with low numbers of seeds used during tests (100 seeds).
- Based on the data to date, it is still recommended that *M. sedifolia* seeds should not be stored beyond 12 months. As seed availability is sporadic, with seed not available every year, the current lack of storage capability beyond 1-2 years continues to be considered as a potential 'bottleneck' in returning this species to the rehabilitated landscape.
- The humidity with the Ginkgo seed store has been shown to be above 40% for several months of the year. It is therefore likely to have reduced the shelf-life of *M.*

sedifolia batches to date. As such it is recommended that a dehumidifier is installed to reduce humidity to ~15% year-round. Once this occurs, the storage performance of future M. sedifolia batches should be monitored to ascertain the potential increases in shelf-life.

- The storage capability may also be improved if M. sedifolia seeds are stored in plastic lined woven Polypropylene (WPP) bags, rather than porous, WPP bags that allow moisture and gas exchange. To this end it is recommended that the current trial should be expanded to determine the effect of storage bag on the ONS 433, ONS 444 and ONS 449 batches.
- Unless the shelf life can be improved (as per above recommendations) other options, such as tubestock planting, may be required as substitutes to broadcasting seed in order to return this keystone species to the rehabilitated landscape.

Longevity Study of Belah (*Casuarina pauper*)

The storage longevity of *Casuarina pauper* (Belah) was also tested by Swainsona Environmental Services between 2016 and 2020 using batches of seed collected from 2015, 2016 that were previously analysed for viability.

Belah is a major component of the floristic composition surrounding the mines. As such, the re-establishment of this species is considered a high priority. However, seeds have been difficult to obtain from this species, with mass seed set only observed every five or so years.

This species in 2016 was producing mass seed set, with the potential to collect enough seed for the next 5-10 years of rehabilitation. However, information is currently lacking on ex-situ storage behaviour and it is unknown how long seeds could be stored without significant loss in viability.

A summary of the findings to date and current recommendations to date are provided below and the full report is attached as Appendix 7.

- Initial results indicated that Belah seeds should only be stored for 12 months, therefore contributing to a potential 'bottleneck' in the ability to return this species to the rehabilitated landscape. However, these results should be treated with caution as re-test samples were taken from either sealed or previously opened bags (bags opened and partially used during seed mixing), with the state of the bag not recorded.
- Current results on ONS 321 has shown that the condition of the bags (sealed vs unsealed) has impacted the rate of viability decline, with results using a sample from a sealed bag indicating that seeds are actually capable of storage for at least 4 years. The viability of ONS 322 has also remained stable after 4 years in storage. Although not confirmed as yet, it is suspected that the ONS 322 re-test samples have also been taken from sealed bags.
- As ONS 366 was found to have declined in viability within 2 years of storage, it is suspected that the re-test samples have been taken from unsealed bags. As such

further tests are required on ONS 366, using a fresh sample from sealed bags, in order to clarify the actual current viability of this batch after 3 years in storage.

- As the state of the bag is expected to have impacted results to date, it is recommended that all future re-tests on Belah seeds should only be conducted on samples from sealed bags, where possible. After sampling, opened bags should then be re-treated with CO₂ and resealed properly using a heat sealer.
- It is also recommended that in future any bags that are opened and partially used during seed mixing are re-treated with CO₂ and re-sealed to prevent an increased rate of ageing during subsequent storage.

6.2 Seeding Conditions

Seeding of 53Ha commenced at the former Snapper off path tails dam (OPTD) on 20 May and concluded on 25 May. Conditions for seeding native vegetation at Snapper this year were excellent with around 30mm of rain being received 2 weeks before seeding commenced. The final seeded surface presented with roughness allowing seed to maintain soil contact and not blow away. No significant follow-up rain was received until 7th August when 28.2mm of rain was received over 2 days. A further 11.2mm was received over several smaller events between 9th and 22nd of August. Initial germination was observed across seeded areas in the weeks following these rain events.

6.3 Dozer seeding

The Gessner drum seeder is a rotating cylinder with adjustable slots for controlling seed delivery rates, mounted to a D8 or D9 dozer and is used primarily to seed batter slopes that have timber spread over the surface. Felled timber from clearing activities is re-used and spread over the batters to improve erosion control, create habitat, add organic matter and create niches for seed to germinate. The dozer is equipped with 2 rippers only, to prevent logs from being caught up between the rippers while seeding. The dozer rips & seeds to surveyed and marked contour lines along the batter slopes, this ensures contours are accurate and effective in erosion control from runoff. Seed mixtures of primarily chenopods are sown at a rate of 9.6 kg/ha on batters, the seed mix used for batter seeding in 2020 is shown in Table 18.

Table 18- Seed species used in Gessner drum seeder 2020 (Batters)

SeedMixType	Scientific Name	common name	GPerHa
Drum (Batter)	Atriplex holocarpa	Pop Saltbush	200
Drum (Batter)	Atriplex lindleyi	Eastern Flat-top Saltbush, Flat-top Saltbush, Baldoo	200
Drum (Batter)	Atriplex nummularia	Old Man Saltbush	1000
Drum (Batter)	Atriplex rhagodioides	Silver Saltbush, River Saltbush	1500
Drum (Batter)	Atriplex stipitata	Mallee Saltbush	100
Drum (Batter)	Atriplex vesicaria	Bladder Saltbush	2000
Drum (Batter)	Enchylaena tomentosa	Ruby Saltbush	100
Drum (Batter)	Maireana brevifolia	Small-leaf Bluebush	100
Drum (Batter)	Maireana pyramidata	Black Bluebush	3000
Drum (Batter)	Maireana sedifolia	Pearl Bluebush	300
Drum (Batter)	Nitraria billardierei	Nitre Bush, Dillon Bush	400
Drum (Batter)	Olearia pimelioides	Showy daisy-bush	200
Drum (Batter)	Zygophyllum aurantiacum	Shrubby Twinleaf	500
TOTAL			9600

2020 Dozer seeding

Approximately 15Ha of the 53Ha seeded were batters on the off-path tails dam (OPTD)

Dozer seeding of OPTD batters was completed using 3 ripper tines on the batters that did not receive timber trash due to the batter slopes being approximately 10:1VH. Slopes of this nature are considered low risk for erosion when cross ripped to contours.

Batters that had slopes of approximately 7:1VH received timber trash and were seeded using 2 dozer tines to prevent timber being caught up in the dozer rippers. This has been standard practice across Tronox's Ginkgo and Snapper sites with good success regarding stability and erodibility.



D9 dozer with Gessner drum seeder mounted above 3 rippers.

6.4 Tractor seeding

Tractor seeding consists of an agricultural plough utilising a five tine arrangement with the Gessner drum seeder mounted to the top. The plough can accommodate the same Gessner drum seeder used on the dozer.

The plough is towed by a wheeled tractor and is limited to flat areas and gentle slopes of less than 1:7. Using this arrangement allows faster seeding times than the dozer and a much better soil surface for seed niches. The use of multiple narrow tines allows compacted soil to be broken up leaving a well prepared surface for seed delivery, and limits the amount of subsoil being brought to the surface where it can contaminate the topsoil horizon. The tines on the plough can be set to the desired ripping depth, in this case approximately 350mm or just below the depth of the topsoil.

The plough is also equipped with a crumble roller that helps break soil clods up and incorporate seed into the soil surface. This seeding arrangement was used to sow chenopod species at rate of 8.25 kg/ha on mine path patties and former stockpile areas. The 2020 seed mix for the Gessner drum seeder on flat areas is shown in Table 19.

