APPLICATION Mining Act 1971 and Mining Regulations 2020

PROGRAM FOR ENVIRONMENT PROTECTION AND REHABILITATION (PEPR) FOR A MINERAL LEASE

Further information on requirements for a PEPR is available on the Department for Energy and Mining (DEM) Minerals website www.energymining.sa.gov.au .

SECTION A – GENERAL DETAILS

Tenement details	ML6498, ML6499, ML6500, MPL158 and MPL159.
Tenement holder(s) (for each tenement)	Kalkaroo Copper Pty Ltd. (Havilah Resources Limited, PO Box 3, Fullarton SA 5063)
Operating company	OZ Minerals Limited (2 Hamra Drive, Adelaide Airport SA 5950)
Agency agreement (if applicable)	OZ Minerals Limited and subsidiaries authority to operate on Kalkaroo Copper Pty Ltd ML 6498, ML 6499, ML 6500, MPL 158 and MPL159 Letter (**submitted to DEM 05/10/2022**)
PEPR prepared by	Amy Lockheed, Havilah Resources Limited, amy.lockheed@havilah-resources.com.au, 0438 822 771
Project supervisor/contact person(s)	Andrew Oswald, OZ Minerals, Lead Approvals, B.Eng (Civ and Env) ,10+ Years of hard rock mining compliance experience in South Australia, Andrew.Oswald@ozminerals.com Shaun Light, OZ Minerals, Project Geologist, Shaun.Light@ozminerals.com Chris Giles, Havilah Resources Limited, Technical Director, chris.giles@havilah-resources.com.au
Project/prospect name	Kalkaroo Project
Location details	The project area is in the northeast of South Australia close to the NSW border (**Figures 1 and 2**). Geologically the project is in the Curnamona province.
Project description, commodity type and mineralisation model	Drilling of up to 30 Diamond (DD) drill holes within the bounds of ML6498 for resource verification, metallurgical bulk samples and geotechnical verification purposes. A combination of existing and new tracks will be utilised. To support the program activities the following key supporting infrastructure items will be established on MPL 158. • Exploration camp and amenities – to accommodate up to 32 personnel • Wastewater treatment plant and disposal area. • Diesel storage and diesel generators • Potable water storage and treatment plant Key program activities and supporting infrastructure items are shown conceptually in **Figures 3 and 4**.

Proposed project schedule				
	Start date	10/10/2022	End date	31/03/2024

DECLARATION

I, the tenement holder, declare under regulation 84 of the Mining Regulations 2020, that I have taken reasonable steps to review the information in this PEPR/revised PEPR to ensure its accuracy.

Name	Chris Giles	Signature (digital allowed)	
Position	Technical Director	Date	03/11/2022

Copy and paste the above table if there is more than 1 tenement holder.

Note: An authorised representative from each tenement holder must sign the declaration (eg in accordance with the Corporations Act 2001).

SECTION B – PROGRAM PREPARATION AND ACCESS TO LAND

Work undertaken in preparing the proposal

Summarise the research and fieldwork undertaken in preparing the proposal including:

- desktop reviews of existing information
- field visits for reconnaissance
- contractor consultation (i.e. equipment scale, type)
- other information used when planning the proposed program.

Drill hole locations were planned by OZ Mineral's geologist following review of Havilah's Kalkaroo Project data and previous drilling. Work, which has involved extensive collation and interpretation of existing data (both historical from previous companies and from Havilah's ongoing regional exploration) in combination with the enormous local geological knowledge which the Havilah geologists, who have been working in the area for many years. Notification for a Native Title Clearance survey request has been presented to NAWNTAC and a survey will be completed September-October. Note that, Havilah Resources owns Kalkaroo Station on which the drilling will occur.

Consultation (r. 64)

Using the table below, provide a summary of the landowners consulted and the results of consultation undertaken on the proposed operations.

Tenement	Stakeholder, landowner and station name	Land tenure	Land use	Date notice of entry (Form 21) served	Date use of declared equipment (Form 22) served	Type of exempt land	Date waiver of exemption (Forms 23A, 23B) obtained	Date consultation/access agreement and/or permits signed/authorised	Landowner concerns raised and how addressed
ML6498 ML6499 ML6500 MPL158 MPL159	Kalkaroo Pastoral Company Pty Ltd (Kalkaroo Station)	Crown Lease CL 6162/839	Grazing	25/07/2022 Form 21B	N/A	N/A	N/A	Kalkaroo Pastoral is a wholly owned subsidiary of Havilah Resources and relevant consultation has taken place. Form 21B submitted in person to Kalkaroo Manager and Owner.	None

If any individual or group of similar affected persons were not able to be consulted, what steps were taken to consult with them?

N/A

Stakeholder consultation

Using the table below, summarise the results of consultation that has been undertaken with Stakeholders (other than the above landowners) on the proposed operation. This must include consultation undertaken with Traditional Owners in relation to matters of Aboriginal Heritage in the area.

Tenement	Stakeholder	Date of consultation	Stakeholder concerns raised and how addressed
ML6498 ML6499 ML6500 MPL158 MPL159	Ngadjuri Adnyamathanha Wilyakali Native Title Aboriginal Corporation	August 2022 – notification and communication regarding heritage survey covering the Kalkaroo MLs and proposed drilling.	Heritage Clearance request submitted in August for survey to clear the specific hole collar and associated drill pads to be completed in September-October 2022.

If any individual or group of similar affected persons were not able to be consulted, what steps were taken to consult with them?

N/A

Provide any additional relevant information.

Ongoing consultation with landowners and occupiers, including site visits, phone calls and email correspondence.

SECTION C – DESCRIPTION OF THE ENVIRONMENT

Include a description of the features of the environment that are expected to be affected by the proposed operations. Each of the elements of the existing environment listed below must be described only to the extent that they may need to be considered in assessing the impacts that the proposed operations are reasonably expected to have on the environment. If the element is not likely to be impacted by the operation, a statement to that effect must be included.

Where the terms and conditions of the lease include environmental outcomes, include any new baseline environmental data relevant to the control strategies or measurement criteria, and where changes to the environment are identified, provide an updated description of the environment to describe the changes.

Proximity to infrastructure and housing

Provide the following information:

- Settlements – indicate the name and distance of the nearest town, and residences within, or near the proposed operations.
- Roads and tracks – indicate existing fence lines, roads and tracks, including those which are to be used in the program.
- Other human infrastructure such as schools, hospitals, commercial or industrial sites, roads, sheds, bores, dams, ruins, pumps, scenic lookouts.
- Railway lines, transmission lines, gas and water pipelines, communication lines – e.g. fibre optic cables etc., if these may be impacted by the proposed operations.

Provide this information on a locality plan/map.

There are no settlements or places of human habitation within the area of proposed drilling. Station roads, tracks, fences, bores, tanks, and dams are the only infrastructure, none of which will be affected by the proposed drilling activities. Havilah's exploration camp is located at the Kalkaroo Homestead, which is the closest to any of the areas of proposed drilling and is owned by the Kalkaroo Pastoral Company Pty. Ltd., a wholly owned subsidiary of Havilah Resources Limited. No drilling will occur within or near exempt areas associated with dams (which in any case are owned by Havilah) (**Figure 3**).

Land use and tenure

Using the table below, select the land tenure and land use that the proposed operations will occur in. Include additional information where prompted.

Land tenure/type	Applicable
Freehold	☐
Pastoral lease	☒
Perpetual lease	☐
Crown land	☒
Mining reserve	☐
Aboriginal freehold/leasehold land (e.g. Anangu Pitjantjatjara Yankunytjatjara and Maralinga Tjarutja lands)	☐
Forestry reserve	☐
Marine parks	☐
National parks, conservation parks, conservation reserves, regional reserves*	☐
Adelaide Dolphin Sanctuary	☐
Murray Darling Basin	☐
N/A	
Other*	☐
N/A	

Land use	Applicable
Grazing	☒
Cultivated land	☐
Residential	☐
Township	☐
Industrial	☐
Tourism	☐
Conservation	☐
Defence activity	☐
Road reserve	☐
Sites of scientific significance (geological monuments, fossil reserves etc.)	☐
Orchard/vineyard	☐
*Native vegetation heritage agreements	☐
N/A	
*European heritage sites	☐
N/A	
*Other (e.g. historic mining)	
N/A	

* Indicates more information required in field immediately below.

Describe any council policies (or out of council) or development plans that may impact the program area.

N/A

Provide a description of any known plans for future land use changes by other parties.

N/A

Provide any additional relevant information.

Note that, Havilah Resources owns Kalkaroo Station on which the drilling will occur. The property is currently not stocked.

Woomera Prohibited Area (WPA)

Will activities be conducted within the WPA	Yes ☐ No ☒ (If no, no further information in this section required.)		
In which zone will activities be conducted?	Do you have a resource exploration permit in place?	Yes ☐	No ☐
Does the Exploration Permit allow the operator to conduct exploration operations in the WPA?		Yes ☐	No ☐
What is the expiry date of the resource exploration permit?			
Identify closure periods that may impact on the exploration program.			

Land owned or controlled by the Commonwealth Department of Defence

Lands in South Australia that are owned or controlled by the Commonwealth Department of Defence, which they manage either as a training or test area, include the Port Wakefield Proof and Experimental Establishment, Murray Bridge Training Area, and Cultana Training Area.

These lands remain to be mineral land under the Mining Act 1971 (SA) and can be accessed for mineral exploration and mining subject to certain restrictions and conditions under the Defence Act 1903 (Cth) and the Defence Regulation 2016 (Cth).

Will operations be conducted within the Port Wakefield Proof and Experimental Establishment, Murray Bridge Training Area, or Cultana Training Area?	Yes ☐	No ☒
Do you have a Deed of Access with Defence?	Yes ☐	No ☐
What is the expiry date of the Deed of Access?		
Provide the date the Range Control Officer granted access permission to conduct the proposed operations. Describe the results of consultation and how any concerns raised were addressed.		

Native title

Using the table below, describe how you have complied with the requirements of Part 9B of the Mining Act for each tenement (for further information refer to Minerals Regulatory Guidelines MG22).

Native title			
Is the proposed area of operations located on native title land?		Yes ☒ No ☐ (If no, no further information in this section required.)	
Are there registered native title party/parties in the area of proposed operations?	Yes ☒ No ☐	NAWNTAC Consent Determination 14/12/2018, East area.	If no, an Environment, Resources and Development (ERD) Court determination is required.
Have you negotiated a native title mining agreement?	Yes ☒ No ☐	Is the agreement registered?* Yes ☒ No ☐	Instrument number 286
Have you accepted an Indigenous land use agreement (ILUA)?	Yes ☐ No ☒	Is the ILUA registered?* Yes ☐ No ☐	
Have you obtained ERD Court determination?†	Yes ☐ No ☒	Is the determination registered?* Yes ☐ No ☐	

* The registration date refers to the date the agreement, determination or ILUA was registered with DEM.

† An ERD Court determination cannot be conjunctive (i.e. cannot apply to subsequent licences).

Provide any additional relevant information.

N/A

Landform and topography

Describe the topography of the general area affected by the proposed program. Include the susceptibility to erosion and visual attributes (steep or undulating slopes, plains, rocky outcrops, dunes, saltpans, claypans etc.).

The area of proposed drilling lies within the plains of the Lake Frome Basin. The plains are flat to slightly undulating, with the land surface falling gradually at a gradient of about 1 in 1,000 towards Lake Frome, 100 km to the northwest of the project area.
Apart from three isolated basement ridges (Mooleulooloo Hills and Mt. John) near Mooleulooloo Homestead and a rocky knoll at Kalkaroo (Johnny Hill), the nearest areas of elevated topography are the Olary Ranges about 60 km to the south. To the east, the Barrier Range lies beyond the New South Wales border.

The landscape surrounding the project area is characterised by a flat to slightly undulating sandy plain, with low sandy dunes and shallow interdunal areas, scattered with small claypans, trending in a south westerly – north easterly direction (**Photo 1**).

Soil and surface cover

Describe soil types and soil surface cover - e.g. gibber, rocky - in the general area affected by the proposed program. Include details on the susceptibility to compaction, erosion, dust, runoff and any other soil characteristics – e.g. acid sulphate – that may require control strategies to reduce environmental impacts during operations or rehabilitation.

Topsoil development in the project area is limited to a 0.1-1 m layer of light red soils occurring on alluvial material near drainages and a 1-2 m layer of aeolian sand, comprising mostly quartz grains in other areas. Sandy clays +/- gypsum occur at the basal interface between the quaternary and underlying Tertiary clays.

Minor dust and track compaction are expected to be associated with the drilling activities and will be rehabilitated. Given the lack of topography the project area is not susceptible to runoff and associated erosion.

Surface water

Will the proposed program interfere with surface water bodies and natural drainage (e.g. drainage lines, creeks, floodplains, wetlands)? If yes, describe the potential interference and surface water bodies and natural drainage on maps. If no, indicate why.	Yes ☐	No ☒
There is a drainage line running through the Kalkaroo Deposit that lies within the area of proposed drilling (**Figures 3 and 5**). No drilling or related disturbance will occur in or near the drainage.		
Is the program area located within water protection areas defined under the *River Murray Act 2003*? If yes, provide the name(s).	Yes ☐	No ☒
N/A		
Is the program area located within any prescribed watercourses or prescribed surface water areas under the *Landscape South Australia Act 2019*? If yes, provide the name(s).	Yes ☐	No ☒
N/A		

Groundwater

Is groundwater likely to be intersected when conducting the program? If yes, use the table below to describe the expected groundwater (hydrogeological) conditions, and identify groundwater aquifers in the area(s) that may be affected. Indicate the approximate depth of drillholes in each area. Copy and paste a new table for each area where different groundwater conditions are expected. If no, provide evidence or any supporting information demonstrating this.	Yes ☒	No ☐

Water Technology completed a draft Groundwater Impact Assessment for the mining lease area in 2021 after DEM review of a draft mining PEPR. This PEPR was formally withdrawn before submission of a final version by Havilah in 2022 subject to the outcome of studies by OZ Minerals. Key hydrogeological features reported by Water Technology are:

- 0 to ~30 m depth – unsaturated low permeability clay rich Quaternary and Tertiary (Namba Formation) aged sediments.
- Eyre Formation sediment deposits are largely absent beneath the Namba Formation near the Kalkaroo deposit. No palaeochannels were identified in previous mining resource drilling by Havilah (approximately 25 m grid space, over 600 drill holes) in the mining lease area.
- ~30 m + in the mining lease area – weathered bedrock profile includes saprolite grading to saprock then fresh bedrock at depth:
    - Saprolite is typically characterized by low permeability clay rich materials representative of weathered bedrock.
    - Basement shear zones extending through the saprolite layer comprise brecciated with quartz veining and are significantly more permeable compared to surrounding saprolite. Exploration drilling has identified appreciable water inflows from these shear zones within the saprolite horizon.
    - Underlying saprock retains much of the structure and texture of fresh bedrock with the bedrock shear zones also interpreted to provide zones of higher permeability than surrounding saprock.
    - Fresh bedrock similarly is of low permeability outside shear zones that can provide areas of relatively high permeability and correspondingly high well yields.

Water Technology characterise the saprolite down to and including fresh bedrock as “strip aquifers” (shear zones) surrounded by low-permeability basement rock confined by overlying low permeability Namba Formation (aquitard). The water table for the bedrock aquifer is typically in the order of 30 m below ground surface in the saprolite horizon, transitioning into the Namba Formation away from the mining lease areas to the northeast as the depth to bedrock increases. The shear zones are assumed to be sub-vertical and extend to depth within the basement rocks.

Appendix 1 – Draft Kalkaroo Groundwater Impact Assessment by Water Technology. Please note it is a draft report with the review process suspended in 2021 subject to the outcomes of OZ Minerals mining studies of the Kalkaroo deposit. Water Technology presented the findings of this report to DEM and DEW in 2021, which included discussion on the absence of palaeochannels in and around the Kalkaroo mining leases, while Havilah were preparing a revised mining PEPR (formally withdrawn in 2022).

All proposed drilling under this PEPR will be within ML6498 (which is the central rectangle in **Figure 6** “Tertiary (Palaeogene) Sedimentary Distribution (SARIG)” from the attached Water Technology report. This figure also depicts the data available to Water Technology that enabled their interpretation:

“Isolated occurrences of Tertiary sand at the base of the Namba Formation have been intersected in a few basement topographic low areas over the deposit, but these are not continuous or connected enough to define a channel or layer of any significance. The closest recognised palaeochannel to the Kalkaroo Deposit is the Yarramba Palaeochannel located 12 km to the east. An interpreted tributary palaeochannel trends to the southwest from the Yarramba Palaeochannel towards Kalkaroo as shown in Figure 4-3 (**Figure 6** in PEPR), but this has not been proven to contain significant deposits of Tertiary sand. Review of available drill hole logs from SARIG suggest that these materials are predominantly silty clays, and it is therefore interpreted that they are associated with the Tertiary Namba Formation.” (Page 12 of Water Technology, 2021 (attached)).

As mentioned above, all drilling under this PEPR will be within ML 6498. On completion of the estimated 600 drill holes completed in and around the Kalkaroo mining leases no evidence of palaeochannels were identified. The attached Water Technology contains X-sections of the mining lease area and previously proposed pit. The Water Technology findings in relation to the absence of palaeochannels in the vicinity of the Kalkaroo deposit are consistent with conditions observed by Havilah Resources’ geologists during the completion of exploration and resource drilling.

Formation age and/or stratigraphic unit	**Stratigraphic intervals (depth range) (m)**	**Aquifer formation name**	**Aquifer interval/thickness (from–to) (m)**	**Type of aquifer(s) intersected (e.g. unconfined, confined, artesian)**	**Provide aquifer salinity, depth to water level and any other relevant comments**
Quaternary sediments	0 to 15 m	NA	NA	NA	NA
Tertiary Namba Formation	15 to 30 – 60 m	NA	NA	NA	NA
~1700 ma Wilyama Supergroup Curnamona and Strathearn Groups	~30 – 60 m+	NA	30-60 m + Higher permeability shear zones (strip aquifers) are sub-vertical	Unconfined bedrock with sub-vertical strip aquifers in shear and fracture zones	Depth to water is about 29 m below ground level (BGL) (approximately 40 m AHD) TDS of 13,625 mg/L (ave.) pH of around 7.8 (ave.)

Provide the environmental value of each aquifer present determined according to the current Environment Protection (Water Quality) Policy.

Based on salinity of groundwater from the higher permeability shear zones (>13,000 mg/L), water quality is not suitable for the environmental value: primary industries – livestock drinking water (salinity between 3,000 and 13,000 mg/L). There are no known operational groundwater wells within 10 km of the mining leases.

Provide a description of the existence, location and value of all Groundwater Dependent Ecosystems (GDEs) within and immediately surrounding the project area.

There are no known permanent GDE's in the area. All vehicle movement during drill programs will be restricted to cleared tracks and drilling on selected pad areas. No off-track driving will occur.

Is the proposed program located within a prescribed wells area or prescribed water resource area? If yes, provide the name of the area.	Yes ☐	No ☒
N/A		

Provide any additional information, if required.

The groundwater in the drilling area is too saline for stock use and for this reason there are no active bores in the general area that are used by pastoralists.

Native vegetation

Will you be working within areas of native vegetation? If yes, provide the following information: • description of the formation and structure of vegetation in the area (e.g. woodland, shrubland, grassland) • list of the dominant species. If yes, a Native Vegetation Management Plan (NVMP) prepared by an accredited consultant must be included with the PEPR. The NVMP must: • describe the vegetation type to be cleared and include a map showing the proposed clearance area; and • state the quantum of significant environmental benefit (SEB) to be gained in exchange for the clearance and describe how the SEB will be provided. If no, indicate why you will not be working within areas of native vegetation?	Yes ☒	No ☐

The Kalkaroo project has typical low shrubland vegetation consisting of sparse saltbush or bluebush, with very minor patches of acacia scrub and minor sheoak/black oaks. The area is one of disturbed vegetation with a long history of heavy grazing by native and domestic herbivores, combined with past drought conditions.
Badman (2008) assessed the Kalkaroo Project area as falling into the category of "Native vegetation with some disturbance" based on the following criteria:
The vegetation structure has been altered.

- Most seed sources are available to regenerate the original structure
- Obvious signs of disturbance
- Minor clearing of native vegetation (<10 % of the area cleared by grazing)
- Evidence of some grazing

Significant Flora
A search for information on threatened species indicated that there are no flora species listed as threatened under either the Commonwealth EPBC Act 1999 or the South Australian National Parks and Wildlife Act 1972. *Acacia carneorum* (Purple- wood Wattle or Needle Wattle) is listed as vulnerable and is known from the general area but is outside the proposed area of drilling.

Havilah/Oz Minerals field personnel are supplied with Fact Sheets to assist with the recognition of Threatened Flora. Areas of Purple-wood Wattle are well known to Havilah personnel through its conservation efforts and will not be affected.

A Native Vegetation Clearance (NVC) Data Report is attached as **Appendix 2** (Kalkaroo Copper Project – Temporary Camp), along with an updated SEB calculation report for the proposed camp area and drill sites, where minimal to no clearing is required.

Calculated SEB: $46,865.92 – Paid to Native Vegetation Fund.

Significant habitats and flora

If you are working within areas of native vegetation, use the table below to list any significant habitats and any rare or endangered flora species located or reported to have been in the area that may be impacted by the proposed program. Include known sightings of listed species on a locality plan/map.

Species/habitat	Common name	NPW Act rating*	EPBC Act rating†
Acacia carneorum	Purple-wood Wattle (Needle Wattle)	Vulnerable	Vulnerable
Swainsona procumbens	Broughton Pea	Vulnerable	Not Rated

* *National Parks and Wildlife Act 1972* (NPW Act) conservation status includes extinct, endangered, vulnerable, threatened and rare.

† *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) listings include extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent.

Weeds and pathogens

Provide information of the extent the area is affected or potentially affected by weeds and pathogens (e.g. phytophthora; buffel grass *Cenchrus ciliaris*).

The project area is in the Buffel Grass (Figure 1) Management Zone 2 (Contain Spread) however there are no known occurrences of Buffel Grass within the area. Should an area of Buffel Grass infestation be encountered during the drilling program, cleaning procedures will be implemented when leaving the area of infestation and the area avoided.

Figure 1: Buffel Grass

Badman (2008) recognised twenty introduced species of which two *Echium plantagineum* (Salvation Jane) (Figure 2) and *Lycium ferocissimum (*African Boxthorn*)* (Figure 3) *are* Proclaimed Species, as listed by APCC (2004). The introduced species recorded during the October 2007 survey represent 16% of the total species list for this survey.

Figure 2: Salvation Jane

Figure 3: African Boxthorn

Fauna

Describe the native and feral fauna that may be present in the application area, including feral species.

A review of Nature Maps (Enviro Data SA) did not find records of native fauna of significance (NPW Act or EPBC Act rating) at or within proximity to the project site.

Significant fauna

Where possible, using the table below, list any rare or endangered fauna species located or reported to have been in the area that may be impacted by the proposed program. Include known sightings of listed species on a locality plan/map.

Species	Common name	NPW Act rating	EPBC Act rating
None Recorded			

Note: NPW Act conservation status includes extinct, endangered, vulnerable, threatened and rare.
EPBC Act listings include extinct, extinct in the wild, critically endangered, endangered, vulnerable and conservation dependent.

Environmentally sensitive locations

Are there any environmentally sensitive locations within or close to the proposed area of operations (e.g. areas having particular ecological, cultural, scientific, aesthetic or conservation value)? If yes, provide a description of identified environmentally sensitive location(s). Mark these areas on a locality plan to identify any areas of conflict so that access roads or other activities can be planned and located effectively.	Yes ☐	No ☒
N/A		
Are you likely to impact on the environmentally sensitive area? If yes, detail the likely effects the proposed program may have.	Yes ☐	No ☒
N/A		
Include a statement concerning whether or not an Aboriginal heritage survey has been conducted by the proponent and if so, the results of the survey.		
Notification for a Native Title Clearance survey request has been presented to NAWNTAC and a survey will be completed October.		

SECTION D – DESCRIPTION OF PROPOSED OPERATIONS

Each of the elements listed below must be described only to the extent that they apply to the proposed program.

Equipment and personnel requirements

Using the table below, describe the equipment, size and composition of field crews, and proposed working hours/days required to conduct the proposed program.

Type of personnel	Number	Name of contractor company (if applicable)
Geologists	2-3	OZ Minerals Limited and Havilah Resources Limited
Field assistants/technicians	2-3	OZ Minerals Limited and possibly Euro Exploration
Drilling crew diamond	6-8	Diamond drilling contractor not yet finalised included nightshift operation
Site preparation and rehabilitation	1	Havilah Resources Limited contracted to OZ Minerals Limited
Core Scannings (ore explore)	4-7	1 NS remaining plus 3-6 DS included technicians and geologists
RC drilling (through Havilah) Exploration	3-4	DS only
Study Team + approvals	4-6	Part time on site

Shifts worked per day	Hours worked per day	Days worked per week
1	12 hrs per shift	7

Equipment type	Owner/operator	Description/capacity	Activity/purpose
Diamond Drilling			
Multi-purpose or Diamond Drill Rig	Diamond drilling contractor not yet finalised	UDR 650/1000 or similar	Drilling
Compressor/rod Trucks	As above	1 x 6 or 8 wheel flat bed	Drilling support vehicles
Water Truck	As above	1 x 8 wheel 20,000L	To supply drilling water, only when too far to pipe e.g., >3km. No tanks required.
Backhoe	Havilah Resources Limited	CAT or JCB Backhoe	Site Preparation (including digging of Sumps) & Rehabilitation
3 x 4WD Utilities	OZ Minerals Limited and drilling contractor	Landcruiser or Hilux dual cab utes.	Field crew vehicles for access, sampling & logging. In addition to transportation for drilling crew to and from the site.

Provide any additional information, if required.

During May and July 2022 Havilah and OZ Minerals entered into agreements that confer on OZ Minerals an up to 18-month study period (if not extended) during which it will undertake a comprehensive study and work program with the aim of progressing and completing an update to the current Kalkaroo project pre-feasibility study. This will initially include up to an estimated 30 diamond drillholes for resource verification, metallurgical bulk samples and geotechnical verification purposes.

Low impact exploration activities

Will low impact exploration operations be conducted that are not covered by the Generic program for environment protection and rehabilitation – low impact mineral exploration in South Australia, (generic PEPR)? If yes, describe each type of low impact operations proposed.	Yes ☐	No ☒
N/A		

Drilling activities

Will exploration drilling activities be conducted? If yes, fill out the below table	Yes ☒	No ☐

Tenement	Drilling type	Maximum number of drillholes	Maximum drillhole depth (m)	Maximum number of sumps required at each site	Maximum size of sumps (length x depth x width) (m^3)	Average size of each drill pad* (m^2) (no excavation required)	Number of sites requiring pad excavation	Average volume (m^3) of material to be excavated (excluding sumps)
ML6498, ML6500, and MPL158	DD	30	450	2	3x2x2m (12m^3)	50mx50m (2,500m^2)	-	-
TOTAL		**30**	**13,500**	**60**	**720**	**75,000**	**-**	**-**
		Total number of	Total metres proposed	Total number of	Total volume of sumps (maximum	Total area of disturbance (number of holes x	Total number of pads requiring	Total volume of material to be excavated (number of sites

drillholes (add each row to calculate the total).	(maximum number of holes x average depth for each row, then add each row to calculate the total).	sumps (maximum number of sumps x drillsites for each row, then add each row to calculate the total).	size of sumps x number of sumps for each row, then add each row to calculate the total).	average size for each row, then add each row to calculate the total).	excavation (add each row to calculate the total).	requiring excavation x average volume for each row, then add each row to calculate the total).

* The footprint includes all areas of disturbance associated with the drillsite.

Drillsite preparation

If exploration drilling activities are proposed, describe the methods used to prepare sites, including vegetation clearance requirements, site levelling and digging of sumps.

It will not be necessary to clear access tracks or the drill sites, except for small excavations for sumps. Bushes will be removed by hand (shovel), if required to make an area to lay out drill cuttings in small piles in rows on the ground or to make a safe drilling platform Drill sites will be located to cause the least impact to the environment. No trees will be removed.

To accommodate the equipment, each drill site will measure approximately 50 m x 50 m in size. Each diamond drill hole will require up to two small sumps at the collar measuring approximately 3 m x 2 m x 2 m each, to contain the mud and drill cuttings. Sumps will be bunded and a ramp will be installed in each sump to enable animals to escape, should they inadvertently happen to fall into one. The sumps will not be lined. A backhoe will be on site to dig the sumps. Topsoil will be stockpiled separately for later use in the rehabilitation. Materials excavated during sump preparation will be sequentially placed back in the order of removal during rehabilitation.

Drillhole construction and decommissioning

Have the personnel responsible for implementing the proposed program read and understood the Earth Resources Information Sheet M21, Mineral exploration drillholes – general specifications for construction and backfilling?	Yes ☒	No ☐

Describe how drillholes will be constructed, including the casing material to be used, depth of casing, if the casing will be cemented, cementing intervals and the class of driller that will install the casing.

Diamond holes will be constructed as follows:

Rotary mud (RM) or Aircore (AC) or Reverse Circulation (RC) precollar through Quaternary sands & clay, Namba Fm. clay and saprolite until the hole is into fresh rock at a maximum depth of approx. 130m. PVC casing through the unconsolidated cover will be required. PQ/HQ size diamond coring from the base of the precollar through the target zone to a maximum depth of approx. 400m.

When describing drillhole decommissioning requirements, include the materials to be used, stratigraphic intervals where cement plugs will be placed, if the casing will be removed and when decommissioning will occur after drilling is completed.

Previous drilling experience in the region has shown that casing or cementing is not required to manage groundwater. The Namba Fm. and saprolite are essentially self-sealing and close in soon after drilling is completed.
Upon completion the 6" PVC collar will be cut off approx. 0.5 m below ground level, capped with a heavy-duty PVC cap and backfilled. A backhoe will be on site to conduct rehabilitation.
The sumps will be allowed to dry out and will then be backfilled first with the remaining RM/AC/RC sample piles and any cuttings from around the collar and then with spoil from the sumps. All core and rubbish will be removed. Topsoil retained for the purpose will be spread back over the site where required to aid in regeneration and the site will be raked or scarified with the teeth of the backhoe bucket to return the landform to its pre-drilling state. Partial rehabilitation will be ongoing as drilling progresses and final rehabilitation will be completed as soon as practical after completion of the program.

Final Rehabilitation:

No bulk sample disposal pits will be required for the diamond drilling. The sumps will be allowed to dry out and will then be backfilled firstly with the remaining RM/AC/RC sample piles and any cuttings from around the collar and then with spoil from the sumps. All core and rubbish will be removed. Topsoil retained for the purpose will be spread back over the site where required to aid in regeneration and the site will be raked or scarified with the teeth of the backhoe bucket to return the landform to its pre-drilling state. Materials excavated during sump preparation will be sequentially placed back in the order of removal during rehabilitation.

Where confined or artesian conditions are expected, include a schematic diagram demonstrating how drillholes will be constructed and decommissioned

Costeans and trial mining pits

Will trial mining/costeans/trial mining/bulk sample disposal pits be required for the proposed program? If yes, fill out the table below.	Yes ☐	No ☒

Tenement	Number of costeans/pits	Size of costean (length x width) (m^2)	Average depth (m)	Volume excavated (m^3)	Total volume excavated (m^3) (number of costeans/pits x volume)	Total area of disturbance* (length x width) (m^2)
TOTAL						
	Total number of costeans/pits (add each row to calculate the total).				Total volume of material to be excavated (add each row to calculate the total)	Total area of disturbance (number of costeans/pits x area of disturbance for each row, then add each row to calculate the total).

*Includes storage of excavated material at the site (e.g. topsoil and subsoil segregation).

Costeans and trial mining pit preparation

If costeans/trial mining/bulk sample disposal pits are required, describe site preparation methods, vegetation clearance, and safety and maintenance requirements.

N/A

Sample management

Describe the size of samples collected (including drilling samples and bulk sampling), collection methods, materials used when collecting the sample, sample disposal methods (including removal of sample bags), safety management and any other sample management requirements at the exploration site (e.g. tarps or matting used to contain cuttings). Include requirements for on-site geological sample management (splitting of archive samples, bag farms, core processing and storage).

A small area (3 m x 8 m) within each site will be reserved for samples. No clearing will be necessary, apart from the removal of any bushes by hand (shovel), if required. Precollar samples (2 m, 3-5 kg each) of drill cuttings will be laid out as small piles in rows on the ground. These will be disposed of firstly down the drill hole if practicable and then in either a small trench or sump during the partial rehab of the site, shortly after drilling has been completed. There will be no need to store bulk sample or samples in a pit or bag farm. No sample material will remain on the surface. All plastic sample bags and rubbish will be removed and disposed of properly at the Broken Hill refuse depot. All drill core will be removed and will be processed and stored at Havilah's camp at the nearby Kalkaroo Homestead. All drilling, sampling and rehabilitation activities will be conducted to minimise risks to personnel, wildlife and the environment that might be associated with sumps, pits, sampling, and rehabilitation.

Access routes to work areas

Will existing tracks require upgrading and/or maintenance? If yes, detail the work required to upgrade/maintain existing tracks.	Yes ☐	No ☒
N/A		
Will access be required across adjoining tenements? If yes, detail the method(s) for gaining access, and if an agreement is in place with all stakeholders. Include the total area of disturbance required (i.e. length (km) and width (m) of tracks) and provide on a locality map.	Yes ☐	No ☒
N/A		
Will access off existing tracks be required? If yes, detail the method(s) for gaining access and if vegetation clearance is required. Include the total area of disturbance (includes drill traverses and seismic lines) required off existing tracks (i.e. length (km) and width (m) of new tracks).	Yes ☒	No ☐
Approximately 4 km of travel off existing tracks will be required and new tracks will be required branching off towards the drill pad sites. Existing and new tracks are shown on Figure 3. Clearing of new tracks will be avoided and will involve driving across country to the drill sites. Along new tracks the clearest path will be used as often as practical, ensuring that vegetation remains as undisturbed as possible. No track construction is necessary as the ground is flat and sandy and the vegetation consists of blue bush and salt bush, with very minor patches of acacia shrubs and rare sheoak or black oaks, which will be avoided. Access to the Kalkaroo Project and drill areas is shown in **Figures 2 and 3.**		

Indicate planned access routes on a locality plan and distinguish between existing and proposed new access tracks and drill lines (including fence lines).

Campsites, storage and equipment laydown areas

Using the tables below, provide a description of campsites and/or laydown areas required. Indicate the campsite and laydown area on a locality plan.

Campsite details		
Indicate where staff and contractors will be accommodated during the exploration program.		
Temporary camp that is proposed to be situated on the southern boundary of MPL 158.		
What is the maximum number of personnel requiring accommodation?	32	
Is a campsite required to be established? If no, no further information is required.	Yes ☒	No ☐
Provide a description and justification of the camp location (e.g. previously cleared areas etc.), and any other relevant information.		
The temporary camp will be located within the general footprint of the existing exploration camp area and would not require any new tracks or additional vegetation disturbance.		
What will be the total area (ha) of the campsite(s)? Within existing exploration camp area footprint	0.64ha	
What will be the total area (ha) of vegetation clearance for the campsite? N/A	0ha	
If vegetation clearance is required, describe the methods used to prepare the site.		

Units will be placed on the ground with minimal clearance or ground works required. The camp is in a highly impacted area with minimal vegetation. The proposed camp site is 2,400 m^2, Car park 714 m^2, access track 2,067 m^2, storage area 160 m^2 and waste water spray field 2,500 m^2 (**Figure 4 and Photo 2**)		
Will any excavations be required? If yes, describe the purpose of the excavation and the maximum volume (m^3) of material to be excavated.	Yes ☒	No ☐
There may be a requirement for minor shallow excavations to facilitate the camp, potentially 4 m^3.		
Will the proposed ablution facilities be endorsed/approved for use by the Department of Health or local council, where applicable? If no, provide a reason.	Yes ☒	No ☐

Proposed infrastructure (includes caravans, tents, offices, hydrocarbon and water storage requirements etc)	**Quantity**	**Description/capacity**
3 Room Ensuite accommodation units	11	Single person room, include toilet/shower
Kitchen/Dining rooms/Food Store	1	Catering, cooking, and dining equipment, cool room, freezer room, dry store
Laundry	1	Laundry room with 6 washing machines and 6 dryers
Camp Office / Gym / Ice Room	1	Office including furniture, gym, and ice room.
Walkway systems	1	Walkways between all camp buildings.
Generator Skid	2	200 kva Generators with electrical distribution and power leads, and 4,000 L self-bunded fuel cell (**Photo 3 and 4**, respectively).
Toilets and grey water	1	Ensuite toilets for rooms plus 1 toilet block. Sewage treatment will be via pipes to effluent treatment area (septic or other, yet to be determined) and include kitchen grey water disposal subject to appropriate DHW approvals.
Hydrocarbon Storage (bunded areas)	1	100,000 L (size required for drilling and camp requirements) tank proposed to support camp and other infrastructure located close to camp. Hydrocarbon storage will be bunded or double walled to ensure safe storage as per requirements.
Water tank	1 – 3	Potable water to be used for camp. Tank(s) (~60,000L) positioned as close to camp as possible.
Waste Water Treatment Plant	1	Waste Water Treatment Plant to suit, including spray field irrigation.
Waste Management Bins Waste removed from site	15 (Yes)	Rubbish will be segregated and recycled where practical and stored in secure bins in designated areas to prevent scavenging by animals. Rubbish is regularly removed and transported to the nearest registered disposal site. The company implements management strategies that discourage the activities of feral pests, particularly foxes and cats. Campsites present the major risk for attracting feral animals. The company place food in vermin proof receptacles and return those waste to (include town/location) for appropriate disposal.
Provide a description and justification of the camp location (e.g. previously cleared areas etc.), and any other relevant information if required.		
The camp site location will be surveyed by NAWNTAC to ensure no heritage sites are disturbed. The selection of the camp site was made to ensure minimal to no disturbance to native vegetation. The selection of the camp site location is proposed to reduce the requirement for traffic movement thereby reducing the potential for a vehicle-based incident during the drill program. The camp is located as close as convenient to existing camp infrastructure (Havilah's small exploration camp) and is adjacent to well-formed tracks/roads.		

Laydown area details		
Will laydown areas be required? If no, no further information is required.	Yes ☒	No ☐
Will the laydown area(s) be located at the same location as the campsite? If no, has the location(s) been discussed with the landowner?	Yes ☒	No ☐
Laydown to be near the woolshed in an area Havilah currently using for laydown (**Figure 4 and Photo 5**)		
What will be the maximum area (ha) required for the laydown area(s)?	0.25 ha	
What will be the total area (ha) of vegetation clearance for the site?	0 ha	
If vegetation clearance is required, describe the methods used to prepare the site.		
N/A		
Will any excavations be required? If yes, describe the purpose of the excavation and volume (m^3) of material to be excavated.	Yes ☐	No ☒

Proposed infrastructure (includes hydrocarbon and water storage requirements)	Quantity	Description/capacity
Included in camp set-up		
Provide a description and justification of the location (e.g. previously cleared areas), and any other relevant information if required.		

Other exploration methods and/or ancillary operations

Are any other proposed exploration methods (e.g. seismic) and/or ancillary operations required? If yes, describe the activity(s), site preparation, vegetation clearance, and safety and maintenance requirements.	Yes ☐	No ☒

Water supply and management

Will camp and/or drilling or trial mining water be required? If yes, describe how and where water will be sourced for drilling, track maintenance and camping purposes (e.g. groundwater, surface water, mains). Provide details on the volume of water required and how wastewater or runoff water will be managed.	Yes ☒	No ☐
For Diamond Drilling water (saline ground water up to 13,000 ppm TDS) will be obtained from registered bores in the region, located in the immediate vicinity of the proposed drill holes. A usage of no more than 20,000 L/day is envisaged. The water will be piped directly to the drill site from the bore and will be retained in the sumps and circulation by appropriate bunding. Water trucks will supply water to holes where it is too far for water to be piped. Water will be pumped directly to sumps, no tanks required. There will be no wastewater or runoff from the site.		
Will surface water and/or mineral drillholes be used as a water source/supply? If yes, indicate if a licence for water extraction/usage is required (refer to relevant Natural Resources Management water allocation plan available on the Department for Environment and Water (DEW) website. If a licence is required and has been obtained please attach a copy. Where a licence has not been obtained, include a statement confirming that a licence will be obtained before the extraction and/or usage of water.	Yes ☐	No ☒
N/A – No water to be extracted for any purpose.		

Groundwater and drilling investigation activities

Will any water bores be required and/or water investigation activities (e.g. pump testing, water monitoring sites, water storage, turkey nests/dams) be conducted? If yes, describe the water drilling and investigation activities, including site preparation, vegetation clearance, and safety and maintenance requirements.	Yes ☐	No ☒
N/A		
Indicate if well permits have been obtained and whether or not a water extraction licence is required in accordance with the Landscape South Australia Act 2019. If yes, attach a copy of the permit(s)/licences. If no, provide a statement confirming that permits/licences will be obtained prior to commencement of water investigation activities.	Yes ☐	No ☒
N/A		

Water affecting activities

Will any water affecting activities, other than drilling a water well, be undertaken (refer to s. 127 of the Landscape South Australia Act 2019)? If yes, attach a copy of the permit. If a permit has not been obtained, provide a statement confirming that a water affecting activity permit(s) will be obtained and provide a description of the site preparation, vegetation clearance, and safety and maintenance requirements.	Yes ☐	No ☒
N/A		

Management of hazardous materials

Will activities be conducted in areas of known uranium and thorium mineralisation? If yes, attach a Radiation Management Plan and confirmation of endorsement of the plan by the Environment Protection Authority South Australia (EPA).	Yes ☐	No ☒
Will any other hazardous material be encountered when exploring in the area? If yes, list the types of hazardous materials and provide a management plan on how these materials will be managed.	Yes ☐	No ☒
N/A		

Description of rehabilitation and liability estimate

Provide a description of the progressive rehabilitation of the operation, including: • Use of topsoil and overburden • Battering of pit faces and other earthworks • Revegetation Other activities designed to return the site to a safe and stable condition
• Drill sites and access tracks avoid areas of substantial vegetation (very rare in this area). • Access to the drill sites will mainly be along existing station tracks, then by driving across country for a short distance (off-road driving kept to a minimum). • In some (very rare) cases, a backhoe or loader may be required to remove vegetation, using the 'blade up' method depending on the thickness of vegetation. • Vehicles are restricted to a single access track to minimise disturbance of vegetation. • Excavations are constructed with a shallow angle ramp to allow small animals to escape and are appropriately barricaded/bunded to prevent access. • All holes are capped following drilling completion. • Unwanted drill samples and spoil from drilling are place into sumps/pits, which are backfilled, covered with topsoil (stockpiled separately during drilling) and lightly scarified to promote seed germination. • Final rehabilitation of each site will be completed by raking or lightly scarifying to promote seed germination and new vegetation growth. Any stockpiled vegetation will be spread over the site. • All external waste material is removed from site to an approved waste facility. • No fires are lit during the summer months, and only at other times if there is a clear area surrounding and fire danger is minimal (e.g., lack of burnable material and no fire ban period). • Fire management procedures in places, including policy for “extreme fire danger rating” and firefighting equipment/extinguisher are always available. • The land surface will be returned to its original profile. • Materials excavated during sump preparation will be sequentially placed back in the order of removal during rehabilitation. • **Photo 6** shows an example of a rehabilitated area.
Provide the maximum third party cost of rehabilitation at any time over the life of mine covered by the PEPR. The estimate must be based on reasonable third party costs of undertaking the rehabilitation and include costs for project management, inflation, normal project variation, and contingency provision for risk associated with the strategies and uncertainty in the cost estimates.
$50, 000

SECTION E – LEASE CONDITIONS

Mineral leases

Where the retention lease includes specific conditions that are not environmental outcomes, demonstrate where these have been addressed in the PEPR (if relevant) or demonstrate how otherwise they have or will be complied with.

Mineral Lease	Lease condition	How has the condition been complied with
First Schedule – Additional Terms		
MPL 158	Authorised Activities 1. The grant of the Mining Tenement authorises activities for the purposes of construction, operating, maintaining, rehabilitation and closure of the following: 1.1. run of mine pad; 1.2. processing plant; 1.3. gravel storage area; 1.4. topsoil stockpiles; 1.5. power plant; 1.6. mineralised waste dump; 1.7. administration infrastructure; 1.8. workshop and store; and 1.9. landfill; directly related to the conduct of mining operations authorised under mining tenements ML6498, ML6499 and ML6500. 2. Authorised activities on the Land must be consistent with the activities described in the Miscellaneous Purposes Licence management plan dated 11 September 2014 and subsequent Response Documents dated 30 November 2015 and 19 January 2017.	Acknowledged

ML 6498, ML 6499, ML 6500	1. The grant of the Mining Tenement authorises mining operations (only) for the recovery of: 1.1. Copper; 1.2. Gold; 1.3. Molybdenum; and 1.4. Cobalt. 2. In accordance with section 39(2) of the Act, the grant of the Mining Tenement authorises the recovery of extractive minerals including, but not limited to: 2.1. Quartzite; 2.2. Clay; and 2.3. Shale; produced as a result of mining operations conducted in pursuance of this Mining Tenement. 3. The grant of the Mining Tenement authorises mining operations (only) that are consistent with the mining operations described in the Mining Proposal document dated 11 September 2014 and subsequent Response Documents dated 30 November 2015 and 19 January 2017.	Acknowledged

Mineral Lease	Lease condition	How has the condition been complied with
Second Schedule – Additional Conditions		
MPL 158	See **Appendix 3**	Acknowledged
ML 6498, ML 6499, ML 6500	See **Appendix 3**	Acknowledged
Sixth Schedule – Environmental Outcomes		
MPL 158, and ML 6498, ML 6499, ML 6500	See **Appendix 3** for full description	
	Clause 1: Air Quality Outcome	Acknowledged – drilling only.
	Clause 2: Air Quality Strategy	Section E – Rehabilitation, and Section F.
	Clause 3: Noise Outcome	Hearing PPE worn during rig operation.
	Clause 4: Waste Management Outcome	See Section F.
	Clause 5: Waste Management Strategies	See Section F, or N/A (mining activity).
	Clause 6-7: Surface Water Outcomes	See Section F.
	Clause 8: Surface Water Strategies	See Section F.
	Clause 9: Groundwater Outcome	See Section F.
	Clause 10: Groundwater Strategies	See Section F, or N/A (mining activity).
	Clause 11: Groundwater Criteria	N/A – drilling only.
	Clause 12: Native Vegetation Outcome	See Section F.
	Clause 13: Native Vegetation Criteria	See Section C – Native Vegetation.
	Clause 14: Weeds, Pests and Plant Pathogens Outcome	See Section C – Weeds and pathogens, and Section F.
	Clause 15: Weeds, Pests and Plant Pathogens Criteria	See Section C – Weeds and pathogens, and Section F.
	Clause 16: Fauna Outcome	See Section F.
	Clause 17: Soil Outcome	See Section F.
	Clause 18: Soil Strategies	See Section F.
	Clause 19: Visual Amenity Outcome	See Section F.
	Clause 20: Visual Amenity Strategies	See Section F – rehabilitation, no mining being undertaken.
	Clause 21: Traffic Outcome	See Section F.
	Clause 22: Traffic Strategy	See Section F.
	Clause 23-26: Public Safety and Land Use Outcome	See Section F.
	Clause 27: Public Safety and Land Use Strategies	(ML's Only) See Section F.
	Clause 28: Heritage Outcome	See Section F.
	Clause 29: Blasting Outcome	N/A – no blasting to occur
	Clause 30: Blasting Strategies	N/A – no blasting to occur

SECTION F – MANAGEMENT OF ENVIRONMENTAL IMPACTS

Use the table below (instructions provided) to identify all of the potential environmental, social and economic impact events that are likely to occur as a result of the proposed operations, how each of the identified impacts will be managed, and the residual risk, i.e. the level of risk remaining after implementing control and management strategies. Identified potential impact events should be developed based on the aspects of the environment that may be impacted on and the proposed operational details. Potnetial impact events must have corresponding outcomes and measurement criteria.

Where the terms and conditions of the lease include environmental outcomes, list them (where different) in the table below and complete all sections (ie receptor, potential impacts, control strategies, risk assessment and measurement criteria).

Environmental management – potential impacts/events, outcomes, measurable criteria and monitoring plan

			Likelihood of consequence (LH)				
			1	2	3	4	5
			Rare	Unlikely	Possible	Likely	Almost certain
Severity of consequence (CQ)	A	Insignificant	Low	Low	Low	Low	Low
	B	Minor	Low	Low	Moderate	Moderate	Moderate
	C	Moderate	Moderate	Moderate	High	High	High
	D	Major	High	High	Extreme	Extreme	Extreme
	E	Catastrophic	High	Extreme	Extreme	Extreme	Extreme

How to fill out the table

1. Based on the description of the environment and proposed operations, indicate which potential impacts are applicable to the proposed program. Note that some potential impacts are applicable to all programs.
2. For each applicable potential impact (and corresponding receptor), describe control strategies that will reduce the risk of the potential impact to an acceptable level, and achieve the corresponding environmental outcomes.
3. Conduct an impact assessment to determine if the control strategies address the potential impact (i.e. reduce the risk to an acceptable level). Indicate where there is uncertainty pertaining to the likely effectiveness of the control strategies. Where the risk is not considered low, provide justification that the risk is acceptable, or consider additional strategies to reduce the risk to an acceptable level.
4. For each applicable potential impact, the corresponding outcome and outcome measurement criteria are required.
5 Based on the description of the environment and proposed operations, determine if any other potential impacts are applicable. For each new potential impact, describe proposed control and rehabilitation strategies, conduct an impact assessment, and develop corresponding outcomes and outcome measurement criteria.

Use the above matrix to conduct an impact assessment for each potential impact.

Impact assessment							Outcomes	Outcome measurement criteria (inc. monitoring plan)
Receptor Lists are not exhaustive.	**Potential impacts** Lists are not exhaustive.	**Is the potential impact applicable (Yes/No)** Some potential impacts are applicable to all programs.	**Control strategies** Indicate where there is uncertainty pertaining to the likely effectiveness of the control strategies. Where the risk is not considered low, provide justification that the risk is acceptable, or consider additional strategies to reduce the risk to an acceptable level. – refer to Minerals Regulatory Guidelines MG2b for more information.	**Risk assessment** LH = likelihood of consequence CQ = severity of consequence **LH**	**CQ**	**Risk**		
Stakeholders: • freehold land owners • perpetual lease holders • pastoral lease holders • Aboriginal land (Anangu Pitjantjatjara Yankunytjatjara and Maralinga Tjarutja lands) • Department of Defence • state government departments. • local government (councils) • federal government • native title parties.	Interference to: • existing or permissible land use (includes loss of income, noise, dust, light and other emissions). • buildings, structures, existing tracks or other infrastructure. • aesthetic values of an area. Noncompliance with legislative requirements.	Yes (Applicable to all programs.)	• Serve Form 21B – Notice of Entry on Land to: ◦ Native Title Claimants NAWNTAC ◦ SANTS ◦ Kalkaroo Pastoral Company Pty Ltd • Contacting and liaison with Kalkaroo Pastoral will not be necessary as it is a fully owned subsidiary of Havilah Resources Limited. • Avoiding use of station tracks after heavy rains so that they are not damaged. • Strict adherence to sign posted speed limits on station tracks. • Mining Native Title Agreements pursuant to Part 9B in place and registered with DEM	2	B	Low	**Stakeholders are fully informed and satisfied with the proposed methods used to conduct mining operations on their land, and all prescribed forms are served and agreements obtained in accordance with the Mining Act.**	Provide the information requested within the 'annual compliance report demonstrating that all reasonable complaints from stakeholders are resolved to the satisfaction of both parties prior to and ongoing during the course of program, without the involvement of DEM. Provide information within the annual compliance report demonstrating that prescribed forms were served and agreements obtained in accordance with the Mining Act prior to the commencement of operations.
Flora and fauna and their habitats; includes Commonwealth and state scheduled species.	Loss/modification of native vegetation and associated habitats through the clearance of vegetation.	Yes (Applicable to programs located within or impacting on native vegetation.)	• Drill sites and access tracks avoid areas of substantial native vegetation (e.g., tree groves). • There is minor disturbance of native vegetation (Havilah as standard practice never clears its drill sites). • Drill sites and access tracks are rehabilitated in such a way as to promote regrowth of native vegetation. • Materials excavated during sump preparation will be sequentially placed back in the order of removal during rehabilitation. • Vehicles are restricted to a single access track to minimise disturbance of native vegetation. • No fires are lit during the summer months, and only at other times if there is a clear area surrounding and fire danger is minimal (e.g., lack of burnable material and no fire ban period) • Fire management procedures in place, including policy for "extreme fire danger rating". • Monitor CFS warnings, all fire bans, regulations, and directions from the country fire service (CFS) to be observed. • Firefighting equipment/ extinguisher are always available	2	B	Low	**No permanent loss/modification of native flora and fauna populations and their habitats through:** • **clearance** • **fire** • **other** **unless prior approval under the relevant legislation is obtained.**	Maintain before, during and after photographic evidence of all operational sites (e.g. pits, drillsites, new track exit/entry points off existing tracks, costeans, campsites) demonstrating that: • The area and method of disturbance is consistent with that described in the PEPR. • No uncontrolled fires* occurred as a result of mining operations. Representative photos to be included within the annual compliance report.

Impact assessment							Outcomes	Outcome measurement criteria (inc. monitoring plan)
Receptor Lists are not exhaustive.	**Potential impacts** Lists are not exhaustive.	**Is the potential impact applicable (Yes/No)** Some potential impacts are applicable to all programs.	**Control strategies** Indicate where there is uncertainty pertaining to the likely effectiveness of the control strategies. Where the risk is not considered low, provide justification that the risk is acceptable, or consider additional strategies to reduce the risk to an acceptable level. – refer to Minerals Regulatory Guidelines MG2b for more information.	**Risk assessment** LH = likelihood of consequence CQ = severity of consequence **LH**	**CQ**	**Risk**		
All flora and fauna, especially listed species.	Loss/modification of the environment (biological, social and economic) through the introduction of weeds and pathogens.	Yes (Applicable to all programs.)	• Weed Watch Fact Sheet supplied to all field personnel • Vehicles are kept clean and free of mud if coming from an area of known introduced weed species • Inspection of former drill sites to check for any introduced species and removal if found	2	B	Low	**No introduction of new species of weeds and plant pathogens, nor increase in abundance of existing weeds species.**	Provide a statement within the annual compliance report, confirming that: • Vehicle logs were kept during the program, demonstrating that all vehicles are clean and free of plant and mud material prior to entering properties† within the tenement areas, unless otherwise agreed to with the relevant landowners. Provide photographic evidence before and during mining operations and after rehabilitation of disturbed sites was captured, demonstrating that no new weeds and plant pathogens were introduced, nor an increase in abundance of existing weeds recorded.
All fauna	Entrapment of fauna through open drillholes and excavations.	Yes (Applicable to programs that involve drilling and/or require excavations.)	• All holes are capped following completion • Excavations are constructed with a shallow angle ramp to allow small animals to escape • Excavations are appropriately barricaded/bunded to prevent access	2	B	Low	**No fauna traps created as a result of mining operations.**	Maintain before, during and after photographic evidence of all drillholes and/or excavations demonstrating that: • All drillholes were permanently or temporarily capped/plugged immediately upon completion. • No fauna and livestock became trapped in drillholes and/or excavations throughout the duration of the program. All excavations are rehabilitated prior to completion of the program to ensure these do not presenet a trapping risk to fauna Representative photos are to be included within the annual compliance report. Provide the information requested within the annual compliance report.
Aboriginal heritage sites	Disturbance to Aboriginal heritage.	Yes (Applicable to all programs.)	• An Aboriginal Heritage Clearance Survey is conducted with the traditional owners to clear the drill sites and access prior to commencement of drilling. • All employees and contractors on-site are properly advised of the significance of Aboriginal heritage and culture and are to take care to preserve all Aboriginal Sites and Objects as defined by the *Aboriginal Heritage Act 1988*	2	B	Low	**No disturbance to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation is obtained.**	Maintain a database and provide a statement within the annual compliance report demonstrating that: • Heritage sites were not impacted during the conduct of the program, unless prior approval was obtained under the appropriate legislation. • Work ceased on discovery of a significant site and recommenced only after authorisation. • Aboriginal heritage sites identified during the program were appropriately recorded and reported to authorities, if not previously known.
Soil/vegetation/fauna	Soil/vegetation contamination (e.g. hydrocarbons, rubbish, drill samples/cuttings, ablutions, other sources).	Yes (Applicable to all programs.)	• All external waste material is removed from site to an approved waste facility. • Unwanted drill samples are emptied into sumps/pits, which are back filled, covered with topsoil, and lightly scarified to promote seed germination. The empty plastic bags are removed from site. • Drilling rig and ancillary equipment is properly maintained and regularly inspected to ensure there are no diesel or oil leaks. • Stored fuel correctly bunded, spill kits used, contaminated soil immediately removed off site to an approved waste management facility • No visible drill chips or drill samples remain on site. • Drill site is rehabilitated to best practice standards to promote new vegetation growth. • Fuel storage managed in accordance with EPA requirements.	2	B	Low	**No contamination of soil and vegetation as a result of mining operations.**	Demonstrate that all domestic or industrial waste (includes general rubbish and hydrocarbons) is disposed of in accordance with the *Environment Protection Act 1993*, and that all fuel and chemicals are stored in accordance with EPA requirements, by providing: • The name, location and contact details of the authorised waste disposal facility. • A statement within the annual compliance report confirming domestic and industrial waste was removed from all operational sites and disposed of at an authorised waste disposal facility. • Photographic evidence within the annual compliance report demonstrating that all fuel and chemical storage facilities were managed in accordance with EPA requirements. Provide the information requested within the annual compliance report.
Soil	Disturbance to the soil profile and topography, and accelerated soil erosion caused by exploration activities (e.g. construction of sumps, new tracks and drill pads; ground compaction at laydown areas and camps).	Yes (Applicable to all programs.)	• No grading of tracks or preparation of drill sites that will cause permanent disturbance to topsoil profile or topography. • Rehabilitation of each site will be finalised by raking or lightly scarifying to promote seed germination and new vegetation growth. • Heavy vehicle tracks will be scarified and filled in if there is judged to be any danger of gullying and erosion. • The land surface will be returned to its original profile. • All sample material and spoil from the sumps will be backfilled into the sumps. • Topsoil from sumps will be stockpiled separately, spread back over the filled in sumps and lightly scarified to minimise wind and water erosion and promote seed germination and plant regrowth. • If water does have to be carted for diamond drilling, truck movements will be kept to a minimum and tracks will be rehabilitated as described above. Tracks can be watered down if required.	1	B	Low	**Where soil disturbance occurs as a result of mining operations, ensure that:** • **topsoil quality and quantity is maintained** • **the soil profile and topography is reinstated to original conditions** • **there is no accelerated soil erosion.**	Maintain before, during and after photographic evidence of all excavations, drillsites, camps, laydown areas and new tracks demonstrating that at the completion of the program: • The soil profile and topography is reinstated to original conditions and is consistent with natural surroundings • Where required, sufficient topsoil is removed (depending on soil profile), stored separately from subsoil and reinstated (in the correct order). • There are no signs of accelerated soil erosion during and post rehabilitation of disturbed sites. Representative photos to be included within the annual compliance report.

Impact assessment							Outcomes	Outcome measurement criteria (inc. monitoring plan)
Receptor Lists are not exhaustive.	**Potential impacts** Lists are not exhaustive.	**Is the potential impact applicable (Yes/No)** Some potential impacts are applicable to all programs.	**Control strategies** Indicate where there is uncertainty pertaining to the likely effectiveness of the control strategies. Where the risk is not considered low, provide justification that the risk is acceptable, or consider additional strategies to reduce the risk to an acceptable level. – refer to Minerals Regulatory Guidelines MG2b for more information.	**Risk assessment** LH = likelihood of consequence CQ = severity of consequence **LH**	**CQ**	**Risk**		
Surface water	Alteration to surface water – interference to surface drainage.	No (Applicable to exploration programs that are likely to impact on surface drainage channels.)	• Surface drainage will not be interfered with.				**No permanent modification to hydrological features caused by mining operations without obtaining a water affecting permit from the relevant Landscape Board (under Landscapes Act SA 2019).**	Provide before, during and after photographic evidence within the annual compliance report demonstrating that: • Mining operations have not occurred within 25m of the bank of any watercourse; and • original drainage contours (watercourses and lakes) are consistent with the natural relief post rehabilitation. Alternatively, provide copies of water affecting permits within the annual compliance report.
Groundwater/aquifer	Groundwater contamination: • contamination of aquifers through entry of pollutants from the surface • interconnection between aquifers • degradation of natural hydrostatic conditions (maintain pre-drilling pressures).	Yes (Applicable to all programs that may intersect groundwater.)	• Contamination of the fractured rock aquifer because of lost circulation will be prevented using industry standard biodegradable drill mud and additives where required. • Natural hydrostatic conditions will be maintained when the Namba Fm and saprolite clays close in and seal the hole.	2	B	Low	**Drillholes restored to controlling geological conditions that existed before the hole was drilled or, where it is intended to re-enter the hole, the hole must be completed with casing of adequate strength and the casing cemented so that all aquifers are isolated to prevent the movement of any fluids behind the casing.**	Maintain evidence demonstrating that drillholes are decommissioned in accordance with Earth Resources Information Sheet M21, *Mineral exploration drillholes – general specifications for construction and backfilling*, and/or specific conditions from DEW (Groundwater). Provide the information requested within the annual compliance report.
Soil/vegetation/fauna	Discharge of groundwater into the surrounding environment.	Yes (Applicable to all programs that may intersect groundwater or where activities require the discharge of groundwater into the surrounding environment.)	• Groundwater will be contained within the sumps and circulation system. Any inadvertent spillages will be immediately cleaned up and returned to the sumps.	2	A	Low	**No discharge of groundwater outside of the leaseinto the surrounding environment and no discharge of water into a watercourse, unless prior approval under the relevant legislation is obtained.**	Maintain photographic evidence of all drillsites demonstrating that groundwater was not discharged into the surrounding environment, unless water affecting activity permits were obtained allowing the discharge of groundwater into watercourses and/or lakes. Representative photos and water affecting activity permits (where applicable) to be included within the annual compliance report.
Soil/vegetation/fauna	Degradation of rehabilitated access tracks caused by third party access (includes previously closed and rehabilitated access tracks).	Yes (Applicable to programs that create new access tracks.)	• Existing access tracks to be used as much as possible. • Access drill sites by driving vehicles cross country from existing station tracks, deviating around shrubs and trees etc. • Minimise disturbance by confining heavy equipment to a single access track. • Rectify any significant residual compaction along the wheel tracks, if necessary, by light scarifying.	2	B	Low	**Rehabilitated access tracks remain permanently closed, unless prior approval under the relevant legislation is obtained.**	Maintain before and after photographic evidence demonstrating that all tracks are closed and rehabilitated at the completion of the program, unless otherwise authorised. Representative photos are to be included within the annual compliance report.
Community/landowners	Damage to infrastructure and loss of income through fire.	Yes (Applicable to all programs.)	• No fires are lit during the summer months, and only at other times if there is a clear area surrounding and fire danger is minimal (e.g., lack of burnable material and no fire ban period) • Fire management procedures in place, including policy for “extreme fire danger rating”. • Firefighting equipment/ extinguisher are always available.	2	D	High	**No loss of infrastructure or income through fire as a result of mining operations.**	Provide a statement within the annual compliance report confirming that no uncontrolled fires* occurred. Alternatively, provide a report on the independent investigation of all uncontrolled fires* demonstrating that the licensee could not have reasonably prevented the fire through the implementation of precautionary measures.
General public	Injury or death to members of the public as a result of mining operations.	Yes (Applicable to all programs.)	• Restricting access to only Company personnel as far as possible, and only to others (e.g., Contractors) who have had induction. • Enforcing best practice OHS measures • Appropriate danger signs erected • Enforcing speed limits	1	E	High	**No accidents involving the public that could have been reasonably prevented by the tenement holder.**	Provide a statement within the annual compliance report confirming no accidents occurred involving the public during and after the program. If an accident involving the public did occur, provide a copy of the independent investigation report within the annual compliance report demonstrating that the tenement holder could not have reasonably prevented the accident through the implementation of precautionary measures.
Other (if applicable)								

* Uncontrolled fires = fires that escape outside of the work area.

† Properties = freehold (cropping and grazing land); perpetual/pastoral lease land; council land; regional reserves; national, conservation and marine parks; Aboriginal land; Commonwealth land etc.

SECTION G - OPERATOR CAPABILITY

Provide information demonstrating that the tenement holder and operator (where applicable) has the capability to conduct the program in a manner that consistently ensures ongoing achievement of the environmental outcomes. This may be demonstrated within the PEPR by providing an overview of the following:

- Manuals or standard operating procedures that outline the safe and environmentally sound operation of all critical operations associated with the program that ensure compliance with the PEPR.
- Systems in place to monitor, audit and assess compliance against the criteria approved in the PEPR.
- Systems in place to identify and report any noncompliance with regulatory requirements or relevant environmental outcomes (e.g. measures in place to report incidents in accordance with regulation 79(3)).
- Practices and procedures in place to provide appropriate communication of regulatory requirements to employees and contractors (e.g. induction programs).
- Practices and procedures in place to respond to, and communicate with landowners and external parties on the proposed program and compliance matters (e.g. complaints)

The drilling program will be managed by OZ Minerals who are an experienced operator of mineral projects and mineral exploration in South Australia. Havilah Resources will only be involved to the extent requested by OZ Minerals. OZ Minerals employs capable and experienced geological and exploration staff with exploration industry experience spread over many varied terrains, environments, and jurisdictions.

Havilah Resources understands that OZ Minerals has several operational and procedural documents in place which largely parallel those of Havilah, which cover (but are not limited to) the following:

- Employee Induction and HSE
- Remote Areas Operations – Emergency Response and Hazard Awareness
- Guidelines for working on Station Properties
- Project Specific Inductions including guidelines regarding Heritage Clearance conditions and governmental drilling approval conditions
- Field Emergency Response
- Incident Investigation Management Procedure
- Communication, Consultation, and Involvement
- Vehicle Pre-start and Inspection
- Hazard, Risk Management, Incident Reporting and JSA documents and records
- Toolbox Meetings, Training Registers

OZ Minerals environmental staff with oversight responsibility are expected to liaise with Havilah's Principal Environmental Advisor, Geoff Borg, MSc (Hydrogeology and Groundwater Management) who is an experienced hydrogeologist with over 25 years of experience directing, managing, and advising environment assessment, compliance, risk management, and approvals for industrial operations and resource projects across Australia.

It is expected that OZ Minerals Environmental Management System will include Environmental Management Plans with procedures and processes to ensure continuous improvement and compliance with legal and other requirements.

The Environmental Management System is likely to incorporate information for the following:

- environmental governance
- environmental training, awareness, and competence
- audits and inspections
- emergency preparedness, incidents, and response
- monitoring, measurement, and evaluation
- management review
- documentation and records.

All staff and contractors at the current drilling PEPR area will be required to work under the Environmental Management System, with the objective of conducting operations in an environmentally responsible manner and at all times minimising disturbance to the environment.

This would normally involve:

- Review, update and audit this policy and environmental management plans to affect positive environmental outcomes in all activities.
- Discuss and resolve with stakeholders any possible area of environmental conflict.
- Integrate environmental considerations into our work planning and operations.
- Assess and where possible, reduce the potential impact of operations on the environment.
- At all times work towards improving environmental performance.
- Rehabilitate the environment affected by operations, as required by legislation.
- Actively promote environmental awareness and provide relevant environmental information, instruction and training for management and personnel.
- Where necessary, engage the services of expert external personnel to advise on environmental matters.

Co-operate with government authorities, Traditional Owners, environmental groups, landowners and any other stakeholders in the formulation and application of rational and practical environmental guidelines and legislation.

SECTION H –ADDITIONAL INFORMATION

List any other supporting information and/or documents submitted with the application, including land access approvals/permits required to conduct the proposed program.

N/A

SECTION I – PHOTOS

Include photographs in this section:

- that have been obtained during site visits
- that help describe relevant environmental and operational aspects in the PEPR.

To insert photos, copy and paste the photo into the template below. Resize photos to fit page width. Ensure that all information about each photo is completed and refer to the photo number in the relevant section of the PEPR.

Site identification	Date taken	Photo number & PEPR section reference	Easting (GDA94)	Northing (GDA94)	Zone	Details and Comments
Kalkaroo Project	Nov 2013	Photo 1, Section C	454442	6488573	54	General area of proposed drilling looking east at Kalkaroo West.

Site identification	Date taken	Photo number & PEPR section reference	Easting (GDA94)	Northing (GDA94)	Zone	Details and Comments
N/A	N/A	Photo 2, Section D	453700	6486700	54	Aerial view of proposed camp area.

Site identification	Date taken	Photo number & PEPR section reference	Easting (GDA94)	Northing (GDA94)	Zone	Details and Comments
N/A	N/A	Photo 3, Section D	N/A	N/A	N/A	Example of 200 kva generator to be used at camp.

Site identification	Date taken	Photo number & PEPR section reference	Easting (GDA94)	Northing (GDA94)	Zone	Details and Comments
N/A	N/A	Photo 4, Section D	N/A	N/A	N/A	Example of 4,000 L self-bunded fuel cell to work with the generator.

Site identification	Date taken	Photo number & PEPR section reference	Easting (GDA94)	Northing (GDA94)	Zone	Details and Comments
N/A	N/A	Photo 5, Section D	453700	6486800	N/A	Proposed laydown area.

Site identification	Date taken	Photo number & PEPR section reference	Easting (GDA94)	Northing (GDA94)	Zone	Details and Comments
Kalkaroo Project	11/06/2020 / 27/02/2022	Photo 06, Section D	454758	6488838	54	2020 drillhole KKAC0540 after drilling (top), after rehabilitation (bottom).

SECTION J – MAPS

Provide a map(s) showing the following information that is located adjacent to or within the proposed area of operations, where applicable:

- tenement boundaries,
- cadastral information,
- existing surface contours,
- existing vegetation,
- location of the proposed operations (includes drillholes, existing and new access tracks, drill traverses, campsites, laydown areas and other applicable information) and/or the target exploration area(s),
- location of existing ephemeral and permanent rivers, creeks, swamps, streams or watercourses and water management structures,
- location of towns, houses and homesteads, existing roads, rails, fences, transmission lines, buildings, dams and pipelines
- known sightings of listed species,
- location and extent of all environmentally sensitive areas,
- any relevant land use types (e.g. parks and reserves, Aboriginal freehold land, Woomera Prohibited Area).

All maps and sections must conform to the standards outlined in the PEPR Terms of Reference.

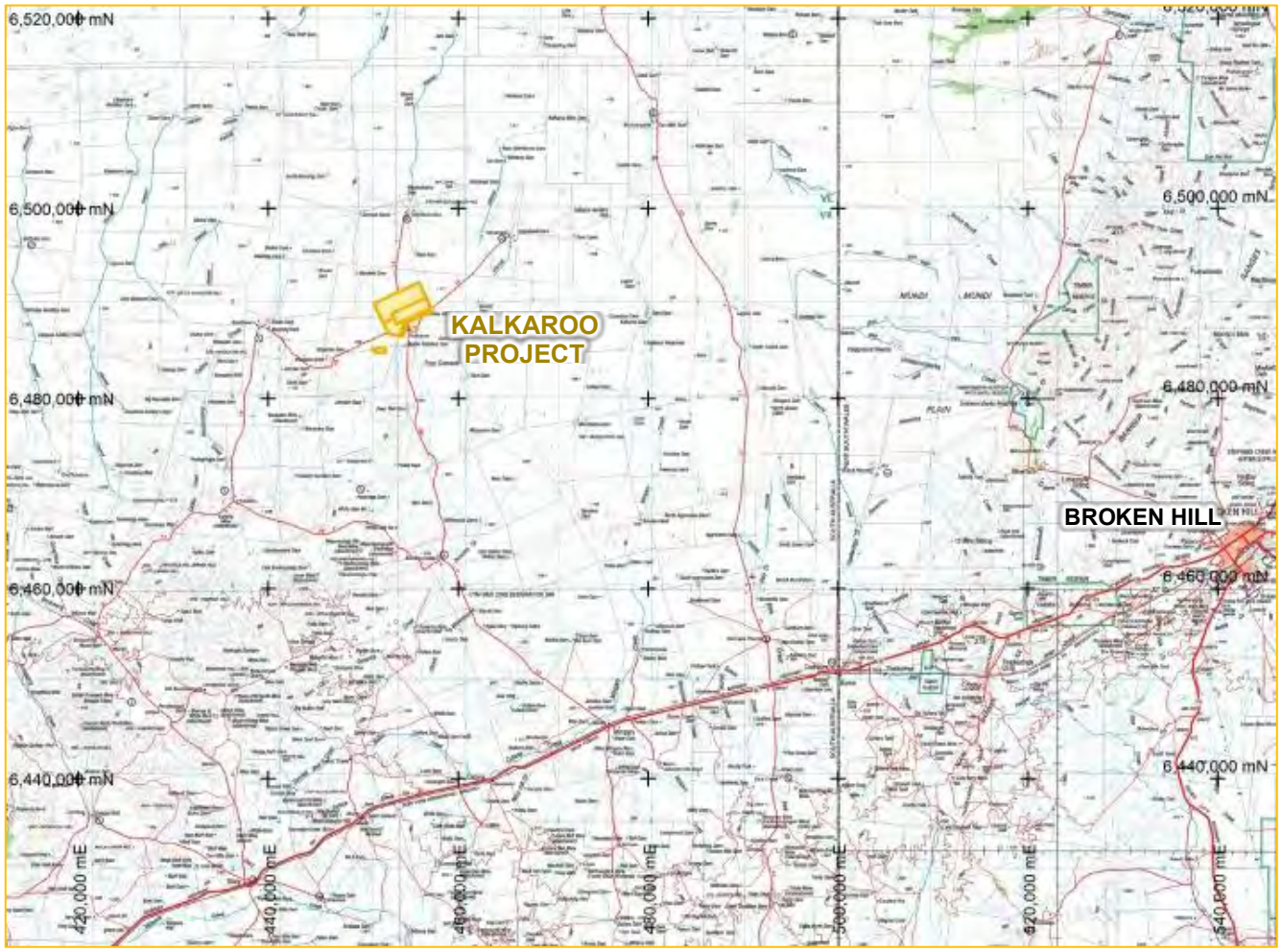

Figure 1: Regional location of Kalkaroo Project.

Figure 2: Kalkaroo Project MLs and MPLs.

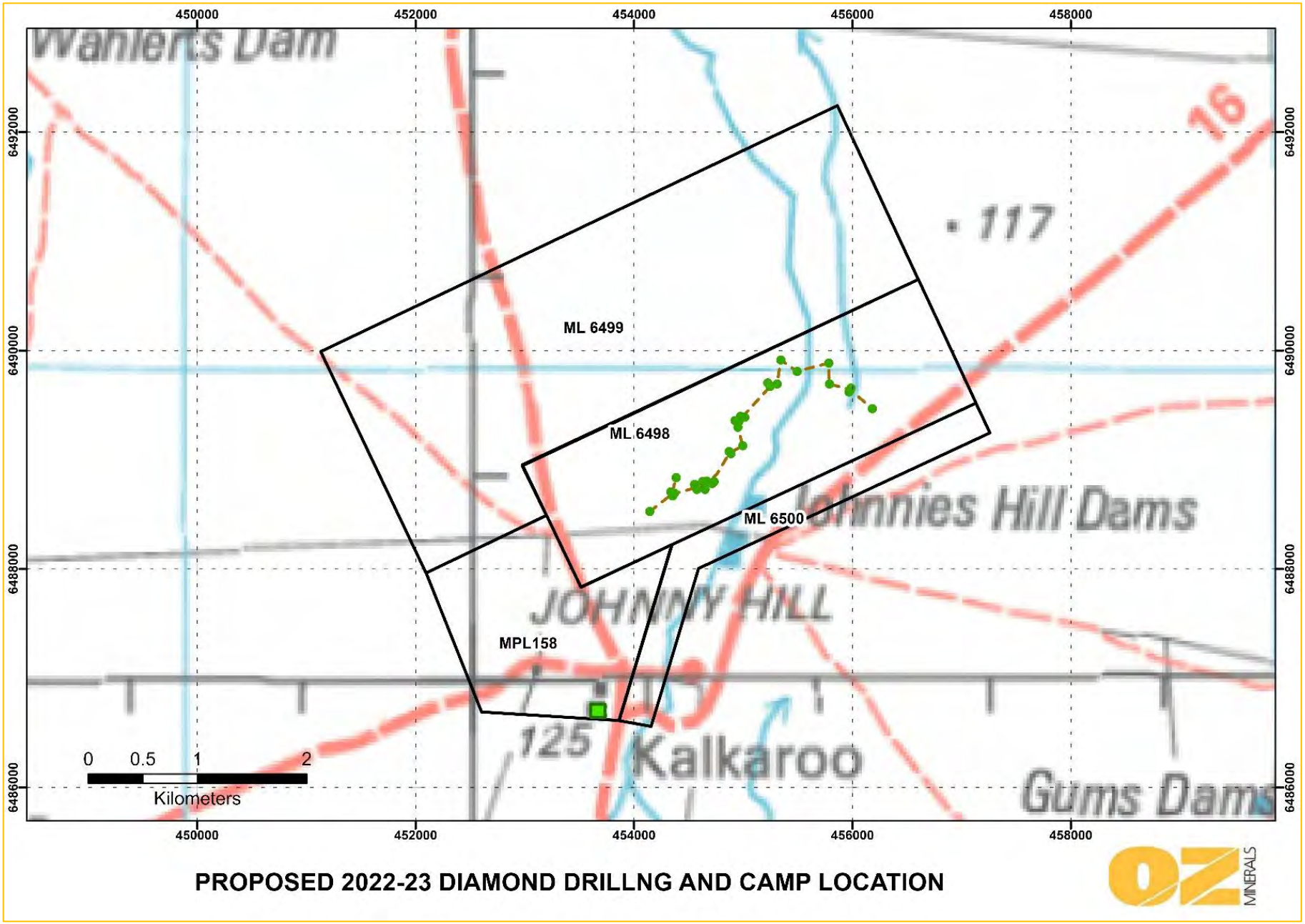

Figure 3: OZ Minerals proposed 2022-23 Diamond drilling and camp location.

Figure 4: OZ Minerals proposed camp location and layout.

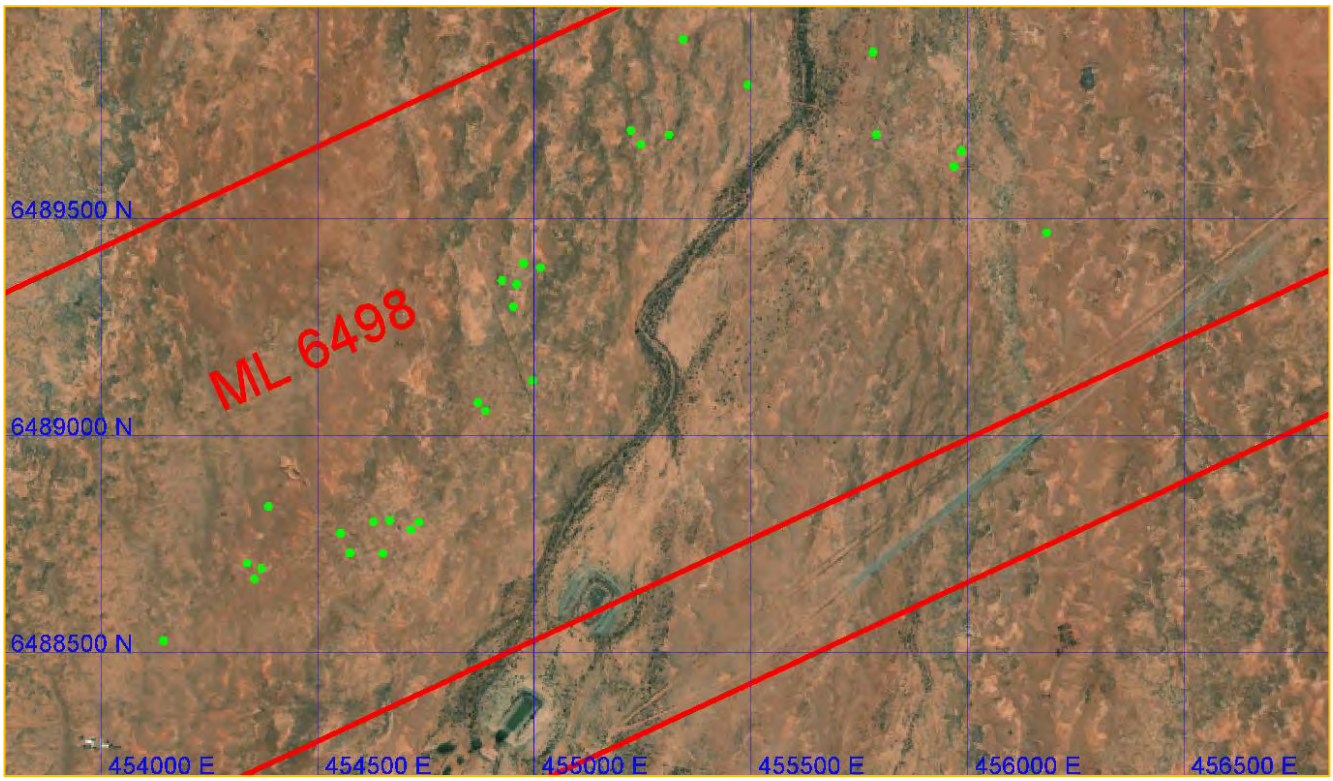

Figure 5: Location of proposed drill locations over aerial image.

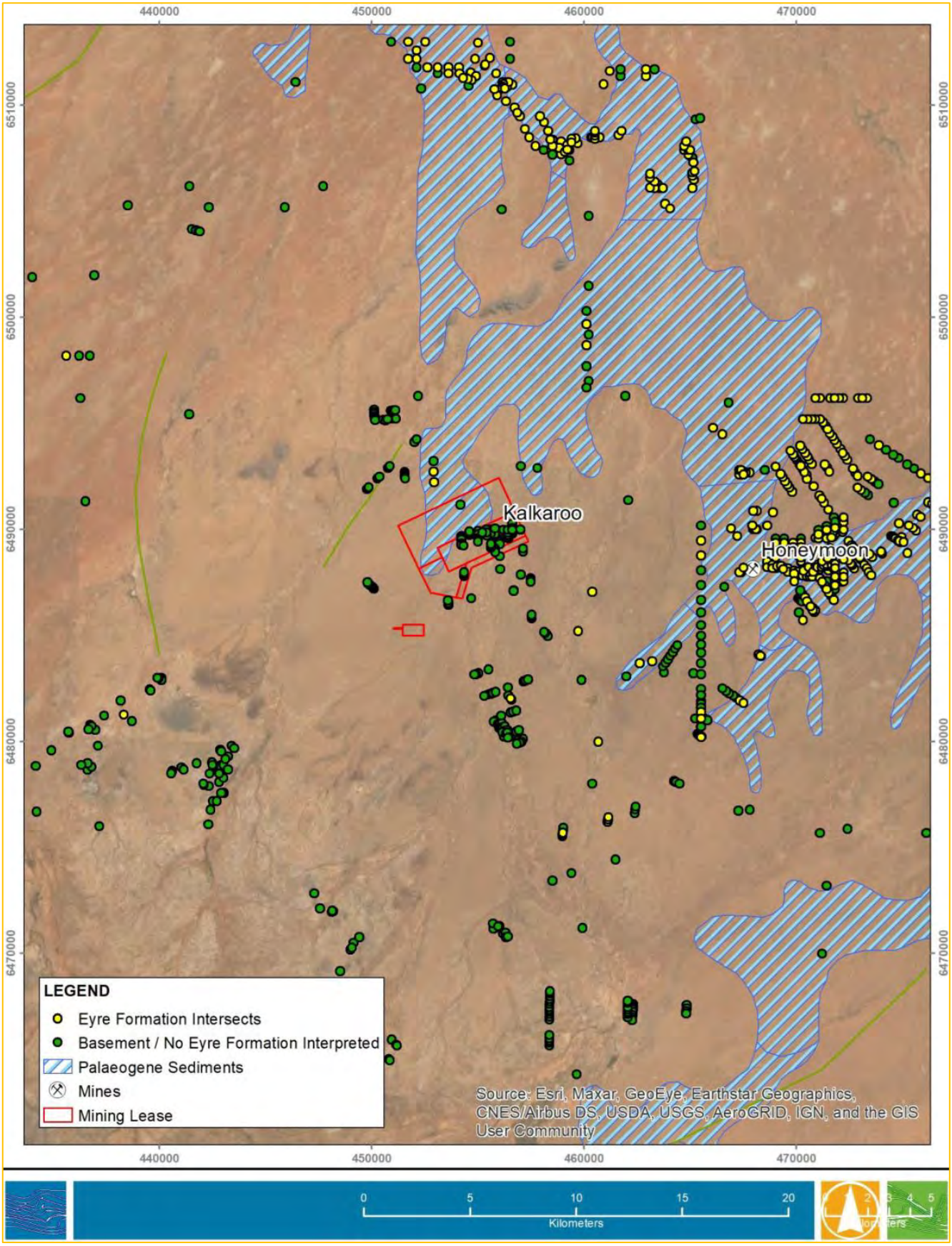

Figure 6: Tertiary (Palaeogene) Sedimentary Distribution (SARIG).

SECTION K – PUBLIC RELEASE

PEPR documents will be registered on the mining register and publicly released in full without the need to request consent from the tenement holder(s). Ultimately, it is the applicant's responsibility to ensure that confidential, or commercially sensitive, information is not included within the PEPR application.

SECTION L – SUBMISSION OF THE APPLICATION

An application for a PEPR or PEPR review must be submitted in the following form, unless otherwise specified by the Director of Mines or an authorised officer:

- an electronic version of the PEPR must be submitted online through the DEM Minerals website using the Production tenement application form,
- the electronic version must be submitted in one single Acrobat PDF file, and
- Microsoft Word-compatible files must be submitted if requested by the Director of Mines (or delegate), or other authorised officers.

APPENDIX 1

Groundwater Impact Assessment

Kalkaroo Copper-Gold Mine

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Groundwater Impact Assessment

Kalkaroo Copper-Gold Mine

Kalkaroo Copper Pty Ltd

1 December 2021

Document Status

Version	Doc type	Reviewed by	Approved by	Date issued
1.0	Draft	NW	RB	01/12/2021

Project Details

Project Name	Kalkaroo Copper-Gold Mine
Client	Kalkaroo Copper Pty Ltd
Client Project Manager	Geoff Borg
Water Technology Project Manager	Rohan Baird
Water Technology Project Director	Andrew Telfer
Authors	Rohan Baird, Nick Watkins and James Hopkinson
Document Number	21030310_R01v01_Kalkaroo GW Impact Assessment_211201

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1 INTRODUCTION

1.1 Project Description

The Kalkaroo Cu-Au deposit is located 60 kilometres northwest of Cockburn and comprises 249 Mt of ore at a grade of 0.36 g/t gold and 0.49 % copper. The project and associated infrastructure are located on approximately 1,910 hectares (ha) which are covered by ML 6498, ML 6499, ML 6500, MPL 158 and MPL 159 (Figure 1-1). The initial open pit is based on mining 3 Mt of ore at a grade of 1 g/t Gold and 0.5% Copper, which will be delivered to a run of mine (ROM) ore pad. In accessing the ore, 19 Mt of waste material will be mined. The pit will cover an area of approximately 27 ha and will have a maximum depth of 110 m. The mined ore will be treated using conventional gravity copper and gold carbon in pulp (CIP) circuits at an annualised processing throughput rate of 750 ktpa. Mining and processing are expected to take approximately five years.

Kalkaroo lies within the South Australia Arid Lands (SAAL) Landscape Board Region. The site is not located within a prescribed water resources or wells area as defined by the Landscape South Australia Act 2019. The Far North Prescribed Wells Area is the nearest prescribed area located 40 km to the north of the site.

This report provides a description of the hydrogeological environment at and around the site leading to the development of a hydrogeological conceptual model and the design and construction of a numerical groundwater flow model to assess the hydrogeological impacts of the proposed mining operation and post-closure period. This report builds on previous groundwater assessments undertaken at the site and considers regulatory feedback related to these assessments, focusing on the hydrogeological conceptualisation of the site and translation of the conceptual model to a numerical groundwater flow model.

1.2 Objectives

The objectives of this assessment are to:

- Provide a description of the hydrogeological environment in which the site is located.
- Identify groundwater receptors which may be impacted by the proposed mining operation.
- Develop a hydrogeological conceptual model of the project area.
- Develop a numerical groundwater flow model based on the hydrogeological conceptualisation to assess the operational and closure impacts of mining on the groundwater system.
- Assess the level of impact to groundwater receptors.
- Develop a groundwater management and monitoring plan to manage identified risks.
- Review and address PEPR review responses by Agencies (DEM, DEW, EPA) and other respondents.

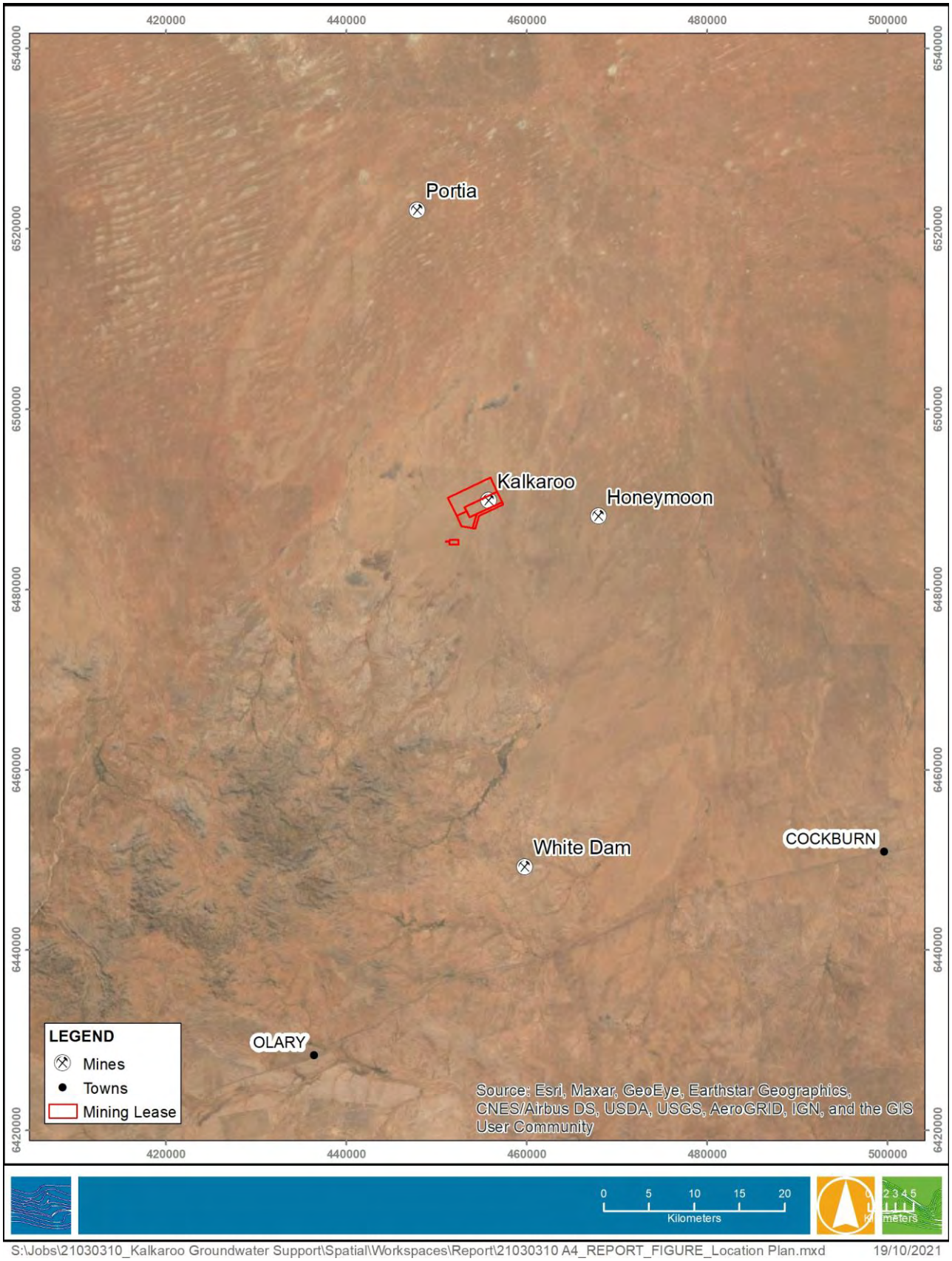

Figure 1-1 Site Location Map

2 PREVIOUS HYDROGEOLOGICAL ASSESSMENTS AND REGULATORY REVIEWS

In 2015 a mining lease was granted for the Kalkaroo Copper Gold Mine Project. The 2015 MLP was supported by a 2013 groundwater assessment completed by Australian Groundwater Technologies (AGT). AGTs assessment drew much of its information from hydrogeological investigations completed by Adam Geoscience in 2009. AGTs 2013 groundwater assessment included numerical groundwater flow modelling completed by Lisdon Associates with the details of the numerical modelling documented in AGTs report. The 2015 mining lease approval included several Sixth Schedule conditions specifically relating to groundwater as summarised below:

10.1. The Tenement Holder must provide a calibrated groundwater model.

10.1.1. The model must include modelling of groundwater mounding caused by the TSF operations;

10.1.2. Adequacy of the current closure modelling approach is to be verified by:

10.1.2.1. Providing volumes of groundwater extracted by the 'drain' cells representing the pit lake;

10.1.2.2. Providing a comparison of the pit lake levels to the regional potentiometric surface immediately adjacent to the pit.

10.1.3. References must be provided for the sensitivity analyses undertaken on the groundwater model.

10.2. The Tenement Holder must establish a program for the establishment and ongoing calibration of the transient groundwater model using data obtained from groundwater monitoring within the proposed PEPR.

10.3. The Tenement Holder must establish a program for the ongoing calibration of the pit lake geochemistry and hydrogeological models using data obtained from operational monitoring to address any assumptions and uncertainty within the model.

10.4. The Tenement Holder must provide further explanation and evidence to support the conclusion that the saprolite and saprock material will behave as a porous media. If evidence cannot be provided, the model must be updated to include a layer representing the saprolite as an aquitard.

In March 2021 Kalkaroo Copper Pty Ltd submitted a PEPR for the Kalkaroo Copper Gold Mine Project. The 2021 PEPR included several notable changes from the 2015 mine plan, specifically, the depth of the pit was reduced from 160 m to 90 m and the mining duration from seven years to five years. The extent of the pit has also been reduced from 33.5 ha to 27 ha.

A request for further information was issued to Kalkaroo Copper Pty Ltd from the Department for Energy and Mining during August 2021. The request for information included comments from DEM, the Department for Environment and Water (DEW), the Environment Protection Authority (EPA), the South Australian Arid Lands Landscape Board and SafeWork SA. Of particular note to this assessment are the comments relating to the hydrogeological conceptualisation, groundwater modelling and groundwater baseline conditions. In response to this, Kalkaroo Copper Pty Ltd have engaged Water Technology to review the existing hydrogeological assessments and to address the issues raised in the request for further information and sixth schedule lease conditions.

The following hydrogeological reports and data sets have been used to inform this assessment:

- Phase 1 and 2 Summary Report (Aldam Geoscience, 2009). This report presents an initial data review and the methodologies and outcomes of drilling, aquifer testing and numerical groundwater modelling, the latter carried out by Lisdon Associates.
- Well completion reports (Schedule 8) for the water wells drilled to support the Phase 1 Aldam Geoscience report.
- Excel data files and outputs from the Clarke Groundwater Software (Clarke ,1988) for the Phase 1 aquifer testing.
- Data files for the various MODFLOW groundwater model versions developed by Lisdon Associates for the Phase 2 report.
- Kalkaroo Mine Dewatering and Hydrogeological Impact Assessment (AGT, 2013). This report builds on the Aldam Geoscience (2009) assessment and includes the results of an extended and updated groundwater model. The report is appended to the current PEPR document (March, 2021).
- Data files for the various updated MODFLOW versions developed by Lisdon Associates for the AGT report.
- Kalkaroo Copper block model data and structural mapping data and advice.

3 CLIMATE AND HYDROLOGY

The Climate of the area is arid with annual average rainfall of 200 mm at Mooleulooloo Station (1982 to current) and 225 mm at Broken Hill Airport (1994 to current). Average annual pan evaporation is around 2,400 to 2,800 mm per year. The distribution of rainfall is reasonably even throughout the calendar year, ranging from 13.1 mm in April to 21.3 mm in February at Mooleulooloo, and 14 mm in May to 26.1 mm in February at Broken Hill Airport. The average number of rain days remains similar throughout the year suggesting higher rainfall in summer months is likely to be associated with infrequent storm events.

The site lies within the plains of the Lake Frome Basin, specifically the Curnamona Plains which are slightly undulating to flat and falling gradually at a gradient of around 1:1,000 towards Lake Frome. The Olary Ranges 60 km to the south form a regional topographic high (Figure 3-1). Local watercourses are ephemeral, responding to high intensity rainfall events. The closest recognised creeks to the Kalkaroo Deposit are Calico and Booloomata Creeks to the west, and Oonartra and Mingary Creeks to the East. These and other smaller ephemeral watercourse in the area flow in a northerly direction towards Lake Frome (Figure 3-1).

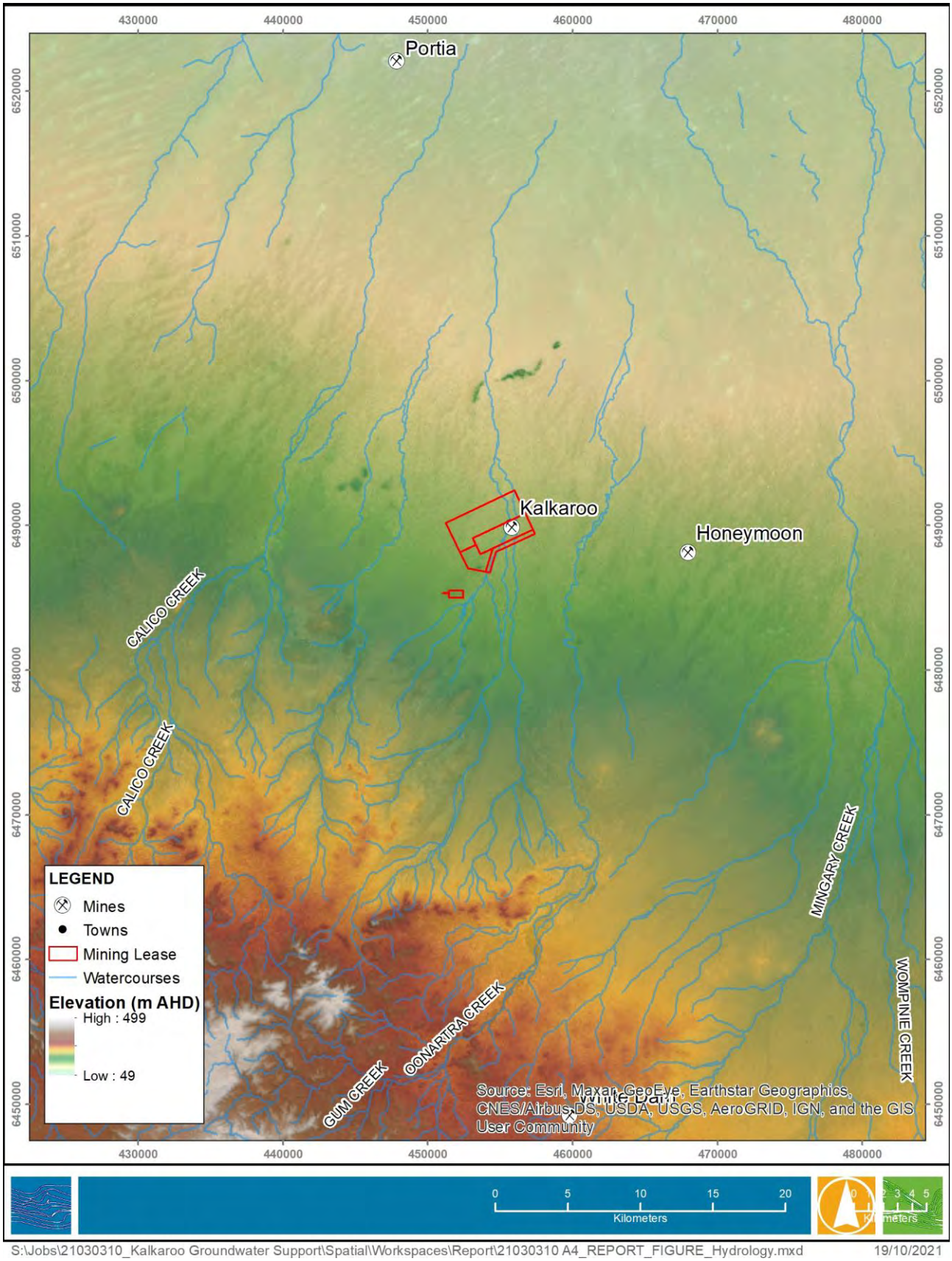

Figure 3-1 Regional Drainage

4 GEOLOGY

4.1 Regional Setting

The Kalkaroo Deposit is located within the Curnamona Geological Province on the Benagerie Ridge (Figure 4-1). At a regional scale the site is flanked by the Olary Ranges to the south, Flinders Ranges to the west and Barrier Ranges to the east (Figure 4-1). Basement rocks of the Willyama Supergroup outcrop in the Olary Ranges south of the site, as shown on the 1:100,000 geological map sheet (Figure 4-2). Locally, flat broad alluvial plains surround the site and comprise Quaternary and Tertiary age sedimentary deposits overlying older Neoproterozoic Basement rocks. Quaternary deposits consist of fluvial and aeolian clays and sandy clays (Magee, 2009) while Tertiary sediments consist of Miocene lacustrine clays and silts of the Namba Formation (Waterhouse and Beal 1978; Magee, 2009).