Table 19- Seed species used in Gessner drum seeder 2020 (Flats)

SeedMixType	Scientific Name	common name	GPerHa
Drum (flat)	<i>Atriplex holocarpa</i>	Pop Saltbush	200
Drum (flat)	<i>Atriplex lindleyi</i>	Eastern Flat-top Saltbush, Flat-top Saltbush, Baldoo	200
Drum (flat)	<i>Atriplex rhagodioides</i>	Silver Saltbush, River Saltbush	1500
Drum (flat)	<i>Atriplex semibaccata</i>	Creeping Saltbush, Berry Saltbush	100
Drum (flat)	<i>Atriplex stipitata</i>	Mallee Saltbush	800
Drum (flat)	<i>Atriplex suberecta</i>	Sprawling saltbush	200
Drum (flat)	<i>Atriplex vesicaria</i>	Bladder Saltbush	2000
Drum (flat)	<i>Enchylaena tomentosa</i>	Ruby Saltbush	100
Drum (flat)	<i>Maireana brevifolia</i>	Small-leaf Bluebush	100
Drum (flat)	<i>Maireana pyramidata</i>	Black Bluebush	2000
Drum (flat)	<i>Maireana sedifolia</i>	Pearl Bluebush	300
Drum (flat)	<i>Nitraria billardierei</i>	Nitre Bush, Dillon Bush	400
Drum (flat)	<i>Olearia pimelioides</i>	Showy daisy-bush	100
Drum (flat)	<i>Vittadinia gracilis</i>	New Holland daisy	50
Drum (flat)	<i>Zygophyllum aurantiacum</i>	Shrubby Twinleaf	200
TOTAL			8250



John Deere tractor with 5 tine plough and Gessner drum seeder mounted.



Crumble roller attached to the rear of the plough.

6.5 Burford tree seeding

The Burford seeder is towed by a 4x4 utility task vehicle (UTV). The Burford tree seeder is a precision seeder as the seed can be placed accurately at the desired depth where it will receive the best chance of germination and survival. Target species and rates for the tree seeder in 2020 can be seen listed in Table 20. Germination of these small seed species has been improved with this new seeding method due to correct seed placement depth of 5-10mm in the soil. Moisture availability in the seeding lines is harnessed due to a small furrow created by the seeders disc. The combination of the UTV and seeder is limited to flat areas such as mine path, former stockpile areas and over burden dump patties.

Legume seeds are treated prior to sowing, this involves processing 50% of legume seed by means of mechanical scarification to thin the seeds hard coating. Seed pre-treatment trials by Swainsona Environmental Services in September 2015 concluded that mechanical scarification treatment of legumes is the preferred pre-treatment method rather than the previous hot water methods used.

Table 20- Tree seed species used in Burford seeder (flat areas)

SeedMixType	Scientific Name	common name	GPerHa
Burford seeder (flat)	<i>Acacia burkittii</i>	Sand hill wattle, Burkitt's wattle, Gunderbluey, fine leaf jam	150
Burford seeder (flat)	<i>Acacia colletioides</i>	Wait-a-while, Pin bush, Spinebush	200
Burford seeder (flat)	<i>Acacia hakeoides</i>	Hakea wattle	100
Burford seeder (flat)	<i>Acacia ligulata</i>	Small cooba, Sandhill wattle, Dune wattle	100
Burford seeder (flat)	<i>Acacia oswaldii</i>	Umbrella wattle, Miljee	100
Burford seeder (flat)	<i>Acacia sclerophylla</i>	Hard-leaf Wattle	50
Burford seeder (flat)	<i>Acacia victoriae</i>	Elegant wattle, Prickly wattle	200
Burford seeder (flat)	<i>Callitris gracilis</i> ssp. <i>murrayensis</i>	Murray cypress pine	100
Burford seeder (flat)	<i>Casuarina pauper</i>	Belah	200
Burford seeder (flat)	<i>Eucalyptus</i> spp. (mallee mix (provenance))		250
Burford seeder (flat)	<i>Myoporum platycarpum</i>	Sugarwood, False Sandalwood	100
Burford seeder (flat)	<i>Rhagodia spinescens</i>	spiny saltbush, berry saltbush	100
Burford seeder (flat)	<i>Senna nothosubsp.</i> (mix)	Cassia	250
TOTAL			1900

It can take several years for legume seeds to naturally overcome physical dormancy, in revegetation programs it is standard practice to pre-treat collections of legume species prior to sowing. Pre-treating seeds enables germination to occur when:

- Soil is soft for easy root penetration
- Minimal competition for moisture, nutrients and light
- Plant growth is maximised while herbivores such as goats and kangaroos are being controlled

Leaving 50% of seed untreated provides a reserve within the seed bank for germination when conditions are most favourable. If all the seed is treated and there is no significant rain event there is a risk of seedlings dying due to insufficient moisture. The treated seeds are also more vulnerable to bacterial and fungal infection in the absence of significant rainfall to drive germination.

During August 2020, one 2Ha fenced plot was direct seeded with *Eucalyptus* species using the Burford Tree Seeder. Drip lines were installed along seeding lines for irrigation, water being delivered via a 15,000L tank and petrol pump. It is hoped that this methodology of tree planting will be far more economical than tube stock planting. Direct seeding has been proven to be successful since 2015 at Ginkgo and Snapper sites, although grazing pressure and ongoing drought has impacted succession. Given that the direct seeded plots are protected from grazing and irrigated it is hoped that good succession can be achieved.

Areas that were seeded with Chenopods (53Ha) in May were seeded with the tree seeder in late August after soil conditions had improved with well received rainfall. It is important that sufficient moisture is available when direct tree seeding to prevent the shallow furrow

being filled by dry and loose material, causing the seed to be buried too deeply and hindering germination.



Burford tree seeder being towed by the UTV.



Tree seed separated in hoppers according to relative size.



Belah (*Casuarina pauper*) established from 2016 Burford seeding

6.6 Grass seeding

Native grasses are mixed with an inert carrier (medium grade vermiculite) and broadcasted across the rehabilitation areas at approximately 1 kg/ha. A wire frame is attached to the rear of the utility task vehicle (UTV) where the grass seed is placed, the action of the UTV travelling over rip lines allows the grass seed to disperse evenly over the landscape. The species list and rates is shown in Table 21. As grasses are prolific seeders in favourable seasons, and the seed is highly mobile, it is anticipated that once the annual grasses are established in the landscape we will see cover across the entire rehabilitation area in the medium to long term.

As there was limited grass seed available for collection due to ongoing drought, only the three 2Ha tree plots were seeded with native grass species in June 2020. It has been demonstrated in other established tree plots at Snapper that grass species perform well when protected from grazing animals (Kangaroos and feral goats). Grass species are given the ability to reach maturity and produce seed when protected from browsing. These protected plots can be seen as seed banks that contribute to the succession of the surrounding rehabilitation sites through seed dispersion.

Table 21- Native grass species list

SeedMixType	Scientific Name	common name	GPerHa
Native grasses (flat)	<i>Austrostipa eremophila</i>	Speargrass	100
Native grasses (flat)	<i>Austrostipa nitida</i>	Speargrass	200
Native grasses (flat)	<i>Enteropogon acicularis</i>	Curly windmill grass	200
Native grasses (flat)	<i>Rytidosperma caespitosum</i>	Ringed Wallaby Grass	100
TOTAL			600



UTV with grass seed broadcaster attached to rear

6.7 Tube stock planting

Historically large numbers of tube stock were planted that were irrigated for a short period of time and survival rates were poor. The focus now is to plant smaller plots of individual trees and nurture them until they can become self-sustaining without irrigation.