Tertiary Eyre Formation sediments consisting of Eocene fluvial sands are known to exist in the broader study area. The extent of these sediments has been assessed using several data sources including the SARIG Eocene Palaeochannel extent, stratigraphic logs from WaterConnect and palaeochannel interpretations from Southern Cross Resources and Geoscience Australia (Magee, 2009). The extent of the SARIG Eocene Palaeochannel layer is shown in Figure 4-3 along with (1) drillholes which have intersected basement with no Eyre Formation sediments interpreted and (2) drillholes which have intersected basement and have been interpreted to intersect Eyre Formation Sediments. The data suggests that most of the drillholes within 10 km of the Kalkaroo deposit have not intersected Eyre Formation sediments. The lithological descriptions of those that did were reviewed and were found to be more consistent with the Namba Formation than with clean fluvial sands of the Eyre Formation. In addition to this, inferred palaeochannel extents from Geoscience Australia (Magee, 2009) and Southern Cross Resources were reviewed to validate the SARIG interpretation. Review of these data sets suggests that the palaeochannel extent is more constrained than the SARIG interpretation. From this review, it has been concluded that the Eyre Formation is not continuous or connected enough to define a channel or layer of any significance near the Kalkaroo deposit. The data review confirms that the nearest Tertiary palaeochannel sediments exist within the Yarramba Palaeochannel which hosts the Honeymoon Uranium deposit, 12 km east of the Kalkaroo deposit site.

Regional geological cross sections constructed for this project based on WaterConnect stratigraphic logs and site data are provided in Figure 4-4 and Figure 4-5. The north-south section indicates that the basement palaeo-topography slopes away from the ranges under the Curnamona Plains (Figure 4-5) toward the north. A lens of sand is interpreted 5 km north of Kalkaroo (7034-1397), however, as discussed above these lenses are not considered to be continuous or connected enough to define a channel or layer of any significance. The east-west hydrogeological cross section shows the interpreted extent of the Tertiary Eyre Formation 12 km to the east of Kalkaroo.

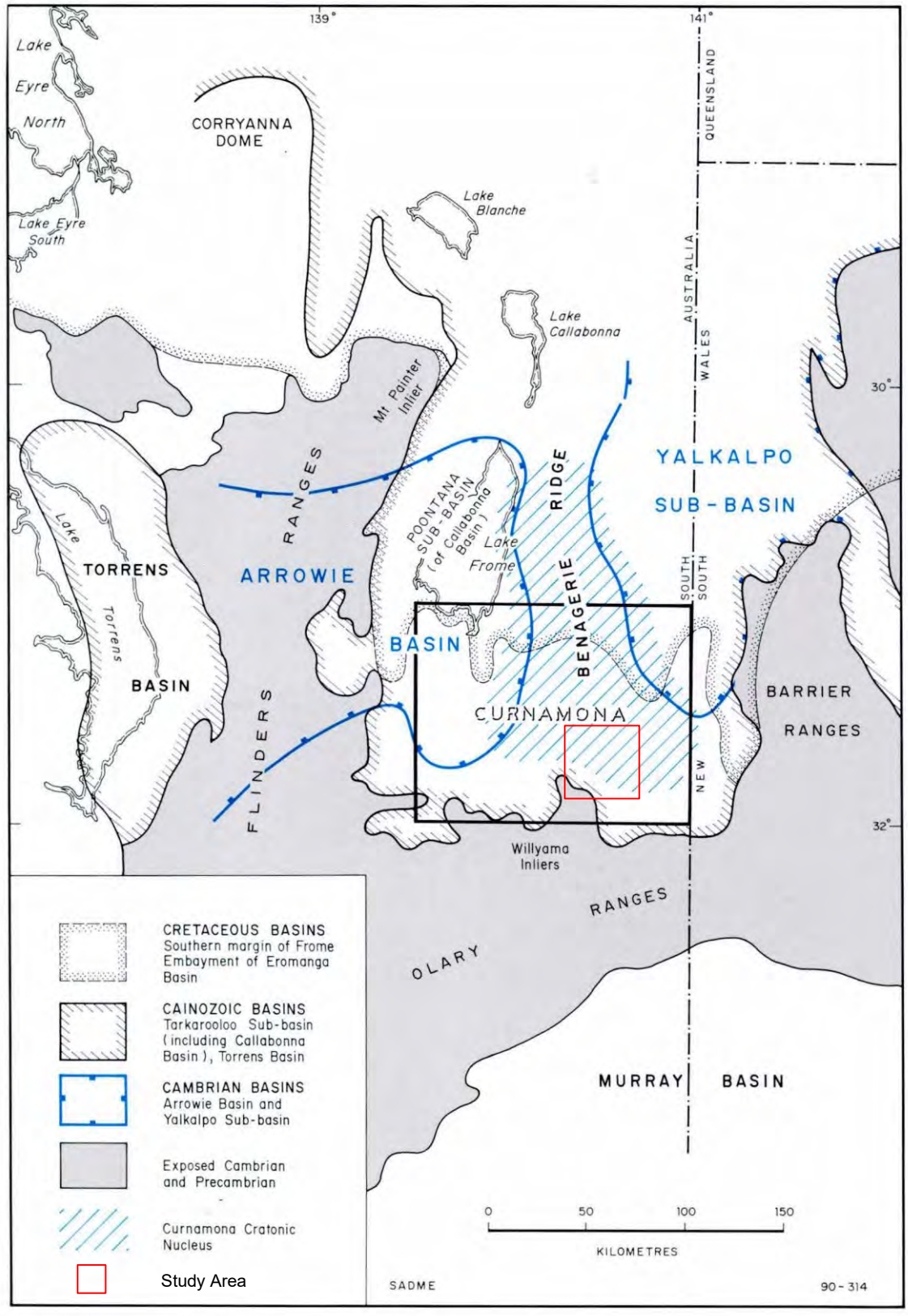

Figure 4-1 Sedimentary Basins (Callen, 1990)

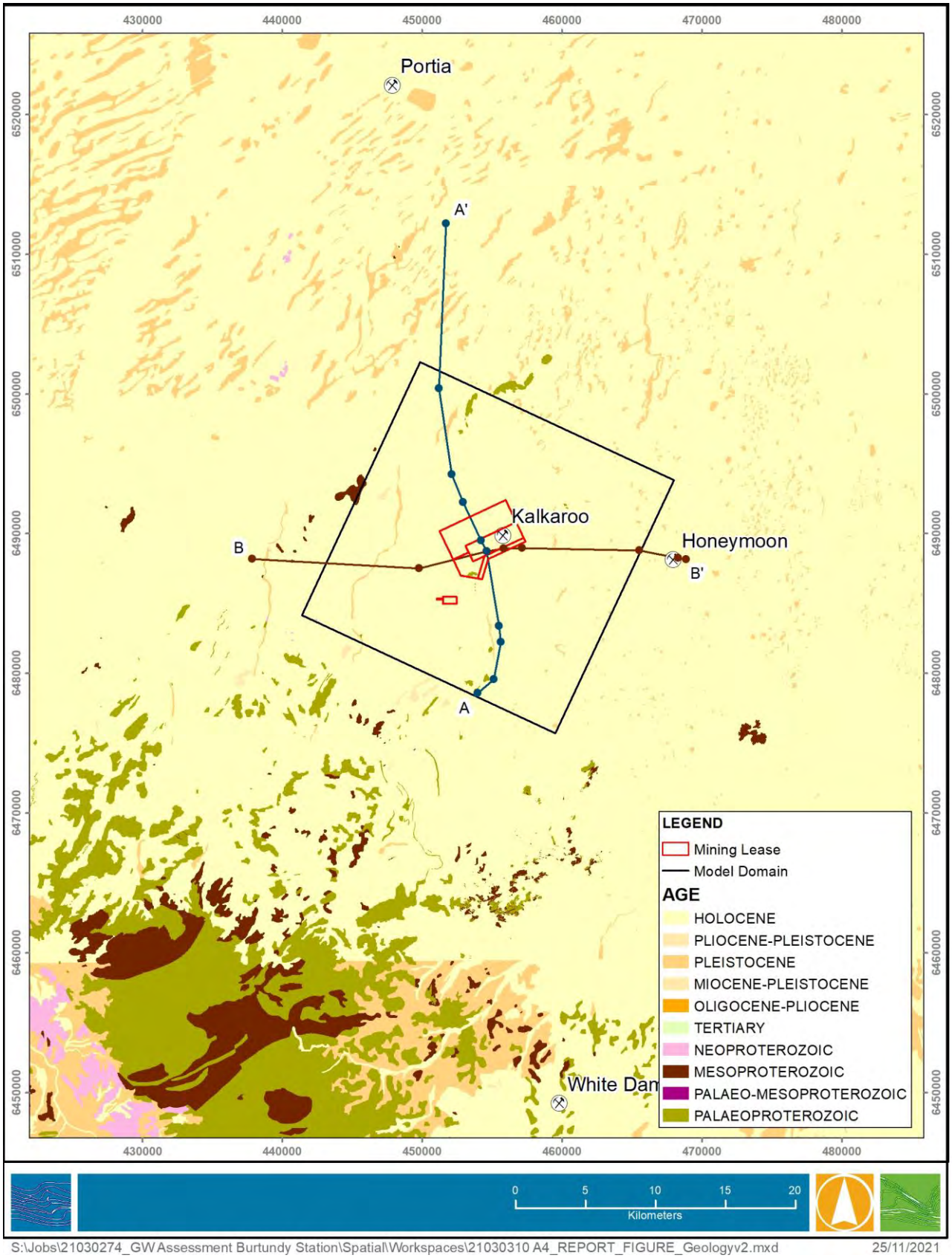

Figure 4-2 Regional Geology and Cross Section Locations (SARIG 1:100,000)

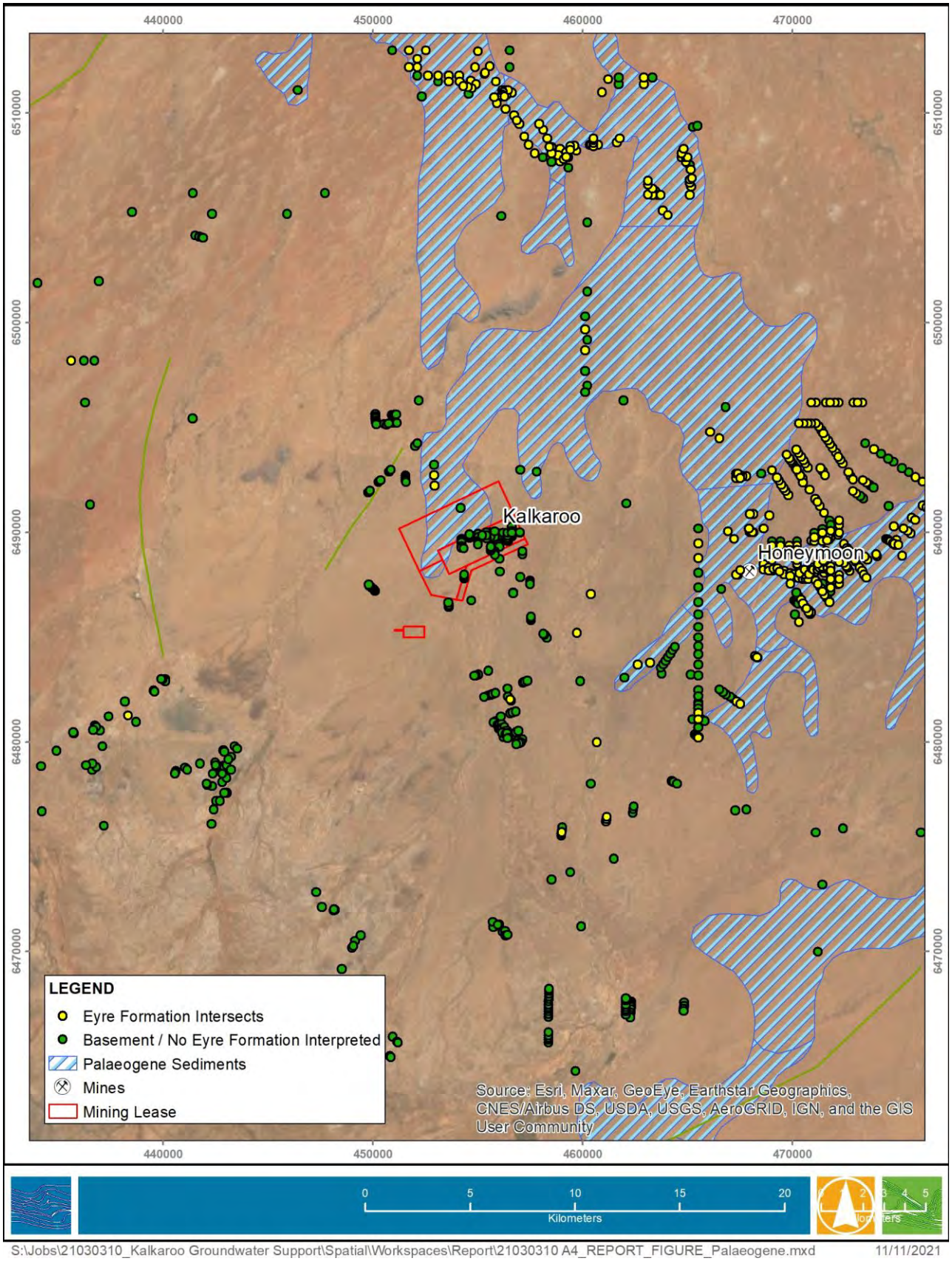

Figure 4-3 Tertiary (Palaeogene) Sedimentary Distribution (SARIG)

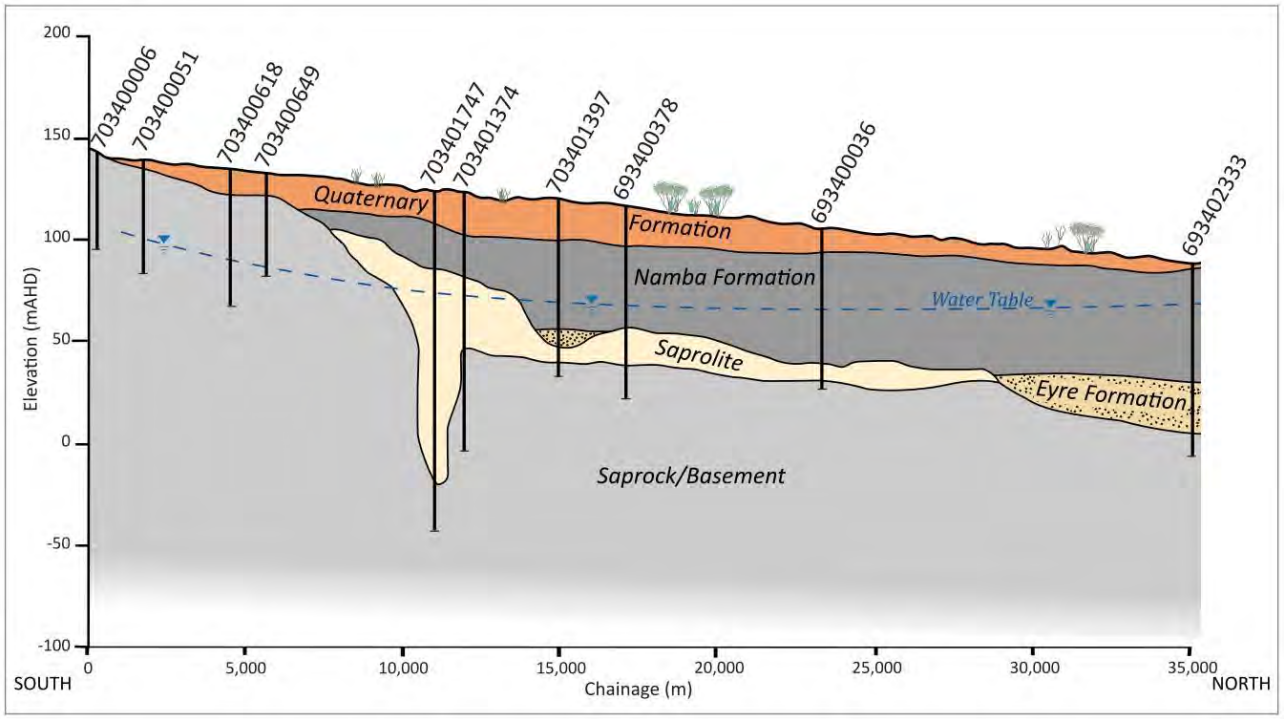

Figure 4-4 North South Regional Hydrogeological Cross Section (A-A')

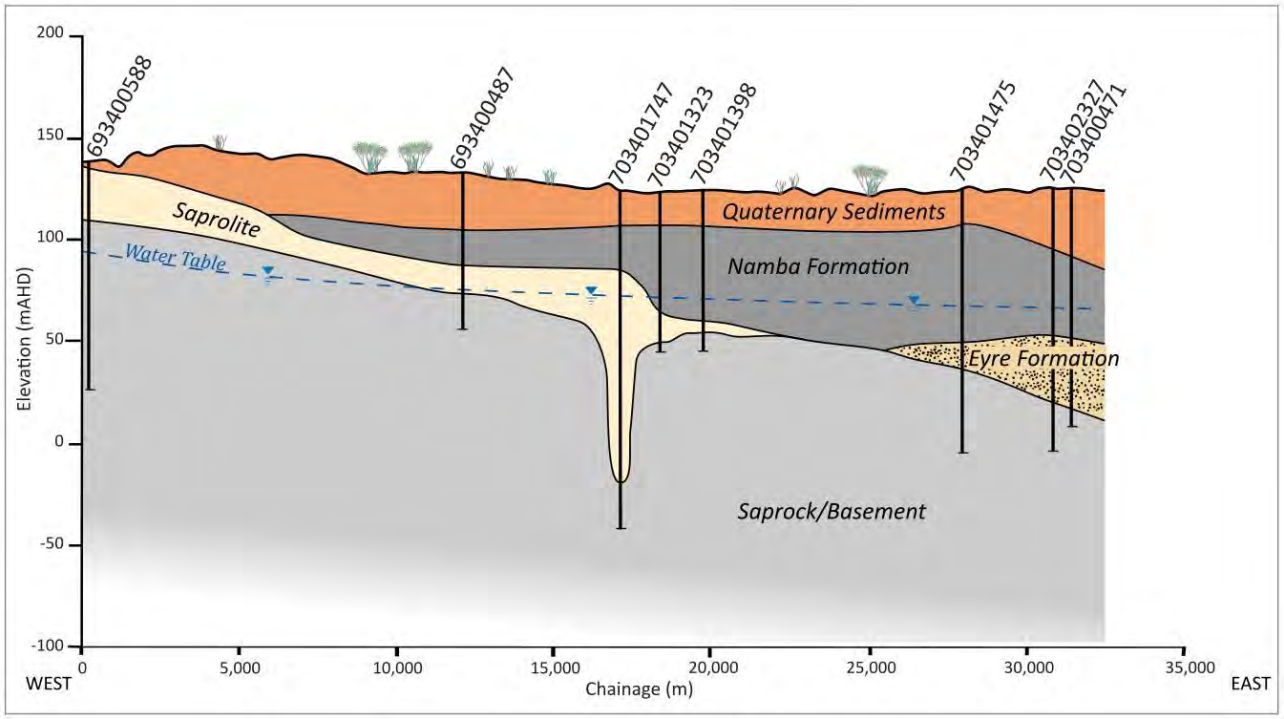

Figure 4-5 East West Regional Hydrogeological Cross Section (B-B')

4.2 Site Geology

The Kalkaroo copper gold deposit is located at depths of between 30 m and 90 m below ground surface within weathered (saprolitic) and fresh Proterozoic graphitic pelite and albitite units of the Broken Hill Group. Core photos of the weathered saprolite material showing remnant bedding and jointing structures are presented in Figure 4-6. The mineralisation is reported to be associated with an approximately east west trending quartzose infilled shear and dome structure (Kalkaroo Copper, 2021). Major structural features reported by Kalkaroo Copper based on interpretation from over 500 exploration drillholes are shown in a plan view in Figure 4-7 and include:

- The Kalkaroo Dome structure which is reported to be a north plunging anticline characterised by a sub-vertical fractured zone causing an area of increased permeability within the mining sequence.
- Kalkaroo West shear which trends approximately east to west, dips steeply and is thought to be about 50 m wide. The shear zone contains fractured quartz and carbonate breccias which appear to be of high secondary porosity and permeability. Deep oxidation and weathering are reported to have produced a trough of saprolitic rocks along this shear zone. A subsidiary shear is also thought to be present about 50 m north of the Kalkaroo West shear.
- Western Limb shear which trends approximately north to south and is quartzitic and steeply dipping.
- Central shear through the dome which is reported to be steeply dipping and trending approximately east northeast to west southwest. It is possible that it is a continuation of the Kalkaroo West shear, with relative displacement to the north along the Western Limb Shear.

Quaternary and Tertiary Sediments overlie the saprolite, saprock and fresh basement throughout the project area. Quaternary sediments comprise undifferentiated alluvial, fluvial and aeolian deposits while Tertiary sediments are associated with the Namba Formation. In additional to the mineralisation within the saprolite, Kalkaroo Copper report that a gold-enriched horizon of supergene origin has been deposited in the organic clays within the Namba Formation due to upward migration from the underlying Kalkaroo orebody (Kalkaroo Copper, 2021). Geological cross sections showing the interpreted stratigraphic layers and mineralisation are presented in Figure 4-8 and Figure 4-9. The cross sections are based on Kalkaroo Copper's exploration drilling.

Isolated occurrences of Tertiary sand at the base of the Namba Formation have been intersected in a few basement topographic low areas over the deposit, but these are not continuous or connected enough to define a channel or layer of any significance. The closest recognised palaeochannel to the Kalkaroo Deposit is the Yarramba Palaeochannel located 12 km to the east. An interpreted tributary palaeochannel trends to the southwest from the Yarramba Palaeochannel towards Kalkaroo as shown in Figure 4-3, but this has not been proven to contain significant deposits of Tertiary sand. Review of available drill hole logs from SARIG suggest that these materials are predominantly silty clays, and it is therefore interpreted that they are associated with the Tertiary Namba Formation.

Advice provided by Kalkaroo Copper indicates that data from a limited number of rotary mud Uranium exploration holes indicates this area could be underlain by weathered granite basement rather than Tertiary sand. Note that the Yarramba paleochannel is actually filled with old Cenozoic Eyre Formation sands, which are unconformably overlain by the Namba Formation. The Eyre Formation is now only found in depressions and paleochannels as it was largely eroded away pre-deposition of the Namba Formation.

Figure 4-6 Core Photo of Weathered Saprolite Material (KKDD00289 74 to 80 m) (Kalkaroo Copper, 2021)

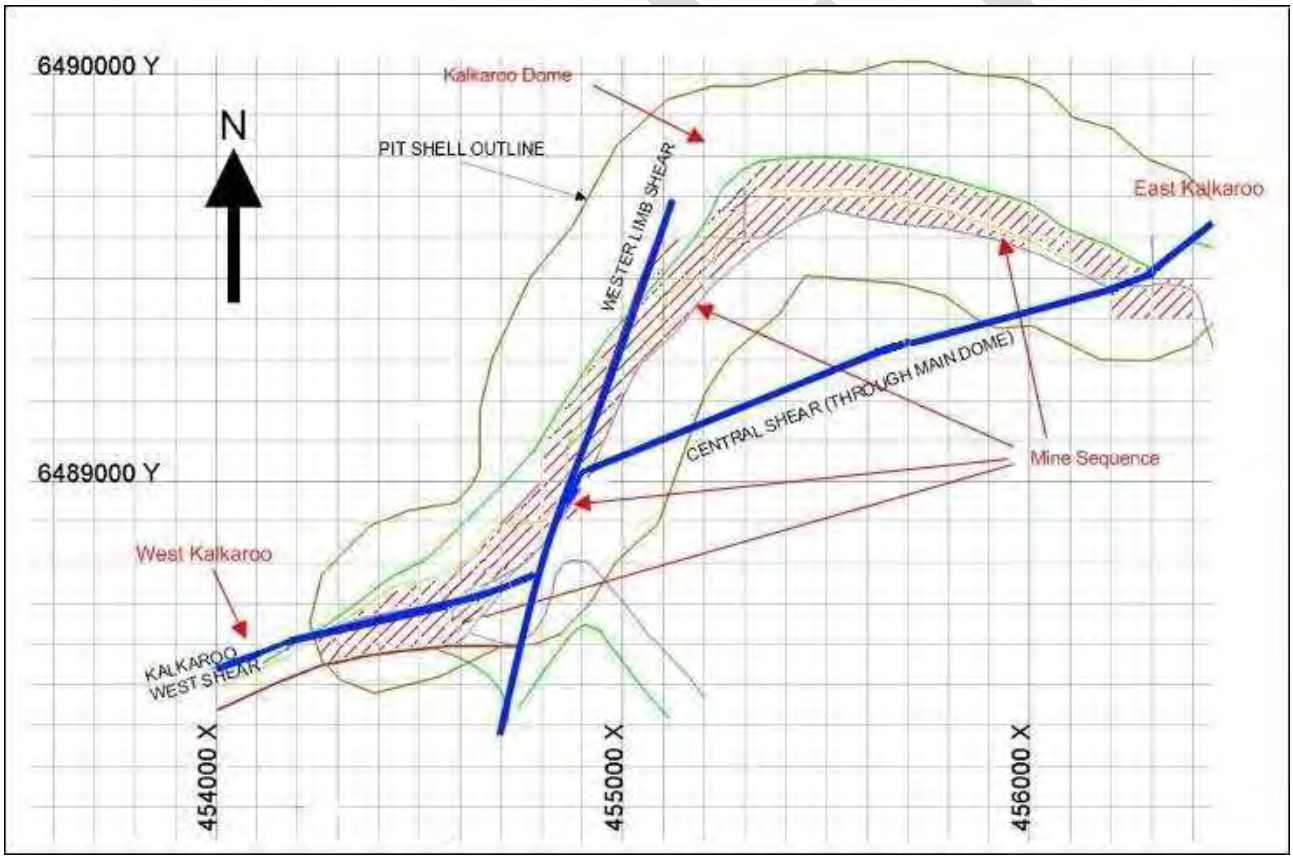

Figure 4-7 Basement Geology and Major Structural Features (Kalkaroo Copper, 2021)

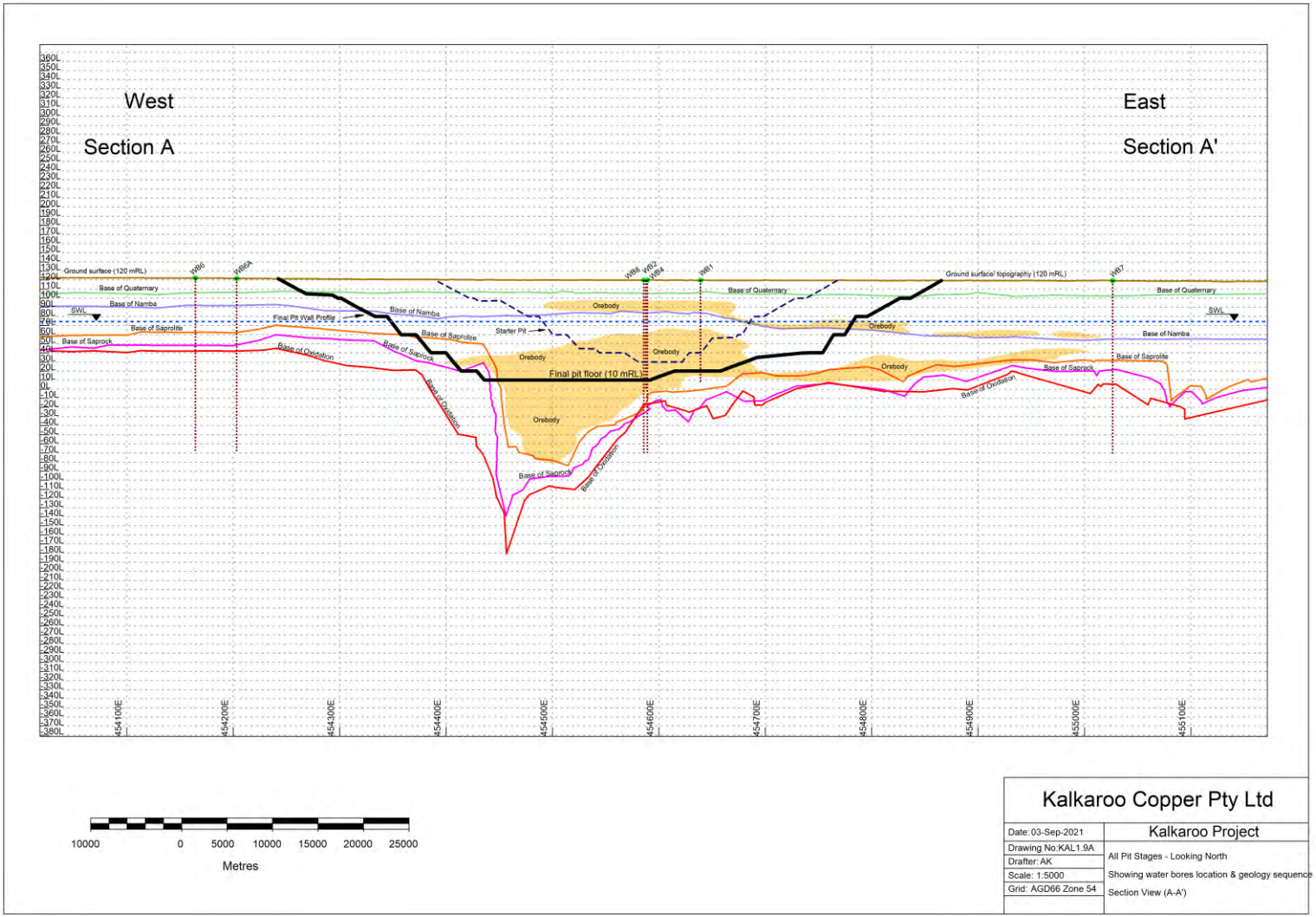

Figure 4-8 Site Geological cross section A-A'

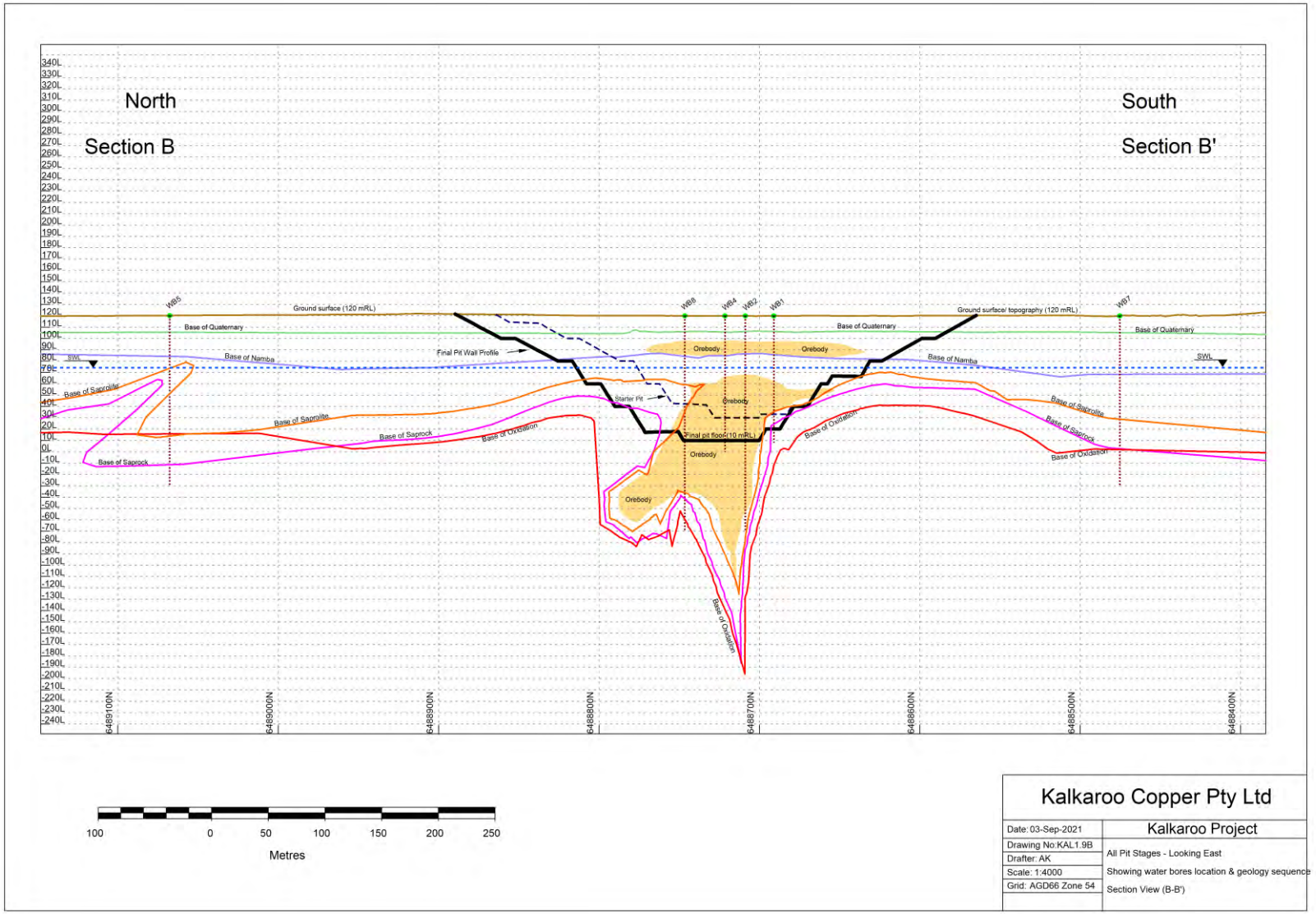

Figure 4-9 Site Geological cross section B-B'

5 HYDROGEOLOGY

5.1 Groundwater Levels and Flow Directions

Groundwater data within 20 km of the site were obtained from the WaterConnect database and analysed to provide further information on groundwater levels and flow directions. Analysis of the data indicates that the water table is within the basement to the south, through the site, and transitions into the Tertiary Namba Formation to the north and east of the site as the basement surface deepens. This is illustrated schematically in regional cross sections A-A' and B-B' (Figure 4-4 and Figure 4-5). Groundwater levels occur at depths of 45 to 50 m below ground level near the Kalkaroo deposit (Figure 5-1).

Quaternary sediments are not known to be saturated within the study area with the water table occurring around 30 m below the base of these sediments. The Tertiary Namba Formation is also unsaturated to the south of the orebody and partially saturated in the north and northeast as the basement topographic level falls away from the Olary Ranges. The low permeability Namba Formation overlies the Saprolite (weathered basement) which is of a similar permeability and the available data suggests that this contact is generally above the water table within the proposed pit footprint. There is currently no evidence to suggest enhanced permeability at the contact between these two low permeability formations. Stratigraphic conditions reported by Kalkaroo Copper in resource drillholes completed on 25 m spacing over the area of the pit indicated little variation in the contact between the Namba Formation and the Saprolite and absence of the Eyre Formation.

Some localised perching may exist in the Quaternary sediments or at the boundary with the lower permeability Namba Formation, however, as this has not been the focus of previous investigations, there is no data to support the occurrence of such conditions. Geotechnical test pit logs around the proposed tailings storage facility reported very stiff to hard clays at depths of up to 2.0 m (BTM Solutions, 2012). These observations are consistent with anecdotal evidence from fauna trenches dug on-site to around 0.5 m which also reported a stiff impenetrable clay layer. The clay layer was reported to be present on the plains and within ephemeral watercourses near the proposed pit. The presence of this clay layer has the potential to significantly reduce recharge, and hence, establishment of perched water tables. Given the paucity of data however, it is suggested that additional drilling investigations be undertaken to determine whether the shallow soil profile (<20 m) between the water course and the pit contains significant intervals of sediments capable of transmitting surface water flows vertically to form a perched water table during flow events, and horizontally towards the pit walls.

The regional groundwater flow within the basement aquifer is interpreted to be in a north-easterly direction from the elevated ranges in the southwest to the low-lying plains in the north and northeast, consistent with the regional topographic gradient (Figure 5-2). Although the potentiometric surface has been derived from groundwater levels spanning several decades, it is considered that the data provides a reasonable representation of the groundwater flow direction within the study area. Localised variations to this generalised flow pattern may be observed within individual hydrogeological units depending on proximity to influencing features such as higher permeability deposits within Tertiary palaeochannels or significant areas of enhanced permeability such as shear zones within the basement rocks.

There is no time series data available within the study area to assess seasonal or long-term climatic influences. Groundwater levels from the site wells (Figure 6-1) were gauged in November 2021 with data indicating that levels were on average around 1 m higher than the levels gauged in 2009, with a range between approximately 0.6 and 1.2 m higher. The cause of this increase is unknown, however, in the absence of any known stresses on the groundwater system it is most likely attributed to long-term climatic conditions.

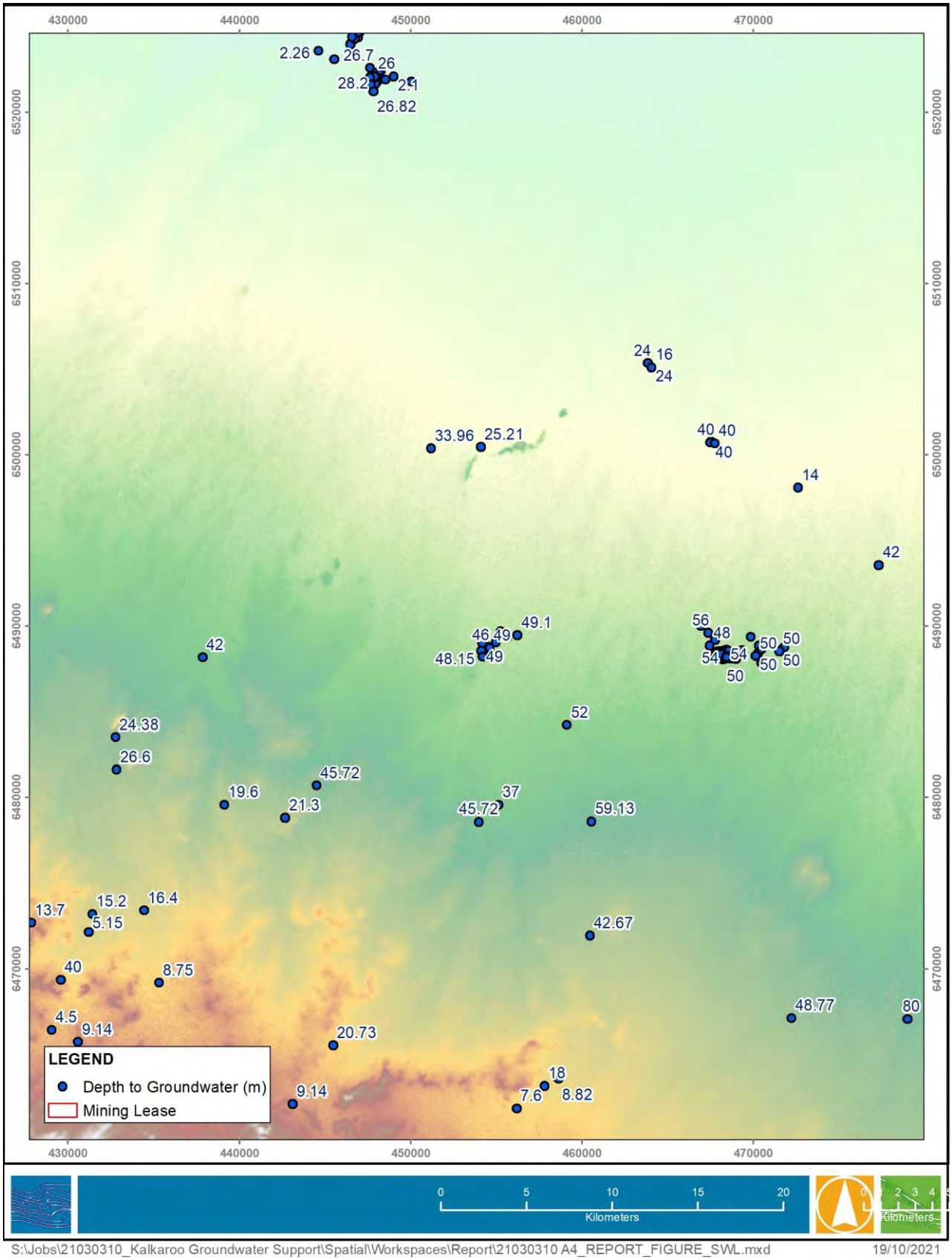

Figure 5-1 Depth to Groundwater from Surface Level

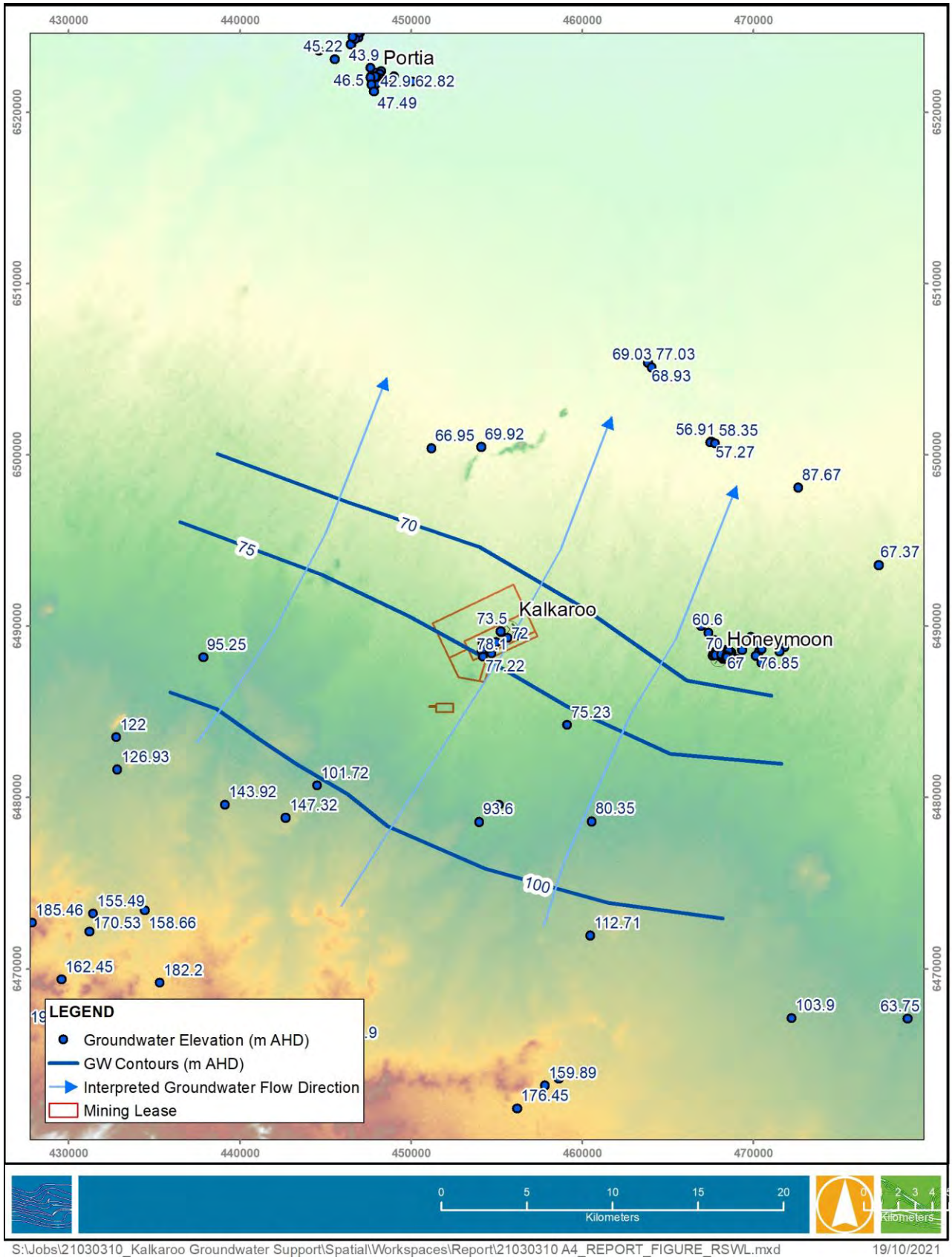

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Figure 5-2 Regional Groundwater Contours and Flow Directions

5.2 Groundwater Quality

Regional groundwater salinities range from 1,105 to 34,536 mg/L based on data sourced from site wells and WaterConnect (Figure 5-3). The data has been classified using the salinity ranges presented in the South Australian EPA Water Quality Policy (2015) which has been used as the basis for defining environmental values for the site (refer to section 11.2). Lower salinity groundwater found within the ranges to the southwest is likely to be associated with enhanced recharge into the outcropping basement formations. Data from well 7034-40 approximately 19 km to the northeast of Kalkaroo records a low salinity of 1,334 mg/L. This salinity is not consistent with other readings in this area and this data is thought to be erroneous.

5.3 Groundwater Recharge and Discharge

Recharge to the basement aquifer is thought to occur by infiltration of rainfall in outcropping areas of the Olary Ranges approximately 30 km to the south, as well as those near the site (Johnny Hill and Mooleulooloo Hill). The distribution of groundwater salinity shown on Figure 5-3 supports the conceptualisation that higher recharge occurs in the ranges to the southwest, resulting in lower groundwater salinity in this area, noting that there are some exceptions to this general trend.

Diffuse recharge on the Curnamona Plain is expected to be low due to low rainfall and high potential evaporation rates. Recharge investigations under natural vegetation in low rainfall areas of southern Australia consistently show recharge values of around 1 mm/y (Dawes, 2002). The available data does not indicate areas of enhanced recharge on the Curnamona Plains (assuming that the salinity in well 7034-40 is erroneous).

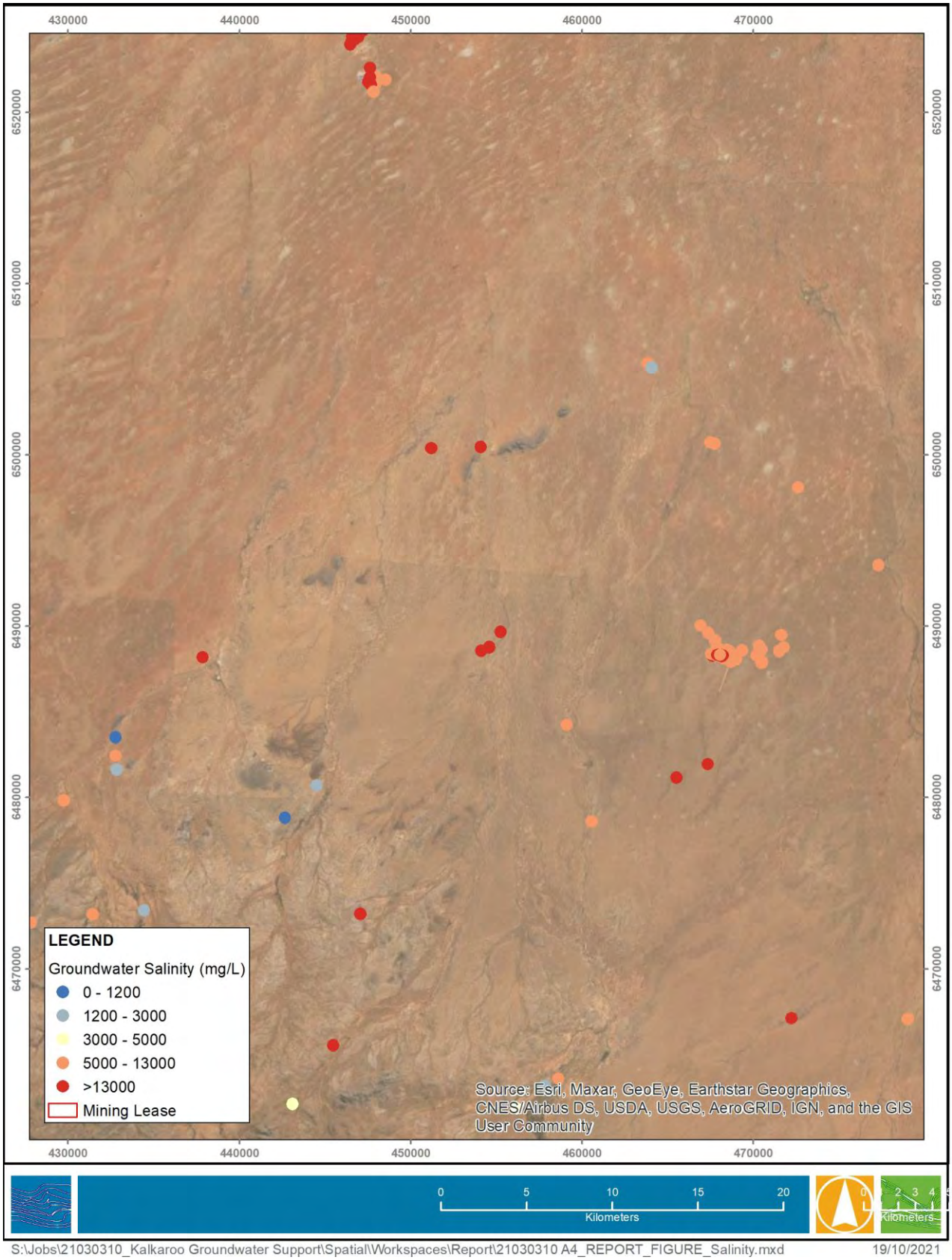

Figure 5-3 Regional Groundwater Salinity

5.4 Well Yields

Well yields recorded in the WaterConnect database in litres per second (L/s) are shown in Figure 5-4. The data indicates regional well yields are generally less than 2 L/s with higher yields more than 20 L/s recorded from the site investigation wells and at the Honeymoon Uranium mine within the Yarramba Palaeochannel. Recorded well yields can be a function of the measurement method, for example airlift during drilling, windmill yield or pumped yield, and therefore may not reflect the true potential well yield. The data does however indicate that shear and fracture zones at the site and palaeochannel sediments at the Honeymoon mine can provide higher yields than are generally measured in the region. This is likely to be a direct function of higher permeability within the shear zones and palaeochannel sediments within the low-permeability regional basement setting.