Individual trees are planted adjacent to access tracks, where they could be hand watered every three weeks during the summer using a fire trailer and hose. Species planted include *Hakea tephrosperma*, *Myoporum platycarpum*, *Alectryon oleofolius* and *Casuarina pauper*. Each tree planting location receives a pile of organic rich topsoil that is recovered from underneath former timber stockpiles. The sites are deep ripped or excavated to help promote deeper root growth and water penetration, a well is formed around the tree using the soil to help maintain maximum water in the root zone. The trees are guarded using a 1m high wire guard for protection against goat and kangaroo browsing. The wire guards offer far better protection from browsing than the plastic guards that have been used in the past and should see the trees get to a stage where they can be self-sustaining.

It was identified that the previously used plastic guards were cooking the trees during extreme temperatures; the wire guards offer better air flow around the trees. The plastic guards are initially installed for frost protection but removed before the start of summer. Tube stock will continue to be planted into newly seeded areas each year with the hope to return some key canopy species to the rehabilitation landscape.

During July and August 2020 three additional 2Ha tree plots were established, two plots received 800 tube stock each of primarily *Casuarina pauper* and limited numbers of *Hakea tephrosperma*, *Myoporum platycarpum* and *Maireana sedifolia*. The plots were fenced to exclude grazing and irrigated with drip irrigation.

Individual tree plantings consisted of 600 tubestock planted in groups of approximately 20 individuals. Each tree well was excavated to approximately 800mm, subsoil was removed and replaced with rich organic soil recovered from beneath timber stockpiles. Excavating the compacted subsoil allows better root development initially and improved soil condition provides better nutrient availability and water holding capacity. A depression was left for the tree to be planted into for water retention during irrigation and rain events. Trees were guarded with a 1m high wire guard and a temporary plastic fluted guard for initial frost protection.



Plots of individuals planted and guarded

6.8 Former start-up water dam works

Rehabilitation works on the former start-up water dam have been ongoing during the reporting period. The capping of slimes and shaping of the landform was completed in December 2018. During 2020, subsoil and topsoil was replaced over an area of 100Ha. Timber was placed on all batters with slopes of >7:1VH and spread over the surface. The area is scheduled for seeding in May 2021.



Capping of slimes with overburden at the former water dam (2018)



Final landform topsoiled and timber being placed onto batters. (July 2020)

6.9 Monitoring Program

6.9.1 Flora Monitoring Protocols

A set of Protocols have been developed for monitoring rehabilitation at Snapper (Ogyris 2010 “Protocol for Monitoring Rehabilitation at the Ginkgo and Snapper Mines”) to establish the baseline data and assessment techniques.

The bases of the rehabilitation monitoring protocols are that they are based on simple repeatable methodologies that are able to be subject to statistical analysis.

The methods for the rehabilitation monitoring are:

- Site and Topographic Delineation and Description,
- Transect Monitoring;
- Permanent Fixed-Area Quadrats; and
- Photo point Monitoring

6.9.2 Site and Topographic Delineation and Description

The description of the site and topographic characteristics of the rehabilitation site are broadly based on the characteristics as described in Speight (1990) in the *Australian Soil and Land Survey Field Handbook*.

The major topographic elements from Tongway (2009) are:

- Crest
- Upper Slope
- Mid Slope
- Lower Slope
- Closed Depression or Lake
- Flat
- Open depression or Stream Channel

6.9.3 Transect Monitoring

The rehabilitation areas have repeat transect monitoring sites in each of the major topographic units represented. The standard transect type is a 20 m x 1 m permanently marked belt transect, this transect is then divided into 20 (1 m x 1 m) quadrats.

The information collected from the monitoring transects include:

- Soil texture and profile assessment at establishment
- Soil surface roughness and resistance to disturbance
- Observations on erosion type and severity
- Incorporation and subsequent deposition of coarse debris and type
- A ground condition assessment for 5 of the 20 ‘mini’ quadrats

- Vegetation species composition, cover and height for each of the 20 'mini' quadrats
- A photograph taken from the start peg looking directly along the monitoring line
- The ground condition part of the field assessment includes:
 - % vegetation cover (perennial and annual)
 - % bare ground and bare ground / vegetation patch ratio along the centre line of the mini quadrat
 - % cryptogram cover
 - % litter cover and type

6.9.4 Permanent Fixed-Area Quadrats and Photo-point Monitoring

A representative number of 20 m x 20 m quadrats will be permanently marked and located in the major topographic units on the rehabilitation areas.

The information collected from these permanent quadrats include species composition and structure, as well as the ground condition assessment. A photo monitoring point will be set up on two permanent stakes (one at 1 m high for the camera and another at 0.5 m high for the photo-point board) located 8 m apart in a north-south direction.

6.9.5 Fauna Monitoring Protocols

Permanent monitoring sites are established across rehabilitation areas at the Snapper mine site, there are also six reference sites located in undisturbed habitat close to the rehabilitation areas.

Pit fall traps have been established at Snapper with five 20 litre buckets connected by a 30cm high flywire fence. Pitfalls are run for five nights in November-December each year to monitor terrestrial vertebrate re-colonisation of the sites.

Bat surveys are carried out using anabat detectors in November-December each year in rehabilitation areas and remnant sites.

Bird surveys are carried out once per year within rehabilitation areas and remnant sites by timed 20 minute random search surveys.

Sites used for fauna surveys are a subset of those used for vegetation monitoring and statistical analyses of the faunal groups will include co-analysis of the floristic and habitat variables collected during that process in an attempt to explain patterns of faunal re-colonisation.

Table 22- Snapper monitoring schedule 2019-2028.

Year of Monitoring	Snapper OB1 (Seeded 2012/13)	Snapper Soil Stockpile Areas (Seeded 2013)	Snapper Mine Path Areas (Seeded 2013)	Snapper OB1 (Seeded 2014)	Snapper Soil Stockpile Areas (Seeded 2014)	Snapper Mine Path Areas (Seeded 2014)	Snapper OB1 (Seeded 2015)	Snapper Soil Stockpile Areas (Seeded 2015)	Snapper Mine Path Areas (Seeded 2015)	Snapper Soil Stockpile Areas (Seeded 2016)	Snapper Mine Path Areas (Seeded 2016)	Snapper Soil Stockpile Areas (Seeded 2017)	Snapper Mine Path Areas (Seeded 2017)	Snapper seeded 2018 (OPTD batters, infrastructure, stockpile s)	Snapper Tails Dam 2020
2019															
2020															
2021															
2022															
2023															
2024															
2025															
2026															
2027															
2028															

6.9.6 Flora Monitoring (Spring 2019) by Swainsona Seed Services

Below is an executive summary of the 2019 flora monitoring at scheduled Snapper revegetation sites. The full report has been attached as Appendix 8.

This report details the results for the 2019 monitoring and includes areas that were rehabilitated in 2014, 2017 and 2018. It should be noted that Western New South Wales is currently experiencing one of the four worst droughts in the past 100 years (NSW Dept. of Planning, Industry and Environment, 2020a). As such, the current performance of the Snapper rehabilitation needs to be taken into context with these extreme conditions.

In the 2014 (Year 5) rehabilitation areas the plant density and cover of the primary shrubs, medium and large shrubs (MLS) and all indigenous vegetation (seeded or natural regeneration) was vastly reduced compared when last monitored in spring 2016. Overall the Snapper over-burden stockpile 1 (SOB1) rehabilitation area had the poorest performance in meeting all 'hurdle' benchmark targets, compared to the Snapper mine path (SMP) and Snapper soil stockpile (SSSP) rehabilitation areas. With the exception of SOB1, the rehabilitation areas currently remain above or close to 'hurdle' benchmark MLS cover. Despite the decrease in cover, the current combined density of all MLS species on the three rehabilitation areas remain above the density targets for the dominant primary shrubs alone as well as the combined MLS benchmark target. Although the MLS (and dominant primary shrub species) density decreased in the SOB1 and SSSP areas, it actually increased for the 2014 SMP rehabilitation area, with recruitment of new *A. vesicaria* plants (seedlings under or within close proximity to adult plants). This indicates that adult plants have successfully reproduced and are self-regeneration on the 2014 rehabilitated areas, with 'self-regenerating vegetation' considered a key component of the ultimate aim of the ongoing rehabilitation program.

While cover of all species on the 2014 rehabilitation has decreased since 2016, there has also been a shift whereby native species are now outcompeting weed species. Legume and tree species had poor success from the seed mix and was likely due to being sown using the Gessner Drum seeding box (attached to a tractor), rather than via a specialised 'niche' seeder. Note that a 'niche' seeder has now been introduced for these species.

In the 2017 (Year 2) rehabilitation areas the density of the primary shrubs has increased in both the SMP and SSSP rehabilitation areas since last monitored in 2018. Despite this, these

densities are well below the current benchmark target of 3,000 plants Ha^{-1} after 2 years. At present both the SMP and SSSP rehabilitation areas currently have a combined MLS density of 2,000 plants/ Ha^{-1} , which is also well below the combined MLS benchmark target density of 9,000 Ha^{-1} . In terms of cover, the MLS species sown in 2017 performed better on the SMP than the SSSP rehabilitation areas in both 2018 and 2019. The cover of MLS species had approximately doubled since 2018 for both rehabilitation areas. Despite these increases, both areas are currently below the 'hurdle' benchmark cover of 5% after 2 years. On the 2017 SMP area the cover from seeded species are currently outcompeting weed species, however, on the SSSP area weed species are currently outcompeting both seeded and other non-seeded indigenous species. Of the species used in the 2017 seed mix, chenopod species performed the best, with minimal success from all other genera.

Like the 2017 rehabilitation areas, the establishment of indigenous vegetation on the 2018 rehabilitation areas was impeded by the drought conditions. Despite the drought the density of primary shrubs after 1 year is currently above the 'hurdle' benchmark target 4,000 Ha^{-1} for both the Snapper off-path tails dam (SOPTD) and SSSP areas, with the Snapper Infrastructure (SI) density falling just below this target. When considering all MLS species, however, only the SOPTD is performing above the combined 'hurdle' benchmark target density of 10,000 Ha^{-1} , with the SI rehabilitation area greatly under-performing. The current cover on both the 2018 SOPTD and SSSP areas are also currently above the 'hurdle' benchmark cover of 1% after 1 year, however, the SI area is underperforming compared to the 'hurdle' benchmark target. In 2019 seeded species had a total cover of higher than or equal to weed species for the 2018 SOPTD and SSSP rehabilitation areas, with less than 1.5% cover from natural regeneration. However, for the 2018 SI rehabilitation area seeded species had minimal cover, compared to natural regeneration or weed species. At present the total cover of all indigenous species (seeded or natural regeneration) on all three rehabilitation areas also falls below the 'hurdle' benchmark cover target.

Overall, the rehabilitation is clearly suffering from lack of readily available water (RAW), with increased wind erosion further reducing rehabilitation performance by the removal of topsoil and broadcasted seed. It is therefore imperative that options for reducing the impact of wind erosion and increasing moisture retention are investigated and implemented. This could include water ponding techniques, as successfully implemented in the Marra Creek waterponding program, (NSW Dept. Planning, Industry and Environment, 2020b). It could also include the potential mulching of timber using a tub grinder (or similar) to increase the spread of the timber and reduce soil movement.

Although establishment may be poor, it is recommended that some rehabilitation is continued to be implemented each year as it is unknown how long it may be before the drought eases. If rehabilitation is put completely on hold until the drought eases, the annual rehabilitation budget will need to be increased in proportion to the additional rehabilitation hectares and resources required in any particular year.

Even though the current drought is considered to be the largest contributor to the current poor rehabilitation performance, the additional pressure from grazing by Kangaroos and feral Goats further reduces the chances of vegetation to recover post-drought. While boundary fencing has been improved to reduce movements of Kangaroos and feral Goats into the mining lease, it is imperative that current densities of both species are reduced through mustering and/or culling.

It should also be noted that the current rehabilitation monitoring program was initially set up 10 years ago. The current techniques are labour intensive, with certain values, such as height data, not utilised in reporting. As such, it is recommended that the current rehabilitation monitoring program is thoroughly reviewed and simplified. It is also recommended that the potential use of a UAV is investigated for more efficiently and thoroughly assessing rehabilitation performance.

In summary it is recommended that the following should be implemented/investigated in order to improve the rehabilitation performance at the Snapper Mine:

- 1) Investigate options for increasing water retention and reducing soil erosion.
- 2) Reduce grazing pressure by improving the feral goat mustering program and introducing Kangaroo control through culling and/or mustering.
- 3) Review the current rehabilitation monitoring methods and update as required with current technology in order to enable a more efficient and thorough assessment of the rehabilitation performance.

6.9.7 Fauna Monitoring (December 2019) by GHD

Below is an executive summary of the 2019 fauna monitoring at scheduled Snapper revegetation sites. The full report has been attached as Appendix 9.

This report outlines the monitoring results of the summer fauna surveys carried out on the MP and OB1 rehabilitation areas of the Snapper Mine and associated remnant habitat areas in December 2019. Surveys for terrestrial vertebrates and birds were completed. Results of these surveys are put into context with different ages of rehabilitated habitat, and previous years' results to monitor progress towards the original community structure.

Fauna were surveyed by pitfall trapping and timed bird surveys over five days, between the 9th and the 13th of December 2019. A total of 23 native and exotic fauna species were recorded during the fauna census, including 10 native bird species, one native and two exotic terrestrial mammal species and ten native reptile species. One species of conservation significance was recorded during the surveys – the Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*), listed as Vulnerable under the NSW Biodiversity and Conservation Act 2016 (BC Act). Surveys recorded a generally good abundance and diversity of native birds, reptiles and terrestrial mammals, although species abundance and diversity dropped from the previous survey (January 2019). Both abundance of animals and species richness varied greatly by site in the current survey.

Mean abundance of terrestrial fauna were found to be similar across rehabilitation sites, however mean species richness was almost three times greater at remnant sites than rehabilitation sites. Greatest abundance and species diversity in remnant areas is to be expected, as these areas contain the greatest variety of fauna habitats and food sources. In particular the lack of larger shrubs and trees within the rehabilitation areas precludes many species that are dependent on these for part of their life-history requirements (such as for shelter, food or breeding). The similarity in mean species abundance across remnant and rehabilitation sites may be due to the lack of rainfall occurring throughout the year (see

section 2.2). In ideal climatic conditions, greatest abundance and species diversity in remnant areas is expected, as these areas contain a greater variety of fauna habitats and food sources. In particular the lack of larger shrubs and trees within the rehabilitation areas precludes any species that are dependent on these for part of their life history requirements (such as shelter, breeding or food) limiting colonisation of some terrestrial fauna communities (Craig et al. 2012).