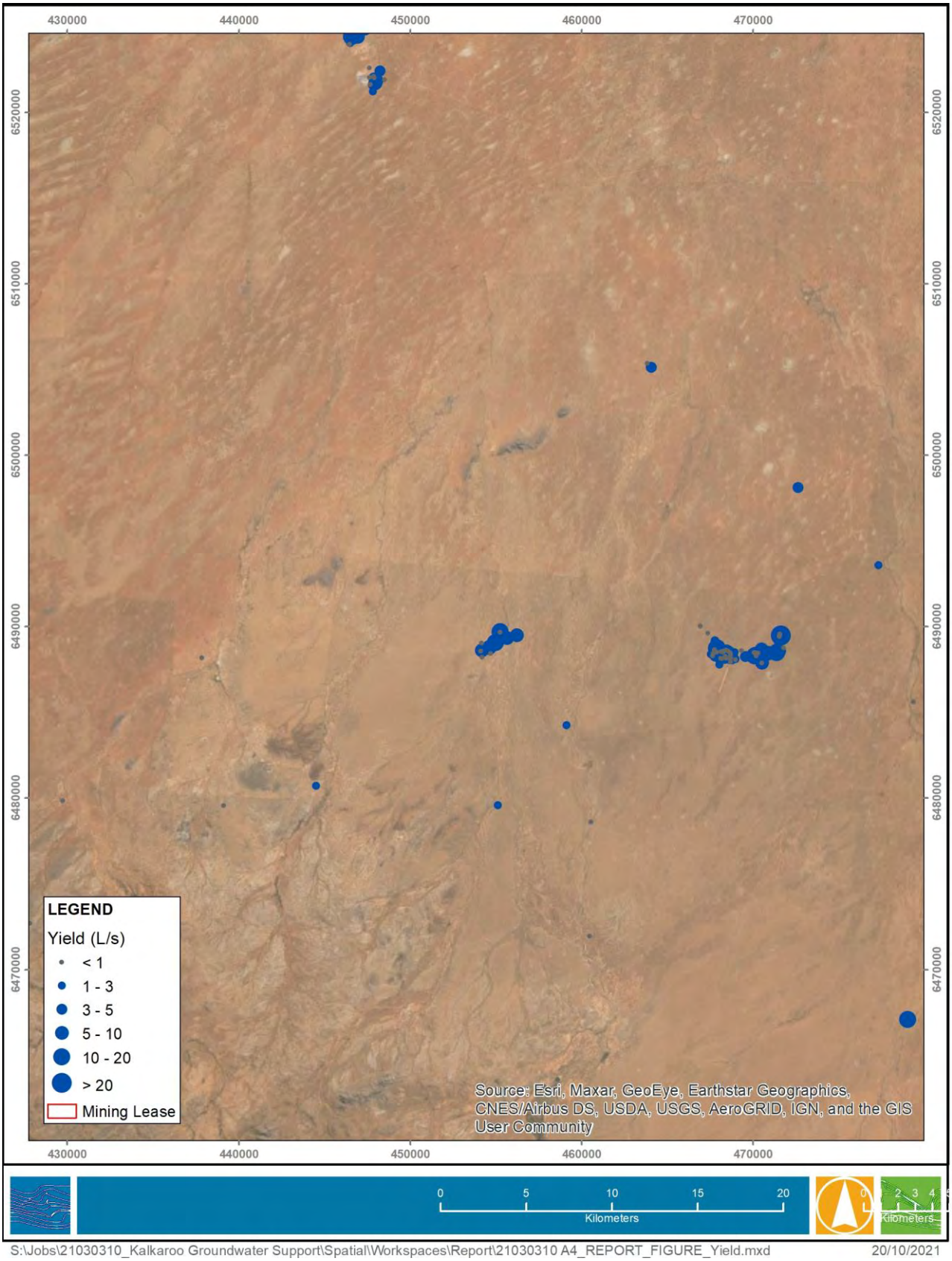

Figure 5-4 Well Yields

6 SITE GROUNDWATER INVESTIGATIONS

6.1 WB Series Groundwater Investigation Wells

Groundwater drilling and aquifer testing was carried out between November 2008 and February 2009 resulting in the installation of twelve site specific investigation wells. The well locations are shown in Figure 6-1 with summary details provided in Table 6-1. Additional descriptive details regarding the drilling and installation program are provided in Aldam Geoscience (2009).

Table 6-1 Kalkaroo Groundwater Investigation Wells

Water Well No.	Unit Number	Depth Drilled (m)	Hydrogeological Unit	Airlift Yield (L/s)	Laboratory Salinity (mg/L)	Comment
WB 2	703401747	165	Basement	10	19,100	West Kalkaroo shear
WB 3	703401746	169	Basement	0.5	9,520	South of west Kalkaroo shear
WB 4	703401745	69	Saprolite	-	-	West Kalkaroo shear
WB 5	703401744	122	Basement	0.5	24,600	North of west Kalkaroo shear
WB 6	NA	150	-	1	-	Re-drilled due to formation collapsing
WB 6a	703401742	174	Basement	10	34,100	West Kalkaroo shear
WB 7	703401741	138	Basement	0.8	12,800	Outside and adjacent western limb shear
WB 8	703401740	174	Basement	8	-	Subsidiary shear at West Kalkaroo
WB 9	703401739	153	Basement	15	25,100	Central shear through dome near junction with western limb shear and mining sequence
WB 10	703401738	123	Basement	7	26,200	Central shear through dome
WB 11	703401737	180	Basement	8	30,000	East Kalkaroo, central shear through dome
WB 13	703401736	162	Basement	15	15,200	Mining sequence dome structure
WB 14	703401735	90	Saprolite	0.1	-	Mining sequence dome structure

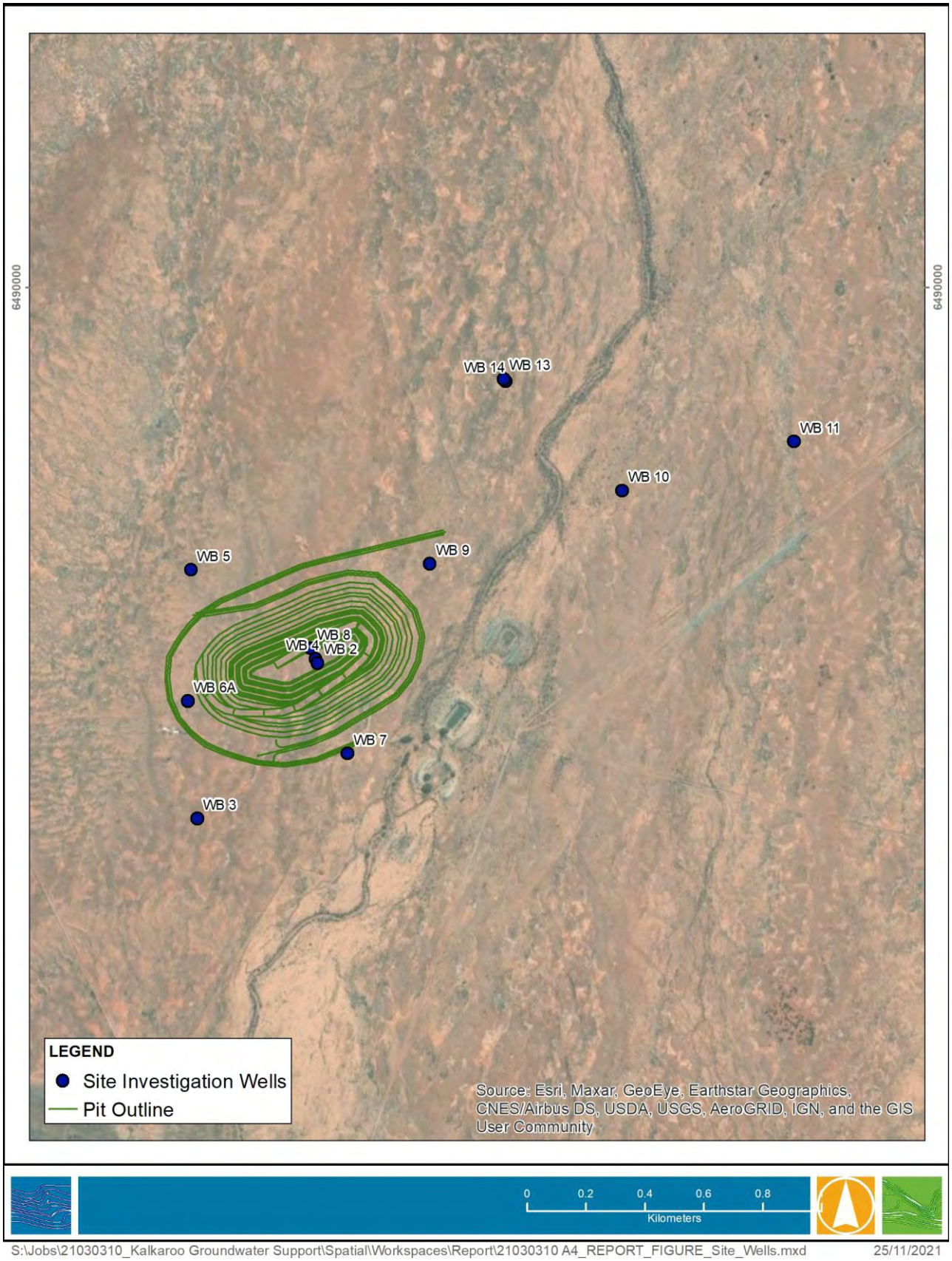

Figure 6-1 WB Series Groundwater Well Locations and Structural Zones

6.2 Groundwater Chemistry

Groundwater samples for a number of the Kalkaroo groundwater investigation wells (WB series) were submitted for laboratory analysis. The major ion data was interpreted using a Piper Plot (Figure 6-2) along with other historical data obtained for 21 other wells in the surrounding area from WaterConnect. Some of these samples are from the Honeymoon site to the east with others to the northeast, west and south of Kalkaroo. The samples from the Kalkaroo water wells show similarity with the historical data, all plotting as sodium-chloride type with high proportions of these ions present. There is some minor spread in sulphate concentration and one of the historic samples shows elevated calcium compared to sodium and potassium, this well is located to the west in an area of potential higher recharge and with a much lower TDS than the other wells. Other historic wells are likely sampling water hosted in similar geology, either the sedimentary rocks of the Eyre Formation or the basement below.

Though the Kalkaroo water wells have been drilled in different domains within the site-specific limbs, shears and dome, the data suggests that they are likely sampling water of the same connected aquifer. WB2 sees slightly elevated concentrations of all major ions compared to the other wells, and WB5 has a slightly higher potassium concentration. The lack of major compositional variation within this set of samples is perhaps unsurprising due to the limited distance between the wells.

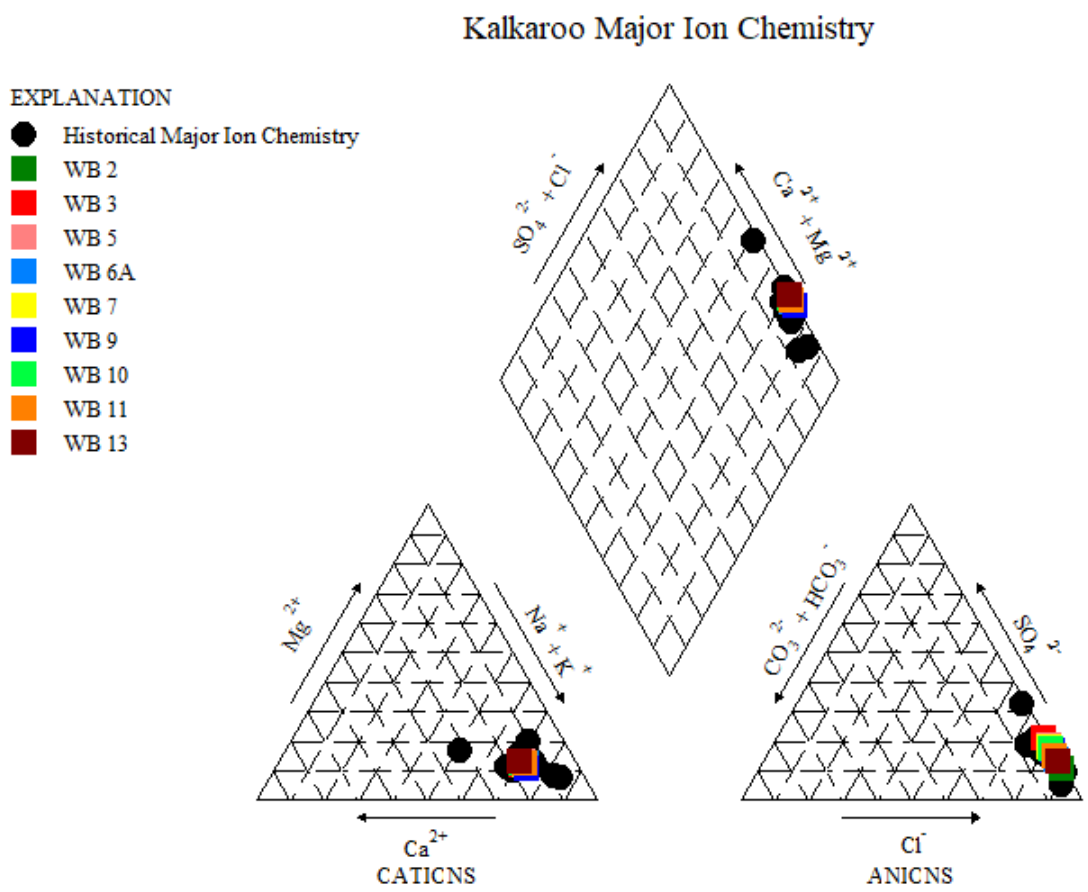

Figure 6-2 Piper Plot of Kalkaroo Groundwater Investigation Wells and Available Historic Data

6.3 Aquifer Testing and Hydraulic Parameters

Aquifer testing was carried out on the site investigation wells as summarised in Table 6-2. Further details regarding the testing program are described in Aldam Geoscience (2009) and test analysis graphs are presented Appendix A

The aquifer testing analysis results have been consolidated to favour those from the pumped well and observation well results from the same unit or hydraulic zone within the Basement. Hydraulic conductivity values have been derived from the analysis results by dividing the thickness of interval tested by the calculated transmissivity.

Table 6-2 Aquifer Test Analysis Summary

WB No.	Unit	Well Yield (L/s)	CD Test Rate (L/s)	Average T (m^2/d)	b (m)	K (m/d)	Average Storativity	Specific Storage (/m)	Analysis	Comment
WB 2	West Kalkaroo shear	10	3.1	158	9	18	$3.4x10^{-4}$	4E-05	Leaky strip	Adopted results from pumping WB 2 and WB 6a ignoring high outlier of 1,864 m2/d
WB 3	South of west Kalkaroo shear	0.5	NA	NA	95	0.002	NA	NA	Hvorslev	
WB 4	Saprolite	-	NA	NA	24	0.02	NA	NA	Hvorslev	
WB 5	Outside west Kalkaroo shear	0.5	NA	NA	4	0.02	NA	NA	Hvorslev	
WB 6a	West Kalkaroo shear	10	3.6	2,630	101	26	$1.9x10^{-4}$	2E-06	Leaky strip	Results from pumping WB 6a
WB 7	Outside west Kalkaroo shear	0.8	0.2	0.6	19	0.03	NA	NA	Jacob	Results from pumping WB 7
WB 8	Subsidiary shear at West Kalkaroo	8	1.3	18	57	0.3	$8x10^{-3}$	1E-04	Leaky strip	Results from pumping WB 8

WB No.	Unit	Well Yield (L/s)	CD Test Rate (L/s)	Average T (m^2/d)	b (m)	K (m/d)	Average Storativity	Specific Storage (/m)	Analysis	Comment
WB 9	Central shear through dome, junction with mine sequence	15	3.6	617	72	9	$1x10^{-3}$	1E-05	Leaky strip	Results from pumping WB 9
WB 10	Central shear through dome	7	3.2	30	11	3	$6x10^{-6}$	5E-07	Jacob and leaky semi bounded strip	Results from pumping WB 10
WB 11	East Kalkaroo, central shear through dome	8	3.2	57	87	1	NA	NA	Jacob	Results from pumping WB 11
WB 13	Dome	15	2.5	173	66	3	$2.9x10^{-4}$	4E-06	Jacob, confined strip and partially bounded strip	Results from pumping WB 13
WB 14	Saprolite	0.1	NA	NA	12	0.0005	NA	NA	Hvorslev	

Notes: 1. NA = Not Applicable

7 GROUNDWATER RECEPTORS

7.1 Existing Users

In arid regions of South Australia where surface water is scarce, groundwater is often used to support stock and domestic users, town water supplies and mining operations. Existing stock and domestic groundwater users within 20 km of the site have been identified using data from WaterConnect. The following filters were applied prior to reviewing the data:

- Removed all drillholes not assigned as water wells (WW).
- Removed all water wells classified as backfilled (BCK).

The remaining wells have been classified by their primary purpose and are presented in Figure 7-1. The data shows that there are relatively few wells in the study area which are likely to be accessing groundwater. Kalkaroo Copper visited the locations of the nearest wells 7034-51, 7034-30 and 7034-1103 during the period 4 to 6 May 2015 to determine their status (refer to Figure 7-1 for locations). None of the wells were found to be operational for stock watering purposes (i.e. no pump/windmills present), however, it is possible that pumping infrastructure may be re-instated in the future and these wells should therefore be classified as not in use. A summary of the well audit details is provided in Table 7-1 below. The closest of the stock wells, 7034-1103 could not be found within a 500 m radius of the coordinates given in WaterConnect, and it is assumed that this well has been has either been abandoned, has collapsed, or the standpipe height is short and possibly obscured by vegetation and debris.

Further to the east, a network of extraction, injection and observation wells exists at the Honeymoon Uranium mine. These wells are completed in the Yarramba Palaeochannel and target the Tertiary Eyre Formation Sediments.

Table 7-1 Existing Users Well Survey (May 2015)

Unit Number (Name)	Distance from pit (km)	Status	Comments
7034-1103 (Mooleulool oo HS.)	6	Not Located	Well 7034-1103 could not be located despite extensive searching of an area surrounding the coordinates given in the Well Connect database of 459125 E 6484232 N (MGA Zone 54). To account for an error in the coordinate system stated, an approximate 500 m radius around the coordinates was searched on 06 May 2015 by vehicle and foot on a grid basis. This would suggest that 7034-1103 has either been backfilled / abandoned, has collapsed or the standpipe height is short and possibly obscured by vegetation and debris.
7034-51	10	Not in use	Approximately 325 m west and 166 m south of the coordinates recorded in Water Connect database. Revised Coordinates 454797 E 6479412 N (GDA94, MGA Zone 54). SWL was recorded on 04 May 2015 to be 39.89 m below TOC. Evidence of a windmill footing was present however there was no water supply infrastructure installed other than the concrete footing and steel standpipe. It is understood that this well has historically been used for water supply across Kalkaroo Station. Although currently not being used, its status as 'not in use' would therefore be appropriate.

Unit Number (Name)	Distance from pit (km)	Status	Comments
7034-30	11	Not in Use	Well 7034-30 is believed to be located at coordinates 453944 E 6500318 N (GDA94, MGA Zone 54). This was approximately 138 m west and 145 m south of the coordinates recorded in the Water Connect database. The SWL was recorded on 06 May 15 to be 24.40 m below TOC. There was no evidence of water supply infrastructure being present.
693400036	12	Abandoned	Not included in field survey as status description in Water Connect as abandoned.

Notes: 1. NA = No Data

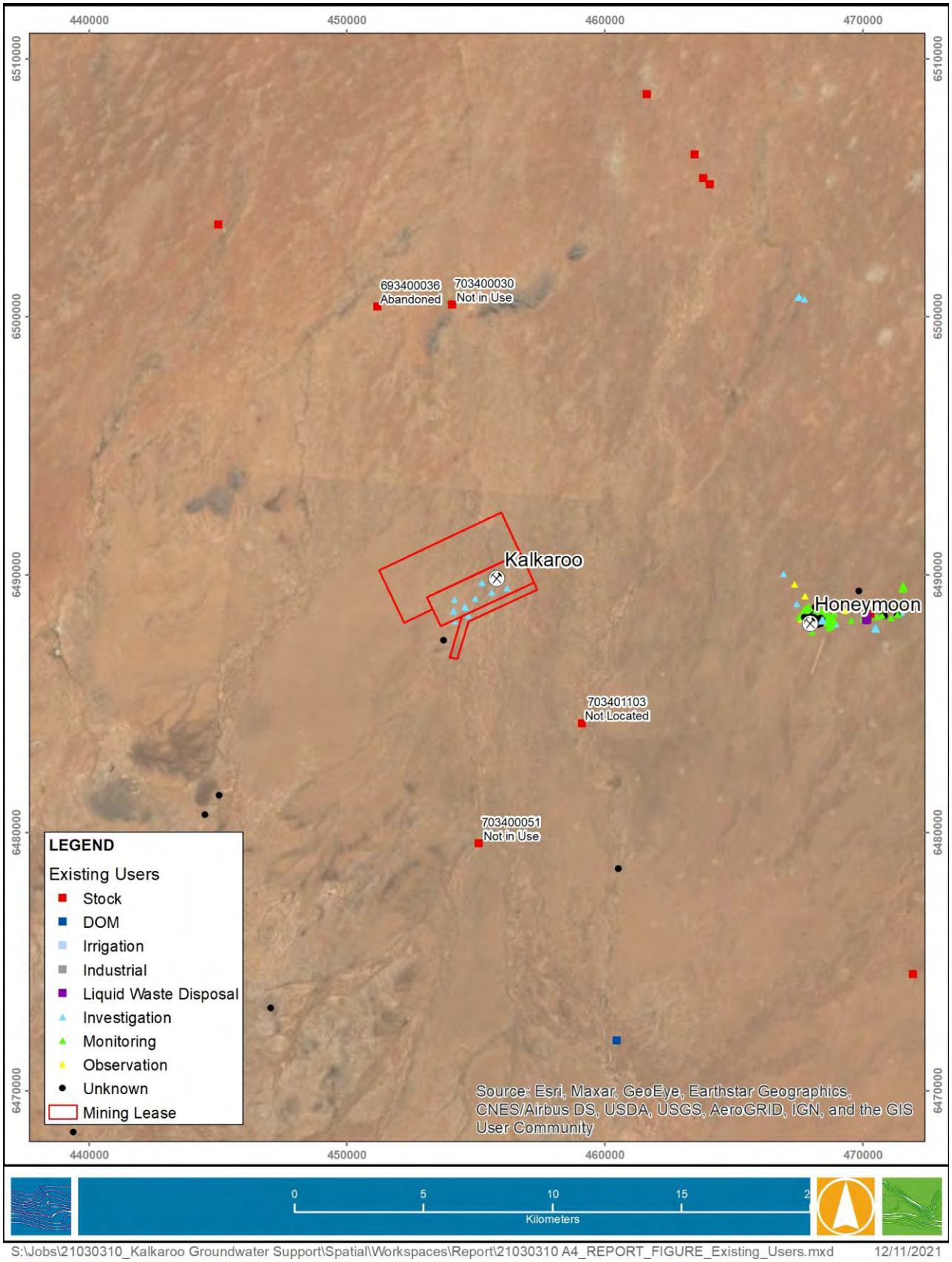

Figure 7-1 Existing Groundwater Users

7.2 Groundwater Dependent Ecosystems

Some ecosystems rely on groundwater to meet ecological water requirements, and as such may be sensitive to changes in the natural groundwater regime. These ecosystems are defined as Groundwater Dependent Ecosystems (GDEs). The Australian GDE Atlas published by the National Water Commission (2012) provides locations of potential GDEs based on broad scale analysis, existing data sets and remote sensing. GDEs are broadly categorised into the following types.

- Aquatic ecosystems that rely on the surface expression of groundwater; this includes surface water ecosystems which may have a groundwater component, such as rivers, wetlands and springs.
- Terrestrial ecosystems that rely on the subsurface presence of groundwater; this includes all vegetation ecosystems.
- Subterranean ecosystems; this includes cave and aquifer ecosystems.

Inspection of the Australian GDE Atlas via the Bureau of Meteorology (BoM) web-based mapping application indicates that the nearest potential aquatic GDEs are located around 7 km northeast of the Kalkaroo pit. These and other potential GDE features in the areas are associated with low lying salt lakes and alluvial plains (Figure 7-2). The likelihood that these systems are supported by groundwater is classified as low within the GDE atlas. Other potential aquatic GDEs in the area include Calico Creek 15 km to the west, Oonartra Creek 23 km to the south and Mingary Creek 22 km to the west of the Kalkaroo deposit. These GDEs are associated with ephemeral drainage lines which discharge in a north to north-westerly direction towards Lake Frome.

Terrestrial GDEs include low level shrublands (less than 1 m) consisting of Sclerolaena divaricate, Atriplex vesicaria ssp and Maireana aphylla (mixed). These low level shrublands are identified as covering the majority of the project area (Figure 7-3). The likelihood that these systems are supported by groundwater is classified as low within the GDE atlas. This classification is consistent with the available groundwater data which suggests that permanent groundwater is in excess of 30 m below ground level and that groundwater is brackish to saline. Other features of interest include a Eucalyptus camaldulensis var. woodland 5 km to the southeast of the Kalkaroo deposit which has been identified as having a high likelihood of being supported by Groundwater.

It is possible that some seasonal vegetation is supported by perched creek sediments which are saturated during wet periods, however, the connection between the permanent water table at depths in excess of 30m and surface vegetation is likely to be low.

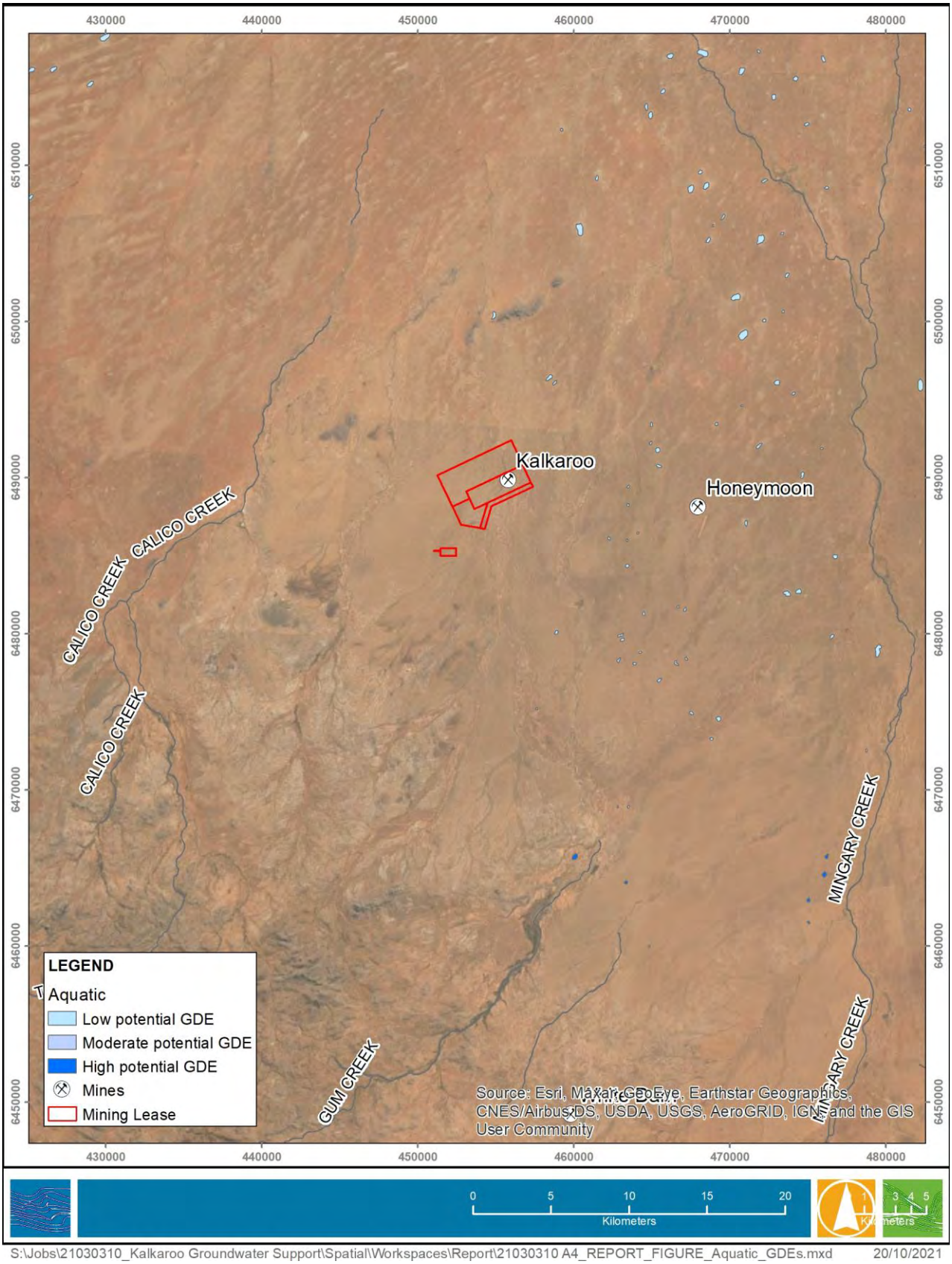

Figure 7-2 Potential Aquatic Groundwater Dependent Ecosystems (BoM GDE Atlas)

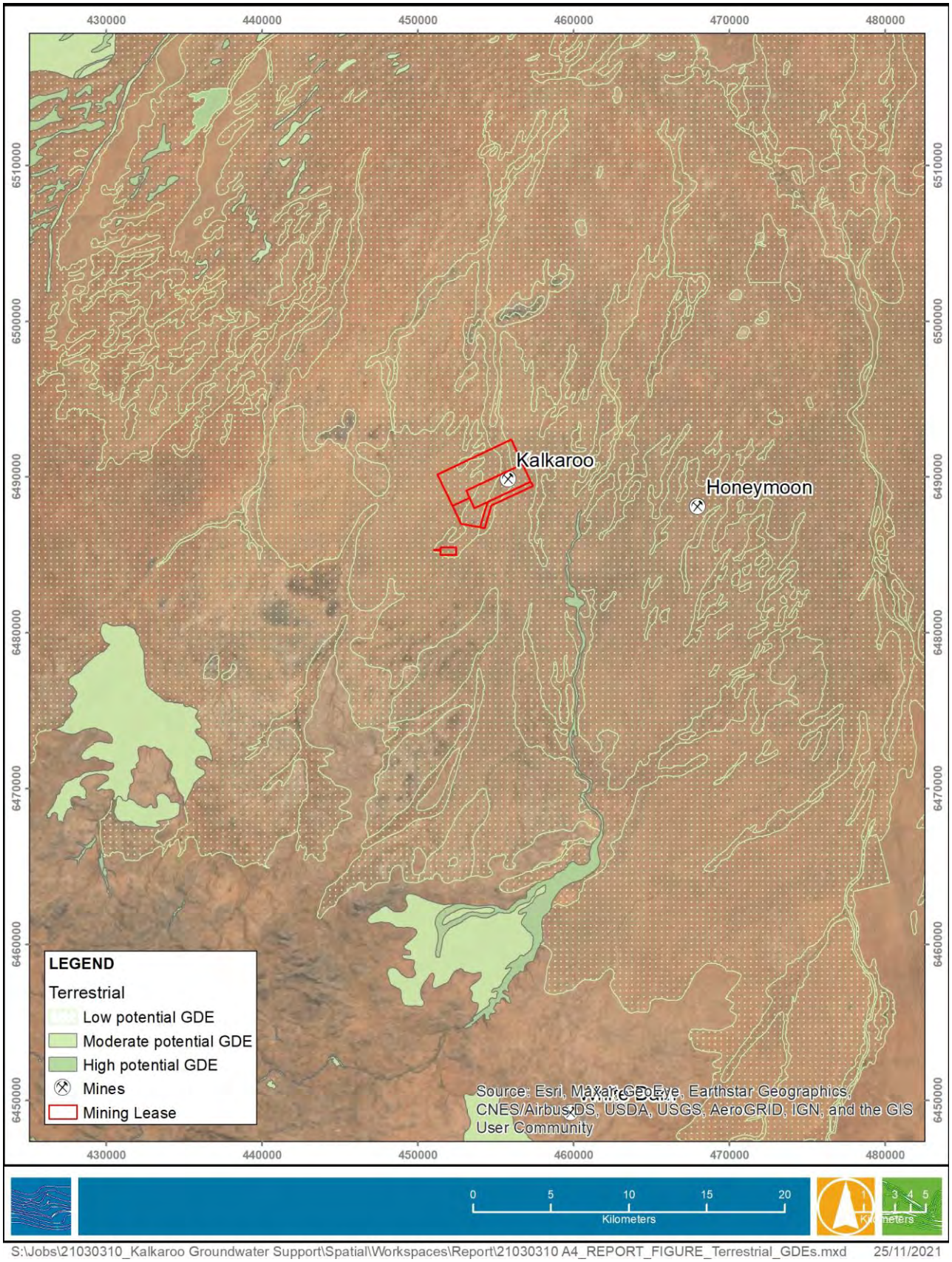

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Figure 7-3 Potential Terrestrial Groundwater Dependent Ecosystems (BoM GDE Atlas)

8 CONCEPTUAL HYDROGEOLOGICAL MODEL

The interpretation of the regional geological and groundwater-related data indicates the Kalkaroo project area is characterised by low permeability Quaternary and Tertiary deposits unconformably overlying saprolitic weathered basement rocks, which grade into fresh basement. Tertiary palaeochannels are incised into the underlying basement and contain deposits of Eyre Formation sediments which can provide layers of higher permeability than the overlying material. These sediments can host roll front uranium deposits such as those mined at Honeymoon Uranium mine 12 km to the east of the site. Analysis of available stratigraphic data and inferred extents from Southern Cross Resources and Geoscience Australia (Magee, 2009) suggests that the Yarramba Palaeochannel is the closest defined palaeochannel to the Kalkaroo deposit.

Regional groundwater throughflow is inferred to be driven by recharge in the elevated basement rocks to the southwest of the site, with regional groundwater flow from the south and southwest to northeast and north towards Lake Frome. It is possible that this process contributes groundwater to the overlying Quaternary and Tertiary sediments on the Curnamona Plain through inter-aquifer leakage., however, there appears to be very limited areas of saturation within these sediments between the ranges and the Yarramba palaeochannel. Areal recharge through the Quaternary sediments on the Curnamona Plain is likely to be very low, possibly enhanced in places depending on surface sediment type and proximity to watercourses but this level of complexity is not able to be understood from the available data. Areas of higher recharge in the ranges are indicated by relatively low recorded groundwater salinity values in this area. In addition to the regional data sets, some important aspects of the local site hydrogeology were obtained from inspection of exploration drill cuttings and cores, and the drilling of the site investigation wells as reported in Aldam Geoscience (2009).

Based on the data review and analysis undertaken, the key hydrogeological features can be summarised as follows:

- The Quaternary sediments and Tertiary Namba Formation are clay rich and are of very low permeability. They are unsaturated over the area surrounding the Kalkaroo site with the water table transitioning to the Namba Formation away from the site as the basement topographic level falls.
- The Eyre Formation in the region appears predominantly as sand deposits within the Yarramba palaeochannel to the northeast and east of the site. The Eyre Formation sand deposits were largely eroded away prior to deposition of the Namba Formation and although remnant deposits may be found in depressions within the basement topography, these sediments are not continuous or connected enough to define a channel or layer of any significance near the Kalkaroo deposit.
- The saprolitic materials within the basement-weathered profile are clay rich and are of low permeability. The basement shear zones extend through the saprolite, are brecciated with quartz veining and have significantly higher permeability than the surrounding saprolite. Exploration drilling has identified appreciable water inflows from these features within the saprolite horizon.
- The shear zones within the underlying less weathered transitional saprock horizon are also interpreted to provide zones of higher permeability.
- Significant fracturing in basement shear zones provide areas of relatively high permeability and correspondingly high well yields. These can be conceptualised as strip aquifers within the surrounding low-permeability basement rock mass. To the immediate east of Kalkaroo and for a few kilometres to the west, the Kalkaroo fault zone, comprising the Central and West Kalkaroo shear zones, passes into very tight graphitic pelites which tend to shear and slip rather than brittle fracture, hence it is interpreted that the permeability of these shear zones will be somewhat reduced away from Kalkaroo. The shear zones are assumed to be sub-vertical and extend to depth within the basement rocks.

- The mining sequence forms a north-plunging anticline structure in the central Kalkaroo area and aquifer testing indicates this is a unit of relatively high permeability, probably due to fracturing associated with the structural deformation. Discussions with Kalkaroo Copper personnel indicate that the fracturing within this unit forms a sub-vertical zone of enhanced permeability within the mining sequence.
- Basement rocks away from the shear zones appear to be relatively unfractured with a very low permeability.

A graphical presentation of the key regional and local scale hydrogeological processes is presented as a conceptual block diagram in Figure 8-1.

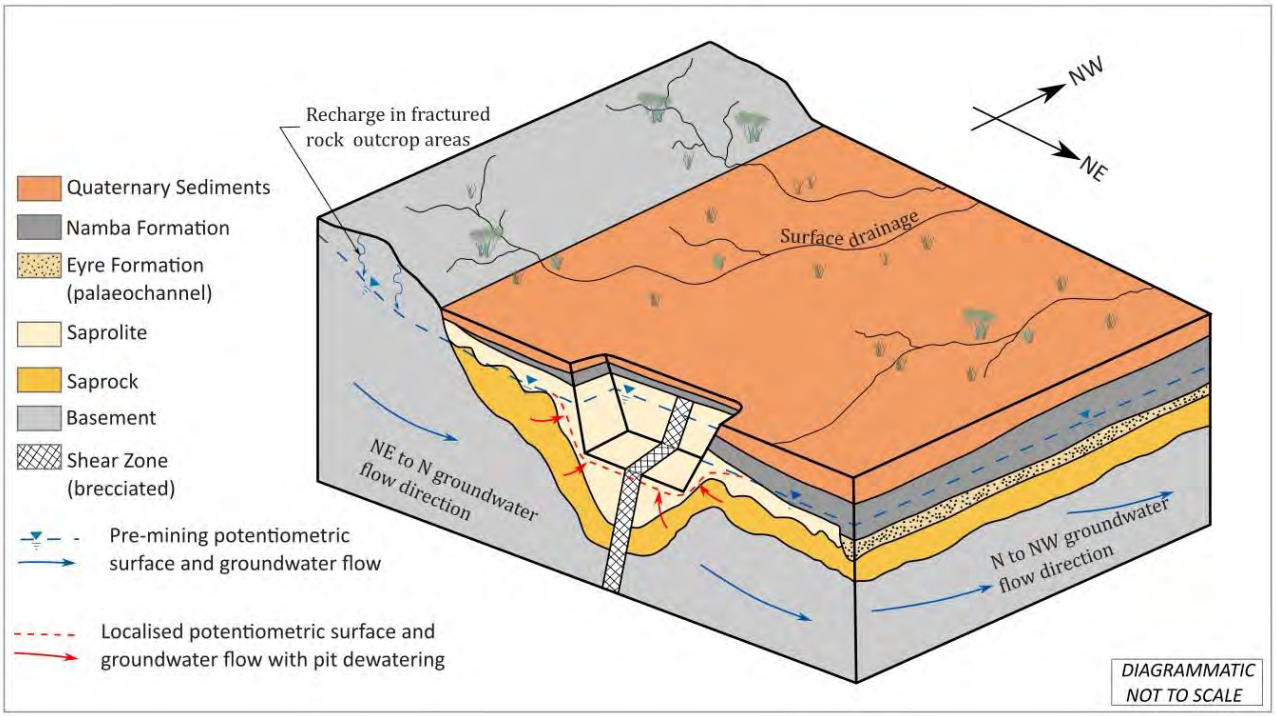

Figure 8-1 Kalkaroo Conceptual Hydrogeological Model

9 PLANNED MINING ACTIVITIES

9.1 Potential Water Affecting Activities

There are several activities on site which have been identified as having the potential to result in groundwater impacts including:

- Local and regional groundwater level drawdown due to pit dewatering and pumping from groundwater supply wells. Previous modelling reported in AGT (2013) and Aldam Geoscience (2009) have modelled the drawdown extents associated with the then proposed operations. The current mining proposal is for a significantly shorter time period, has a much lower proposed pit depth and smaller pit extent than that previously modelled. The revised modelling is therefore required to confirm the drawdown response to these changes.
- Seepage from process water management infrastructure including:
  - A Raw Water Dam (RWD) of 20,000 m^3 capacity which will receive untreated water for site needs including dust suppression and construction activities. The dams will be lined with a 1.5 mm thick HDPE liner on a compacted clay base and seepage is therefore assumed to be negligible.
  - Two Process Water Dams (PWD) of 5,000 m^3 capacity, both of which will be HDPE lined. Seepage from these dams is also assumed to be negligible.
  - Tailings Storage Facility (TSF) which will have a compacted clay floor layer with a vertical hydraulic conductivity (Kv) estimate of 10^{-9} m/s. The consolidated tailings are expected to have a very low permeability of 3 x 10^{-9} m/s. A seepage assessment for the TSF was undertaken by Golder Associates (2021) and this indicated a long-term seepage flux through the compacted clay floor of 56 m^3/day, equating to an approximate seepage flux of 0.00015 m/d over the approximate 600 x 600 m TSF footprint. Seepage from the TSF has been included in the numerical groundwater flow mode at the rates described above.

9.2 Proposed Mining Schedule and Water Balance

Data has been provided by Kalkaroo Copper on the proposed mine excavation schedule and project water requirements. For the purposes of this assessment, mining has been separated into the following key phases:

- Pre-production;
- Production and processing above the water table;
- Production and processing below the water table; and
- Processing with no further excavation.

Figure 9-1 illustrates the proposed pit elevation over the 2.5-year excavation period. Under the proposed mining schedule (Figure 9-1), the water table would be intersected during quarter three and dewatering of the pit would be required from this time through to the end of mining. Prior to the pit reaching the water table and following the completion of pit excavation, a water supply is required for construction and processing activities. It is intended that make-up water will be sourced from production wells in the basement shear zones adjacent the pit prior to pit dewatering, with the well supply to be used to augment later pit dewatering supplies if required. Table 9-1 summarises the key mining stages, pit excavation schedule and water requirements for the project with the excavation stages above and below the water table identified as separate periods for modelling purposes.

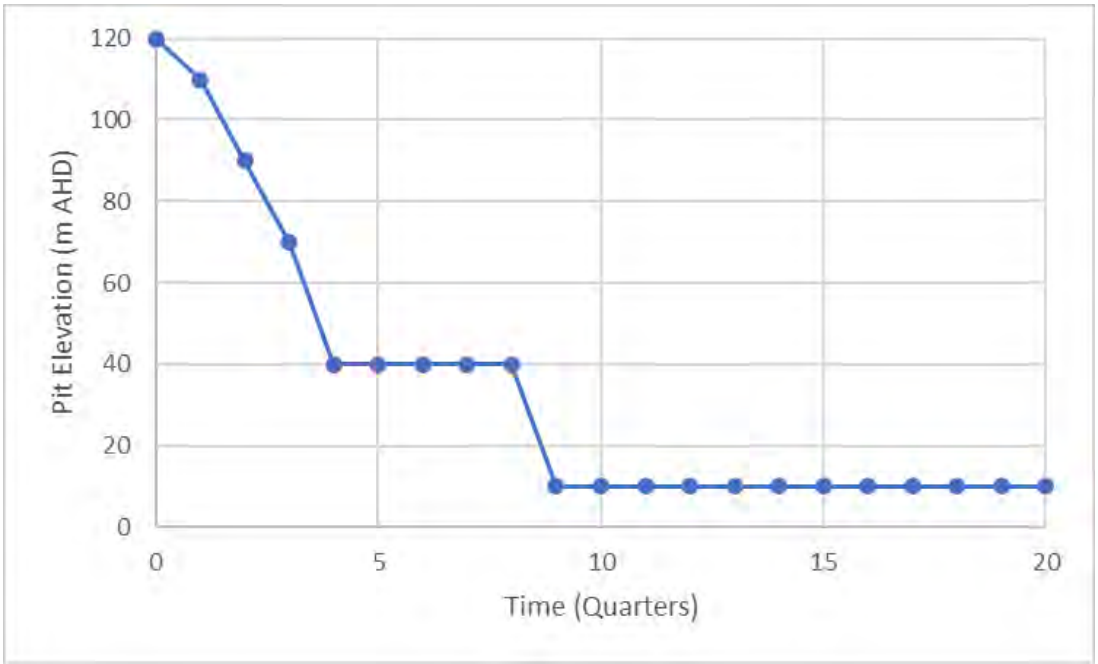

Figure 9-1 Pit Excavation Levels Over Time

Table 9-1 Project Pit Schedule and Groundwater Requirements

Year	Quarter	Stage	Phase 2 Pit Excavation	Phase 3 Pit Excavation	Phase 2 Pit RL	Phase 3 Pit RL	Groundwater Requirement (m^3/d)
1	1	Pre-production and initial pit excavation	Above water table	Above water table	Above water table to RL 90	Above water table to RL 90	1,728
	2						
	3		Below water table	Above water table	Below water table to RL 40	Above water table to RL 90	1,728
	4						
2	5	Production and processing	Below water table	Below water table	Expanded at RL 40	Below water table to RL 40	2,274
	6						
	7						
	8						
3	9				Deepened from RL 40 to RL 10	Deepened from RL 40 to RL 10	2,274
	10						
	11						
	12						
4	13		No further excavation below RL 10	No further excavation below RL 10	RL 10	RL 10	2,274
	14						
	15						
	16						
5	17				RL 10	RL 10	2,665
	18						
	19						
	20						

10 GROUNDWATER FLOW MODELLING

10.1 Overview

10.1.1 Model Objectives

A numerical groundwater flow model was constructed to meet the following objectives:

- Estimate the average rates and volumes of groundwater pumping required to dewater the pit consistent with the mine pit schedule and design depths;
- Identify the groundwater supply balance between that sourced from pit dewatering and from wells outside the pit to meet the project water demands for the life of the project;
- Assess the drawdown impacts associated with the pit dewatering and groundwater supply wells;
- Model the groundwater level recovery post-closure including from pit dewatering and well pumping;
- Estimate the long-term post-closure pit lake level; and
- Assess the fate of potential seepage from the TSF.

10.1.2 Model Design and Class

A summary of the hydrogeological units and permeability estimates for the hydrogeological units within the study area is presented in Table 10-1. Aquifer parameter estimates are available for the fresh basement, the major structural features and the saprolite unit. The structural features within the basement are observed to extend through the entire weathered-to-fresh basement sequence.

The data indicates that the saprolite and fresh basement rock masses likely have similar and very low permeability. The structural features provide high permeability zones within these rock masses. The Quaternary and Tertiary sediments overlying the weathered basement are unsaturated around the site and the water table transitions from the saprolite into the Namba Formation to the north and east of the pit. The Namba Formation can be effectively included as part of the underlying low-permeability saprolite unit.

The above points indicate that the system can be modelled as a two-layer system containing vertical zones of high permeability to represent the main structural features within low permeability geological units.

Based on the available data which has been reviewed and analysed in this study, the revised model could be deemed to have a Class 2 model confidence classification, although there are some inconsistencies in comparing the model inputs with the typical characteristics for model class described in the Australian Groundwater Modelling Guidelines (Barnett et al, 2012). This Class 2 assignment is based on the model characteristics listed below:

- The model objectives relate to providing mine dewatering estimates, regional drawdown impacts of groundwater extraction from pit excavation and wells and undertaking particle tracking of seepage from site infrastructure.
- There are no time series groundwater monitoring data, but recent site and historical regional water level data provide a reasonable basis for initial model steady-state calibration.
- Site investigations have provided estimates of hydraulic parameters for key hydrogeological units of interest. The regional extent and consistency of these parameters is uncertain.
- The site geology has been characterised in detail from exploration and delineation of the ore body through drilling.
- The regional geology is well understood based on Agency mapping and interpretation of regional geophysical data.

Table 10-1 Summary of Hydrogeological Units

Geological Unit or Structural Feature	Hydrogeology	Permeability Estimates (m/d)	Comment
Quaternary sediments	Low permeability sediments above the water table	Kv ~ 0.02 m/d (Table 26, App. F, PEPR – test pit constant head tests)	May contain seasonally perched water tables during wet periods, no effective areal recharge to the water table
Namba Formation	Low permeability sediments above the water table which transitions into this unit away from the site towards the east and north	Kv ~ 0.01 - 10^{-5} m/d (Table 26, App. F, PEPR – laboratory values adopted by Golders as test pit constant head tests appeared high at ~ 0.01 m/d)	Unconformably overlies the basement and confines the Eyre Formation deposits in the Yarramba Palaeochannel outside of the model extent
Eyre Formation	Confined aquifer sand deposits in Yarramba Palaeochannel to the east and north, not identified at or around site or within the current model domain	Nil	Hosts Honeymoon Uranium deposit 12 km east of the Kalkaroo deposit and outside of the model domain
Saprolite	Highly weathered basement, contains relict structural features	Kh 0.01 m/d	Extensive across the region
Saprock	Transitional weathered basement, contains relict structural features	Nil	Extensive across the region
Fresh Basement	Fractured rock	Kh 0.03 m/d	Receives recharge where outcropping or shallow
Mining Sequence Dome	Enhanced structural fracturing	Kh = 3 m/d	Structural features are observed to extend from the fresh basement and into the saprolite zone although variations of permeability with depth are unknown
Kalkaroo West Shear	Shear zone with fracturing and secondary porosity	Kh = 17 – 26 m/d	
Western Limb Shear	Shear zone with fracturing and secondary porosity	Kh = 9 m/d	
Central Shear through dome	Shear zone with fracturing and secondary porosity	Kh = 1 – 9 m/d	

10.1.3 Review of Existing Model

The existing numerical groundwater model developed by Lisdon Associates and reported in AGT (2013) was reviewed to determine its suitability for this phase of modelling. The review showed that:

- The model was developed using appropriate software and an appropriate modelling interface;
- The model was likely to be of sufficient extent to model the expected drawdown impacts with the reduced scale and timing of the proposed pit; and
- The model provides sufficient flexibility in terms of discretising the model spatial grid, model time periods, model layering and parameter zoning.

The review identified several features of the existing numerical model which are not necessarily supported by the hydrogeological conceptual model developed in this study. Given these inconsistencies, and taking into account Agency comments detailed in the request for further information, it was concluded that the following changes would be required to the existing numerical model:

- Removing existing layer 1 (Quaternary) which is above the water table;
- Assign layer 1 as the unconfined Namba and saprolite layer. The high depth to water table (greater than 30 m across the model domain) means that evapotranspiration can be considered to be negligible;
- Assign layer 2 as the confined saprock/fresh basement layer;
- Develop a boundary between layers 1 and 2 based on data derived from the Kalkaroo Copper block model and other available regional data;
- Assign appropriate hydraulic parameters to the regional rock mass and structural features consistent with the results of the aquifer test data review. Discussions with Kalkaroo Copper personnel indicate that well yields increase through the saprolite and into the underlying saprock and fresh basement. The 2-layer model allows the permeability of the structural features to be varied to reflect this;
- Estimating and assigning specific yield and storativity values regionally and to the structural features;
- Adjust the model grid orientation and general head boundaries to reflect the groundwater flow field generated from the regional and site water level data;
- Undertake a steady-state calibration to the observed site and regional water level data set used to generate the groundwater contour map; and
- Use the updated and calibrated model to undertake the required transient predictive dewatering and recovery stage modelling, including sensitivity runs. The dewatering stage time periods will be adopted from the construction and pit expansion schedule, and groundwater demand schedule as identified in this report.

10.1.4 Model Code

The United States Geological Survey (USGS) industry standard groundwater modelling code MODFLOW-2000 was selected with the model constructed in the PMWIN platform (Chiang and Kinzelbach, 1998). The advective transport model PMPATH (Pollock, 1989) was used to carry out the particle tracking modelling of potential seepage from the TSF during the post-mining recovery period.

10.2 Groundwater Model Construction

10.2.1 Model Extent and Grid

The model domain extends for a length parallel to the regional groundwater flow direction of 20 km and a width of 20 km, approximately centred on the proposed mining area (Figure 10-1). The area of the model domain was chosen to include the inferred basement outcrop recharge areas to the southwest and to be of sufficient

size to minimise potential boundary effects on model results. The Yarramba Palaeochannel and the Honeymoon Uranium mining operation were not included in the model domain.

Model grid cell sizes range from 12.5 m square in the vicinity of the proposed pit to enable detail of the hydrogeological zones (shears, dome structure) around the pit to be adequately represented. Model grid cell sizes were increased to 100 m square away from the pit. The model extent, grid and general head boundary conditions are shown on Figure 10-1.