Changes in mean abundance and species richness of terrestrial fauna over time in rehabilitated sites did not show any clear trends. All rehabilitated sites, regardless of age, recorded similar values for terrestrial fauna mean abundance and species diversity. These results are in contrast to surveys completed in 2016 in which older rehabilitated sites recorded greater abundances and diversity, likely as a result of a greater variety of mature fauna habitats and food sources, and greater time period to be re-colonised from the surrounding remnant habitat.

Mean abundance and species richness of native birds was shown to be much greater at remnant sites than at rehabilitation sites. Remnant sites, on average, recording more than three times the mean abundance and mean diversity of bird species. No clear trend was observed in bird abundance or diversity by age of regeneration, though both were much greater at remnant sites. As with terrestrial fauna results, the greatest abundance and species diversity in remnant areas is as expected given that these areas contain the greatest variety of fauna habitats and food sources. In particular the lack of larger shrubs and trees within the rehabilitation areas precludes many bird species that are dependent on these for part of their life-history requirements (such as for shelter, feeding or breeding). This is less of a challenge for more mobile species which may be able to utilise rehabilitated areas as a part of a range of habitats across the landscape. Overall, bird species richness was clearly related to the structural diversity found within the site, where the remnant habitats provided increased resources, (food, shelter, nesting sites), for a greater variety of birds. It is expected that until trees can be re established in the rehabilitation areas, many species present in the broader area will be unlikely to use these areas, and the community will consist of those species adapted to open country, with woodland species largely absent.

Both terrestrial and avian fauna groups recorded highly variable abundance and species diversities, by survey site and by survey year, with no discernible pattern from any specific site, but with sites showing similar trends by year of survey. This suggests the highly variable climate of this semi-arid area is an important driver of both animal numbers and diversity across all sites, including remnant areas. This cycle in animal abundance and diversity is common in arid fauna.

Capture rates of pitfall trapping methods may have also been affected by the general decline in condition over time of the materials used for pitfall trapping. Due to the permanency of pitfall fences and buckets, which are kept in place throughout year-year, the conditions of the fences and buckets have deteriorated significantly. The wire mesh fences have increasing numbers of tears, likely due to larger mammals traversing across and damaging the fence, and deterioration through constant exposure to wind and sun. GHD ecologists, where possible, temporarily mend the pitfall fences when monitoring commences. However, it is recommended to replace the materials used for the pitfall traps to maximise trapping effort. If left unattended, it is highly likely that trapping success and effort will decline as pitfall fences become unrepairable and pitfall buckets deteriorate.

The ongoing monitoring of terrestrial and avian vertebrate fauna values at rehabilitated and control (remnant) sites of Tronox's Snapper Mine provides valuable feedback of the changes in fauna diversity and abundance following site rehabilitation and as a result of management actions. These provide an important measure of the success of mine site rehabilitation, as it relates to biodiversity values.

Monitoring of permanent rehabilitation sites at Snapper in December 2019 used a sub-set of 12 of the 36 rehabilitated sites and six of ten remnant survey sites established in this area. Results from the survey of this subset of sites was sufficient to provide data indicating differences between rehabilitated and remnant sites for avian and terrestrial diversity and abundance. It is therefore recommended that future monitoring continue to survey this strategically chosen subset of the survey sites to continue to provide feedback on the effectiveness of the rehabilitation works for vertebrate biodiversity. The monitoring of terrestrial and avian vertebrate fauna at rehabilitated sites, and comparing these with surveys of remnant control sites which have been strategically selected, allows Tronox to assess the effectiveness of the rehabilitation of the Snapper mine site to provide ecological values and biodiversity within the mining area. These results when input into an adaptive management process allow for a state of continuous improvement in the approach to rehabilitation over time, to provide the best outcomes from rehabilitation works. Ongoing monitoring will continue to inform the effectiveness of the rehabilitation works process.

6.10 Rehabilitation of Disturbed Land

During the reporting period a total of 53 ha of disturbed lands on the Snapper mine off path tails dam were rehabilitated. A further 153 ha of off path tails dam and backfill areas are at various stages in preparation for seeding in May 2021.

The total current disturbance at Snapper at 78Mt of ore mined as stated in the current snapper MOP was 1432 Ha, the rehabilitation at Snapper accounts for 35% of the total disturbed area. Table 23 provides a summary of the disturbed and rehabilitated areas at Snapper.

Table 23- Rehabilitation Summary

		To date: 31/08/2020	Last report	Next reporting period*
A:	MINE LEASE AREA			
A1	Mine Lease(s) Area (ML 1621)	2378		
B:	DISTURBED AREAS			
B1	Infrastructure area (other disturbed areas to be rehabilitated at closure including facilities, roads)	183	162	200
B2	Active Mining Area – includes 21 ha of cleared land in front of mine path and 45ha mining pit.	66	144	100
B3	Waste emplacements Includes unshaped mine path backfill	254	179	100

B4	Tailings emplacements In pit tailings	38	8	20
B5	Shaped waste emplacements Mine path shaped backfill & OPTD	64	192	100
B6	Topsoil Stockpiles-	177	193	150
CURRENT DISTURBED AREAS		782	878	670
C:	REHABILITATION PROGRESS			
C1	Total Rehabilitated area (OB1, Backfill and Stockpiles all seeded and planted) *Was in various stages of either Topsoil or seeded)	650	444	850
D:	REHABILITATION ON SLOPES			
D1	10 to 18 degrees	0	0	0
D2	Greater than 18 degrees	0	0	0
E:	SURFACE OF REHABILITATED LAND			
E1	Pasture and grasses	0	0	0
E2	Native forest/ecosystems	497	444	700
E3	Plantations and crops	0	0	0
E4	Other (include non-vegetative outcomes)	153	66	150

* Estimations only.

Table 24- Maintenance Activities on Rehabilitated Lands

Nature of Treatment	Area Treated (ha)		Comment/Control Strategies/Treatment details
	Report Period	Next Period	
Additional Erosion Control works	0	0	Combined total area cleaning out silt from drains and dams.
Recovering - top & sub soil	0	0	No top soil or sub soil had to be replaced in the reporting period.
Soil Treatment (detail – fertiliser, lime, gypsum etc)	0	0	No additional soil ameliorants were added to Snapper in rehabilitated areas.
Treatment Management (Detail grazing, cropping, slashing etc)	0	0	No grazing or cropping took place on rehabilitated areas.
Reseeding/Replanting	0	0	No additional plantings or reseeding took place at Snapper during the reporting period.

Adversely affected by weeds	0	0	Whilst weeds are present at Snapper it is not deemed to be an adverse effect.
Feral Animal control	497	700	Goat control is ongoing on all Tronox Mining lands.

6.11 Buildings

No buildings were constructed, renovated or moved during the reporting period.

6.12 Other Infrastructure

No infrastructure was decommissioned during the reporting period.

6.13 Rehabilitation Trials and Research

6.13.1 Irrigated hand planted plots

Outcomes from previous tree planting trials have led Tronox to adopt a new approach, whereby small tree plots (approx. 2ha) are established in the rehabilitation landscape and fenced to protect trees from browsing by herbivores. The plots are irrigated using pressure compensating drippers and plots of approximately 800 trees receive between 15-17 litres of water every 3 weeks throughout summer. The watering will continue until trees are more advanced and can sustain seasonal conditions without irrigation.

The survival rate of trees within the plots has been outstanding with more than 90% of the trees surviving since being planted in 2016. The exclusion fence has been successful in keeping goats and Kangaroos from browsing on the vegetation.

There is a notable difference in groundcover between the fenced plot and the surrounding area due to browsing by herbivores absent in the fenced area. Chenopods and native grasses within the plots are producing good amounts of seed, which can be carried by wind to surrounding areas. The plots could be seen as seed banks and when placed throughout the rehabilitation landscape will provide seed for natural regeneration to the wider area.