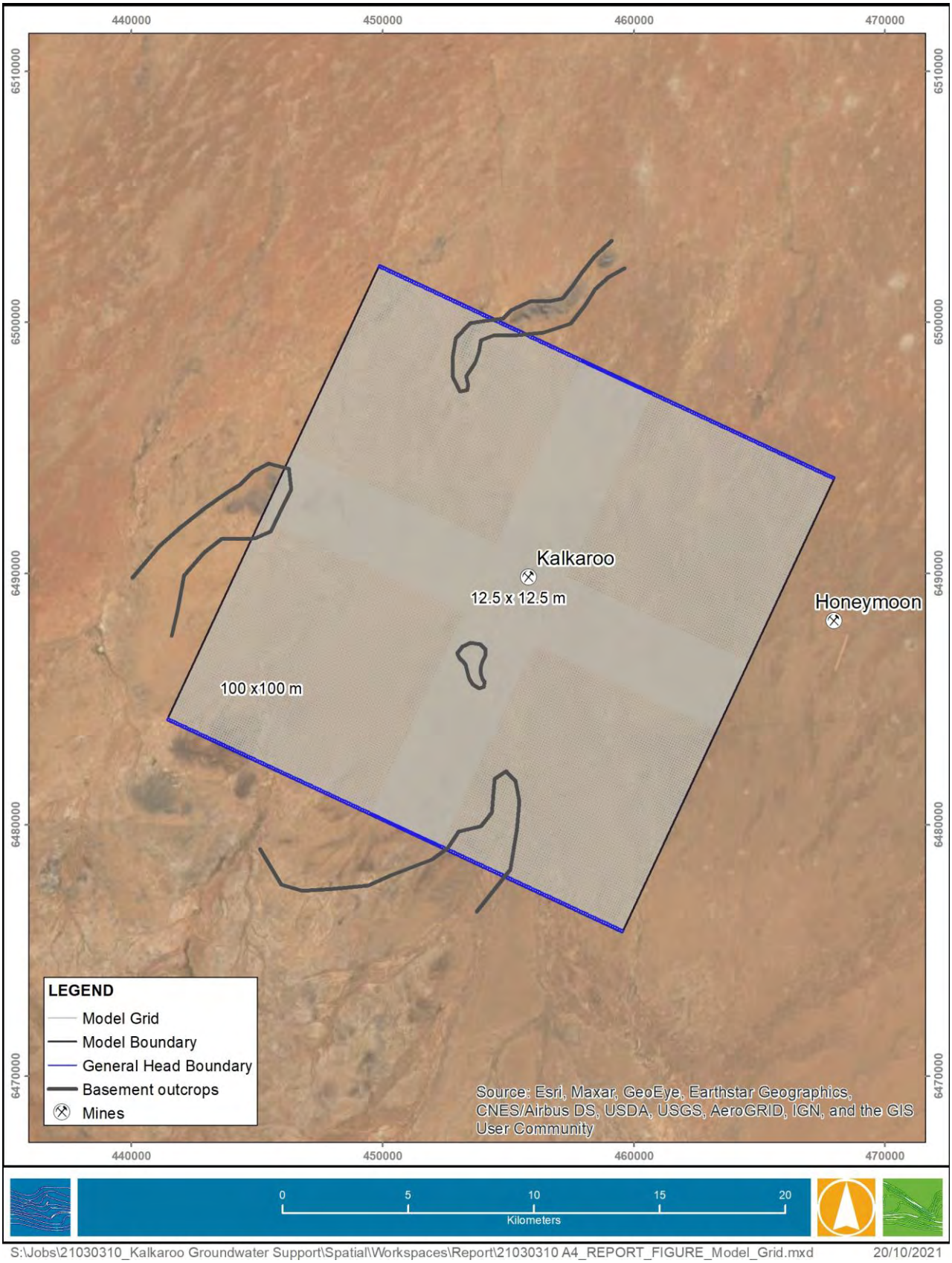

Figure 10-1 Model Extent, Grid and Boundary Cells

10.2.2 Model Layers

10.2.2.1 Layer 1 Saprolite

The water table has been identified as being within the saprolite layer in and around the mine site and is also inferred to be within the saprolite at distance from the mine (Figure 4-4 and Figure 4-5). North and east of the pit, the water table is interpreted to transition into the overlying Namba Formation. The Namba Formation is interpreted to be of low permeability similar to the Saprolite unit and is effectively incorporated into layer 1 for the purposes of modelling (i.e. both units are essentially low permeability and clay rich). This approximation is considered reasonable given the likelihood of small drawdowns being experienced beyond the transition zone and the relative unimportance of whether these drawdowns are assigned to the Namba Formation or to the saprolite.

Several areas of basement outcrop have been identified in the model domain and are shown on Figure 10-1. These have been incorporated into the model by assigning these zones with the basement (layer 2) hydraulic parameters (Figure 10-1). The layer is assigned as Type 1 unconfined and assigned hydraulic parameters are shown in Table 10-2. The base of layer 1 (saprolite) was derived from site and regional data provided by Kalkaroo Copper using the Field Interpolater program in PMWIM. The resulting layer surface is shown on Figure 10-2.

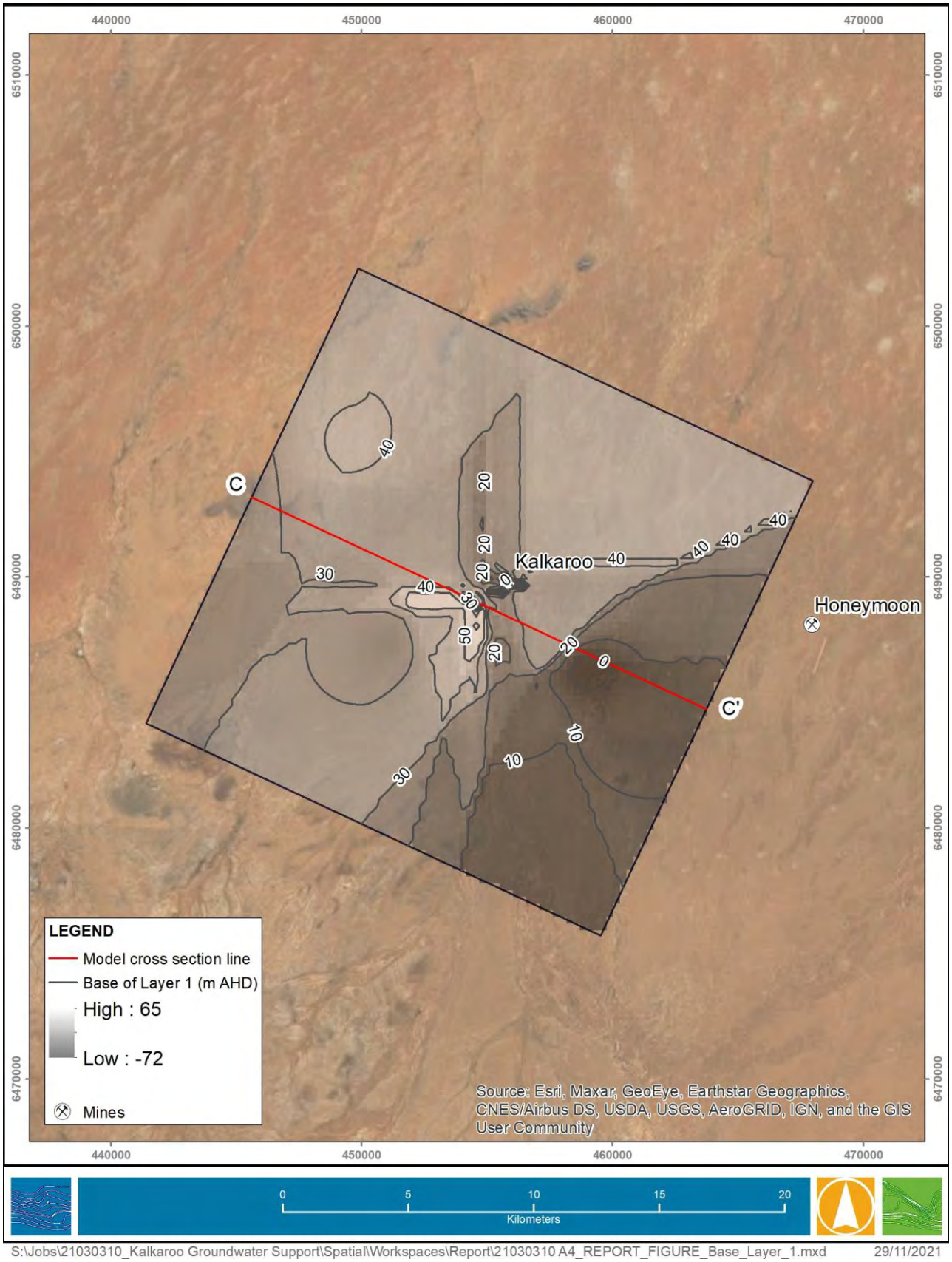

Figure 10-2 Interpolated Base of Saprolite (Layer 1)

10.2.2.2 Layer 2 Saprock and Basement

The transitional saprock horizon has not been hydraulically differentiated from the underlying fresh basement and these units form model layer 2. The layer is assigned as Type 3 confined/unconfined and assigned hydraulic parameters are shown in Table 10-2. The top of layer 2 was set equal to the base of layer 1 and a constant thickness of 100 m was adopted for layer 2. The resulting layer elevations are shown in the example model cross section shown in Figure 10-3 (refer to Figure 10-2 for cross section line).

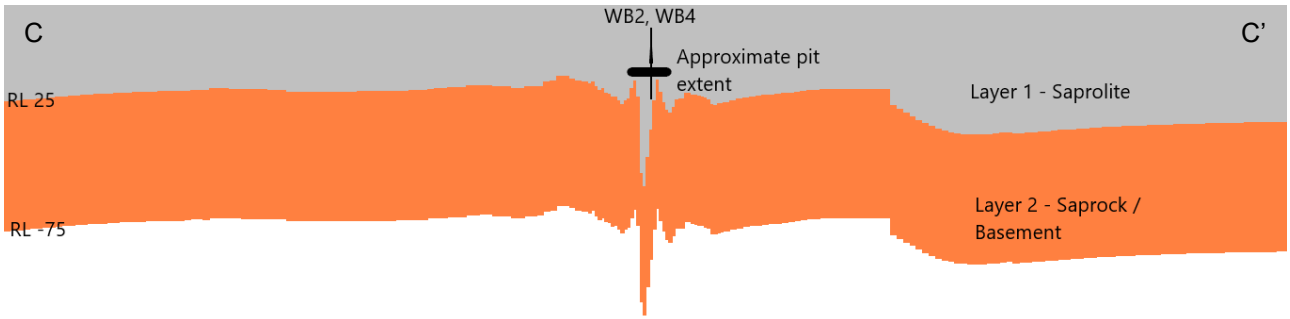

Figure 10-3 Model Layer Cross Section C-C' (refer to Figure 10-2 for location)

The following geological zones have been identified by the geological exploration and hydrogeological investigations at the site. The zones were first identified by Kalkaroo Copper through interpretation of over 500 exploration drillholes, with the water wells being later positioned to test the identified geological zones. The characteristics of the zones are summarised below:

- Kalkaroo west shear – assigned a hydraulic conductivity in model layer 2 of 22 m/d based on the WB2 and WB6a aquifer test results. An upper estimate for specific yield of 30% was assigned (Hazel, 2009).
- Subsidiary shear at west Kalkaroo – assigned a hydraulic conductivity in model layer 2 of 0.3 m/d and an estimate for specific yield of 5% was assigned.
- Western limb shear – no aquifer tests were located in this structure but discussions with Kalkaroo Copper indicate it is of a similar nature to the central shear zone intersected by WB9 and a hydraulic conductivity of 9 m/d in model layer 2 has been adopted based on this test. An estimate for specific yield of 20% was assigned.
- Central shear – three aquifer tests at WB9, WB10 and WB11 were carried out in this structure and the shear zone hydraulic properties in model layer 2 have been graded to reflect this, being 9 m/d, 3 m/d and 1 m/d, with estimated specific yield values of 20%, 15% and 10%, respectively.
- Mining sequence dome structure – based on the WB13 aquifer test a hydraulic conductivity value in model layer 2 of 3 m/d was adopted, and an estimated specific yield of 15% assigned. Discussions with Kalkaroo Copper indicate the fractured mining sequence can be modelled as a vertical fracture zone.

The above values of hydraulic conductivity and specific yield for the structural zones in model layer 2 (saprock/fresh basement) have been transferred to the overlying model layer 1 saprolite with a 50% reduction for the modelling base case. This estimated reduction in hydraulic parameters is qualitatively based on information from Kalkaroo Copper personnel that the structural zones within the saprolite do yield water, with the yield increasing with depth through the saprock/fresh basement. However, the increase has not been quantified. The extents of the structural zones are shown on Figure 4-7 and the model parameter zones reflecting these are shown on Figure 10-4 and Figure 10-5.

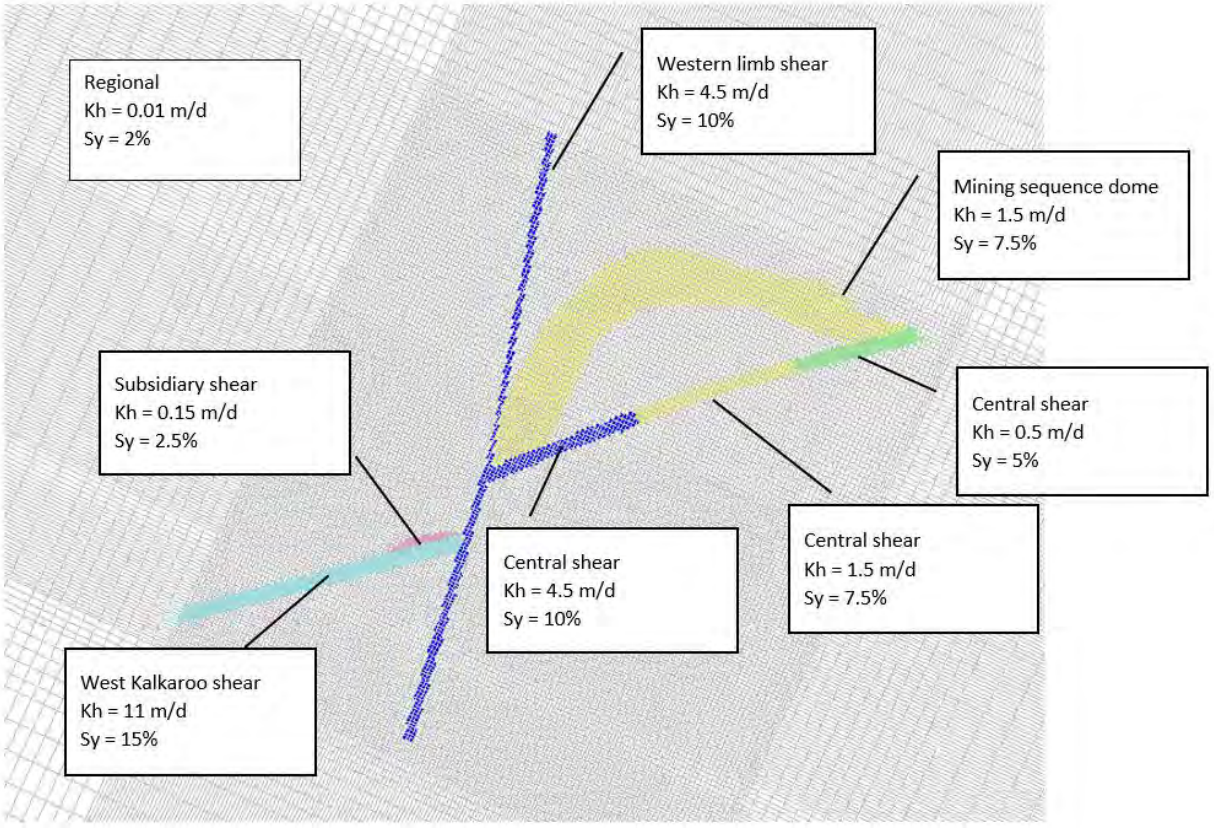

Figure 10-4 Layer 1 Parametrisation (Saprolite)

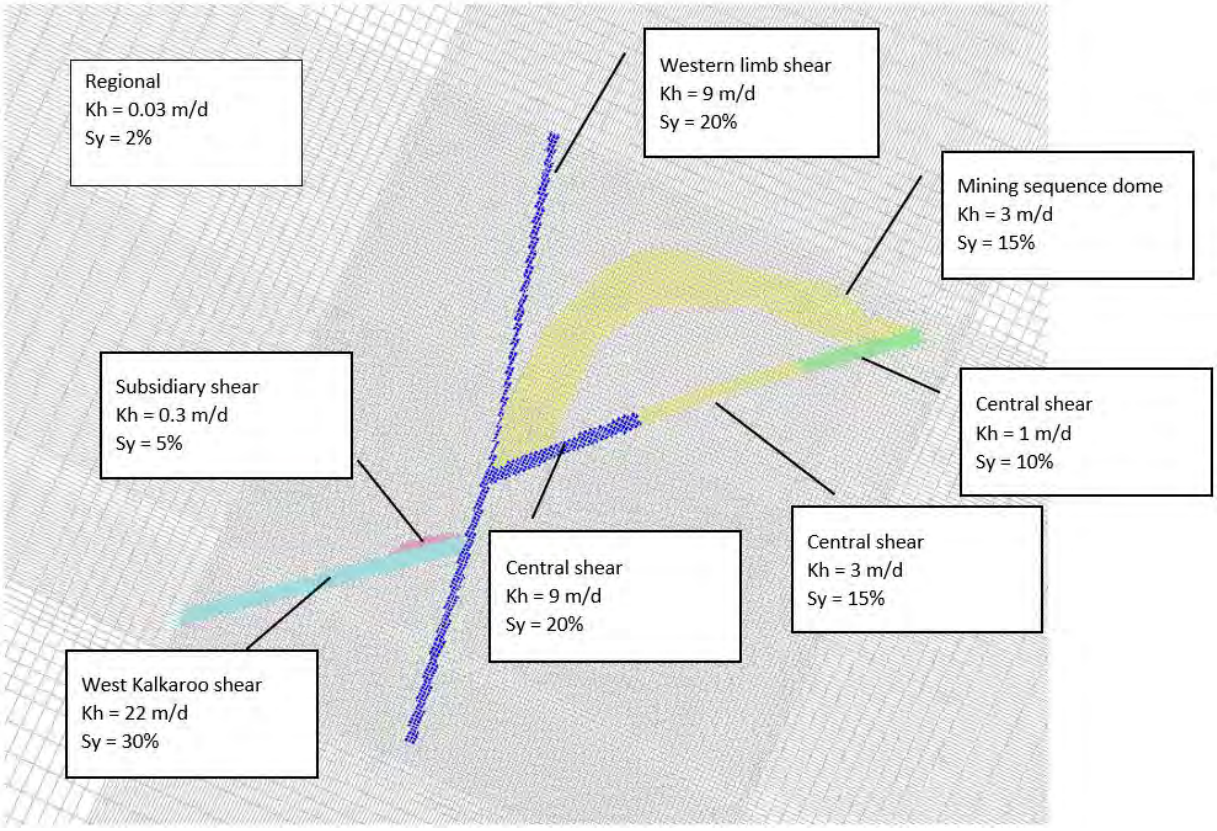

Figure 10-5 Layer 2 Parametrisation (Saprock/Fresh basement)

Table 10-2 Model Layer Parameterisation

Layer 1									Comment
Zone	Saprolite	Central shear through dome (WB9)	Central shear through dome (WB10)	Central shear east (WB11)	West Kalkaroo shear	West Kalkaroo subsidiary shear (WB8)	Western limb shear	Dome (mine sequence only)	Saprolite includes Namba Fm where NF becomes saturated at distance from the pit
Type	Unconfined								
Base	Interpolated from Kalkaroo Copper site and regional data								
Kh (m/d)	0.01	4.5	1.5	0.5	11	0.15	4.5	1.5	Saprolite average of 2 slug tests, shear zones 50% of fresh basement
Sy	2%	10%	7.5%	5%	15%	2.5%	10%	7.5%	50% of fresh basement
Storativity									

Layer 2									Comment
Zone	Saprock/ fresh baseme nt	Central shear through dome (WB9)	Central shear (WB10)	Central shear east (WB11)	West Kalkaroo shear	West Kalkaroo subsidiary shear (WB8)	Western limb shear	Dome (WB13, mine sequence only)	
Type	Confined / unconfined								Layer 2 set as confined/unconfined to allow for dewatering due to extraction from production wells
Base	Set at 100m below Kalkaroo Copper data for base of saprolite (layer 1)								Constructed a constant thickness layer 2 otherwise very thin underneath pit
Kh	0.03	9	3	1	22	0.3	9	3	Based on re-analysis of Aldam (2009) data
Sy	2%	20%	15%	10%	30%	5%	20%	15%	
Storativity		$1x10^{-3}$	$6x10^{-6}$		$2.6x10^{-4}$	$8x10^{-3}$		$2.9x10^{-4}$	Shear zones aquifer test results
Specific storage (/m)		$1x10^{-5}$	$5x10^{-7}$		$2x10^{-5}$	$1x10^{-4}$		$4x10^{-6}$	Storativity / aquifer thickness tested, average of $3x10^{-5}$ adopted

10.2.3 Model Boundary Conditions

General Head Boundary (GHB) cells were assigned to the upgradient (south-western) and downgradient (north-eastern) edges of the model domain to establish and maintain the groundwater flow field across the model domain (Figure 10-1). GHB head values and distances were obtained from the regional groundwater contour map (Figure 5-2) and conductance values were estimated based on these and the estimated saturated layer thicknesses along the boundary edges. Parameters associated with the GHBs are summarised in Table 10-3. No boundary conditions were assigned to the north-western and south-eastern edges of the model domain as these are approximately parallel to the interpreted groundwater flow direction.

Table 10-3 Model GHB Parameters

	Layer 1		Layer 2	
GHB parameter	Upstream	Downstream	Upstream	Downstream
GHB head (m AHD)	92	60	92	60
GHB length (km)	1	1	1	1
Conductance (m^2/d)[1]	0.07	0.03	0.3	0.3

Notes: 1. C value for a 100 m wide model cell, C values for smaller cell widths are proportional relative to 100 m.

10.2.4 Model Stages and Time Discretisation

The groundwater modelling was carried out in 3 separate model stages as follows:

- A steady-state model to generate initial starting heads and test the sensitivity of model calibration to the adopted model hydraulic parameters.
- A transient model to simulate the drawdown effects of the proposed pit expansion over time and the extraction of mine groundwater requirements sourced from pit dewatering in layer 1 and production wells outside the pit in layer 2 if required.
- A transient model to simulate the recovery levels in the pit and regionally within the saprolite and saprock/basement layers post-closure and to test the potential travel paths of seepage from the TSF.

The time discretisation of the models is shown in Table 10-4.

Table 10-4 Model Time Discretisation

Model Period	Type	Stress Period	Length (days)	Time Steps	Comment
Current	Steady state	1	1	1	Used for calibration and provides initial starting heads for transient modelling
Pre-production and initial pit excavation	Transient	1	182	6	Project water supply provided from wells in shear zones in layer 2 outside pit
Phase 2 pit excavated to RL 40	Transient	2	183	6	

Model Period	Type	Stress Period	Length (days)	Time Steps	Comment
Phase 2 and 3 pits excavated to RL 40 Pit deepened to RL 10	Transient	3	365	12	Phase 2 and 3 pit excavated to RL 40, project water supply provided by pit dewatering augmented with wells in layer 2, if required
		4	365	12	Pit deepened from RL 40 to RL 10, project water supply provided as above
		5	365	12	Pit at RL 10, project water supply provided as above
		6	365	12	As above
Recovery	Transient	1	73,000 (200 years)	20	No further extraction from wells and pit, pit modelled as high K/Sy area with evaporative discharge from pit surface, recharge from TSF applied

10.3 Model Calibration

The steady-state model was used to generate current pre-mining groundwater heads and contours in layer 1 and 2 based on the interpreted hydrogeological conceptualisation described above, key elements of which included:

- No areal vertical recharge to the water table through the low permeability Quaternary and Namba Formation sediments.
- The steady-state flow field was generated using General Head Boundaries at the upstream model edge to reflect the assumed recharge to outcropping or shallow basement areas, and at the downstream model edges to provide the inferred groundwater flow direction.
- The inclusion of basement outcrop areas in layer 1 with layer 2 properties assigned.
- An assumed permeability contrast in the structural features from layer 1 to layer 2, assumed to increase by a factor of 2.
- Adopted hydraulic parameters are shown in Table 10-2.

The model calibration data set is shown in Table 10-8 and includes detailed site water level data and regional data obtained from WaterConnect records. The well locations within the model domain are shown on Figure 10-6.

Table 10-5 Calibration Groundwater Level Data Set (November 2021)

Water Well	GDA94 easting	GDA94 northing	RSWL (m AHD)
WB 2	454731	6488907	72.79
WB 3	454323	6488379	74.98
WB 4	454725	6488920	72.41
WB 5	454302	6489223	71.85
WB 6A	454291	6488777	72.64
WB 7	454833	6488600	74.06
WB 8	454709	6488956	72.55
WB 9	455112	6489244	71.90
WB 10	455764	6489492	71.81
WB 11	456347	6489657	71.64
WB 13	455362	6489871	71.76
WB 14	455368	6489862	71.71
6934-36	451193	6500380	66.95
7034-6	453980	6478580	93.60
7034-8	460541.2459	6478606.105	80.35
7034-51	455123	6479580	99.54
7034-1103	459126	6484234	75.23

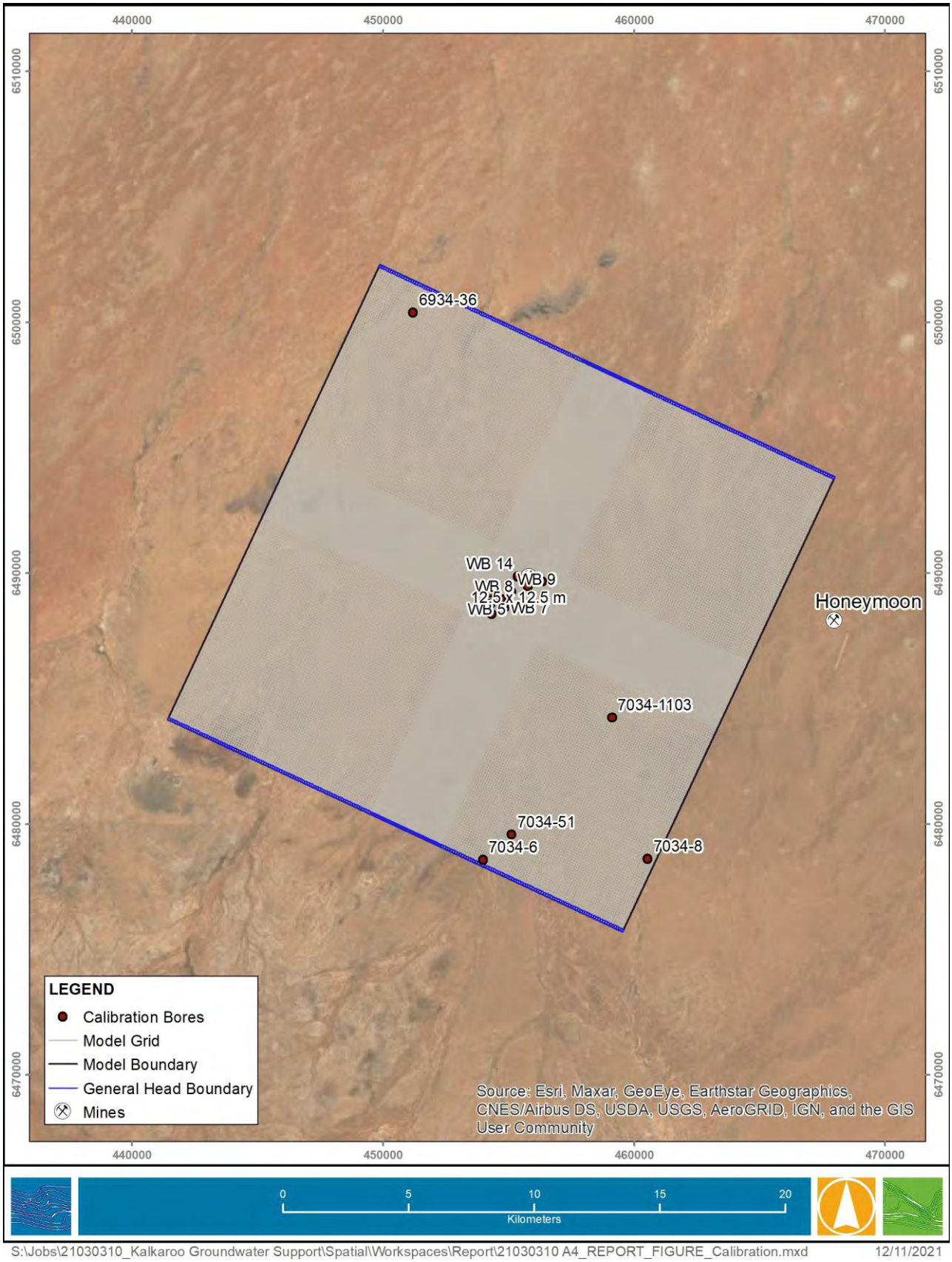

Figure 10-6 Calibration Set Well Locations

10.4 Model Sensitivity

A sensitivity analysis was undertaken for the steady-state pre-mining model results which comprised of increasing and decreasing the regional horizontal hydraulic conductivity values for layers 1 and 2 and increasing the hydraulic conductivity contrast in the structural zones between layer 1 and 2. The results of the sensitivity runs are summarised below in Table 10-6 in terms of the required criteria for the adopted PCG MODFLOW solver for the model to achieve convergence, the model mass balance discrepancy and the statistical analysis of the modelled versus observed groundwater level data.

Additional sensitivity runs were done to test the sensitivity of the calibration to the Kh/Kv ratios in both layers 1 and 2. The results are summarised in Table 10-7 below.

Table 10-6 Steady State Model Sensitivity Results

Model run	Layer 1 Kh	Layer 2 Kh	Required PCG head change criteria (m)	Required PCG mass balance residual criteria (m^3/d)	Mass balance discrepancy (%)	Variance
Base case	**0.01**	**0.03**	**0.001**	**0.01**	**-0.22**	**22.2**
High regional k case	0.1	0.3	0.001	0.01	-0.05	31.2
Low regional k case	0.001	0.003	0.001	0.01	1.35	22.2
K1 = 0.25xK2 in structural zones	0.01	0.03	0.001	0.01	-0.23	22.2

Table 10-7 Kh/Kv Sensitivity Runs

Model run	Required PCG2 head change criteria (m)	Required PCG2 mass balance residual criteria (m3/d)	Mass balance discrepancy (%)	Variance
Kh/Kv = 1	0.001	0.01	-0.23	22.0
Kh/Kv = 10	0.001	0.01	-0.21	22.1
Base case (Kh/Kv = 100)	**0.001**	**0.01**	**-0.22**	**22.2**
Kh/Kv = 1,000	0.001	0.01	-0.24	22.2

The model sensitivity results indicate that:

- All cases converged with the same head and mass balance closure criteria.
- The mass balance discrepancies for the base case were lower than for the high and low regional hydraulic conductivity cases.
- Increasing the structural zones Kh contrast achieved similar results to the base case.
- The steady state model is relatively insensitive to the choice of layer Kh/Kv with similar mass balances and head variance produced for all cases.

When considering the results of the aquifer testing undertaken at the site the results presented above support the adoption of the base case parameter values for the transient modelling. Details of the base case calibration data and statistical analysis are shown in Table 10-8 below, with a graph of modelled versus measured groundwater levels shown on Figure 10-7.

A statistical analysis was undertaken for the modelled and observed head data for the adopted base case with the results provided in Table 10-9. The groundwater contours derived from the base case steady state model runs for layers 1 and 2 are presented on Figure 10-8 and Figure 10-9, respectively.

Table 10-8 Calibration Data and Analysis

Well ID	Observed Head (November 2021)	Difference (m)	Absolute error (m)	Error^2
WB2	72.79	-3.24	3.24	10.48
WB3	74.98	-1.65	1.65	2.71
WB4	72.41	-3.62	3.62	13.12
WB5	71.85	-4.13	4.13	17.07
WB6A	72.64	-3.41	3.41	11.65
WB7	74.06	-2.05	2.05	4.19
WB8	72.55	-3.48	3.48	12.09
WB9	71.90	-3.97	3.97	15.78
WB10	71.81	-4.02	4.02	16.16
WB11	71.64	-4.09	4.09	16.70
WB13	71.76	-4.03	4.03	16.26
WB14	71.71	-4.08	4.08	16.68
6934-36	66.95	3.71	3.71	13.78
7034-6	93.60	3.44	3.44	11.84
7034-8	79.48	-7.04	7.04	49.54
7034-51	99.54	11.04	11.04	121.77
7034-1103	75.23	-4.99	4.99	24.86

Table 10-9 Statistical Analysis of Modelled and Observed Groundwater Levels

Parameter	Value	Kh/Kv = 100
Variance	Mean squared error	22.20
RMS	Root mean squared error	4.71
SRMS	Scaled root mean square error	14.5%
No. of data	Number	17
MSR	Mean sum of residuals	4.25
SMSR	Scaled mean sum of residuals	13.1%

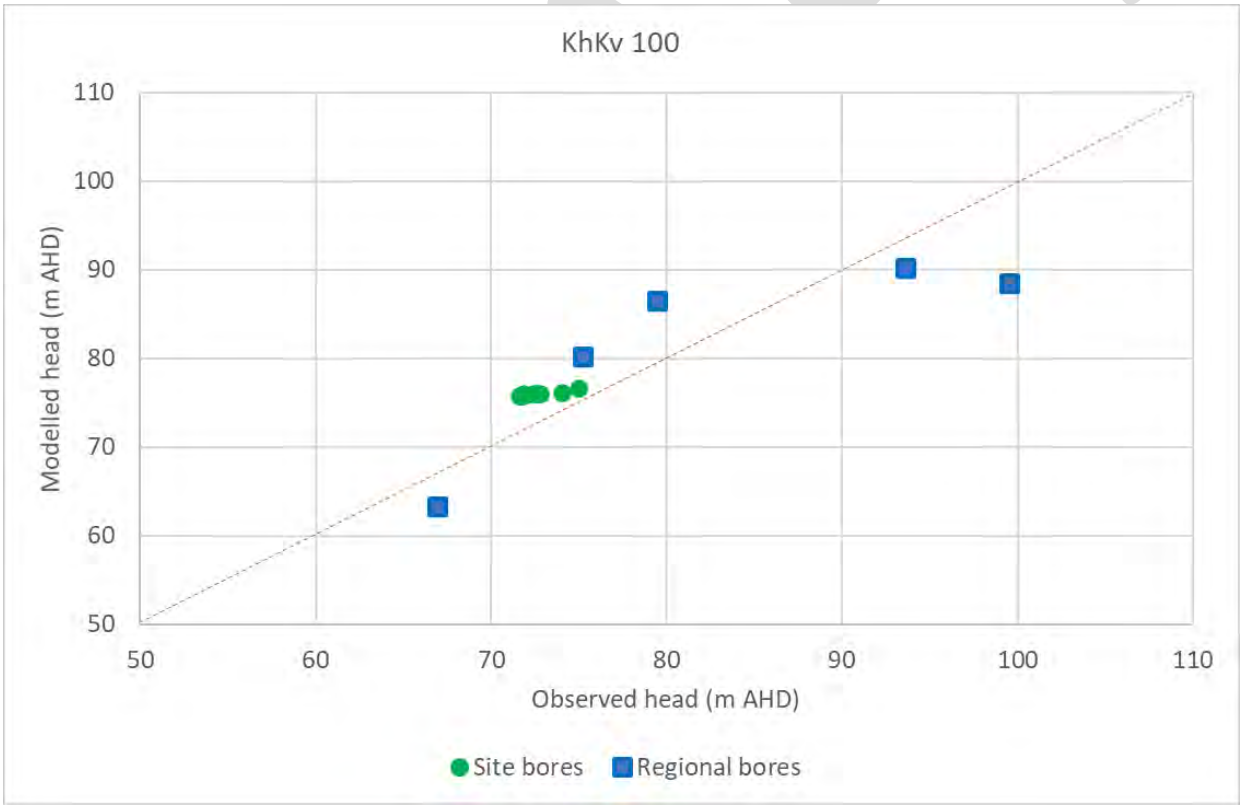

Figure 10-7 Modelled vs Measured Steady State Groundwater Levels

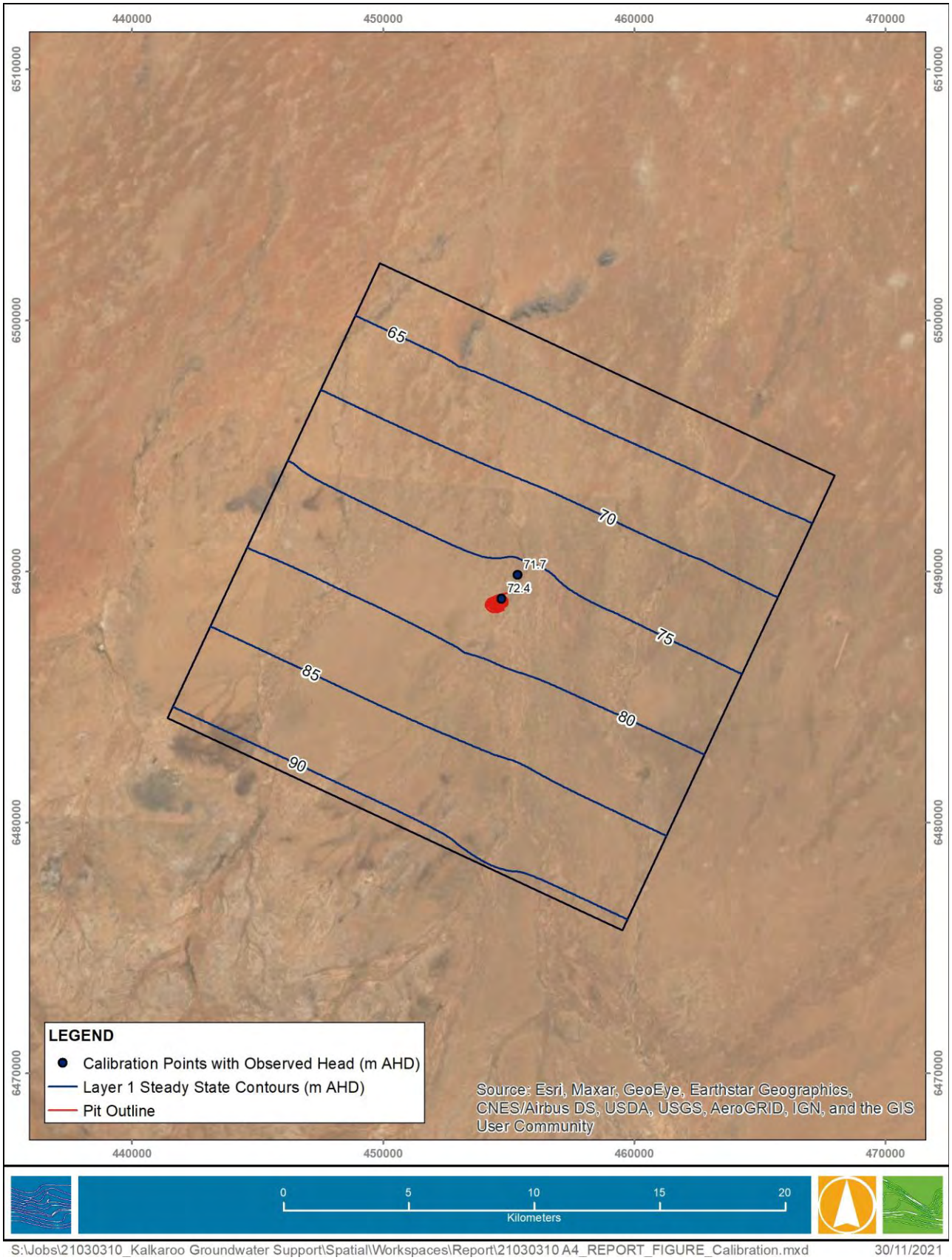

Figure 10-8 Modelled Layer 1 Steady State Groundwater Contours

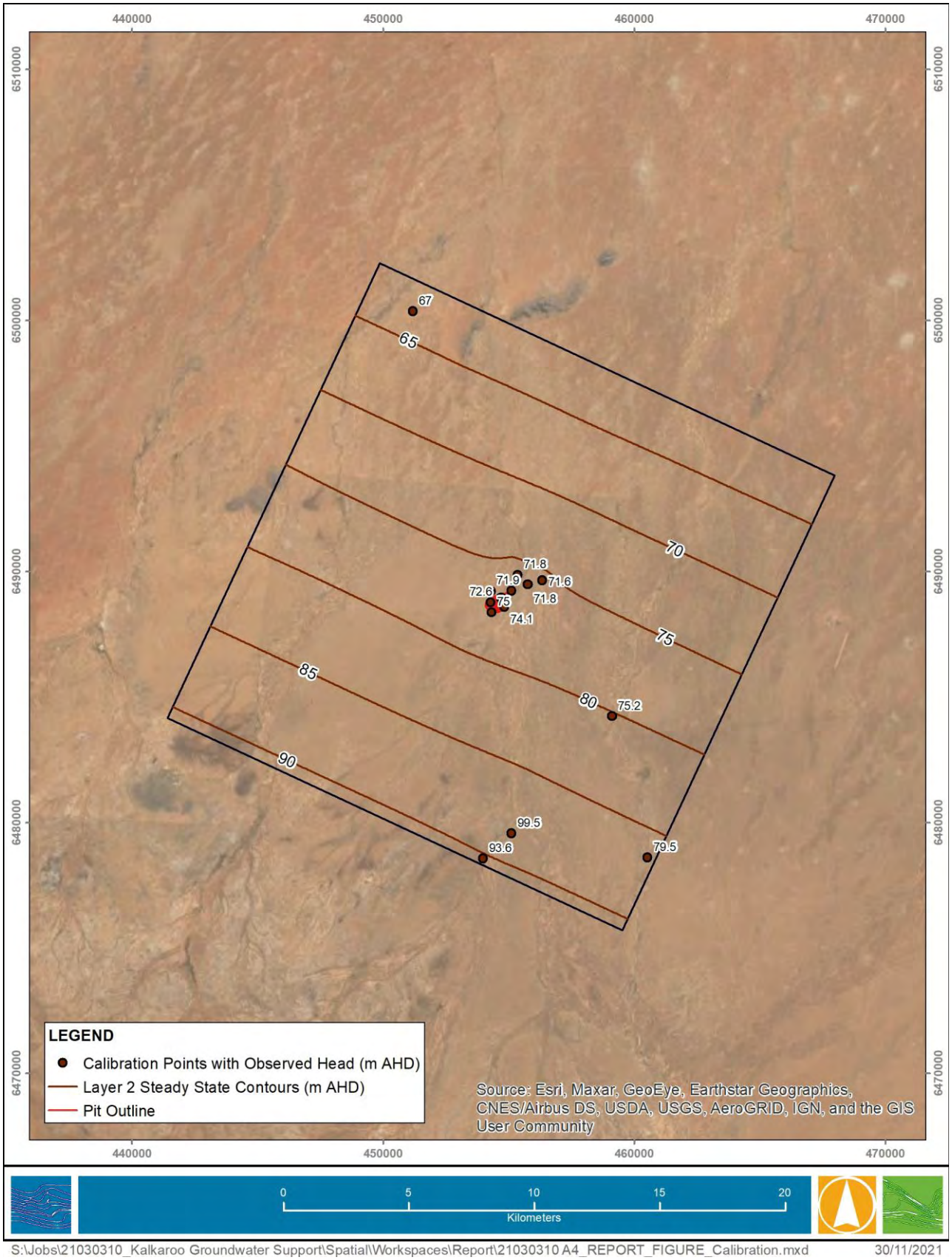

Figure 10-9 Modelled Layer 2 Steady State Groundwater Contours

10.5 Predictive Modelling

10.5.1 Pit Excavation and Ore Processing

The groundwater supply schedule shown in Table 10-10 was developed from the planned pre-production, pit excavation and ore processing timeframes. Inputs to the groundwater model assume that the project water requirements above pit dewatering estimates are sourced from wells within the shear zones outside the pit in model layer 2.

During the pre-production and initial pit excavation stage while the base of the pit is above the water table, the water demand of 1,728 m^3/d is sourced from three wells located around the pit (quarters 1 and 2). During quarters 3 to 4, the pit is excavated below the water table to 40 m AHD. The rate of advancement during this period leads to a predicted in-pit dewatering rate of 2,644 m^3/d to be managed via in-pit sump pumping. The advancement of the pit during quarters 3 to 4 results in an excess of 916 m^3/d above the required water demand. During this time, Kalkaroo Copper propose to manage excess water through evaporation within dedicated purpose-built evaporation basins. From quarters 5 through to 20 the pit advancement rate is reduced and predicted in-pit groundwater seepage is below the project water demand. During this period, make-up water is sourced from four wells located around the pit at the rates presented in Table 10-10.

Groundwater extraction from the pit and wells surrounding the pit causes drawdown in model layers 1 and 2. Groundwater elevation contours and drawdown extents after the 5-year project length (end of quarter 20) are shown in Figure 10-12 to Figure 10-14 for model layers 1 and 2.

Well hydrographs from selected wells within the planned pit extent and in the Saprolite layer to the north are shown on Figure 10-10. The hydrograph for WB4 completed within the Saprolite layer (layer 1) within the pit closely reflects the pit advancement schedule presented in Figure 9-1. Well WB2 also located within the pit, but within the underlying fresh basement (layer 2) shows a more gradual decrease due to pit dewatering and supply of make-up water from external pit wells. Well WB2, 100 m north of the pit within the Saprolite layer is predicted to drawdown by up to 30 m. Model observation wells HM1 (Saprolite) and HM2 (Basement) located near the eastern edge of the model adjacent the Honeymoon mine show no drawdown at this location. An assessment of drawdown impacts on existing groundwater receptors is provided in Section 11.3.

Water budget graphs and solver convergence criteria for the predictive modelling scenarios are provided in Appendix B.

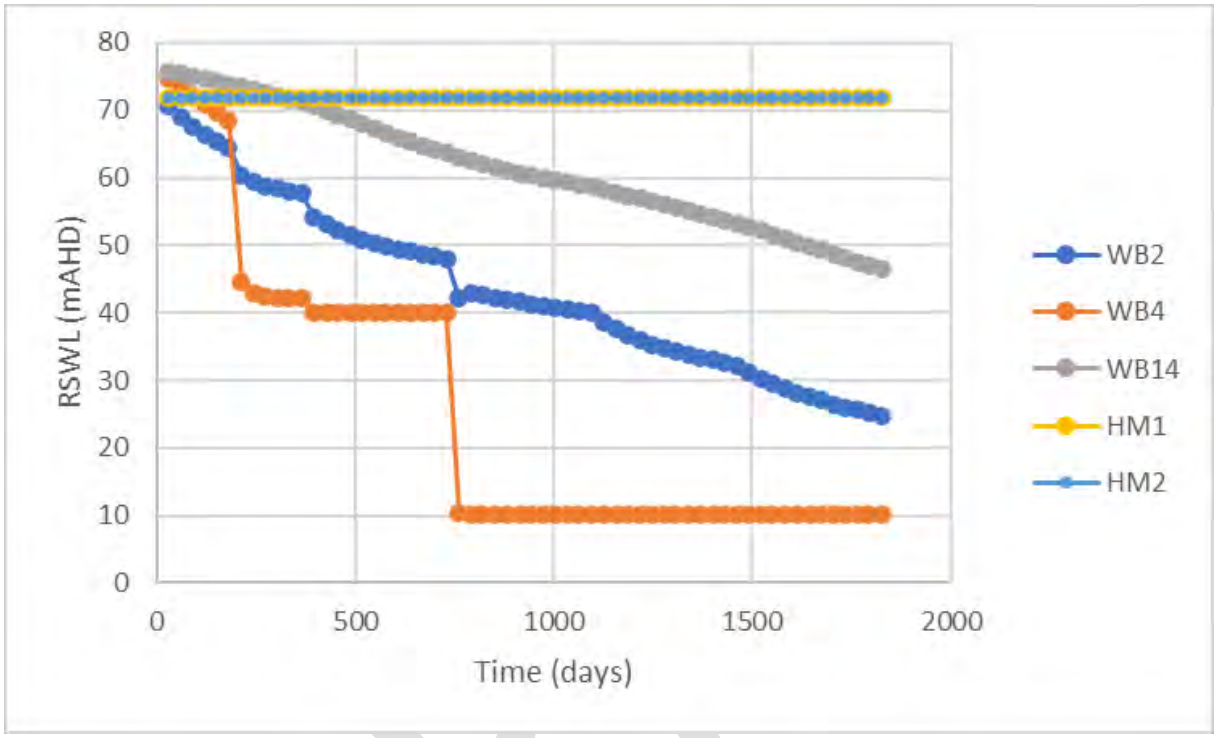

Figure 10-10 Selected Well Hydrographs

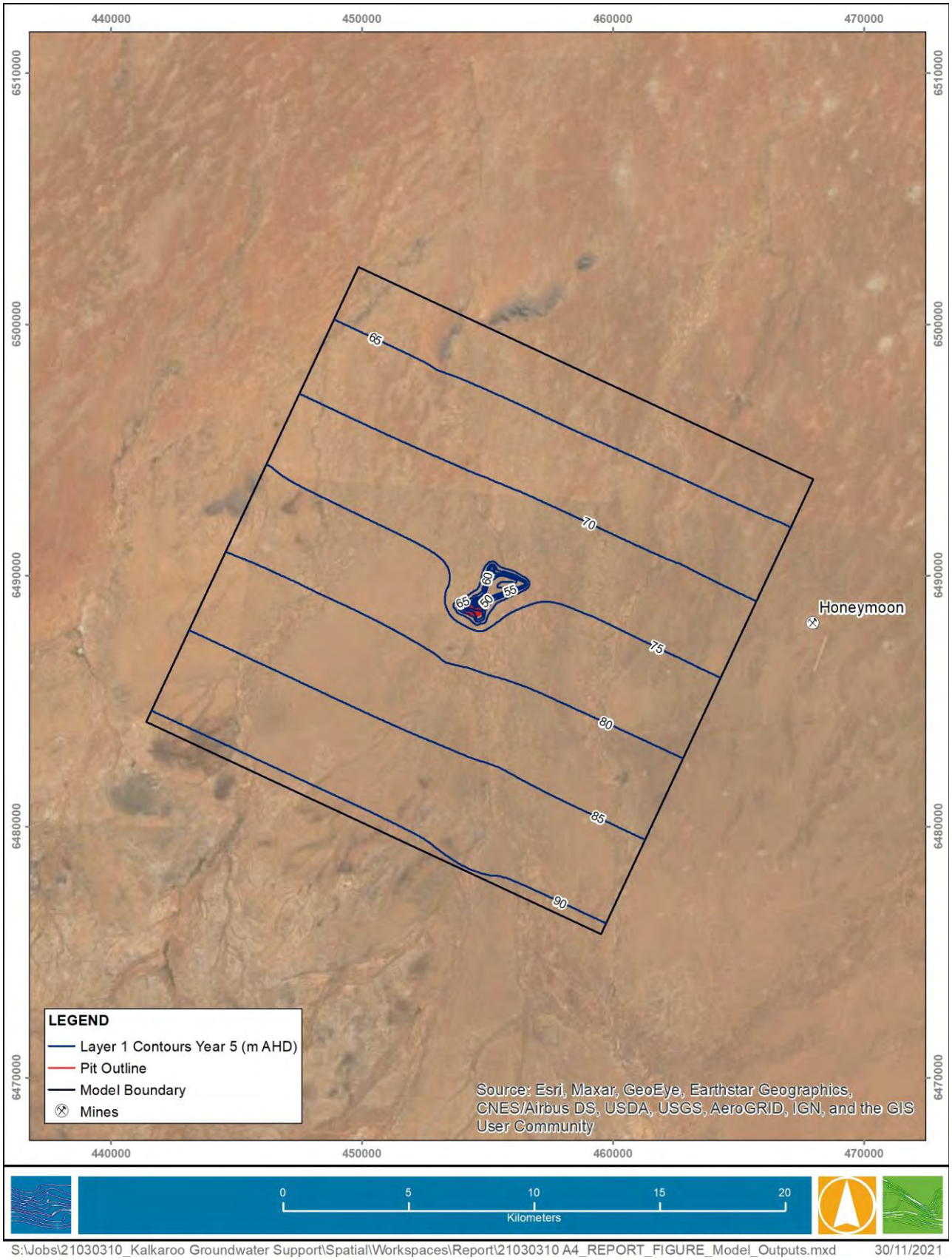

Figure 10-11 Modelled Groundwater Elevations in Layer 1 after 5 Years

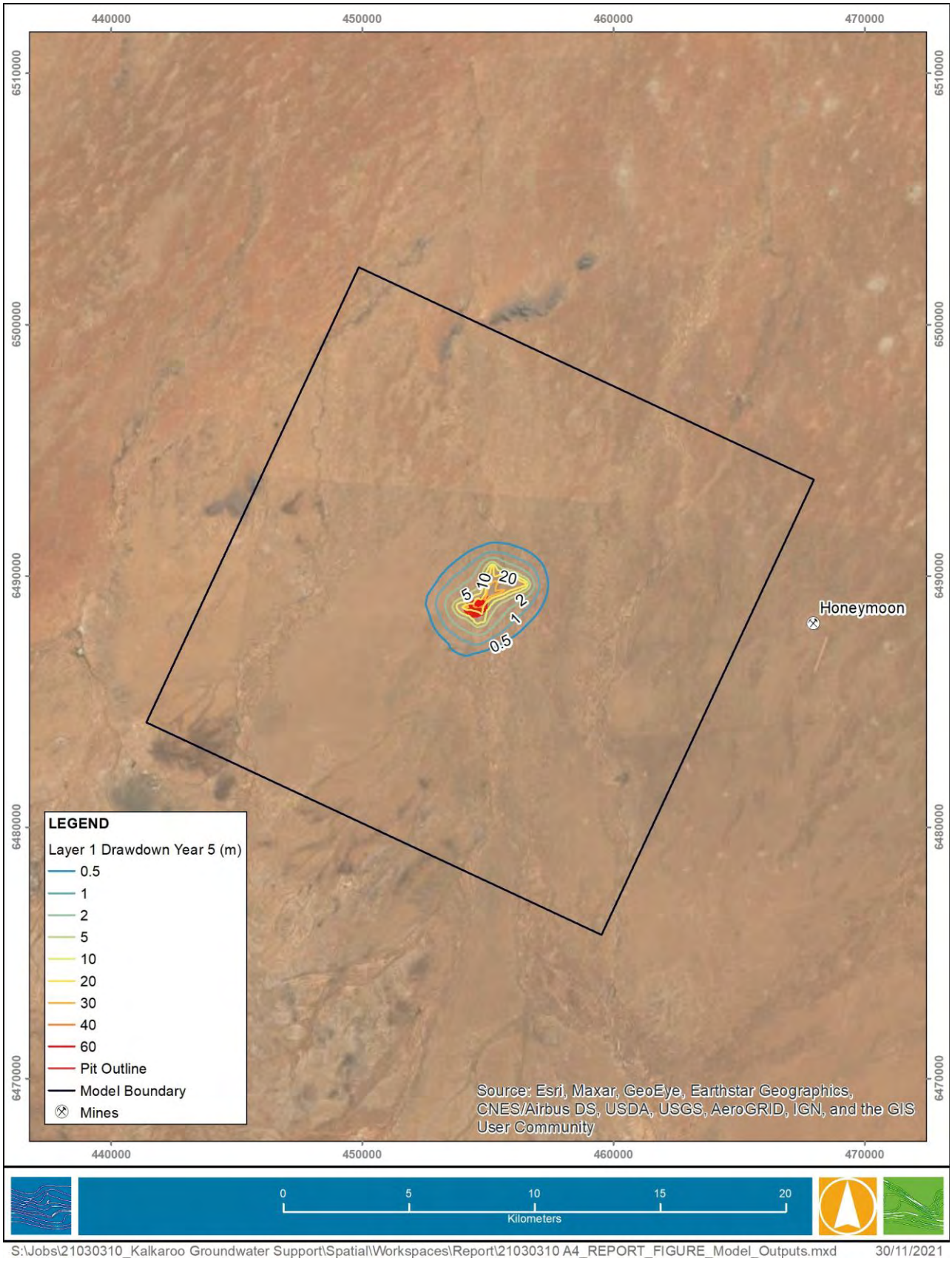

Figure 10-12 Modelled Drawdown in Layer 1 after 5 Years

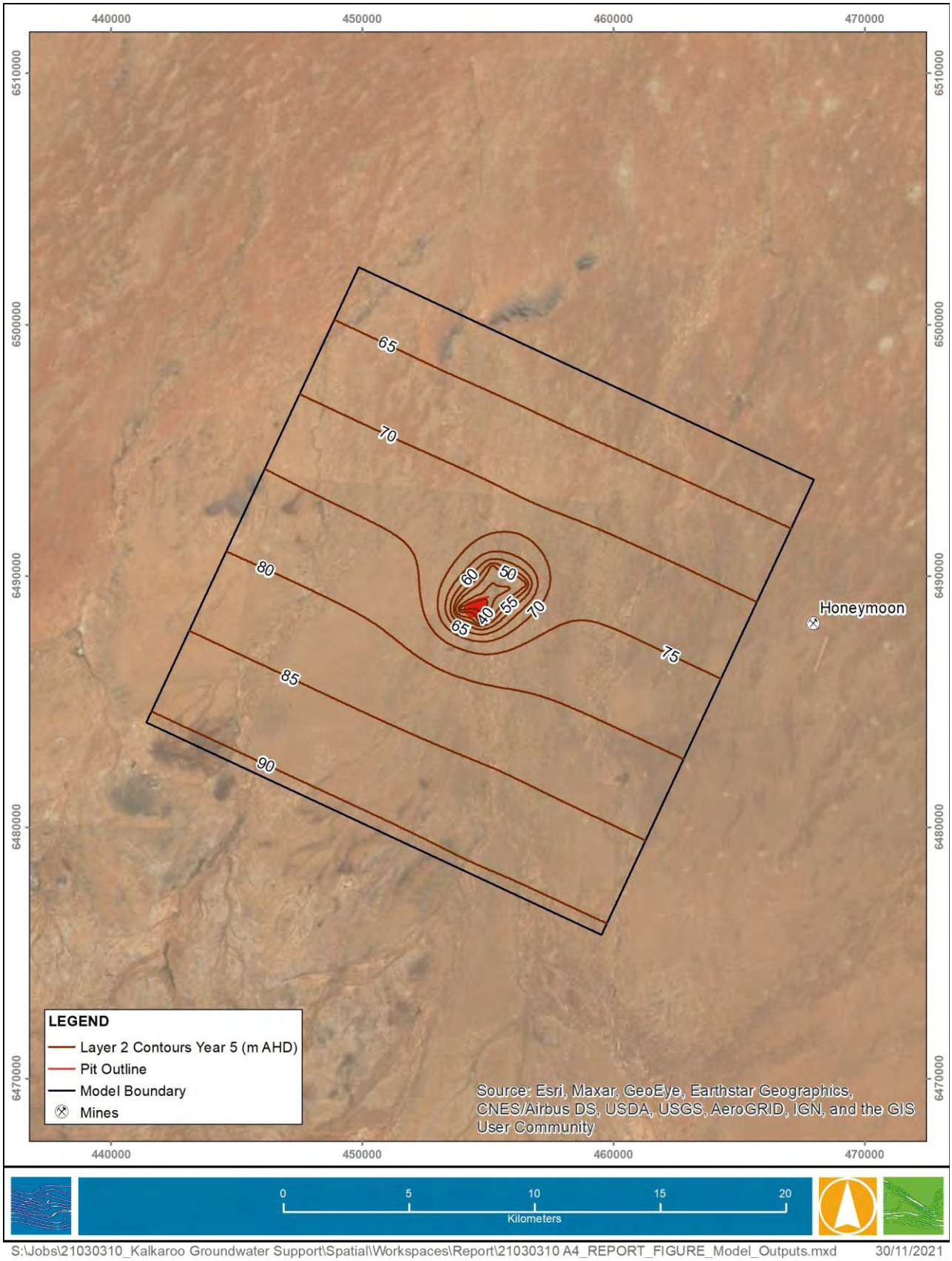

Figure 10-13 Modelled Groundwater Elevations in Layer 2 after 5 Years

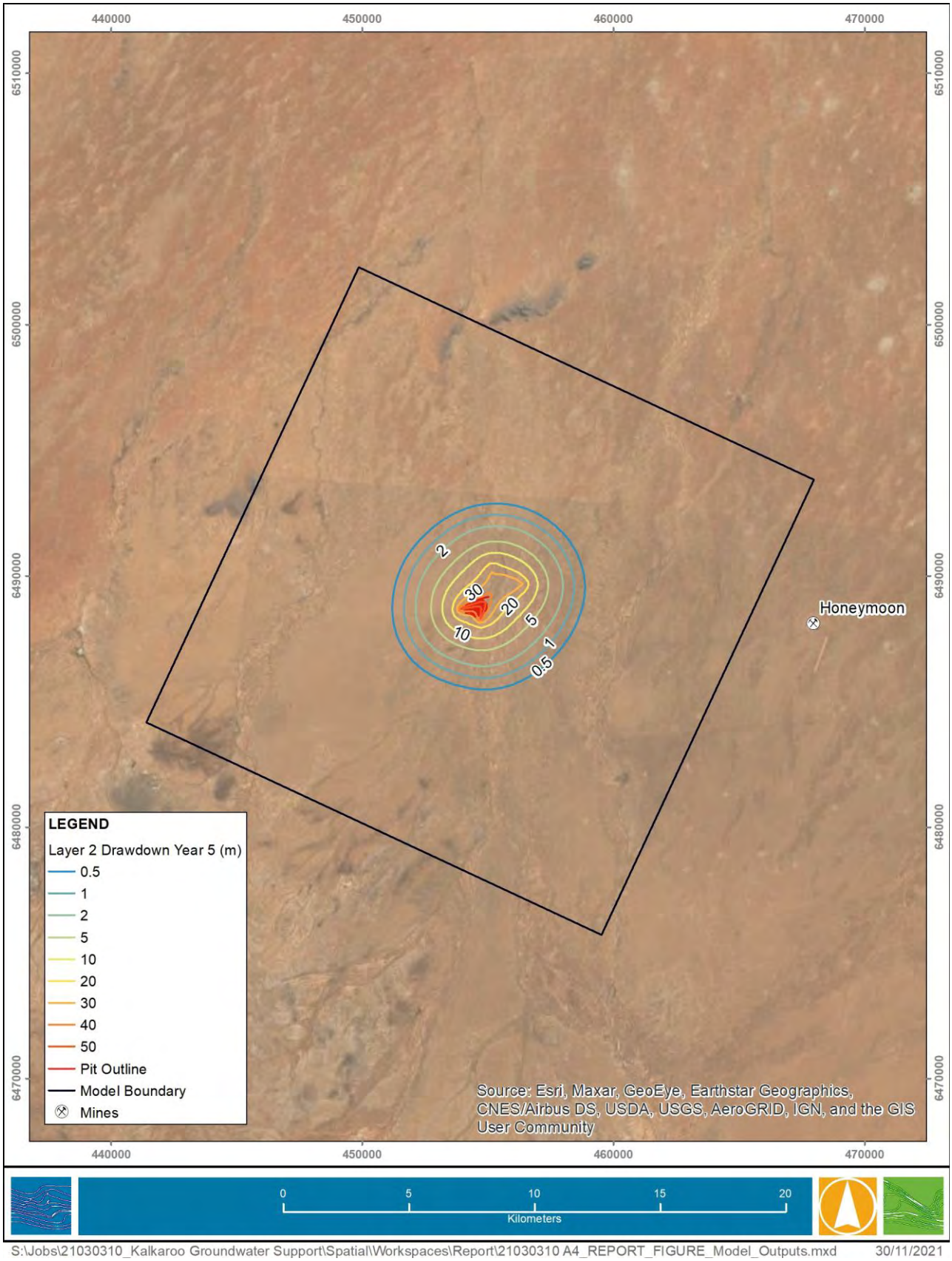

Figure 10-14 Modelled Drawdown in Layer 2 after 5 Years

Table 10-10 Mine Development and Groundwater Supply Schedule

Year	Quarter	Stage	Groundwater Requirement (m3/d)	Average Model Dewatering Rate (m3/d)	Balance from Wells Outside Pit (m3/d)	Notes
1	1	Pre-production and initial pit excavation	1,728	0	1,728	3 wells around pit
	2					
	3		1,728	2,644	-916	Excess to evaporation
	4					
2	5	Production and processing	2,274	1,634	640	3 wells around pit and additional well near WB10 at 100 m3/d to overcome near pit interactions to meet supply
	6					
	7					
	8					
3	9		2,274	2,219	55	
	10					
	11					
	12					
4	13		2,274	1,417	857	
	14					
	15					
	16					
5	17		2,665	1,333	1,332	Well near WB10 increased to 200 m3/d to meet project requirements
	18					
	19					
	20					

10.5.2 Post-closure Recovery

10.5.2.1 Pit and Regional Groundwater Levels

A 200-year post-mining recovery period was modelled with 20 time steps and a time step multiplier of 1.2, with the following inputs:

- Pit modelled as a high K / high Sy zone (1,000 m/d / 1) in layer 1.
- A nett discharge from the pit of 0.002 m/d based on an average annual evaporation of 2,717 mm/a, rainfall of 207 mm/a and a pan evaporation factor of 60%. The effective rainfall area contributing to the pit was extended to include the local catchment area created by the flood bund.
- Starting groundwater heads for layers 1 and 2 were derived from the final heads of the 5-year pit dewatering and well supply model.

The resulting model groundwater heads are shown on Figure 10-15 and Figure 10-16, and the water level recovery curve for the pit, approximated by well WB-4 and selected observation points shown in Figure 10-17. The results show that:

- Groundwater recovery levels have stabilised in layers 1 and 2 within the 50-year recovery period.
- The pit level recovers to approximately RL 57 m AHD, approximately 19 m below the pre-mining level therefore creating an evaporative groundwater sink (indicated by observation well WB4). This is also displayed by the modelled recovery hydrograph for WB14 located 850 m northeast of the pit which shows that drawdown in layer 1 initially continues to expand during the recovery period, before stabilising at approximately 17 m below the pre-mining level.
- The recovery level in observation well WB2, located within the layer 1 pit footprint, recovers to 58 m AHD compared to a pre-mining level of 73 m AHD.

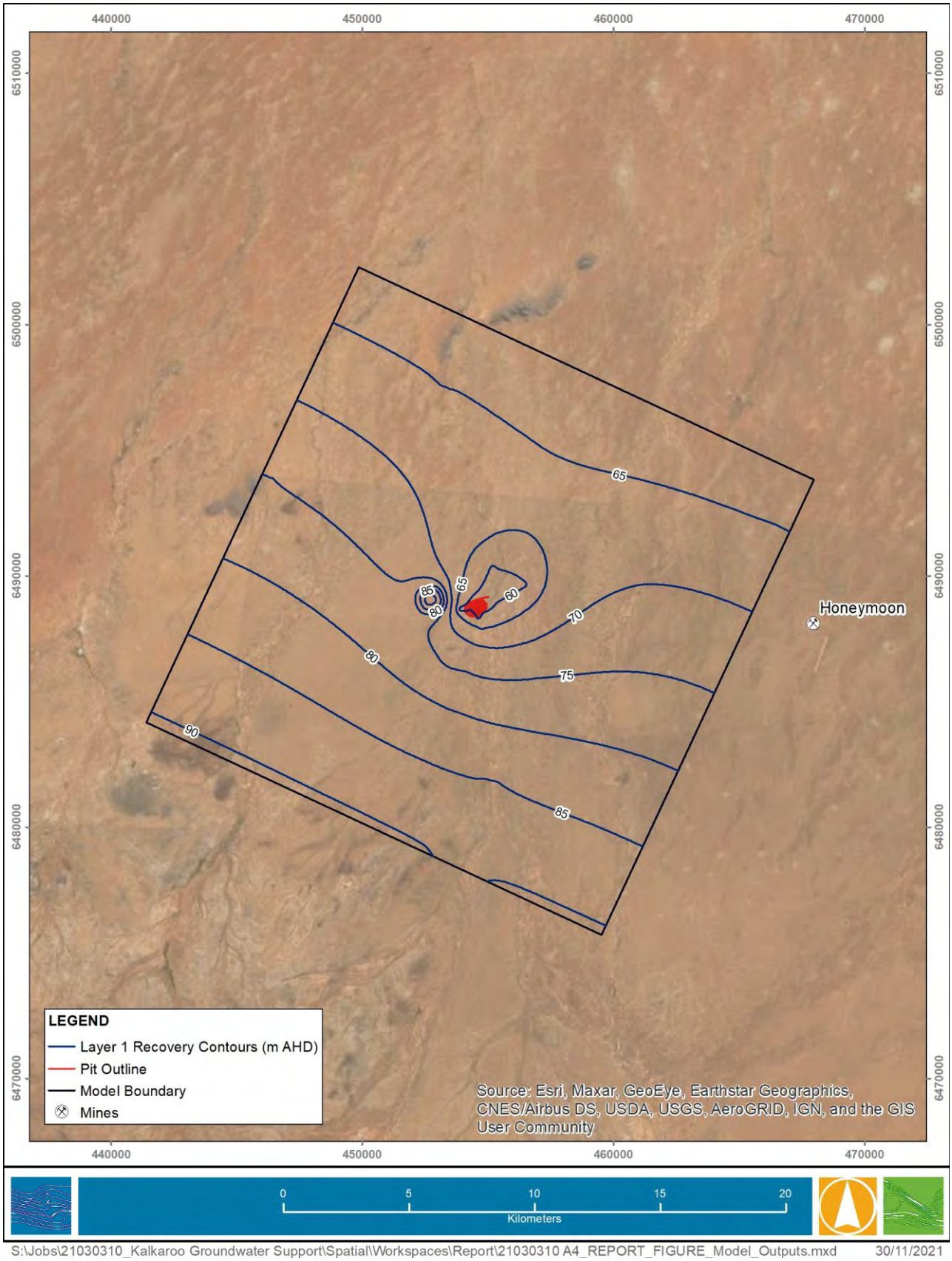

Figure 10-15 Modelled Groundwater Levels in Layer 1 after 50 Years

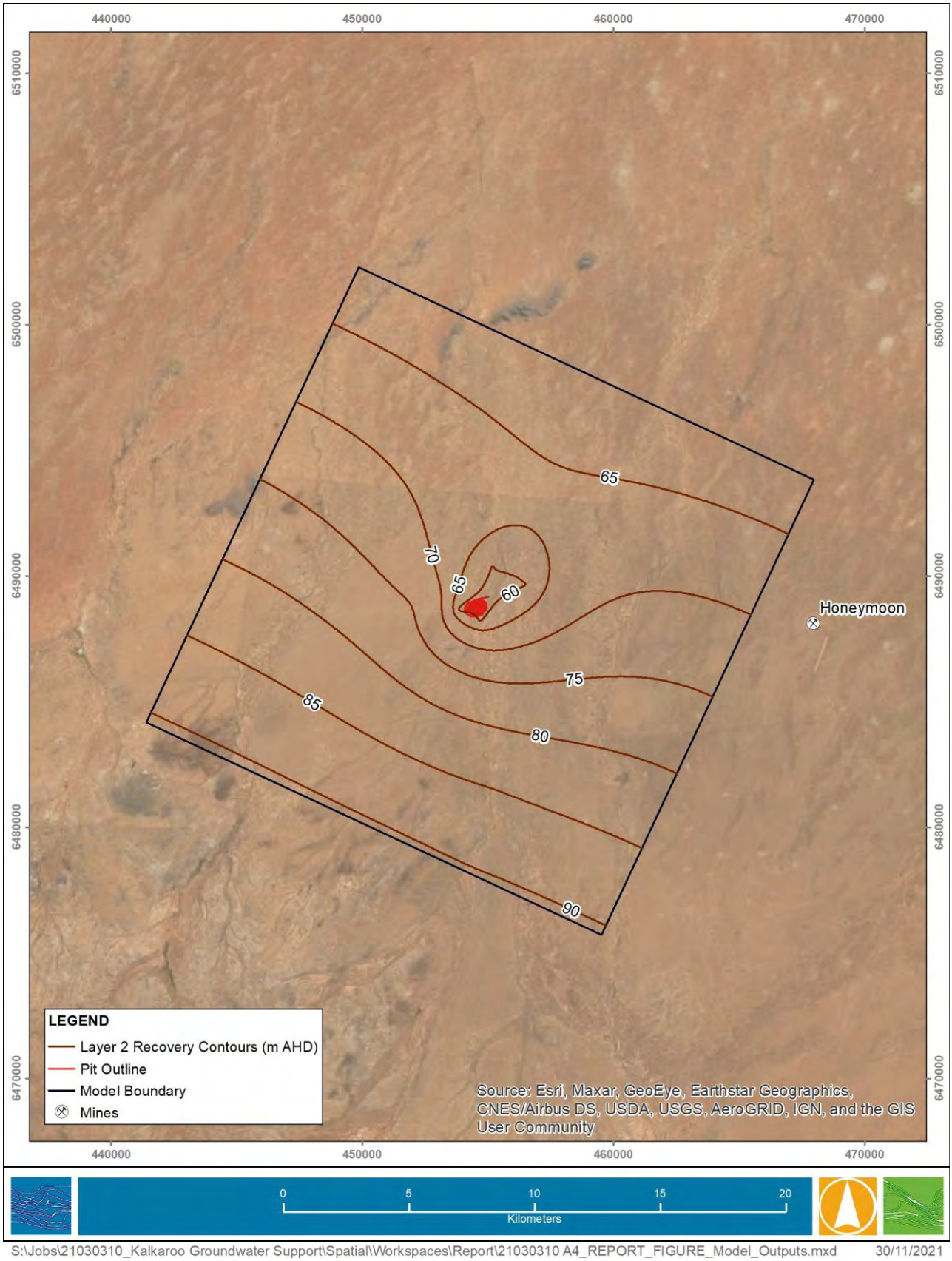

Figure 10-16 Modelled Groundwater Levels in Layer 2 after 50 Years

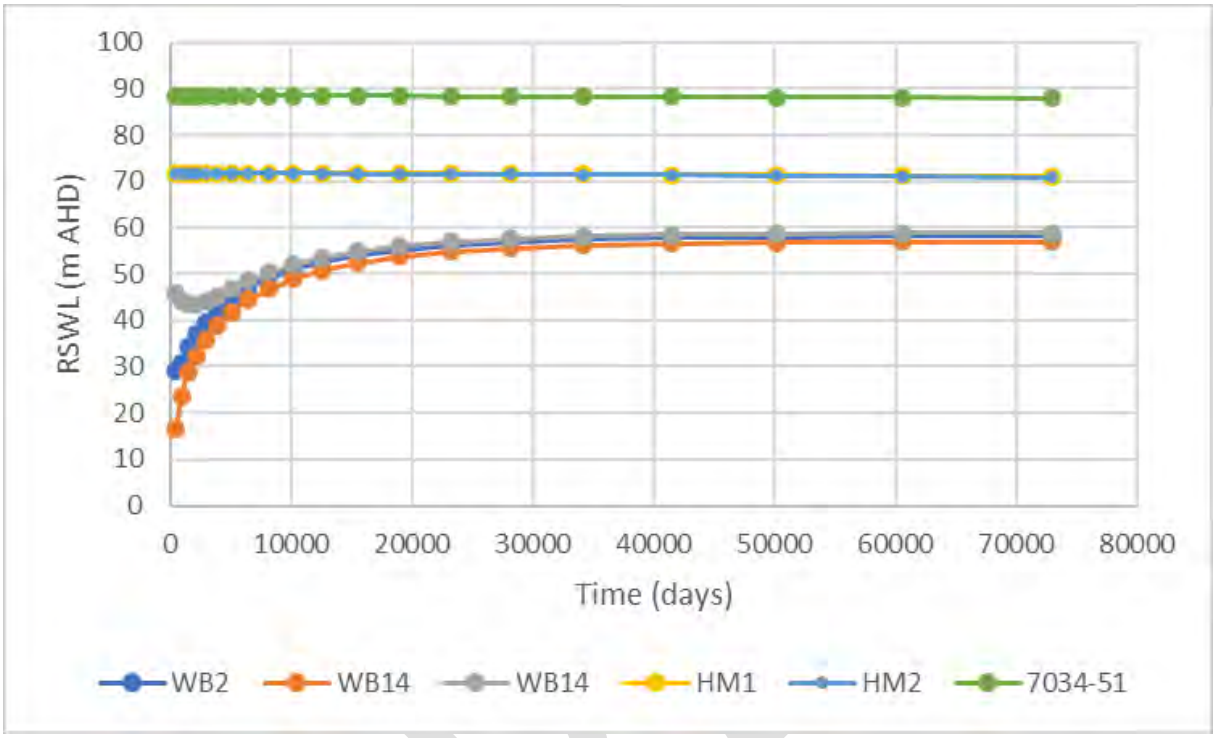

Figure 10-17 Modelled 50 Year Recovery Hydrographs

10.5.2.2 TSF Seepage

Modelling data provided by Kalkaroo Copper indicate that an estimated 56 m^3/d of seepage could occur through the floor of the TSF. This was modelled in the recovery phase by conservatively applying this recharge rate to layer 1 from the start of recovery. A recharge rate of 0.000091 m/d was applied over the TSF area to simulate the 56 m^3/d seepage supplied by Golder Associates (2021).

The advective transport model PMPATH was used to model the fate of seepage particles over a time period of 200 years. The particle tracking results are shown on Figure 10-18, which show that over the 200-year time frame:

- Seepage particles from the TSF travel radially away from the TSF due to the establishment of the recharge mound.
- For the base case travel distances over the 200 years are within 500 m from the edges of the TSF to the north and west. Particles from the east and south of the TSF are drawn towards the dewatered pit area and the high permeability Kalkaroo West shear zone and particle travel distances are modelled to be between 1 to 1.5 km. A conservative parameter case (high Kh in layer 1 of 0.02 m/d and layer 2 of 0.06 m/d, low effective porosity in layers 1 and 2 of 1%) was also run with similar patterns of response to the base case. Travel distances were increased to within 1 km from the edges of the TSF to the north and west. Particles from the east and south of the TSF confirm the influence of the dewatered pit area and the high permeability structural zones with particle travel distances modelled to be between 1.2 to 2 km.

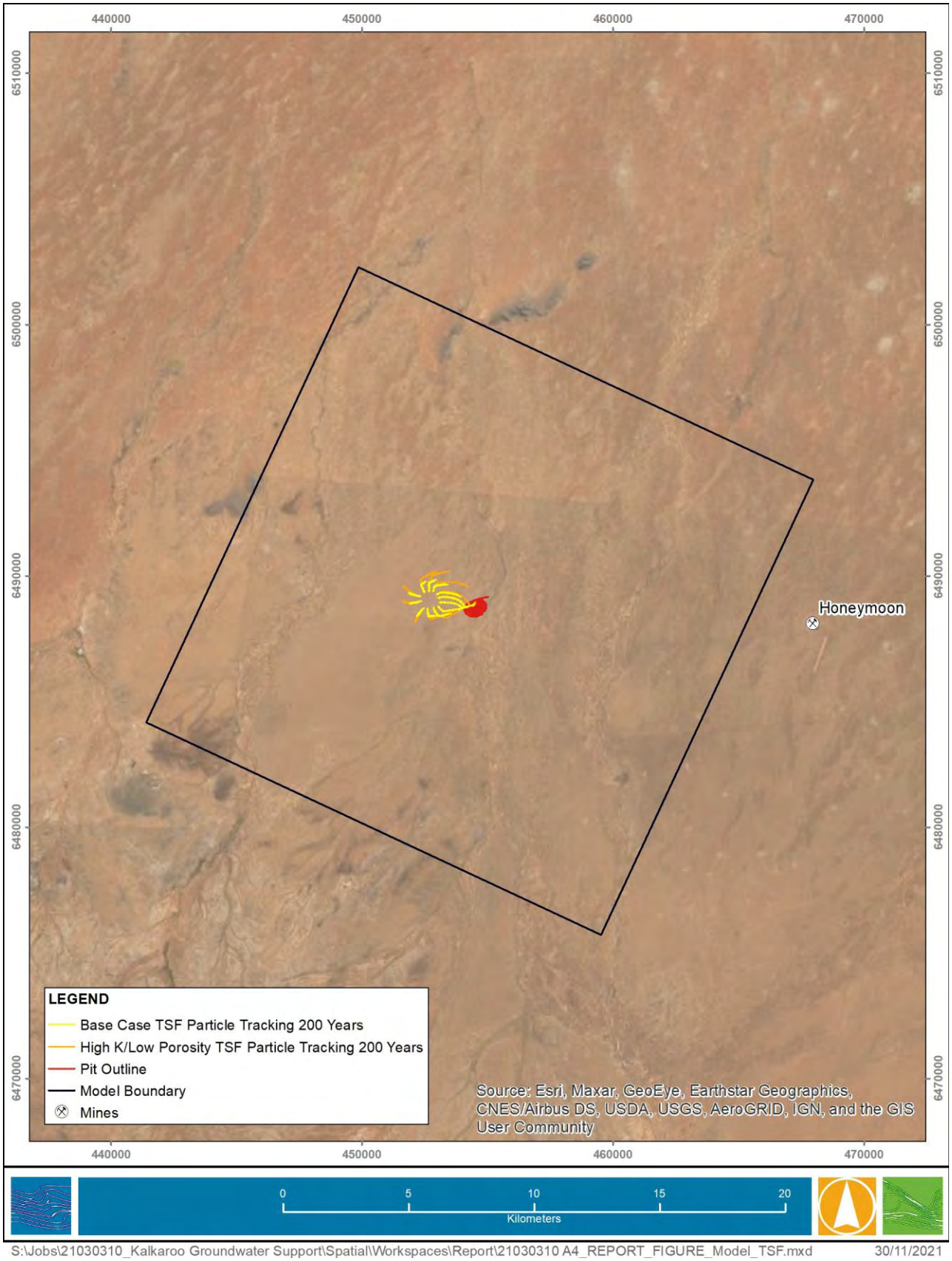

Figure 10-18 Particle Tracking Model of TSF Seepage 200 Years

10.5.3 Model Uncertainty

Key areas of model parameter uncertainty include regional values of hydraulic conductivity, estimated and adopted specific yield values and the ratios of horizontal to vertical hydraulic conductivity and hence vertical interaction between the model layers. To test the sensitivity of the model outputs to variations in these parameters the following transient runs were undertaken for the mining period:

- Case 1 – increase horizontal vertical conductivity in layers 1 and 2 by a factor of 2, reduce specific yield in layers 1 and 2 and specific storage in layer 2 by a factor of 0.5.
- Case 2 – retain base case parameters and increase Kh/Kv ratio in layers 1 and 2 from 100 to 1,000.
- Case 3 – retain base case parameters and decrease Kh/Kv ratio in layers 1 and 2 from 100 to 10.

The sensitivity runs were carried out in the transient mining period without re-calibrating the steady-state model to these parameters and adjusting the transient model starting heads, so some inconsistencies in the results can be expected. However, these parameter changes provide an indication of the possible effect on the magnitude and extents of the modelled regional drawdown patterns, with the following observations made:

- Case 1 - layer 1 and 2 hydraulic conductivity, Sy and Ss changes. The 0.5 m drawdown extent within the unconfined layer 1 is increased by approximately 1,500 m from the base case. A similar situation is observed for the reduction in potentiometric pressure in the confined layer 2 with the 0.5 m value increased by approximately 1,000 m.
- Case 2 – increased Kh/Kv ratio results in the 0.5 m drawdown contours in layers 1 and 2 being increased by approximately 200 m and 800 m, respectively.
- Case 3 – decreased Kh/Kv ratio results in the 0.5 m drawdown contours in layers 1 and 2 being decreased by approximately 500 m and 1,000 m, respectively.

A comparison of the drawdown effects of the cases in layers 1 and 2 are shown on Figure 10-19 and Figure 10-20.

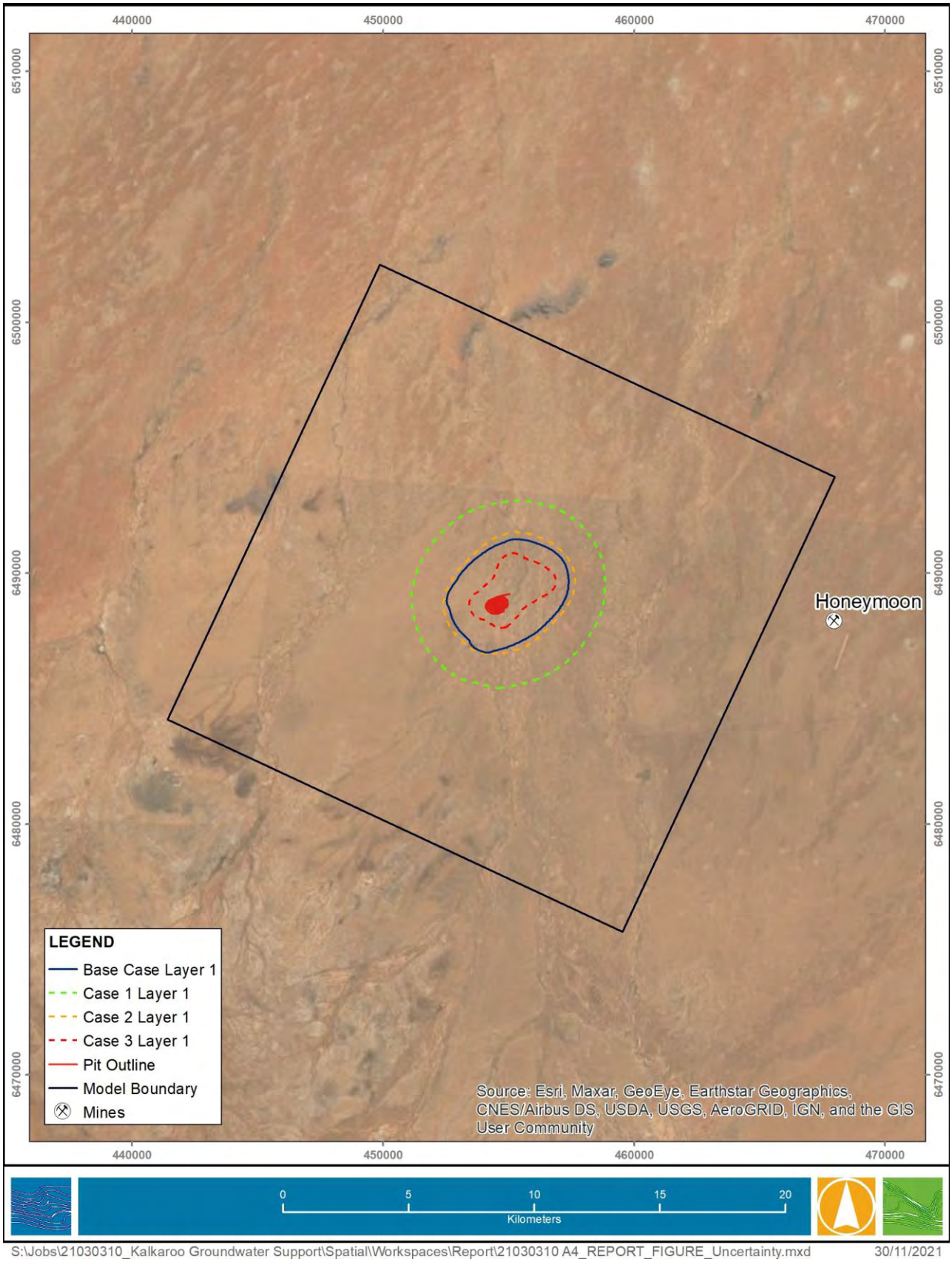

Figure 10-19 Layer 1 Uncertainty Analysis Outputs

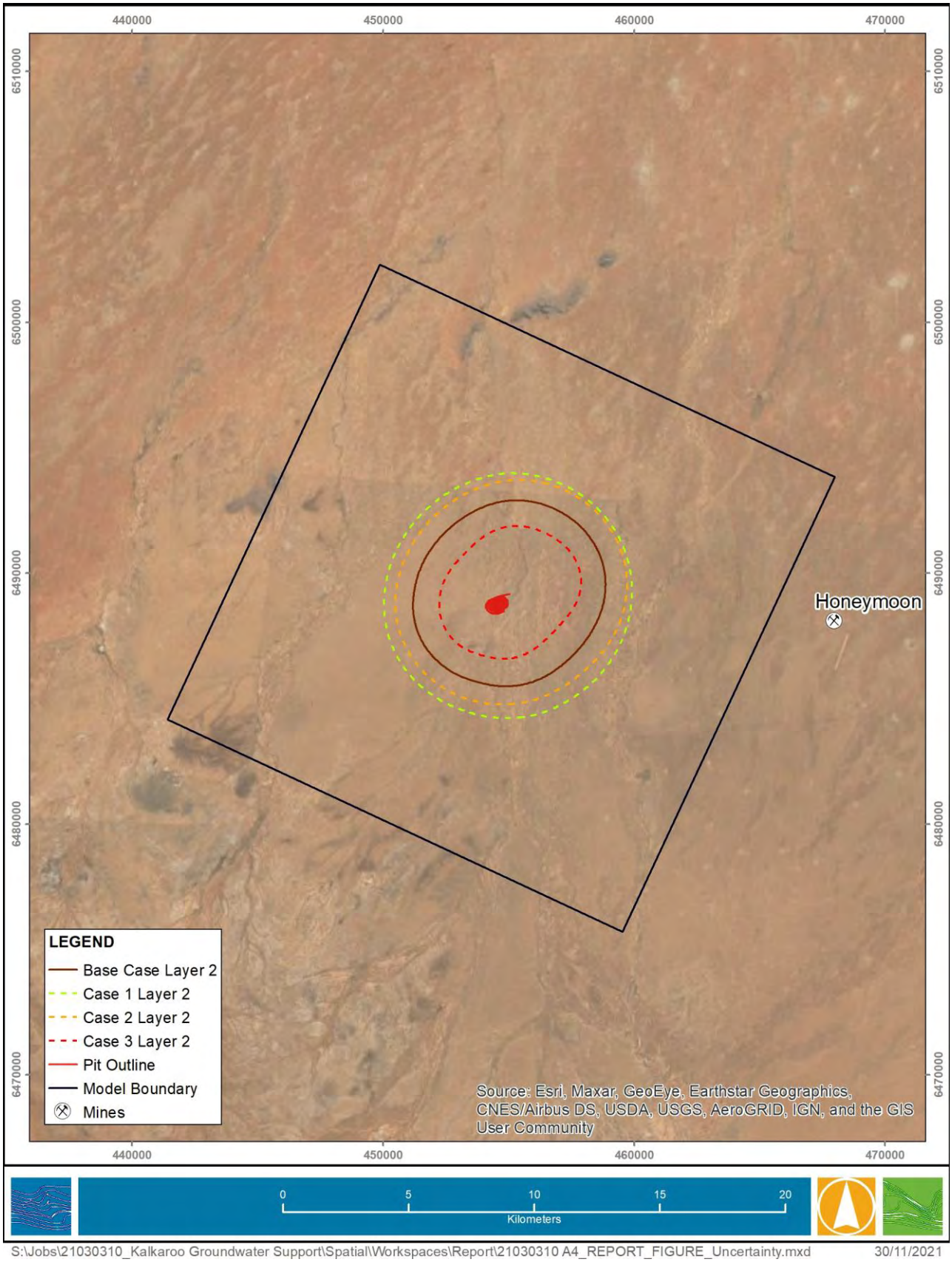

Figure 10-20 Layer 2 Uncertainty Analysis Outputs

10.6 Model Capabilities and Limitations

The modelling methodology and model code used are considered appropriate for the level of detail required to achieve the stated model objectives and are compatible with the various data inputs and hydrogeological conceptualisation, producing model outputs consistent with project requirements.

Model outcome uncertainty is described in Section 10.5.3 and based on this, the main limiting factors of the model relate to uncertainty in the vertical connectivity of the saprolite and fresh basement layers, and extending the hydraulic parameters of the layers and identified structural zones within the layers from a site scale to the semi-regional model scale. A major simplifying assumption within the model is that the layers and structural zones have been represented as homogeneous porous media but in reality are probably more typical of fractured rock units.

The model in its current state provides estimated ranges for the expected drawdowns across the model domain and it is anticipated that these will be confirmed by groundwater monitoring during the mining and recovery stages. The model also provides estimates of pit dewatering rates over the mining period but is not of sufficient detail at this stage to be used to provide detailed dewatering design parameters. The planned mine development and pit excavation schedule control the modelled project water requirements, and hence the groundwater supply to meet this can be modelled to be provided by pit dewatering augmented with wells located outside of the pit if required. This produces a groundwater supply schedule which will be sensitive to the actual pit dewatering requirements. As the project advances and data on actual water supply needs and pit dewatering become available, the model will be updated to provide improved estimates of future drawdown impacts. The model is currently not of sufficient detail to provide a basis for geotechnical applications such as pit wall seepage and pit wall instability.

11 IMPACT ASSESSMENT

11.1 Approach

The impacts described in this section have been assessed using the outputs from the mine site numerical groundwater flow model presented in Section 10. The assessment follows the National Water Commission (NWC) framework for assessing direct effects relating to groundwater quantity, groundwater quality, surface water – groundwater interaction (including groundwater dependent ecosystems) and aquifer disruption (Howe, 2011).

11.2 Environmental Value

The SA EPA Water Quality Policy (2015) describes water by its suitability for different purposes, defined as environmental values. Groundwater salinity is used as the primary guide to assess the applicable environmental values for a particular groundwater source. The salinity data collected from the on-site groundwater wells confirms that two of the nine wells sampled during 2009 had salinities between 3,000 and 13,000 mg/L which is suitable for primary industries. The remainder of the samples had groundwater salinities in excess of 13,000 mg/L. The environmental values that are applicable to this site are therefore:

- Primary industries - livestock drinking water (salinity between 3,000 and 13,000 mg/L); and
- Primary industries - aquaculture and human consumption of aquatic foods (salinity between 3,000 and 13,000 mg/L).

Of these environmental values, primary industries - livestock drinking water is considered the only environmental value that is likely to be realised at the site. The use of groundwater for aquaculture and human consumption of aquatic foods is very unlikely to occur in this arid and remote area. It is noted that lower salinity groundwater exists in the broader study area in the Olary Ranges to the south (Figure 5-3). The salinities in this region have not been used in identifying environmental values for the site as site activities are unable to impact on upgradient recharge areas to the south.

11.3 Groundwater Quantity

Groundwater levels provide a means of assessing the degree to which the quantity of groundwater within the regional groundwater system may change in response to mining activities. As a result of pit dewatering and supply of additional make-up water, groundwater levels surrounding the pit are expected to decline. At the end of mining (5 years), the 0.5 m drawdown contour is predicted to extend up to 3 km from the pit in the Saprolite aquitard and up to 5 km in the basement aquifer. The nearest groundwater well to the pit is located 10 km away and hence there are not expected to be any impacts on existing users during the mining phase (Figure 11-1 and Figure 11-2). Note well 7034-1103 could not be located during the field survey by Kalkaroo Copper in 2015, however, its presence does not change the impact assessment for the mining phase as it is located outside of the 0.5 m drawdown extent.

During the 200-year recovery model simulation, groundwater levels in the saprolite aquitard respond to seepage from the TSF and ongoing evaporative losses from the pit lake. The effects of these two processes leads to the development of a groundwater mound beneath the TSF and a cone of depression surrounding the pit lake as depicted in Figure 11-3. The peak of the mound is predicted to remain 30 m below ground level while the pit lake is predicted to stabilise at approximately 57 m AHD, 19 m below the pre-mining level. Groundwater levels within the regional basement aquifer in the pit footprint are modelled to recover to within 18 m of pre-mining levels (Figure 11-4).

There is a small amount of drawdown predicted in the Honeymoon uranium mine model observation points of around 1 m at the end of the 50-year recovery period (Figure 10-17). These simulated points are located 3 km from the actual Honeymoon uranium mine (Figure 11-1), so impacts at the mine would be expected to be less. Drawdown during the recovery period is thought to be a result of the time taken for the system to re-equilibrate following pit dewatering. Similarly, existing stock wells within the model domain also show a small amount of drawdown in the order of 0.5 m during the recovery phase (Figure 10-17), however, it is noted that these wells are currently not operational. It is recommended that the closure predictions are re-evaluated once 12 to 24 months of monitoring data becomes available to re-calibrate the model.