Spear grass within a fenced tree plot (August 2020)



A fenced and irrigated tree plot showing good progress (August 2020)

Another strategy being used to bring tree canopy species into the rehabilitation areas is by establishing plots of approx. 10-20 individuals along access tracks where they can be hand watered using a fire fighting trailer. The trees are protected from browsing using 1m high wire guards as shown below. Plastic tree guards are only initially left on until the risk of frost damage has passed and then they are removed before summer.

Topsoil containing high organic matter is gathered from beneath timber stockpiles pushed up from previous years of clearing activities. The high organic content offers additional nutrients to the trees and promotes better growth. A well is formed around each tree using

the soil as so when water is applied it remains primarily in the root zone of the plant and doesn't run off.

In July 2020 an additional 30 individual tree plots were established across the Snapper off path tails dam area. Changes were made to the way tree wells are constructed to promote water harvesting and root penetration.

A 3-tonne excavator was used to scrape away approximately 200mm of topsoil and remove approximately 600mm of underlying sub-soil and overburden materials. The hole was backfilled with remaining topsoil and rich organic soils found beneath timber stockpiles. A well was formed below ground level to encourage water harvesting to the primary root zone of the trees.



Tree wells being excavated with a 3 tonne digger

6.13.2 Irrigated direct seeding plots

Hand planting tube stock is expensive and labour intensive, therefore Tronox is conducting a trial by direct seeding in fenced 2 ha plots and applying irrigation drip tubing to the seeding lines.

A 2ha plot at Snapper was established and seeded with Eucalyptus Mallee species in August 2020. It is hoped that with irrigation and protection from herbivores that tree establishment will be successful and be far more economical than former hand planting techniques, allowing a greater number of plots to be established across rehabilitation sites each year and recruitment of tree canopy species.



A lateral irrigation tube placed in direct seeding line

6.13.3 Shredding timber

Felled trees during vegetation clearing are currently pushed up into stockpiles and later applied to rehabilitated slopes for erosion control, fauna habitat and seed niches.

In 2019 Tronox's rehabilitation contractor (Ecotypic Pty LTD) proposed the use of a tub grinder as an alternative use for felled timber in mine site rehabilitation.

Tub grinders and shredders are designed for high-volume land-clearing and wood recycling operations. They consist of a feed hopper and a hammermill which is the primary grinding mechanism. Timber is loaded into the hopper using an excavator with log grabs or a front end loader depending on the material being processed. The final material size can be varied depending on the screen size that is installed.

In 2019 a mini trial was conducted using a Tana Shark Shredder to shred felled Belah timber. The shredder made easy work of the Belah timber, but the size of the material was thought to be too small for better stabilisation purposes. It was recommended that different aperture

screens are tailed to produce larger pieces of timber. Further trials are needed to confirm the most effective size of material for batter stabilisation whilst not hindering germination.

Potential benefits are:

- Initial groundcover to reduce topsoil wind erosion
- Mulch to assist with water retention
- Assist with preventing batter erosion from water runoff
- Provide a source of organic matter and carbon for soils
- Potentially easier to apply to land surface then un-mulched timber



A Tana Shark Shredder (image not from actual trial)

6.13.4 Surface water ponding

Mini-catchments are an adaption of the “waterponding” technique, which has been successfully used to revegetate scalded duplex soils in western NSW rangelands, for mine rehabilitation. The technique involves the construction of horseshoe or completely circular shaped banks to create small catchments which accumulate runoff and provide niches for plants to establish (Thompson, 2008)



A 2004 waterponding treatment (mini-catchment) on a scalded flat at Neds Corner Station, 30km from Cullulleraine Victoria.

Mini-catchments will be trailed on the final surfaces of the backfilled mine voids. The mini-catchments will be created using horseshoe shaped embankments that are 250m long. The embankments will be constructed with a grader to a minimum height of 45cm and a base width of approximately 1.8m. Each mini-catchment will be approximately 0.4ha in size and the horseshoe embankments will be spaced approximately 5–10 m apart.

The images below depict the process of developing mini-catchments which requires laser levelling to aid in the site-specific design of the mini-catchment and dozing of the embankments to the specifications described above.



Construction of mini catchments by NSW Local Land Services

6.13.5 Further research

Tronox funded Federation University student Corrine Duncan who completed a PhD “*Seeds, soils and moisture: Ecophysiology to inform mine site restoration in arid zones*”

Summary/Abstract

Mining in arid regions of Australia is followed by restoration and rehabilitation efforts. However, attempts to reintroduce many woody plant species have been unsuccessful. Water is the key limiting resource to plant growth and seed germination in arid zones. In this thesis, I investigated ecophysiological processes that may help improve recruitment across novel arid landscapes. I tested seed traits and dormancy cues of eight keystone plants and found that six of them had non-dormant, rapidly germinating seeds; a trait we propose is an adaptation to the region's unpredictable rainfall. To identify the germination niche of species, I incubated seeds under different temperatures and water potentials, and found drought avoidance to be an important survival strategy for arid species. I collected soil samples to compare biophysicochemical properties of reconstructed soils to remnant ecosystems, and found that the distribution of clay content in the reconstructed soils did not mirror the remnant soils, compromising their ability to sustain perennial vegetation. I also monitored soil moisture and found that soil reconstruction reduces rainfall infiltration and retention, and subsequently increases evaporation. The synthesis of these results demonstrate some of the limitations to successful restoration in these systems, such as (1) unknown dormancy

cues and poor seed longevity, (2) infrequent and episodic plant recruitment due to water limitation, and (3) reduced hydrological function of reconstructed soils. The failure to reinstate hydrological function is the major constraint to ecological restoration in this arid zone. Nonetheless, results from this study suggest that restoration is possible through more strategic use of seed, careful selection of drought tolerant species, and increasing soil moisture. Further failures to reinstate ecosystem function and community dynamics in arid zones with reconstructed soils can be prevented by understanding the edaphic constraints to plant establishment, and ameliorating conditions to mimic ecohydrological processes in remnant ecosystems.

Corrine's Thesis has been attached as Appendix 10.

6.14 Further Development of the Final Rehabilitation Plan

6.14.1 Final Land Use Objectives

The mine site is located on Western Lands Leases which are pastoral leases administered under the jurisdiction of the Western Lands Commissioner appointed by the NSW Land and Property Management Authority. Land use on the mining lease and in the nearby area is predominantly light intensity livestock grazing of native pastures.

Subject to further consultation with stakeholders and regulatory authorities, the objectives of the rehabilitation program are to revegetate the disturbance areas to return the land to a condition suitable for light intensity grazing of native pastures.

This objective aims to maintain the Agricultural Suitability Class 4 and Rural Land Capability Class VI land classification.

These objectives were set up and agreed upon in the original Environmental Assessment at the start of mine life.