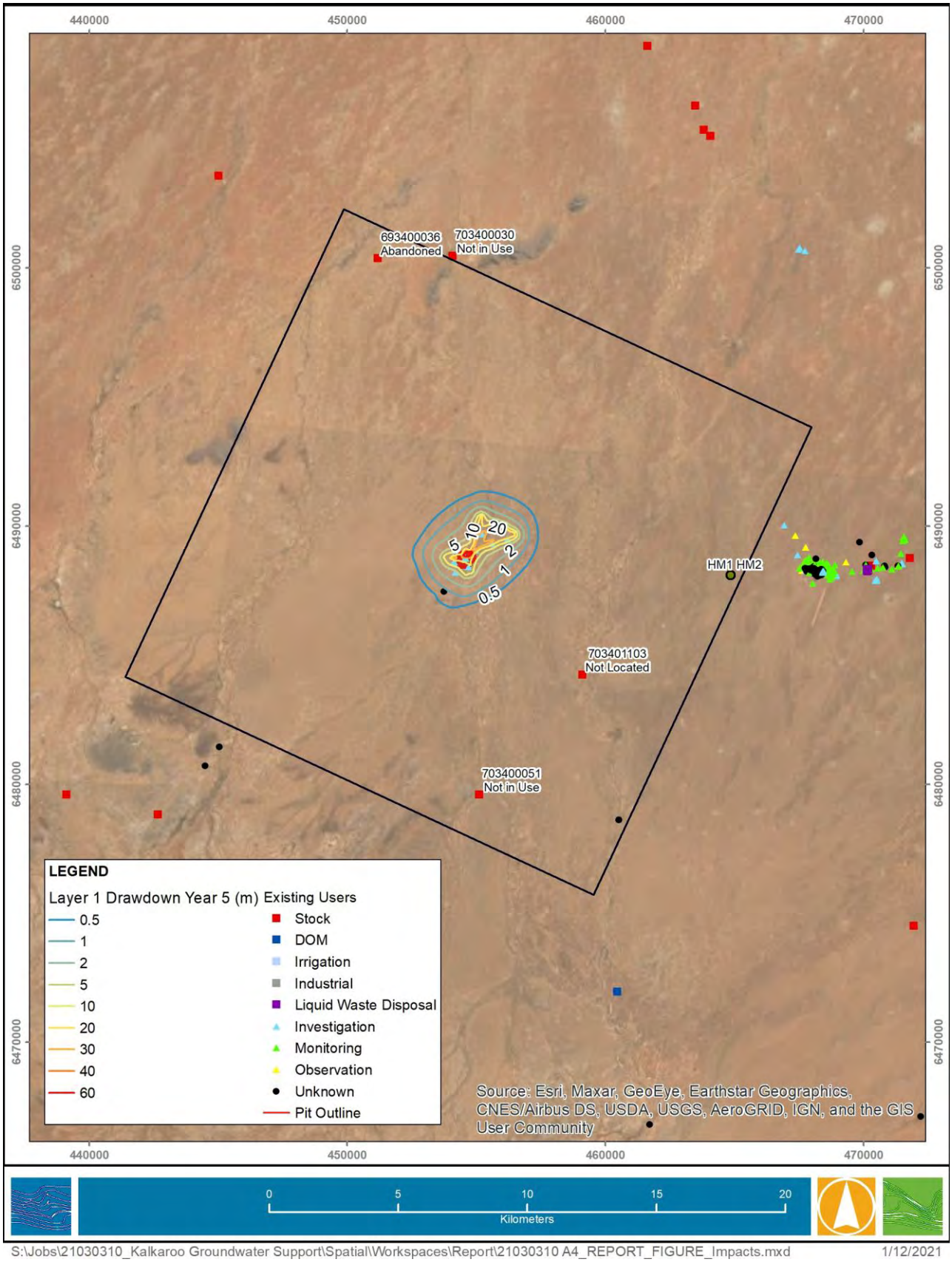

Figure 11-1 Modelled Drawdown Layer 1 End of Mining and Existing Users

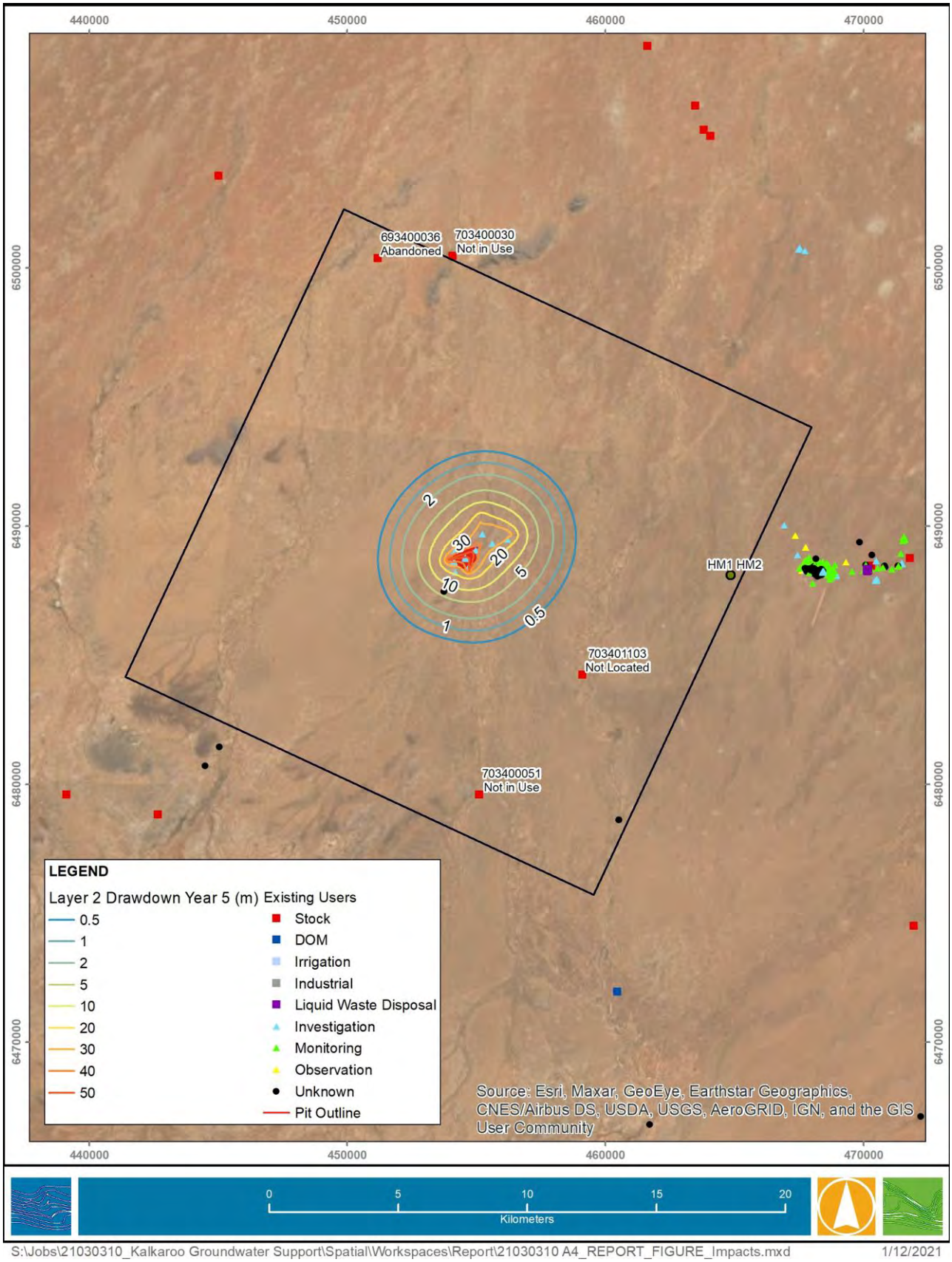

Figure 11-2 Modelled Drawdown Layer 2 End of Mining and Existing Users

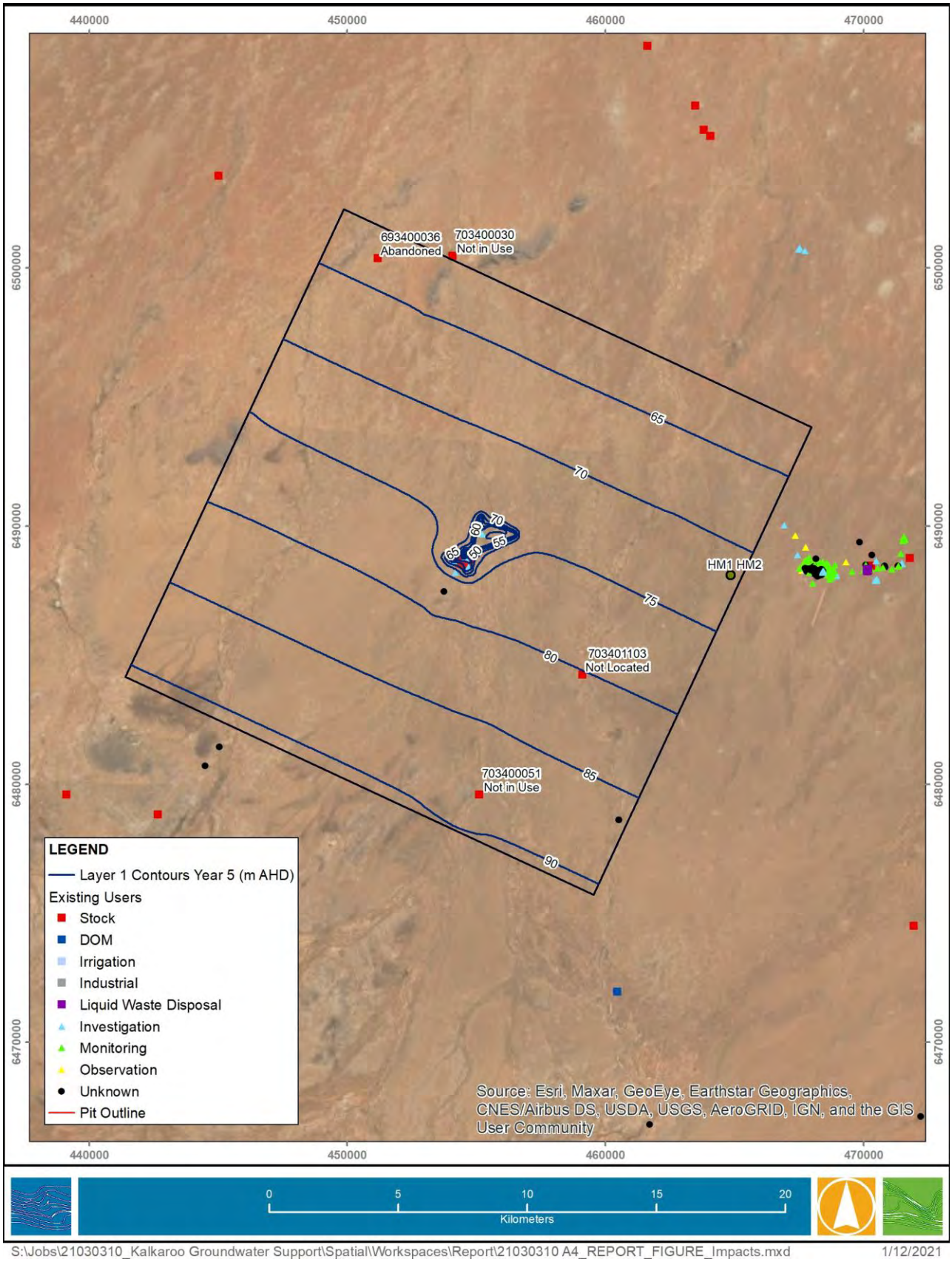

Figure 11-3 Modelled Groundwater Levels in Layer 1 after 50 Years Recovery and Existing Users

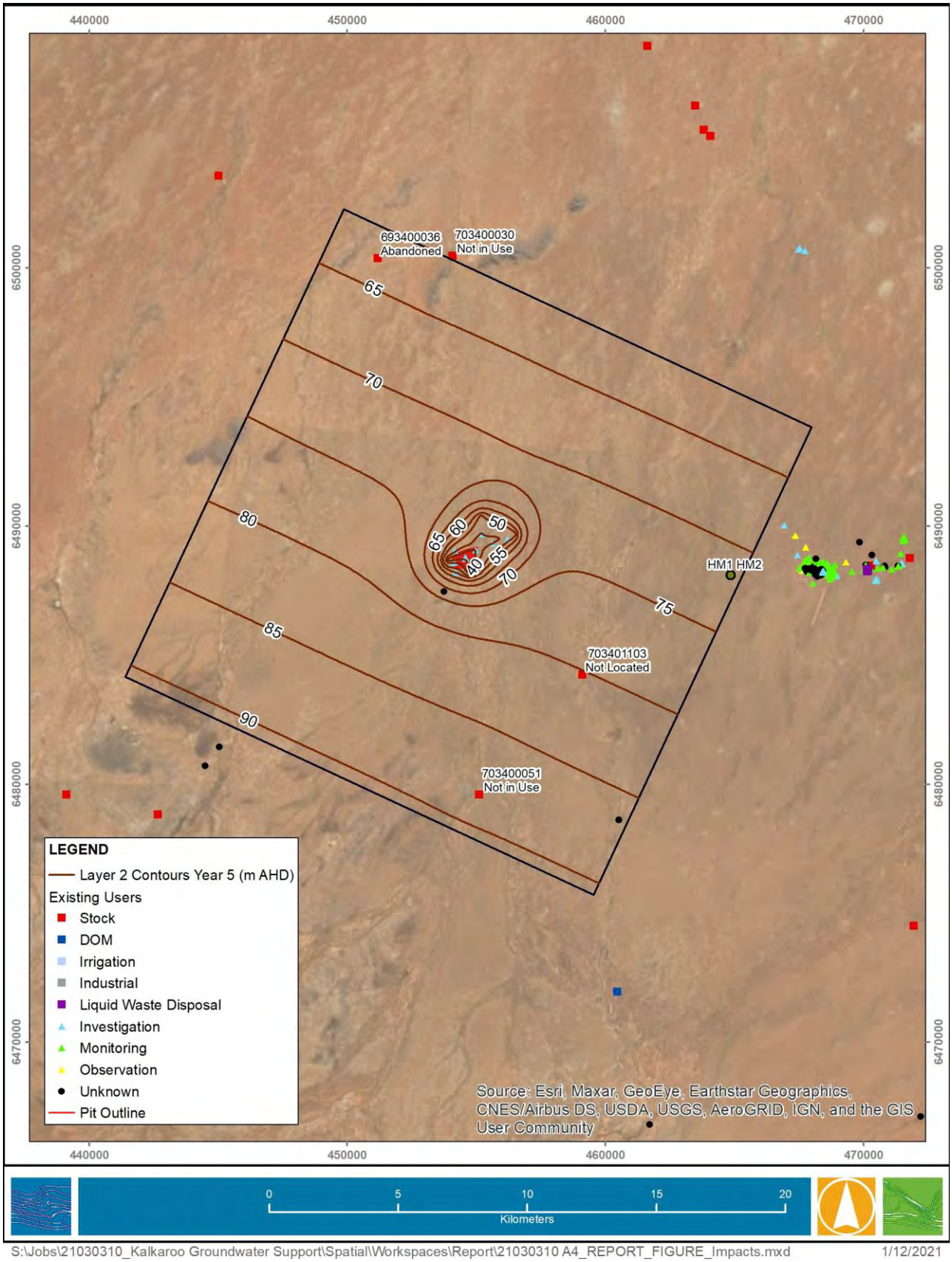

Figure 11-4 Modelled Groundwater Levels in Layer 2 after 50 Years Recovery and Existing Users

11.4 Groundwater Quality

Seepage from the TSF is the main on-site activity which has the potential to impact on groundwater quality. It is noted that primary controls are in place to reduce the impacts of this activity, such as lining of the TSF with compacted clay and groundwater interception if mounding occurs beneath the TFS. Further details regarding these primary controls can be found in the Kalkaroo Copper PEPR (Kalkaroo Copper, 2021).

In the event that these primary controls fail, the fate of potential contaminants has been assessed using particle tracking within the numerical groundwater flow model for a base case and conservative parameter set (refer to Section 10.5.2.2 for details). It is noted that this assessment does not account for other factors such as dilution, sorption or retardation which would reduce the concentration of potential contaminants.

The results of the particle tracking indicate that seepage from the TSF travels radially away from the TSF due to the establishment of the recharge mound (refer to Figure 10-18). For the base case travel distances over the 200-year simulation period are within 500 m from the edges of the TSF to the north and west. Particles from the east and south of the TSF are drawn towards the dewatered pit area and the high permeability Kalkaroo West shear zone and particle travel distances are modelled to be between 1 to 1.5 km. A conservative parameter case was also run with similar patterns of response to the base case. Travel distances were increased to within 1 km from the edges of the TSF to the north and west. Particles from the east and south of the TSF confirm the influence of the dewatered pit area and the high permeability structural zones with particle travel distances modelled to be between 1.2 to 2 km. The particles are not predicted to impact on any existing groundwater receptors throughout the 200-year simulation period.

There are not expected to be any Acid Melliferous Drainage (AMD) issues. The results from modelling and the static test work shows that there is a very low risk to AMD from the waste rock of all types. Approximately 1% of the total mass of waste to be mined has been classified as having some acid forming potential by sulphur modelling or from static testing analysis (Kalkaroo Copper, 2021).

11.5 Surface Water – Groundwater Interaction and Groundwater Dependent Ecosystems

There is no established linkage between groundwater and surface water within 10 km of the site and there are therefore not expected to be any impacts on groundwater – surface water interactions as a result of mining activities. The nearest potential aquatic GDE to the site is located around 3 km outside of the predicted drawdown extent in the saprolite layer and impacts on aquatic ecosystems are not expected.

Areas of potential Terrestrial GDEs including low level shrublands (less than 1 m) consisting of Sclerolaena divaricate, Atriplex vesicaria ssp and Maireana aphylla (mixed) exist within the predicted extent of drawdown. Although drawdown is expected beneath these potential GDEs, it is considered very unlikely that this will result in impact on these communities due to the fact that groundwater levels in this area are between 45 and 50 m below ground level. This interpretation is consistent with the assigned low probability of groundwater dependence reported in the Australian GDE atlas for these ecosystems.

11.6 Aquifer Disruption

Following the completion of mining when dewatering and water supply infrastructure are decommissioned, the pit void will remain open and a pit lake is expected to form. Once groundwater inflows equilibrate with evaporation, a new steady state flow regime will be established, the impacts of which are assessed in Sections 11.3, 11.4 and 11.5.

12 GROUNDWATER MONITORING AND MANAGEMENT

12.1 Overview

The groundwater monitoring and management plan has been developed to provide data to demonstrate compliance with the environmental outcome for the project which states that the tenement holder must during construction, operation and post-mine completion, ensure that there is no adverse impact to the quantity and quality of groundwater available to existing users as a result of mining operations. The monitoring plan also considers the general environmental duty or care which states that proponents must take all reasonable and practicable measures to prevent or minimise environmental harm resulting from undertaking an activity that pollutes or might pollute waters (EPP, 2015).

The groundwater monitoring program has been designed to:

- Collect groundwater level and pit lake water level data to be used for groundwater model calibration;
- Collect regional groundwater level data to be used to validate model predictions;
- Collect groundwater level data to assess seepage from flood events east of the pit; and
- Collect targeted groundwater quality and level data near the TSF to monitor for potential changes in groundwater quality and level as a result of mining operations.

The approach taken to develop the groundwater management and monitoring plan has been guided by the Queensland Department of Environment and Science's (DES, 2021) guideline for assessing groundwater quality and developing site-specific groundwater quality criteria.

12.2 Understanding the System

DES (2021) report that developing appropriate site-specific groundwater quality guidelines requires an understanding of the site-specific hydrogeology including aquifers and aquitards, groundwater flow and groundwater – surface water interactions. A summary of the relevant information relating to these aspects of the hydrogeological conceptualisation is provided in Table 12-1. Further details regarding the broader conceptualisation are provided in Sections 4 to 8. In summary, the groundwater system is expected to be slow moving with no groundwater – surface water interactions within at least 10 km of the site. The level of seasonal and yearly variability is expected to be low. Recommendations for establishing baseline conditions and monitoring frequency are guided by these factors.

Table 12-1 Understanding the System using the DES (2021) Framework

Theme	Summary
Aquifers and Aquitards	There are two main hydrogeological units identified at the site including a saprolite unit and fresh basement. Major ion data suggests that groundwater in the basement aquifer is of similar ionic composition suggesting that this aquifer is well connected. There is currently no major ion data available for wells screened in the saprolite unit.
Groundwater Flow	Groundwater flow is in a north-easterly direction. The groundwater flow rate in the regional fresh basement rocks is expected to be low resulting in high residence times. Seasonal variability is expected to be minimal given the very low recharge rates that are expected over the study area.
Groundwater – Surface Water Interactions	There is no established linkage between groundwater and surface water within 10 km of the site.

Theme	Summary
Environmental Values	The identified environmental values for the site include primary industries - livestock drinking water. Groundwater is not known to support any aquatic ecosystems with 10 km of the site.

12.3 Review of Existing Data and Applicable Guideline Values

Existing water chemistry data for the site is limited to one round of laboratory results from nine wells in 2009. Although the data does not span multiple time-steps, similarities in the ionic composition of the sampled wells are observed as illustrated in the Piper Diagram (Figure 6-2). This may imply that spatial variability is not expected to be significant, however, further monitoring is required to confirm this.

The water chemistry data has been compared against guideline values for livestock drinking water in Table 12-2. The full laboratory analysis results for the 2009 sampling event are provided in Appendix C with exceedances above livestock drinking water guidelines highlighted. Of note are the concentrations of copper and mercury in well WB10 and mercury in well WB7 which were marginally above the stock guideline values. TDS, calcium, magnesium and sulphate were also reported above the livestock drinking water guidelines. As there are no known historic site activities which have impacted groundwater, it would appear that these constituents are naturally elevated above the livestock drinking water guidelines values, however, further monitoring is required to confirm this.

Table 12-2 Comparison of Site Groundwater Quality against Livestock Drinking Water Guidelines (ANZEEC, 2000)

Parameter	Trigger Value (mg/L)	Min	Max	Range	No. of Samples	No. of Exceedances
TDS	13000	9520	34100	24580	9	7
Calcium	1000	754	1860	1106	9	8
Magnesium	600	337	922	585	9	4
Nitrate as N	400	0	0.09	0.09	9	0
Nitrite + Nitrate as N	30	0	1.44	1.44	9	0
Sulphate	1000	2360	3390	1030	9	9
Aluminiumn	5	-	-	-	-	-
Arsenic	0.5	0.012	0.099	0.087	9	0
Boron	5	-	-	-	-	-
Cadmium	0.01	0	0.0019	0.0019	9	0
Chromium	1	0	0.006	0.006	9	0
Cobalt	1	0.008	0.101	0.093	9	0
Copper	0.5	0.009	0.587	0.578	9	1
Fluoride	2	-	-	-	-	-
Lead	0.1	0	0.076	0.076	9	0
Mercury	0.002	0	0.004	0.004	9	2
Molybdenum	0.15	-	-	-	-	-
Nickel	1	0.006	0.06	0.054	9	0
Selenium	0.02	-	-	-	-	-
Uranium	0.2	-	-	-	-	-
Zinc	20	0.009	1.13	1.121	9	0

12.4 Establishing Baseline Conditions

The existing groundwater chemistry data suggests that there are similarities in the ionic composition of the sampled wells, however, the lack of temporal data does not allow for establishment of robust baseline conditions. To address this, it is recommended that quarterly groundwater quality sampling is undertaken for a period of one year, after which time the data is reviewed to assess the variability in the collected data. If groundwater quality parameters are stable, it is recommended that this data is used to establish baseline water quality criteria for the site. If there is unexplained variability in the data, sampling may need to continue at a quarterly frequency until the variability can be explained and baseline conditions can be established. Although the proposed number of sampling events is less than that recommended by DES (2021), site specific conditions suggest that (1) groundwater movement is expected to be very slow and (2) there is not expected to be any seasonal variability due to the low areal recharge and lack of groundwater-surface water interactions at the site.

12.5 Groundwater Quality / Chemicals of Concern

Ore will be processed using conventional gravity separation and sulphide flotation circuits. The ore material will be crushed, ground, and screened in order to generate a commercial grade saleable copper-gold concentrate product. Reagents added in the processing stream include Hydrochloric Acid, Sodium Cyanide, Lime and Sodium Hydroxide (Kalkaroo Copper, 2021). A summary of these reagents and their reaction with ore and water is provided in Table 12-3 along with the proposed laboratory analytes used to assess whether these reagents appear in groundwater.

Table 12-3 Chemicals of Concern and Proposed Monitoring Constituents

Reagent	Reaction with Ore and Water	Proposed Monitoring
Hydrochloric Acid - Commercial	Used in elution process to remove contaminants from the carbon. Reacts with water to lower the pH. Has no reaction with the ore.	pH Dissolved and total metals
Sodium Cyanide	Dissolved in water as 10% w/w solution to dissolve gold, and other minor amounts of base metals from ore.	Cyanide – free cyanide Cyanide – total cyanide Cyanide – weak acid dissociable (WAD) Dissolved and total metals
Lime	Dissolved in water inside the mill to increase slurry pH to a level where HCN gas levels are minimized. Has no reaction with the ore.	pH Dissolved and total metals
Sodium Hydroxide	Used in the elution process to remove gold from carbon. Dissolves in water. Has no reaction with the ore	pH Dissolved and total metals

12.6 Monitoring Locations and Frequency

Proposed monitoring locations, parameters and frequency are summarised in Table 12-4 and shown spatially in Figure 12-2. The following site characteristics have been taken into consideration when developing the monitoring locations and frequency:

- The low regional hydraulic conductivity resulting in long residence times; and
- The significant depth to groundwater and presence and thickness of the Namba Clay leading to significant lag times between water infiltrating at the surface and reaching the water table.

In addition to the proposal groundwater monitoring wells, a series of wells installed in the unsaturated Quaternary sediments and Namba Clay are proposed around the TSF (Golder, 2021). These wells are intended to be used to monitor for seepage from the TSF and will be used to validate the TSF seepage model predictions. Further details regarding TSF monitoring locations and frequency are provided in Golder (2021).

Table 12-4 Groundwater Monitoring Program

Purpose	Location	Parameters	Frequency
Model Calibration	WB13 (Basement)	Groundwater level	Monthly in first year Quarterly thereafter
		Groundwater quality	Quarterly
	WB14 (Saprolite)	Groundwater level	Monthly in first year Quarterly thereafter
		Groundwater quality	Quarterly
	WB3 (Basement)	Groundwater level	Monthly in first year Quarterly thereafter
		Groundwater quality	Quarterly
	WB11 (Basement)	Groundwater level	Monthly in first year Quarterly thereafter
		Groundwater quality	Quarterly
Regional Trends	7034-51	Groundwater level	Quarterly
		Groundwater quality	Twice yearly
	7034-30	Groundwater level	Quarterly
		Groundwater quality	Twice yearly
TSF Seepage	TSF 1 (Saprolite)	Groundwater level	Quarterly
		Groundwater quality	Twice yearly
	TSF 2 (Saprolite)	Groundwater level	Quarterly
		Groundwater quality	Twice yearly
Bank Infiltration	(Namba)	Groundwater level	Quarterly
		Groundwater quality	Quarterly if saturated
	(Namba)	Groundwater level	Quarterly
		Groundwater quality	Quarterly if saturated
Production	Production 1 (PB 1)	Groundwater level	Quarterly
		Groundwater quality	Twice yearly
	Production 2 (PB 2)	Groundwater level	Quarterly
		Groundwater quality	Twice yearly
	Production 3 (PB 3)	Groundwater level	Quarterly
		Groundwater quality	Twice yearly

12.7 Leading Indicator Criteria

12.7.1 Groundwater Levels

Groundwater levels in the WB series of wells should be collected monthly for the first year and quarterly thereafter. The monitoring frequency for these wells is higher in the first year as they are expected to respond to extraction from production wells surrounding the pit and pit dewatering. The frequency of all other wells is quarterly as the expected rate of change in these wells is low.

Groundwater levels should be compared against model predictions to validation and, if necessary, re-calibrate the model. It is proposed that model recalibration occurs after 24 months of operations of beforehand if:

- Drawdown is measure in the regional wells; or
- If groundwater levels in the WB series of wells deviate from model predictions by more than 10 m

The predicted responses in the regional and WB series of wells are illustrated in Figure 12-2.

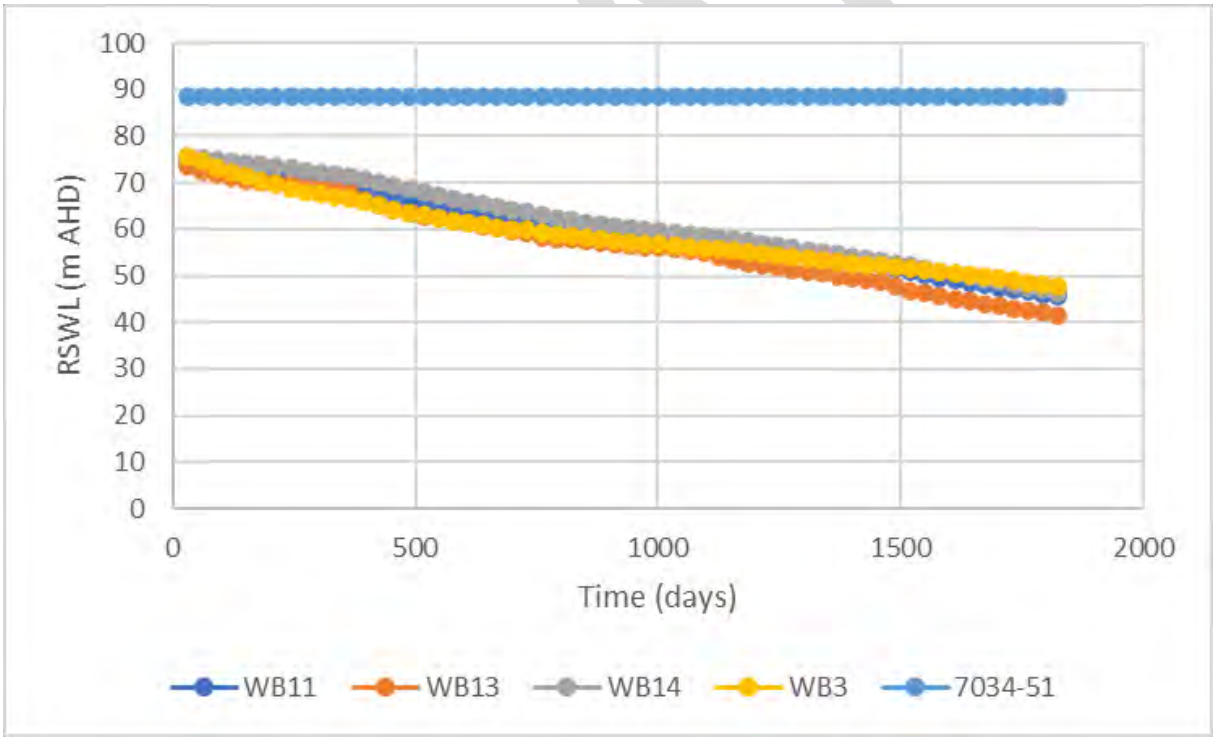

Figure 12-1 Predicted Groundwater Level Response in Monitored Wells (Operational Phase)

12.7.2 Groundwater Quality

Groundwater quality Leading Indicator Criteria (LIC) will be established once baseline condition for the site have been established. The parameters to be included in the monitoring program include pH, electrical conductivity (EC), total suspended solids (TSS), total and dissolved metals (arsenic, barium, arsenic, barium, beryllium, cadmium, cobalt, chromium, copper, cyanide, iron, manganese, nickel, lead, vanadium, zinc) and total petroleum hydrocarbons (TPH).

12.8 Site Water Balance

To track the movement of water around the site, it is recommended that all inputs and outputs are metered and recorded in the form of a site water balance. The data should be reviewed fortnightly to ensure that inputs and outputs can be accounted for.

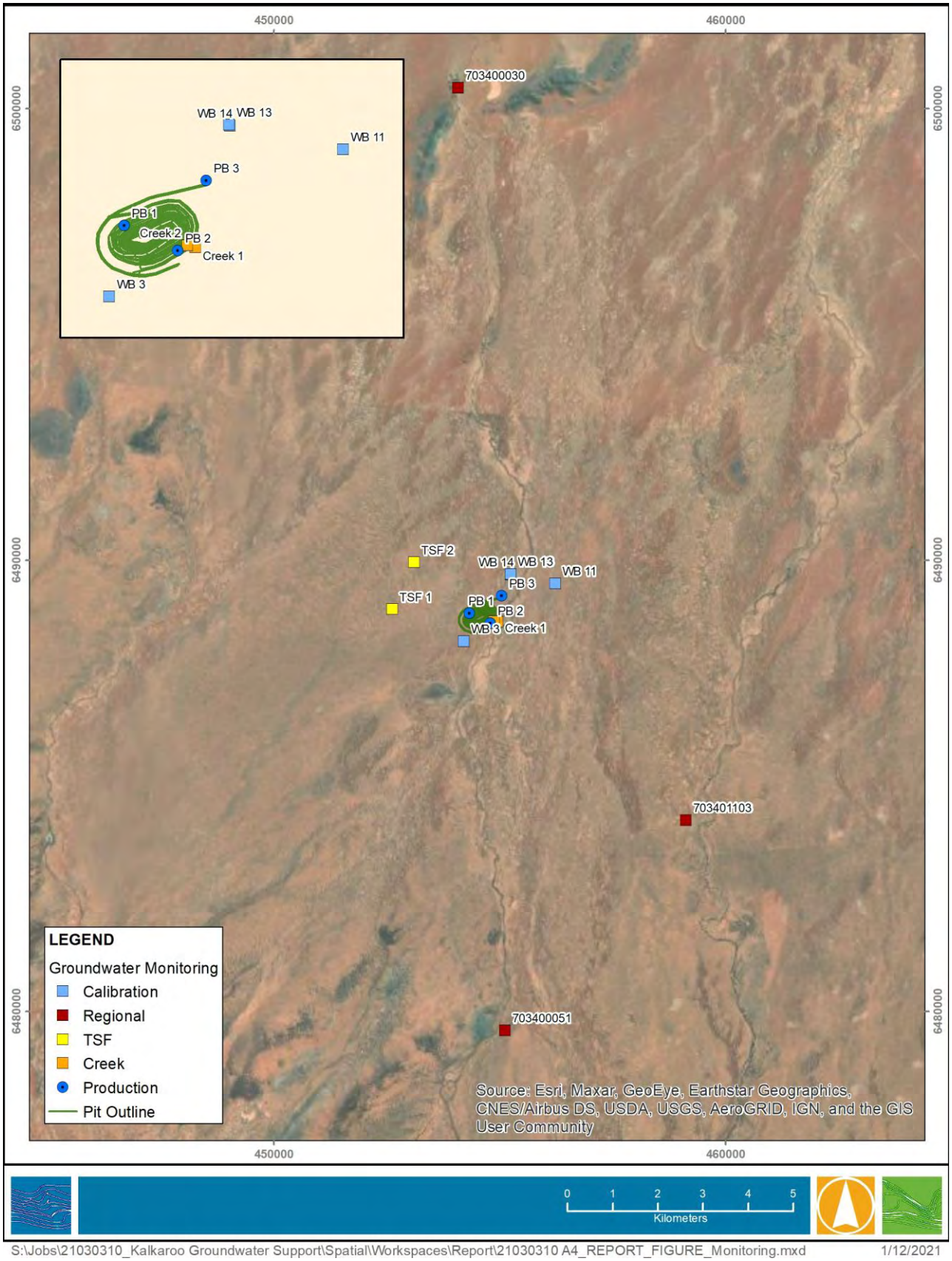

Figure 12-2 Groundwater Monitoring Locations

13 SUMMARY

The hydrogeological conceptualisation and numerical groundwater flow modelling for the Kalkaroo Copper-Gold Mine has been updated to address Government's Request for Further Information relating to Kalkaroo Copper's PEPR submission (March 2021) and review of existing hydrogeological reports and publicly available data for the site and surrounding areas. Key outcomes of this assessment are documented below:

- The numerical groundwater flow model which exists for the site (AGT, 2013) has been revised to (1) include additional supporting evidence to support aspects of the existing groundwater model set-up such as parameterisation of the shear zones and (2) better reflect the updated hydrogeological conceptualisation of the site through modification of several aspects of the model set-up including grid orientation, boundary conditions, model laying and calibration.
- In-pit dewatering rates are expected to range from 2,644 m^3/d to 2,219 m^3/d during the excavation period. Additional water to meet the site water demand will be sourced from dewatering wells targeting the basement shear zones surrounding the pit.
- During the initial pit dewatering phase when the pit is excavated below the water table to 40 m AHD, dewatering requirements are predicted to exceed the project water demand resulting in an excess of water of around 916 m^3/d for a period of 6 months. During this time disposal of excess water is predicted to be required.
- Groundwater drawdown from pit dewatering and water supply is predicted to extend up to 3 km from the pit in the Saprolite layer and 5 km in the basement aquifer by the end of the 5-year mining period.
- A pit like is expected to form following the completion of mining with the level stabilising at approximately 57 m AHD, 19 m below the pre-mining groundwater level. Residual drawdown in the saprolite layer is predicted to remain into perpetuity due to ongoing evaporative losses of water from the surface of the pit lake. Groundwater levels in the basement aquifer within the pit footprint area are predicted to recover to within 18 m of pre-mining levels.
- Seepage from the TSF has been conservatively modelled by applying water directly to the water table resulting in a groundwater mound developing beneath the TSF. Particle tracking suggests that groundwater may migrate up to 2 km away from the TSF over the 200-year closure simulation period. There are no known groundwater receptors within 10 km of the mine site.
- Groundwater from two of nine on-site wells was found to be suitable for livestock drinking water purposes based on its salinity classification. The lowest recorded salinity in the wells was 9,520 mg/L. Elevated levels of Copper and Mercury were found in two wells suggesting that these parameters may be naturally elevated.
- There are no known operational groundwater wells within 10 km of the site and impacts to existing groundwater users are not expected.
- Aquatic and terrestrial GDEs in the study area are not expected to be impacted by site operations. All potential aquatic GDEs are located outside of the predicted drawdown extent while terrestrial GDEs are not expected to be reliant on groundwater which occurs at depths of 45 to 50 m below ground level.
- A groundwater monitoring and management plan has been presented to provide the necessary data to validate the modelled predictions and impact assessment.

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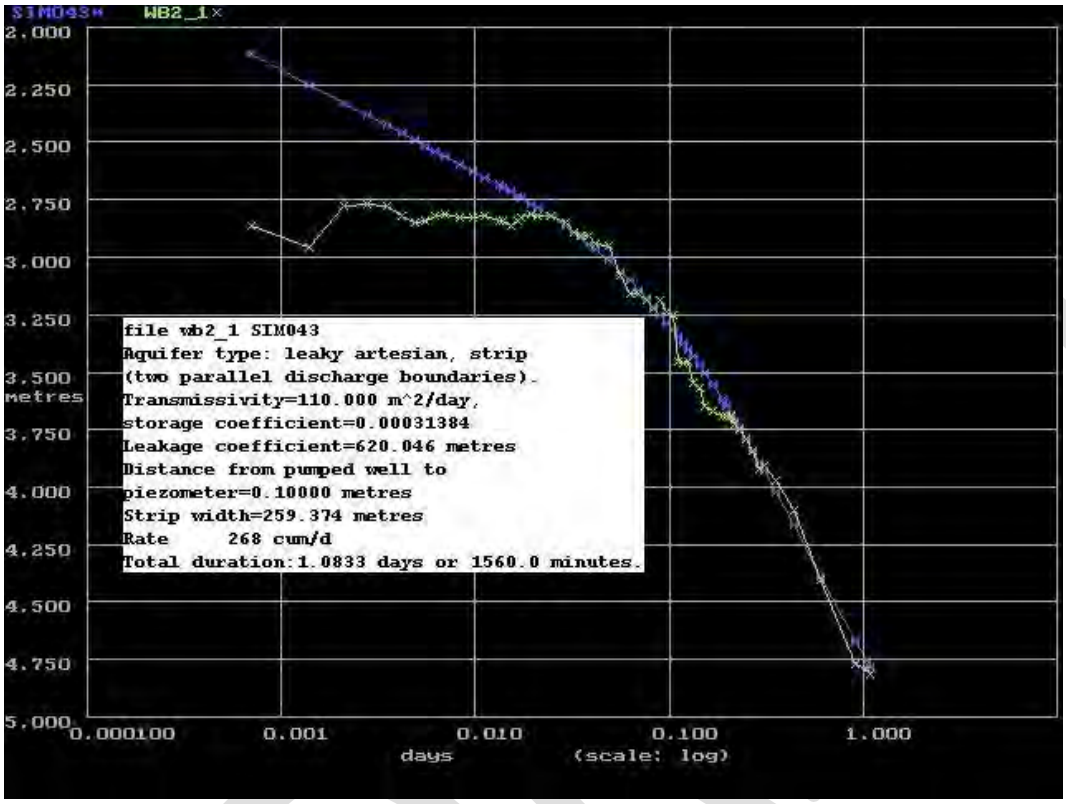
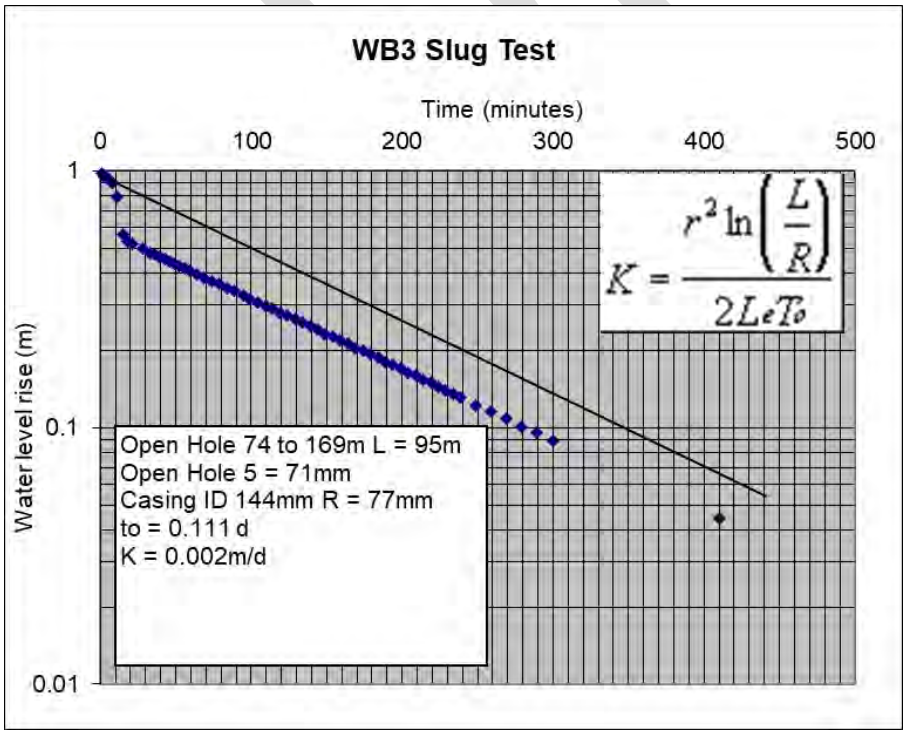
APPENDIX A
AQUIFER TEST DATA SHEETS (AFTER ALDAM, 2009)

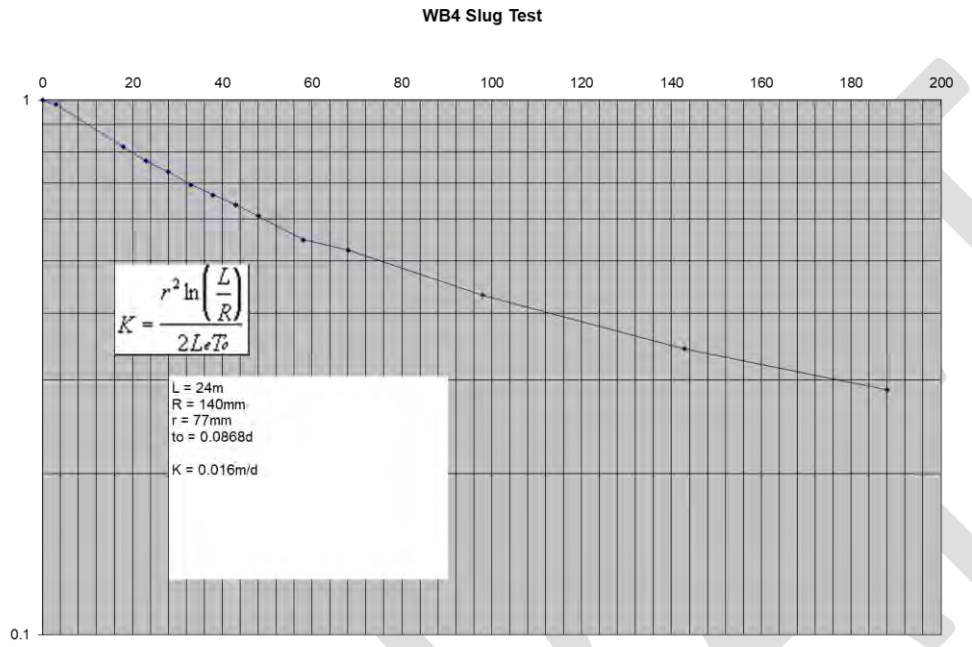
WB-2 Pump Test 1



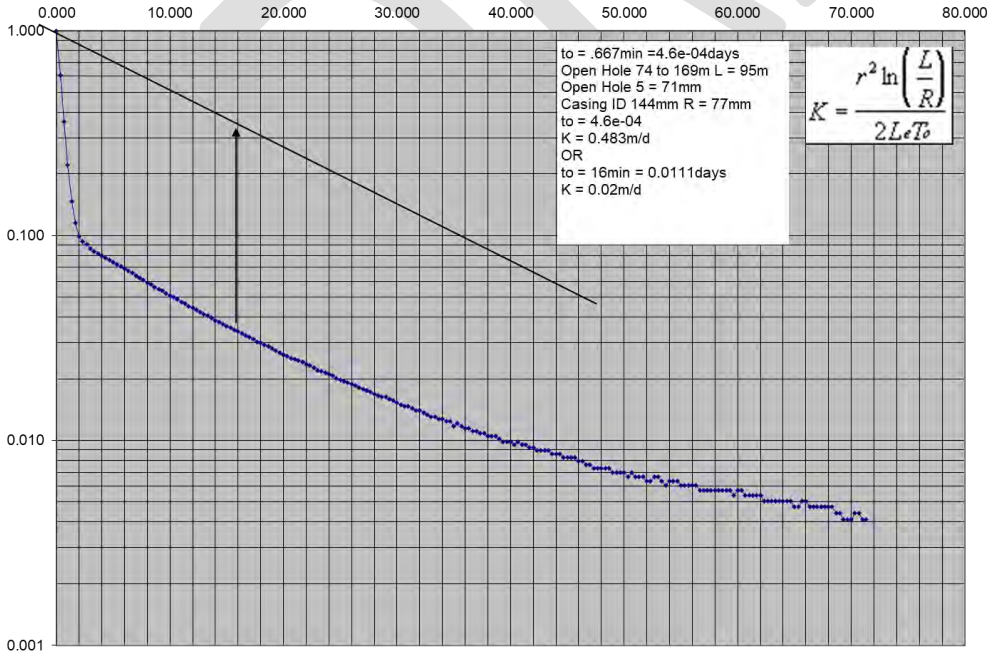
WB-3 Slug Test



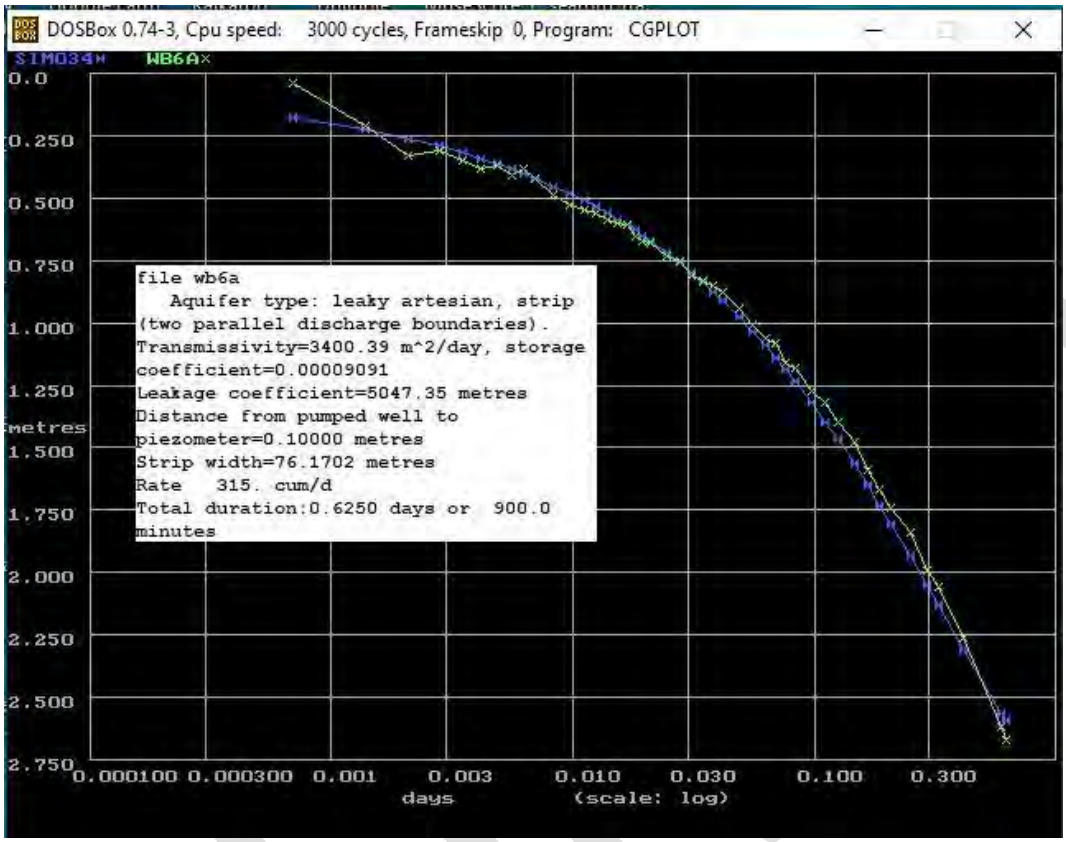
WB-4 Slug Test

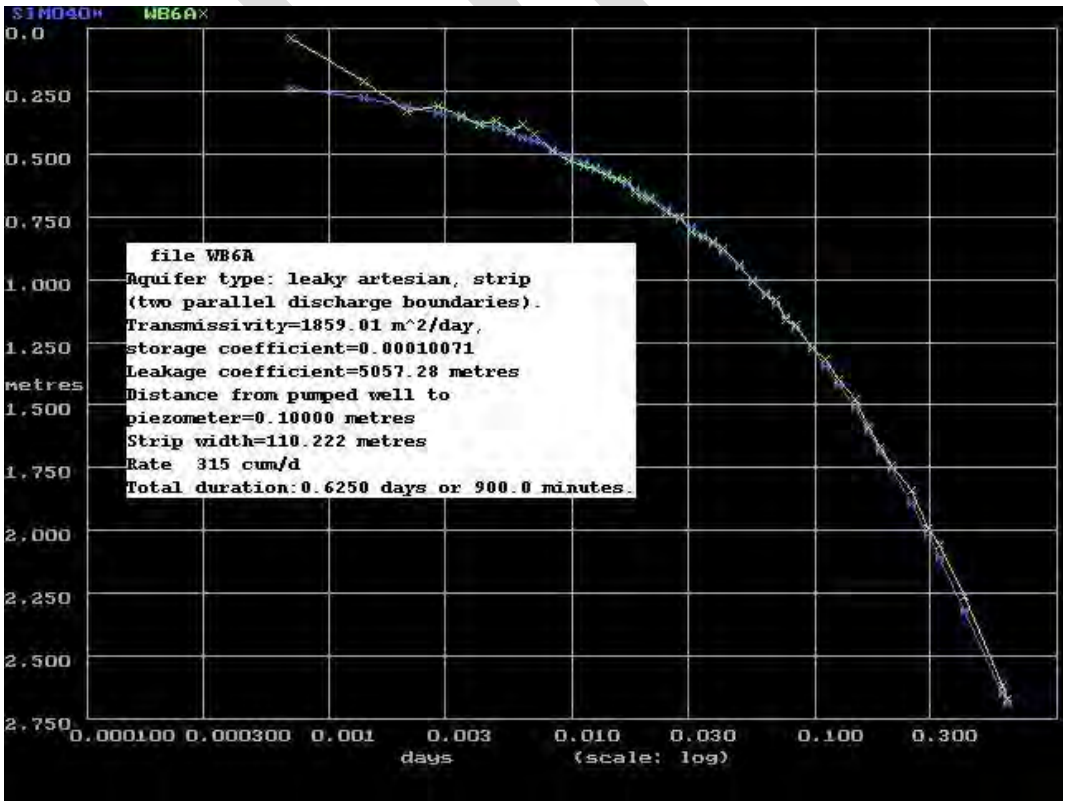


WB-5 Slug Test



WB-6a Pump Test





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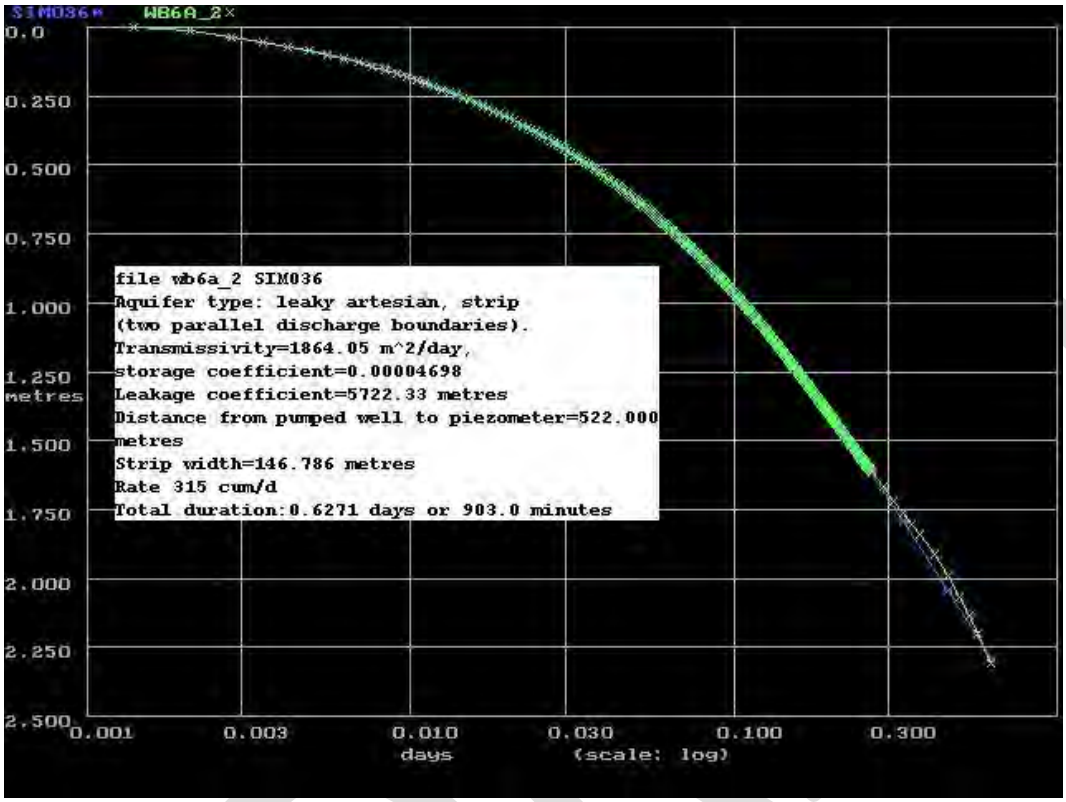