6.14.2 Rehabilitation Design Principles

- Landform batters are constructed at approximately a 1:5 to 1:7 ratio with overall heights ranging from 10m to 20 m
- Landform structures are designed with flat tops which have paddies of approx. 3-5 hectares
- Bunding of approximately 300mm high around the tops of all batters
- Minimum of 200mm topsoil and 200mm subsoil respread
- Timber laid and batters ripped along contour
- Stag trees stood up for bird and bat habitat
- 1m of non slurried overburden over any slurried overburden or salt affected areas
- Seeding of all disturbed areas

6.14.3 Short Term Rehabilitation Objectives

- Minimise clearing disturbance areas
- Commence vegetation pre clearance in accordance with the Flora and Fauna Management Plan
- Clear approved vegetation areas 12 months in advance of mining operations in the appropriate season (Feb-May)
- Carry out topsoil assessments as part of the Vegetation Clearance Protocol VCP
- Employ suitable topsoil removal and storage practices to allow maximum survival of soil biota
- Schedule mine planning operations so that OB placement to be consistent with rehabilitation requirements and designs
- Progressive rehabilitation
- Pest flora and fauna control
- Monitoring, Evaluation, Reporting and Improvement to ensure continual improvement

6.14.4 Long Term Rehabilitation Objectives

- Restoration of a self-generating native landscape that is capable of supporting light intensity grazing
- Development and completion of low maintenance, non-polluting and stable rehabilitation landforms
- Removal of all required infrastructure and complete rehabilitation of the site
- Relinquishment of the mining lease and release from any further liabilities

6.14.5 Completion Criteria

This section provides a summary of some of the completion criteria used to measure achievement of the rehabilitation and land use objectives. A more detailed outline is provided in the Snapper Mining Operation Plan.

Completion criteria need to be developed to determine when rehabilitation of the disturbance area at Snapper can be agreed to be complete. An approved set of completion criteria will be used as a basis for assessing this completion. Conceptual completion criteria are outlined in Table 25.

Preliminary discussions have taken place with stakeholders including landholders and representatives from the Industry and Investment NSW, and industry experts.

Tronox has currently adopted a stepped approach to the completion criteria for the mine sites. The stepped approach allows for targets to be set throughout the mining operation lifecycle to ensure each step is completed satisfactorily and also to track areas that need attention.

Table 25- Conceptual completion criteria

Objective	Performance Indicator	Completion Criteria	Complete (Yes/No)	Progress as at Aug 2017
All mining related infrastructure removed	Administration Buildings , Workshops and Amenities removed	Complete removal of buildings and sheds (Inspection)	No	Not commenced
	Bores Decommissioned and pipes removed	Bore pumps and infrastructure removed (Inspection)	No	Not commenced
		Bores capped (Inspection)	No	Not commenced
		Bore licences cancelled (Letter of cancellation sent to NoW)	No	Not commenced
	Access and haul roads closed	All unnecessary roads closed and rehabilitated (Inspection – final Arial image)	No	Not commenced
	Reverse Osmosis (RO) Plant removed	RO plant decommissioned and removed (Inspection)	No	Not commenced
	Power services disconnected and infrastructure removed	Power is disconnected, Power infrastructure dismantled and removed. (Inspection)	No	Not commenced
	Contractor lay down yards	All buildings, plant and equipment removed	No	Not commenced
		Oil and fuel storage removed (Inspection)	No	Not commenced
	The HMC tower, pumps and associated equipment will be	HMC Tower, pumps and pipelines removed. (Inspection)	No	Not commenced

	decommissioned and removed.			
	HMC material removed	HMC material relocated into pit. (Survey)	No	Not commenced
Off Path Tails Dam (OPTD) to be safe and all infrastructure removed	Pipelines, pumps, wire boxes, decants and any other temporary infrastructure removed	All infrastructure removed. (Inspection)	Yes	Complete
	Closure of the prescribed dam and release from the NSW DSC Prescribed dams register	Inspection by Dam Design Engineer and sign off from NSW DSC. (Letter from NSW DSC)	Yes	Complete
In pit tails cells infrastructure removed	Infrastructure removed ie pipelines, tail stacker facility, pumps	All infrastructure removed. (Inspection)	No	Not commenced
Process water management structures- includes Water Dam, HMC drainage and overflow, and salt water truck fill dam (Rivetts dam) closed and capped	Dams are drained, decommissioned and infrastructure such as pumps and pipelines removed	Dams are dry and all infrastructure has been removed. (Inspection)	No	Not commenced
	Salt affected material is excavated	Salt areas removed after drying (Inspection)	No	Not commenced
	Dams are backfilled with clean fill	Dams capped with minimum 1 m clean OB. (Survey)	No	Not commenced
Storm water management structures retained	These areas will remain after rehabilitation	Structures left in safe non-polluting condition. (Inspection and Photograph)	No	Commenced
Overburden Dump No 1 (OB1) - to be safe and all infrastructure removed	Lighting towers, signage and haul road delineators removed	No infrastructure or plant or equipment left on OB1. No rubbish or other debris remaining	Yes	Complete

		(Inspection)		
	Ramps, bunding and batters left in safe condition	All ramps, bunds and batters left in safe condition. (Inspection and Photograph)	Yes	Complete
Mine path Backfill area to be safe and all infrastructure removed	Lighting towers, signage and haul road delineators removed	No infrastructure or plant or equipment left in pit. No rubbish or other debris remaining. (Inspection)	No	Commenced
	Ramps, bunding and batters left in safe condition	All ramps, bunds and batters left in safe condition. (Inspection and Photograph)	No	Commenced
Dredge, wet plant and associated infrastructure is removed	Dredge and Concentrator to be dismantled and removed	Dredge and concentrator removed (Inspection and Photograph)	No	Not commenced
Overburden plant and equipment removed	All Earthmoving contractors machines and equipment are to be removed	Equipment has been removed (Inspection)	No	Not commenced
All ancillary equipment is removed	All pipes, pumps, power, water and communications infrastructure are removed	Infrastructure has been removed (Inspection)	No	Not commenced
Landform established to blend in with surrounding landscape and is suitable to sustain a native ecosystem	Areas are graded relatively smooth ready for topsoiling	Areas are level (Survey)	No	Commenced
	Any elevated areas are contoured at 1:7 batters	Elevated areas are surveyed to ensure batters at 1:7 (Survey)	No	Commenced
	Drainage, bunding and paddies installed in areas with elevated finished levels	Drainage and paddies installed to 300mm (Survey)	No	Commenced

	Saline material capped with minimum of 1m of clean OB fill	1m of clean OB fill capped over area (Survey)	No	Commenced
Water Management areas closed	Salt water dried and salt affected material excavated	Salt affected material disposed of into pit. (Inspection and Photographs)	No	Not commenced
Landform is stable and established to conform with surrounding landscape and is suitable to sustain a native ecosystem	Long term stability as per Landloch 2009 simulation	No erosional issues during operational to relinquishment phase. (Long term monitoring results, Photographs)	No, ongoing, however batters did experience 1:100 years rain event with no failure.	Commenced
	Dredge pond is backfilled to 2-4 m above the local groundwater table level	Void has been backfilled and final landform is 2-4 metres above water table. (Survey)	No	Not commenced
	Areas are graded relatively smooth ready for topsoiling	Areas are level. (Survey)	No	Commenced
	Inverted batters are graded and contoured at 1:7	Batters at 1:7. (Survey)	No	Commenced
	Drainage, bunding and paddies installed in areas where required	Drainage and paddies installed	No	Commenced
	Long term stability	Ability to withstand 1in 100 year rain events with no failures. As per	No, ongoing, however batters did experience 1:100 years rain event with no failure.	Commenced
	Safe for public	1m high bund around top of void with interpretive signs	No	Not commenced

		to inform public of history and hazards (if any). (Photograph and Inspection)		
	Subsoil applied at a minimum of 200mm	200mm of suitable geochemical assessed subsoil has been applied. (Survey and Soil Pit tests)	No	Commenced
To ensure sufficient topsoil is replaced to support plant growth	Topsoils applied at a minimum of 200mm	200mm of suitable geochemical assessed topsoil has been applied. (Survey and Soil Pit tests)	No	Commenced
	Correct amounts of gypsum applied as per soil scientists report	Applied 10 tonnes of gypsum per hectare to all areas to increase soil moisture holding capacity. (Inspection during application)	No	Commenced
Ensure soil amelioration products are applied as required	All Top and Sub soil tested.	Soil pit testing completed prior to removal by independent soil scientist. (Report)	No	Commenced
Ensure Top and Sub soils are tested to ensure physical properties are adequate for the growth of native plants prior to application	Salvaged timber is replaced on the batter areas and covers 30% of batter	Inspection to ensure timber has been laid and covers approx. 30% of available batter	No	Commenced
Elevated areas are stable and non-eroding	Batters are ripped on the contour	Inspection to ensure batters ripped correctly	No	Commenced

	Areas are seeded by dozer whilst ripping topsoil	Seedlings are germinating	No	Commenced
Seeding and germination of native seeds	Growth from topsoil seed bank	Species present not in seed list	No	Commenced
	Salvaged timber is spread on landform	Inspection to ensure timber has been laid	No	Commenced
Artificial habitat reinstated	Stags are stood up across the landform	Inspections to ensure stags are stable	No	Commenced
	Ground cover	>40% at all times.	No	Commenced
Vegetation established and developing in structure and complexity	Species richness	Range of 5 to 10 species as per Vegetation Communities* benchmarks.	No	Commenced
Native fauna re-populating areas	Native fauna species present in survey counts	Native fauna species present. 70% present compared to analogue sites	No	Commenced
Vegetation communities are self-regenerating	New seedlings establishing	Native flora species regenerating from own seed	No	Commenced
Landforms are stable and non-polluting	Erosion monitoring	No erosion present beyond acceptable levels	No	Commenced
Landform is suitable to light intensity grazing	Species richness suitable for grazing to occur	Successful light intensity grazing trials conducted	No	Not commenced

7 ACTIVITIES PROPOSED IN NEXT AEMR PERIOD

Environment and community activities proposed for 2021 have been previously reported within relevant sections of this document. These actions were based upon the implementation of all aspects of the environmental management plans as activities on site progress from construction to operational phases.

During the reporting period activities will be carried in accordance with the approved Mining Operations Plan (MOP).

The seeding program at Snapper during the next reporting period includes an area of approximately 208Ha, most of this area is made up by the former start-up water dam and mine path backfill areas. Figure 24 illustrates the area at Snapper that will be rehabilitated in May-June 2021.

The former start up water dam will have subsoil and topsoil returned, timber will be placed on all batters to prevent erosion leading up to the seeding of the landform. Crest bunds and backslope will be applied to all landform slopes to prevent erosion.

Tree plots will be established across the rehabilitation area, these will be guarded from browsing and watered regularly. The seeding program is due to commence in the May to June period to take advantage of any potential winter rains to allow the establishment of seedlings prior to the harsh hot summer period.

Areas for seeding will be sprayed with a knock down herbicide in the weeks leading up to sowing if weeds are present. Stockpiles will be monitored for weeds and sprayed as necessary to prevent an increase in weed seed that could be spread on newly formed rehabilitation areas.

Goat control particularly through the summer months will remain a high priority in the rehabilitation areas whereby regular musters, trapping and fence maintenance will be extremely important in protecting newly seeded areas.

Kangaroo numbers will also be monitored in rehabilitation areas and control measures will be implemented to help maintain a healthy population that the current vegetation structure can sustain.

There is 85ha of clearing scheduled for 2020-2021. The target area has very sparse tree cover and is primarily an open bluebush community that is degraded due to grazing. The proposed area for vegetation clearing is shown in Figure 25.



Figure 24- Rehabilitation progress

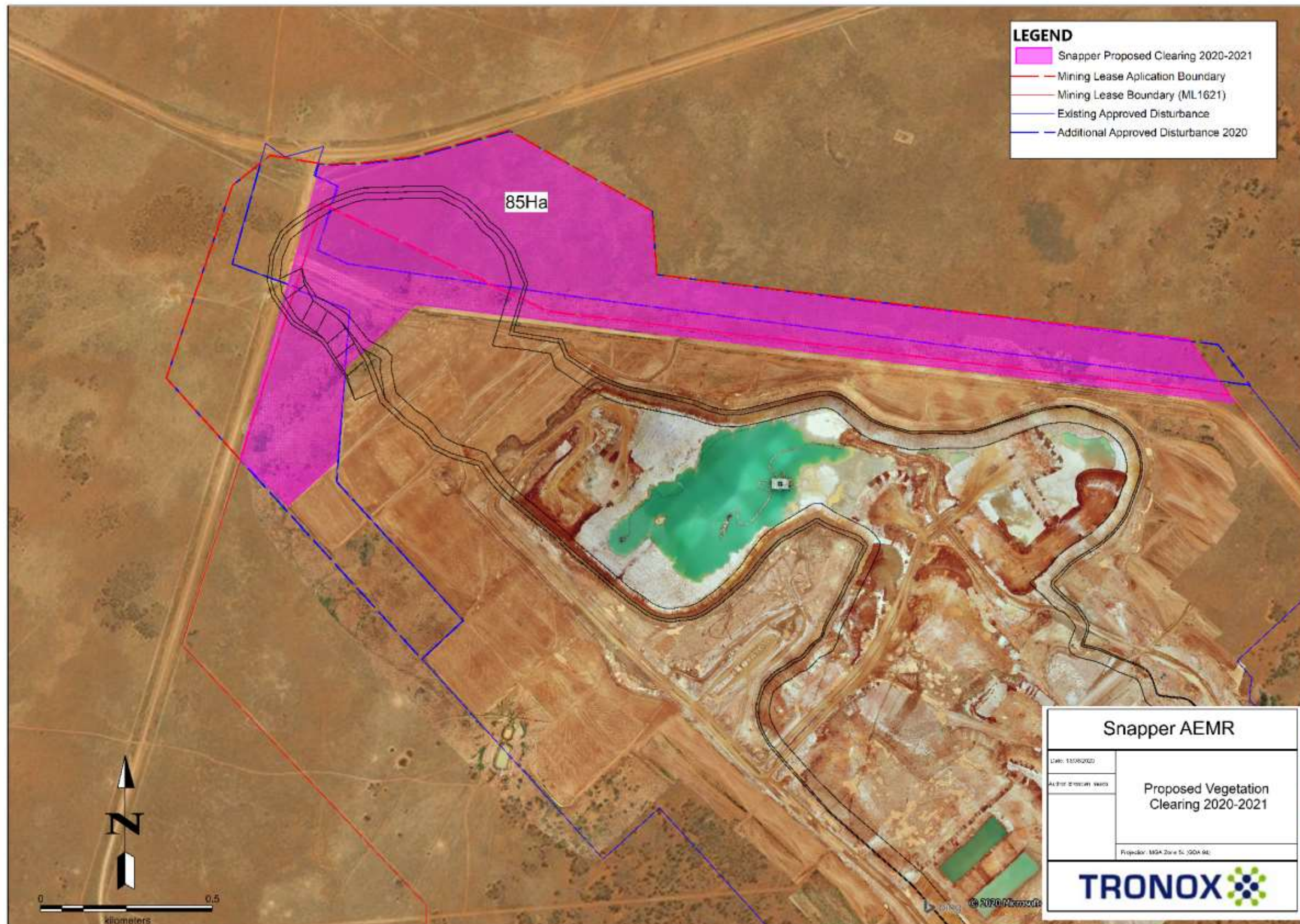


Figure 25- Proposed 2020-2021 vegetation clearing