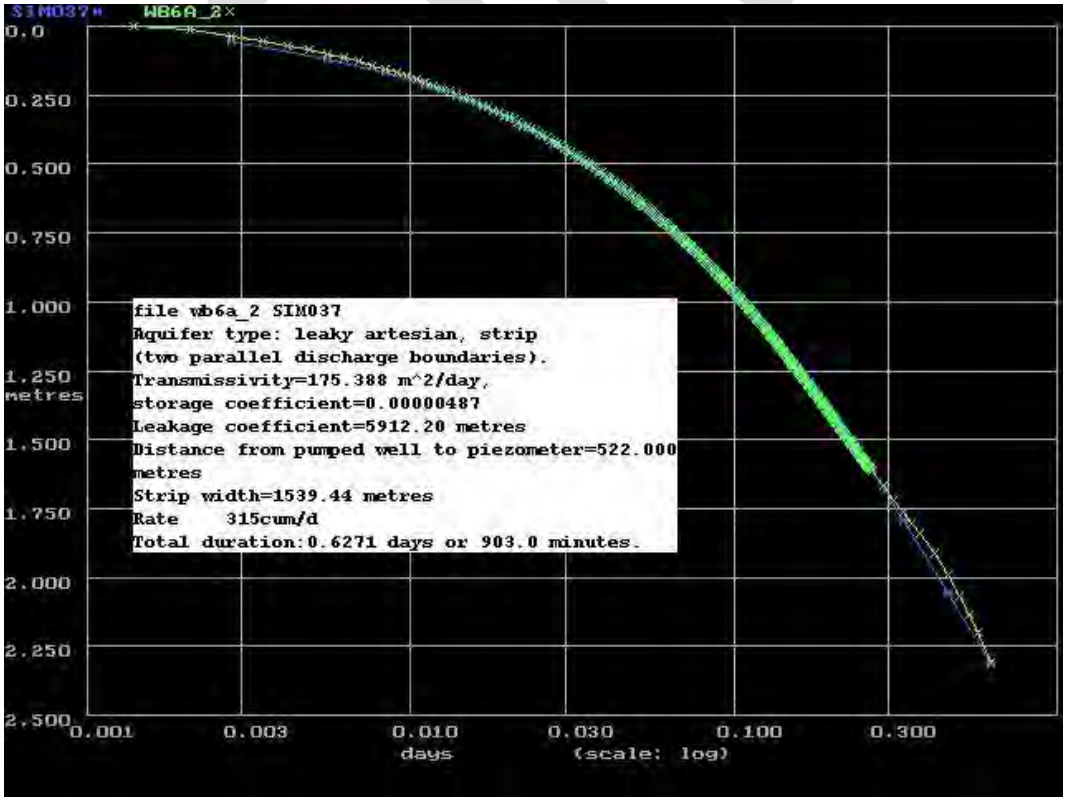

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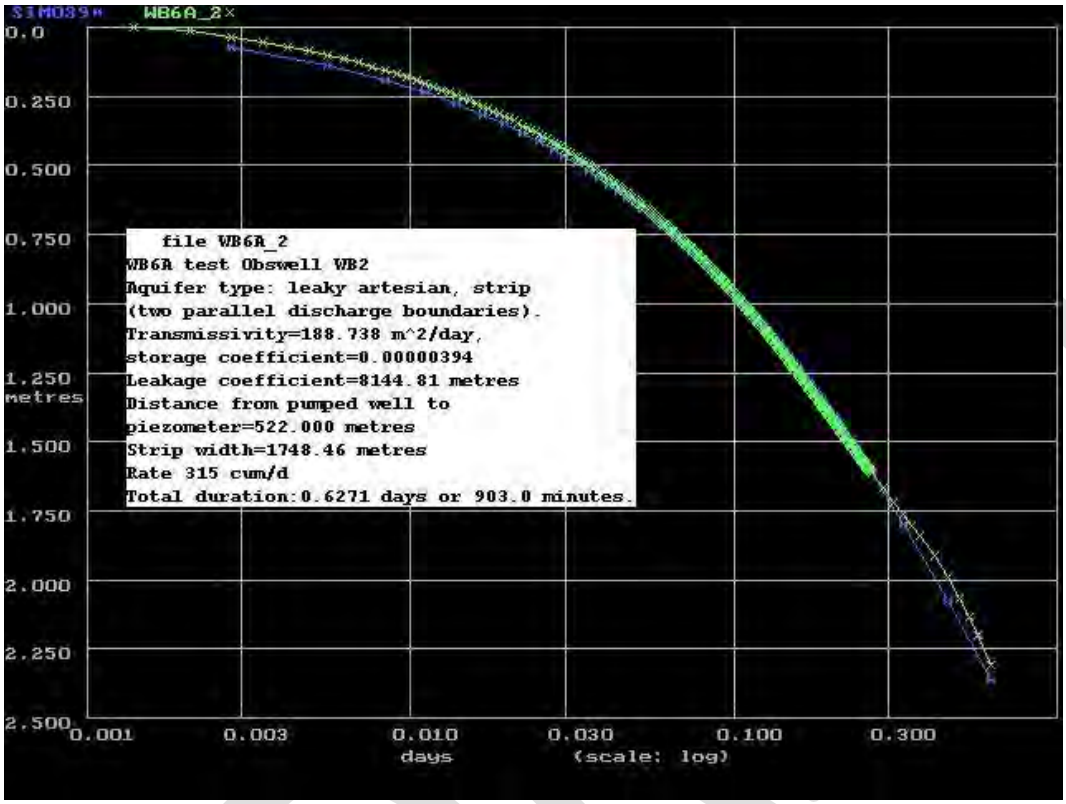
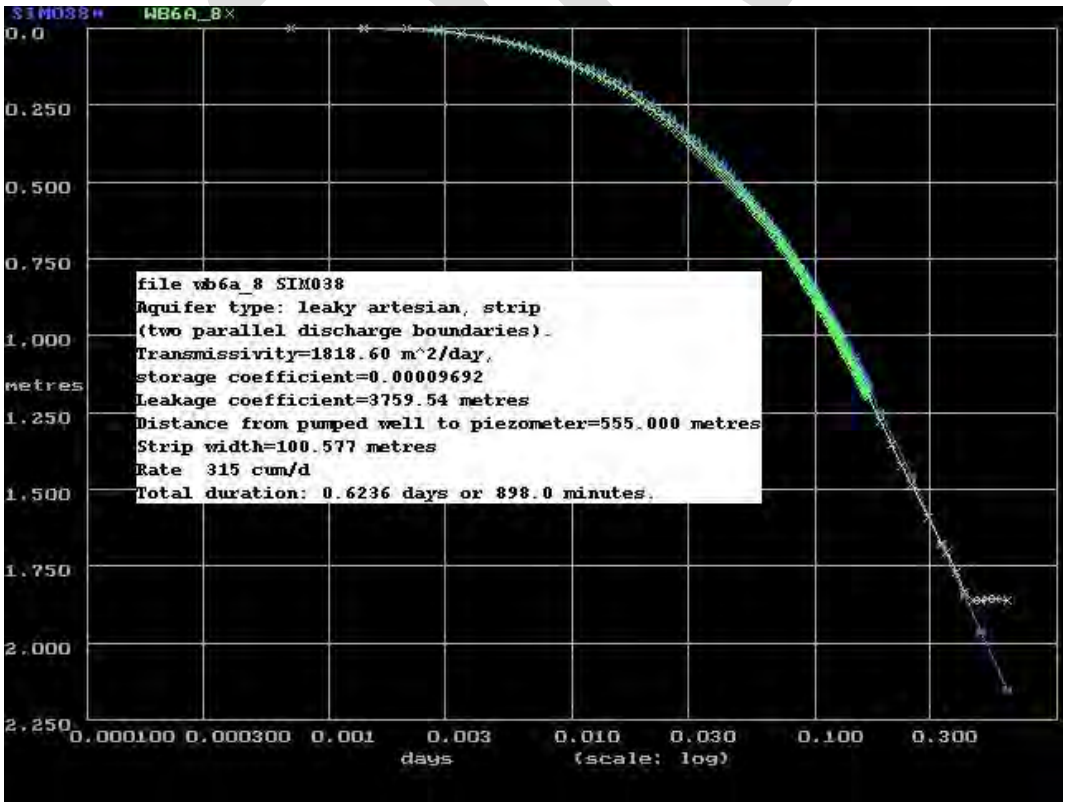
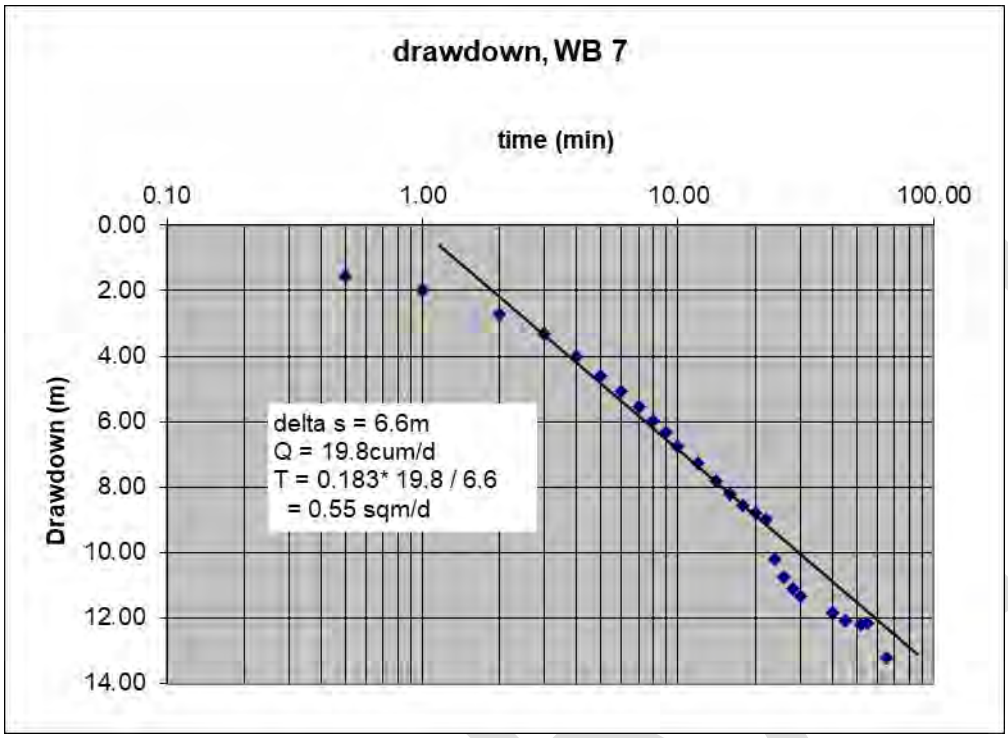




WB-7 Pump test



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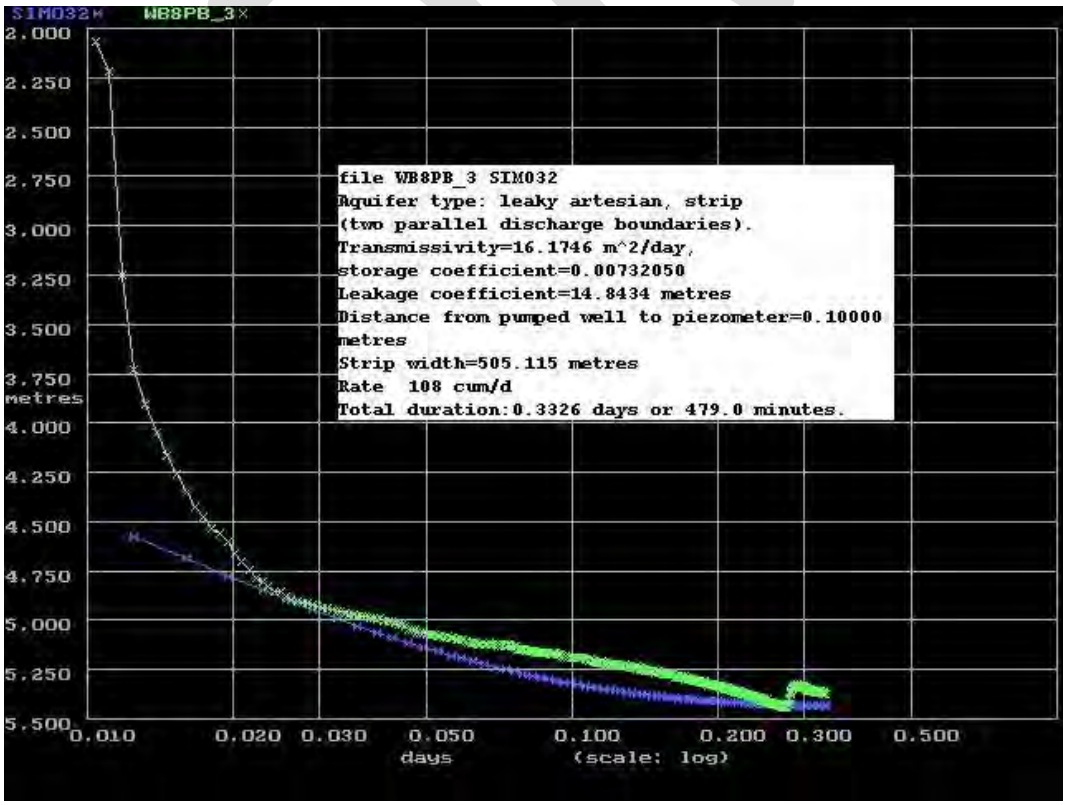
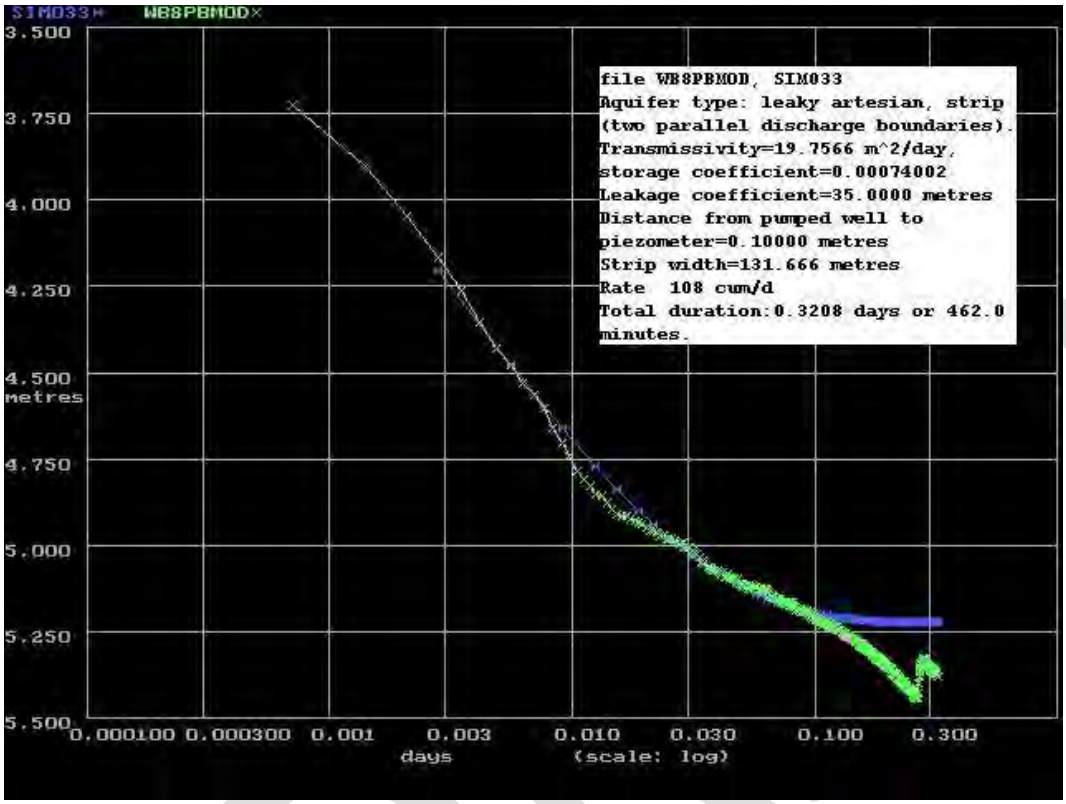
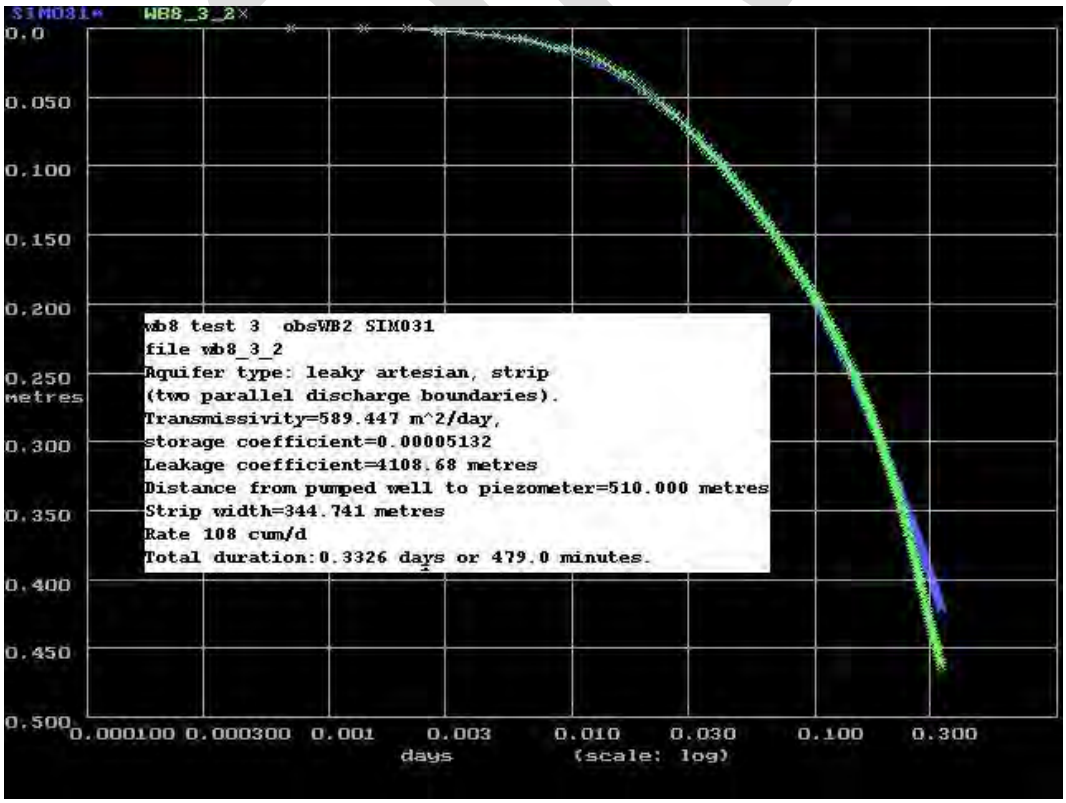
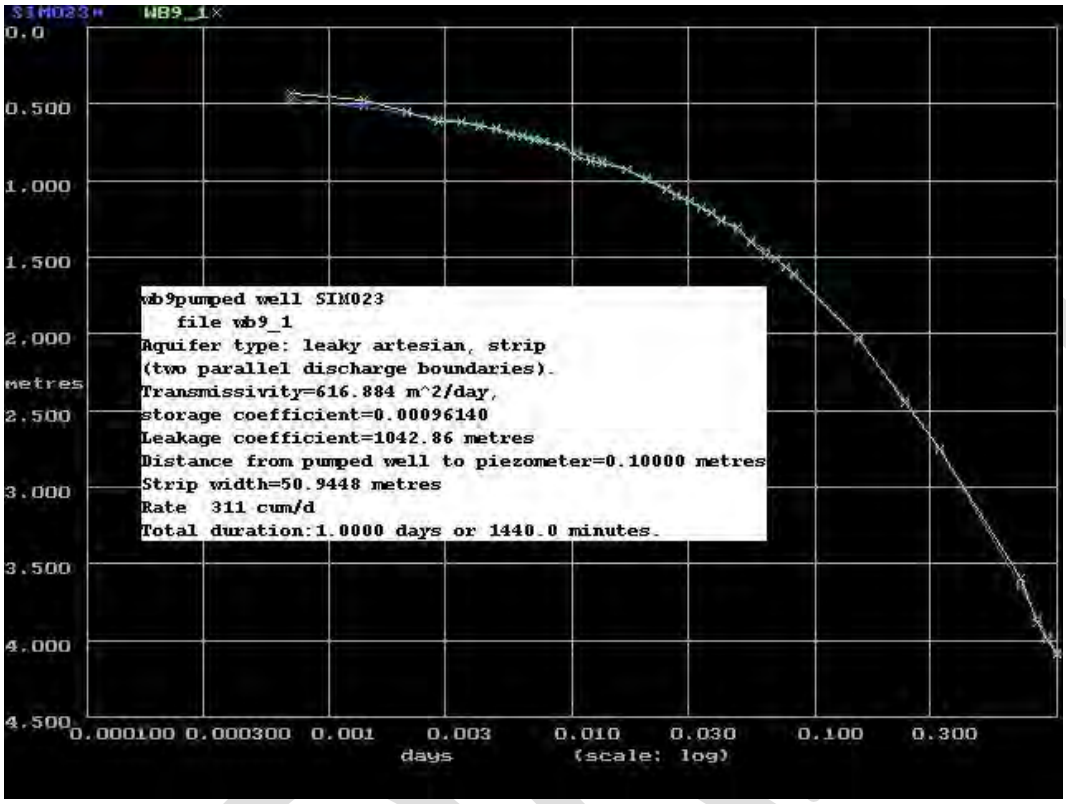


WB-8 Pump Test (continued)

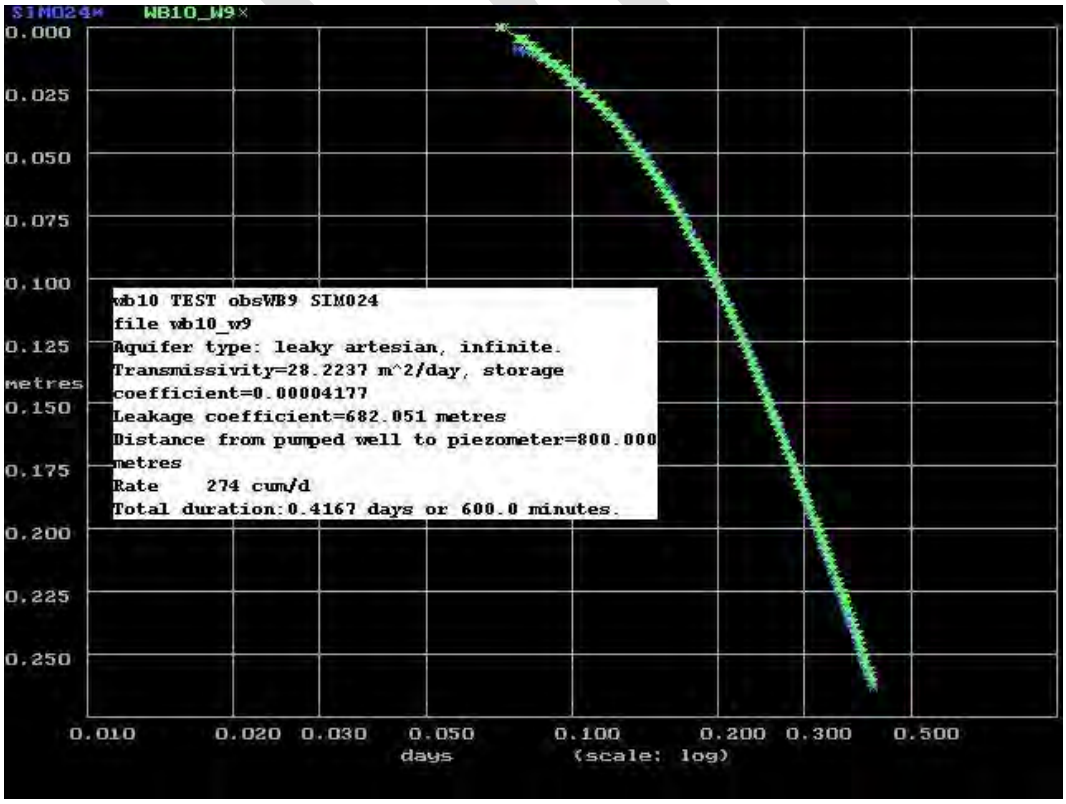




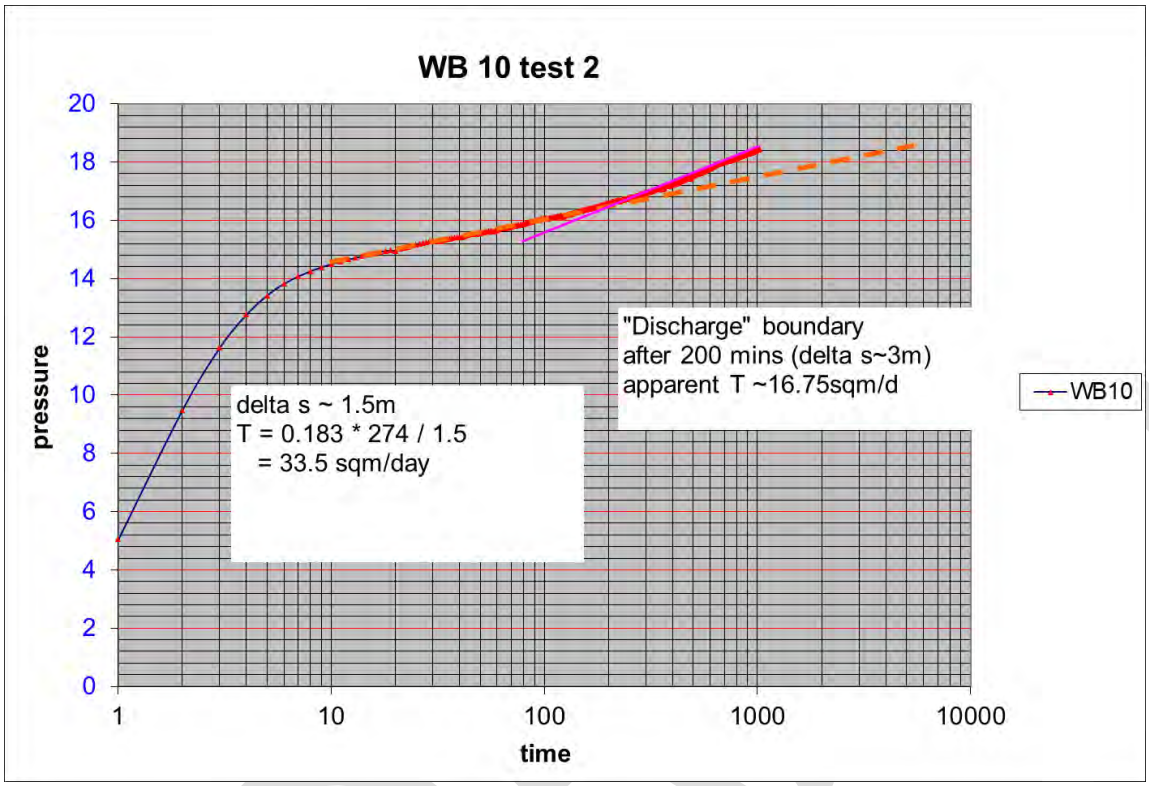
WB9 Pump Test



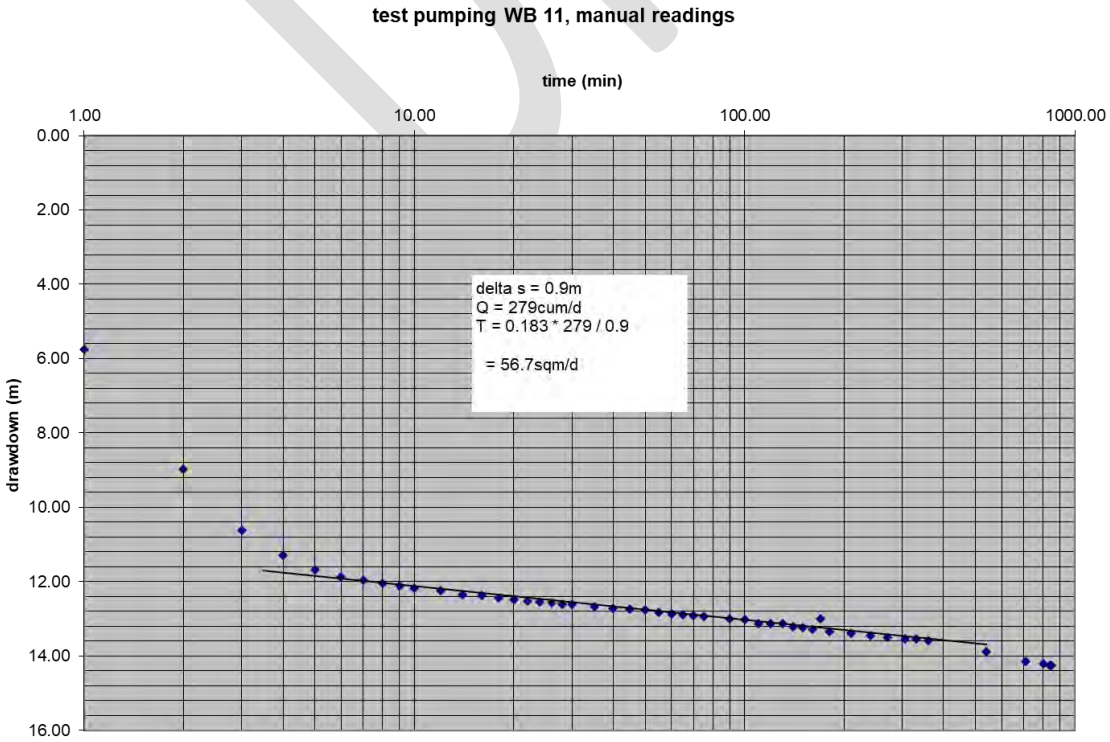
WB10 Pump Test 2



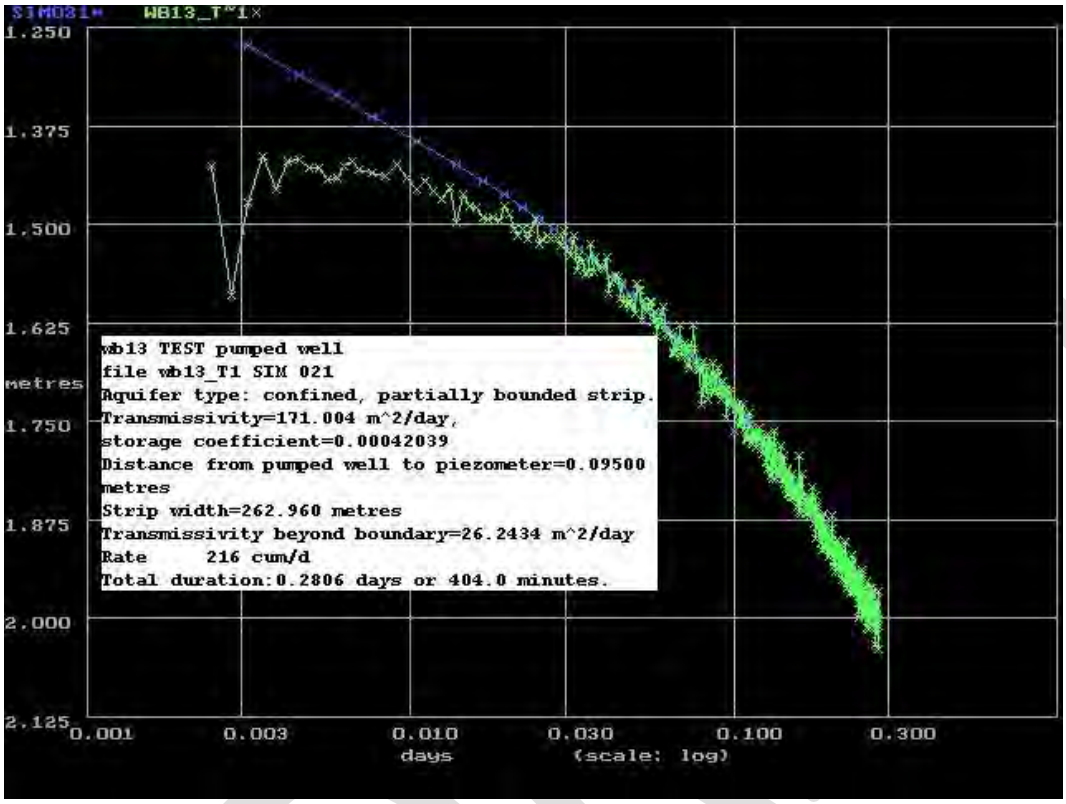
WB10 Pump Test 2 (continued)

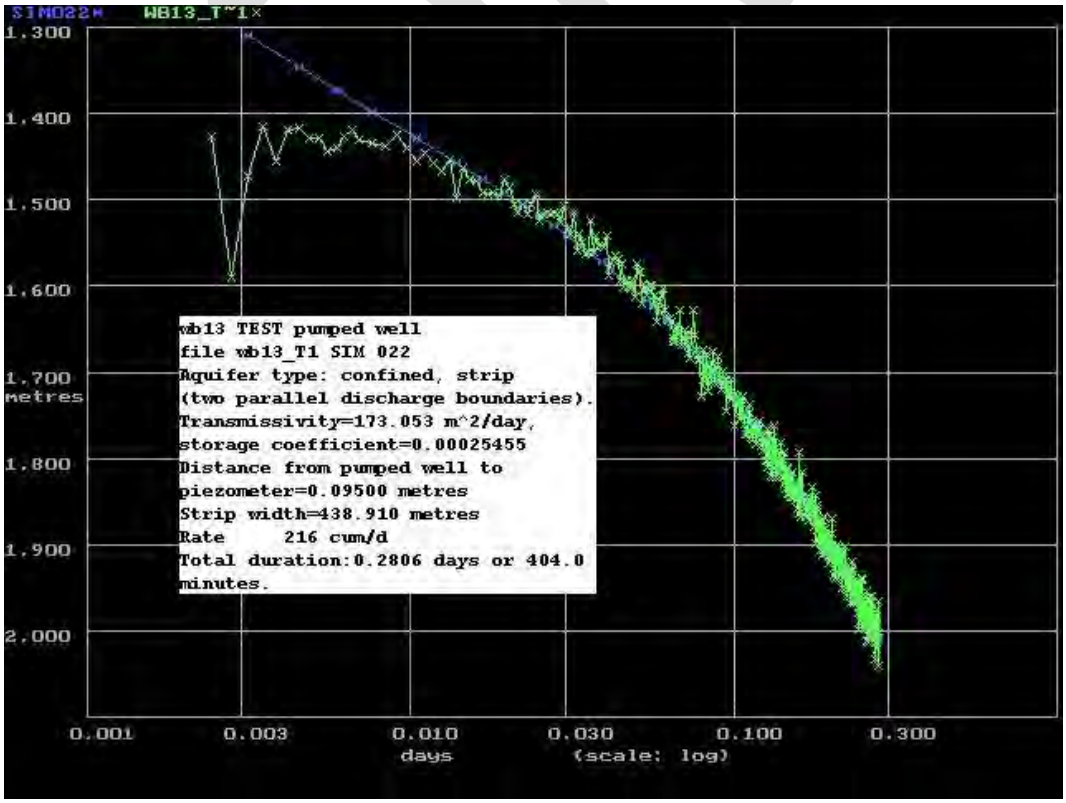


WB11 Pump Test

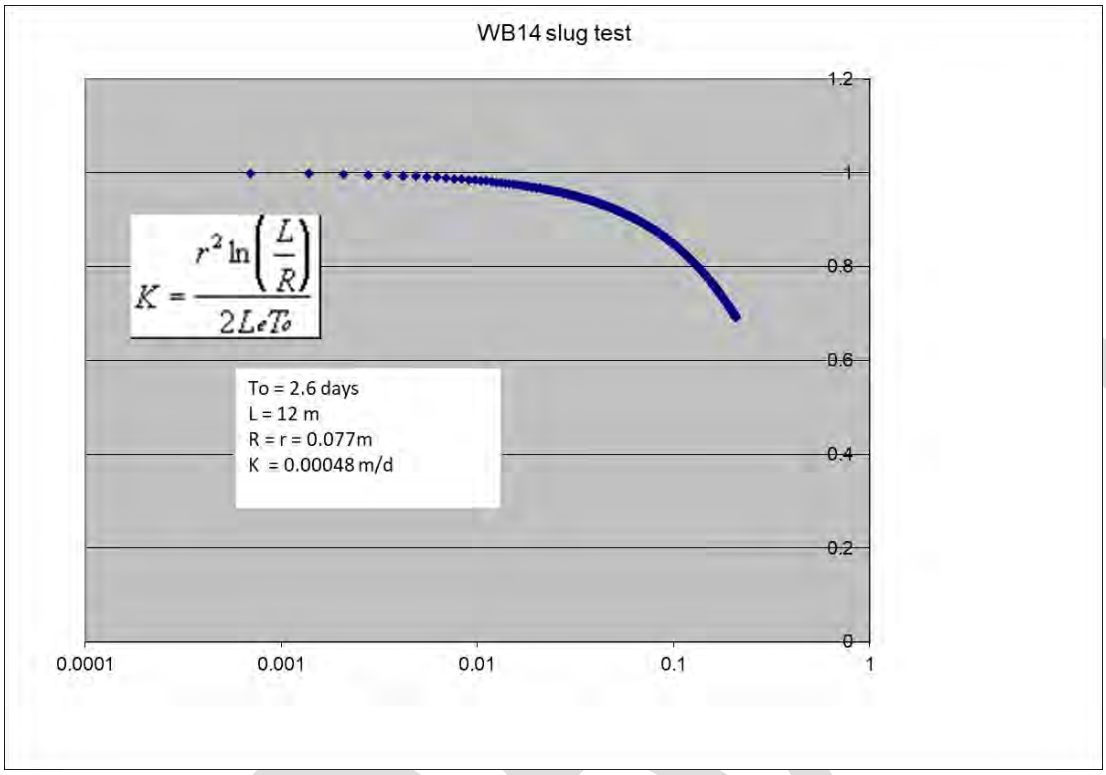


WB13 Pump Test



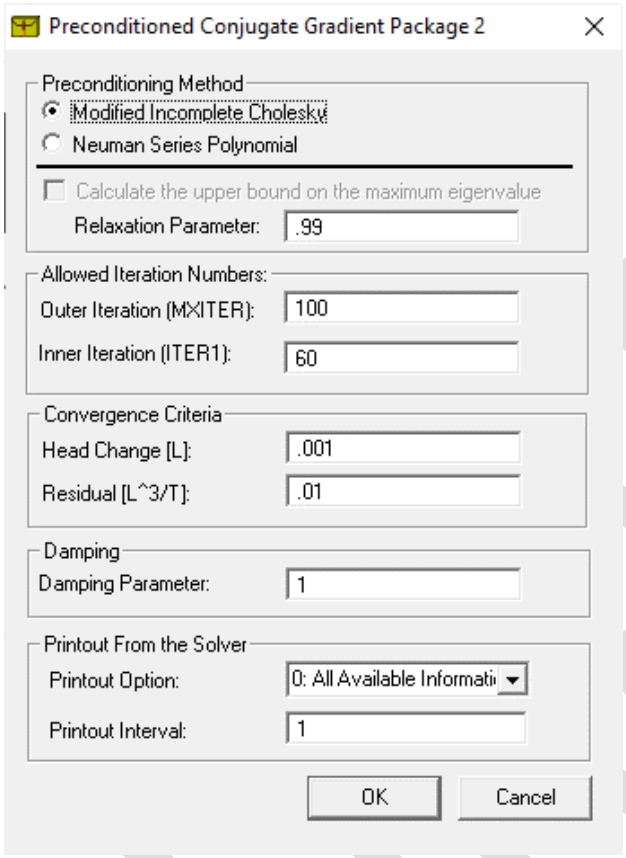


WB14 Slug Test

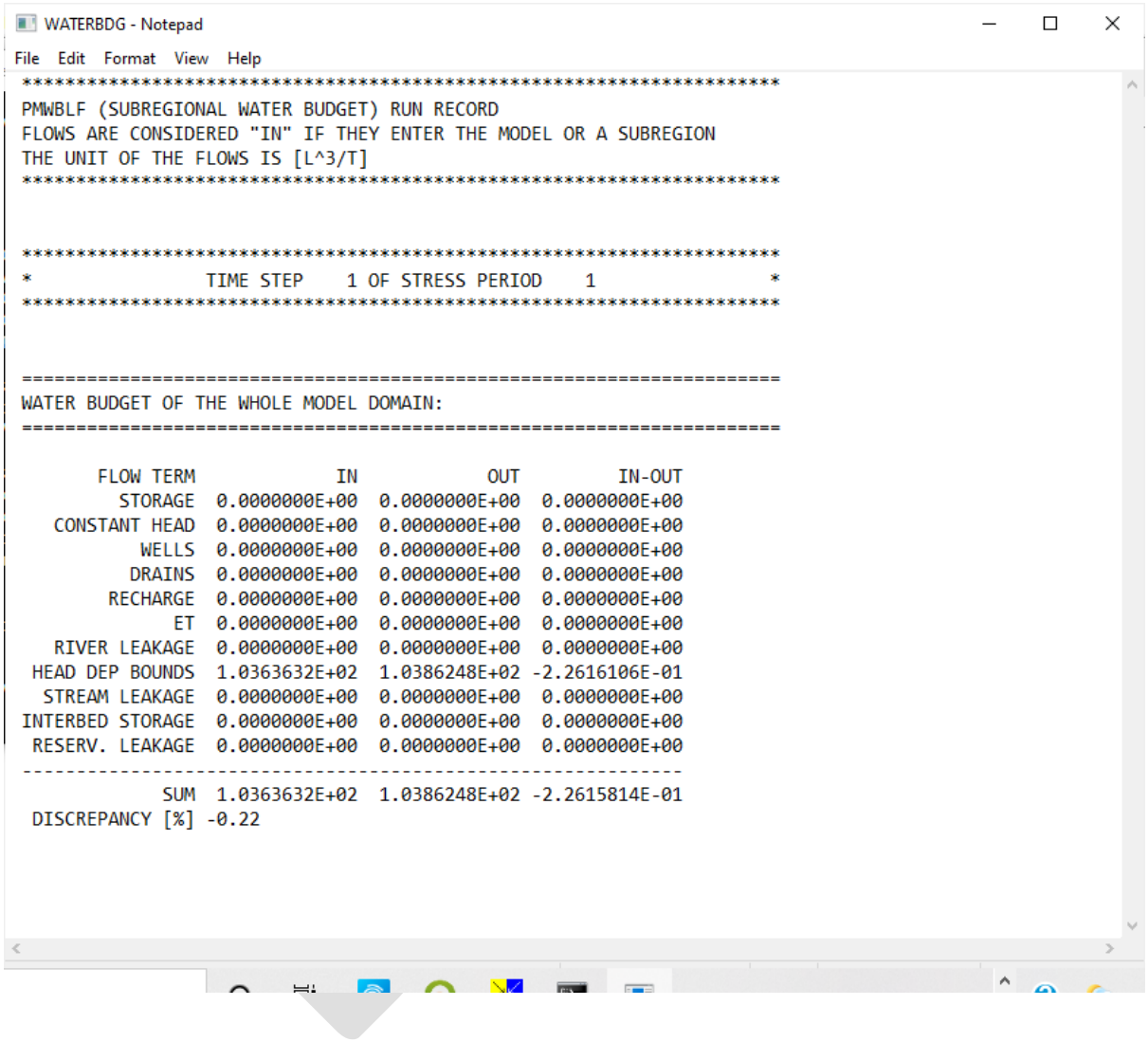


APPENDIX B
WATER BUDGET GRAPHS AND SOLVER CONVERGENCE CRITERIA

Steady state pre-mining solver settings



Steady state pre-mining water budget



WATERBDG - Notepad

File Edit Format View Help

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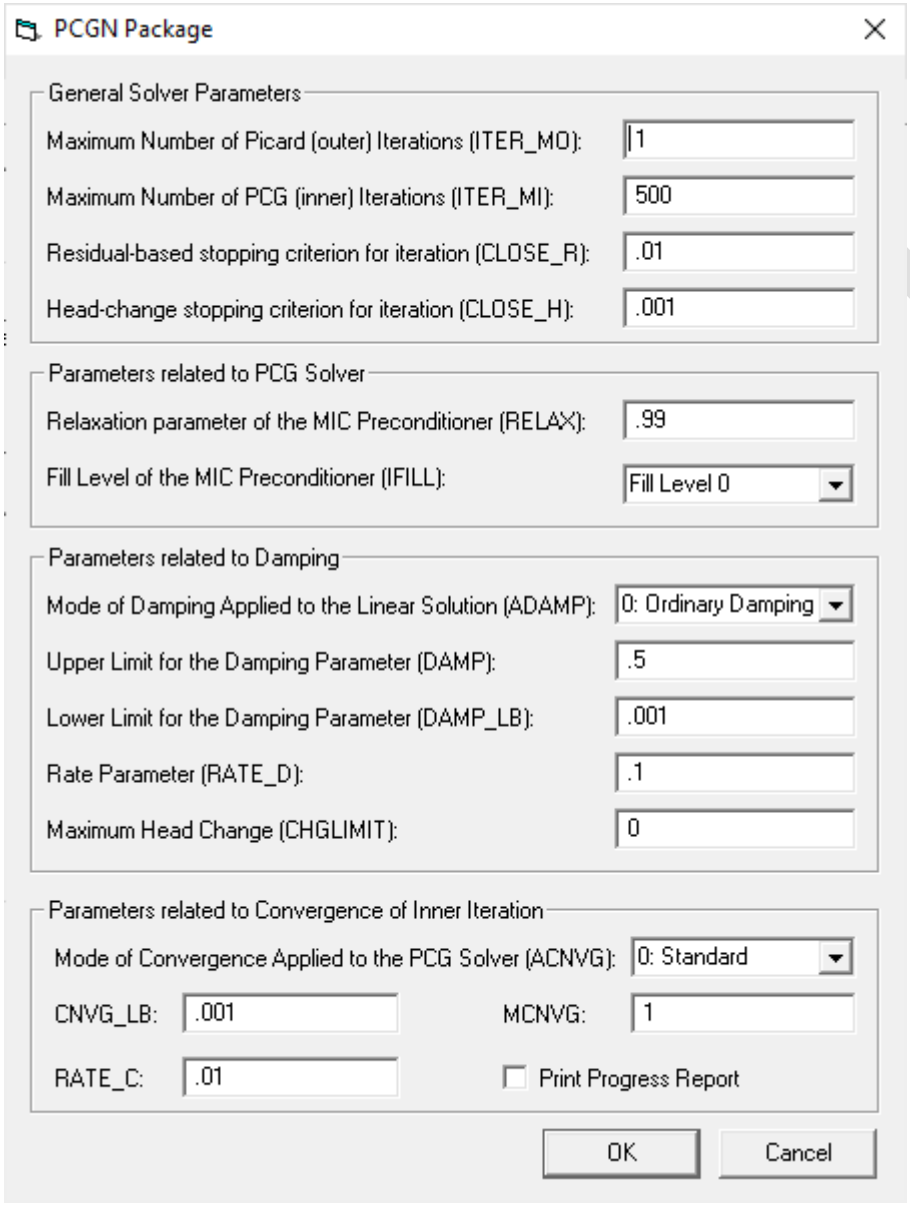
**************************************************************************
PMWBLF (SUBREGIONAL WATER BUDGET) RUN RECORD
FLOWS ARE CONSIDERED "IN" IF THEY ENTER THE MODEL OR A SUBREGION
THE UNIT OF THE FLOWS IS [L^3/T]
**************************************************************************


**************************************************************************
*                TIME STEP    1 OF STRESS PERIOD    1                    *
**************************************************************************


==========================================================================
WATER BUDGET OF THE WHOLE MODEL DOMAIN:
==========================================================================

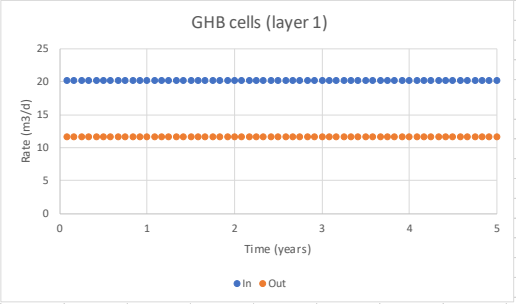
       FLOW TERM             IN            OUT         IN-OUT
         STORAGE  0.0000000E+00  0.0000000E+00  0.0000000E+00
   CONSTANT HEAD  0.0000000E+00  0.0000000E+00  0.0000000E+00
           WELLS  0.0000000E+00  0.0000000E+00  0.0000000E+00
          DRAINS  0.0000000E+00  0.0000000E+00  0.0000000E+00
        RECHARGE  0.0000000E+00  0.0000000E+00  0.0000000E+00
              ET  0.0000000E+00  0.0000000E+00  0.0000000E+00
   RIVER LEAKAGE  0.0000000E+00  0.0000000E+00  0.0000000E+00
 HEAD DEP BOUNDS  1.0363632E+02  1.0386248E+02 -2.2616106E-01
  STREAM LEAKAGE  0.0000000E+00  0.0000000E+00  0.0000000E+00
INTERBED STORAGE  0.0000000E+00  0.0000000E+00  0.0000000E+00
 RESERV. LEAKAGE  0.0000000E+00  0.0000000E+00  0.0000000E+00
--------------------------------------------------------------
             SUM  1.0363632E+02  1.0386248E+02 -2.2615814E-01
 DISCREPANCY [%] -0.22
```

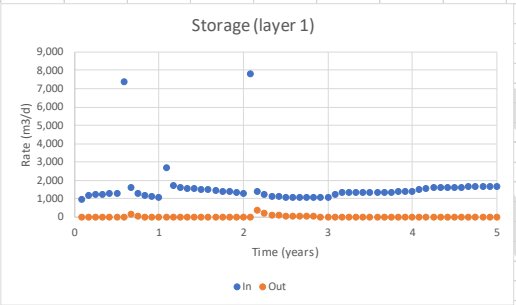
Mining and recovery period solver settings

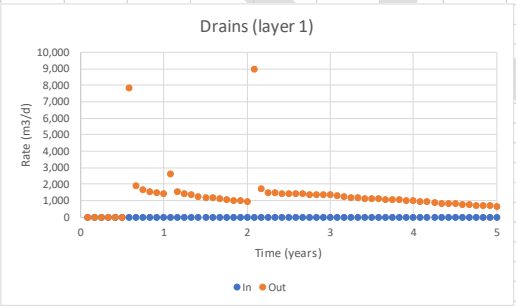


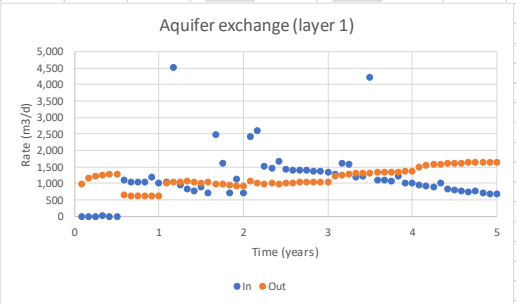
Mining and recovery period water budget graphs

Mining Period V6 - Layer 1

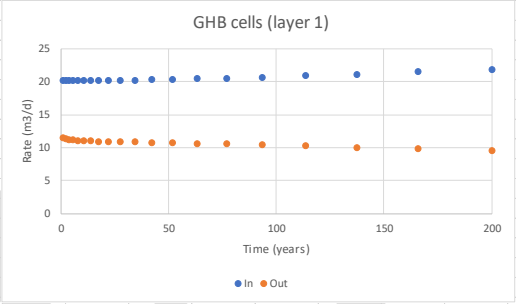


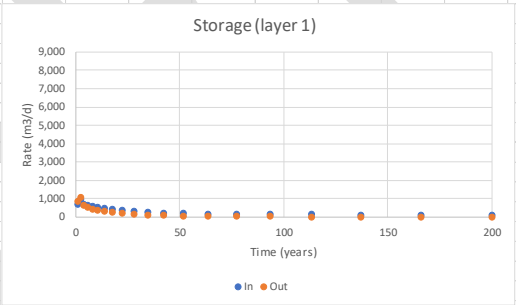


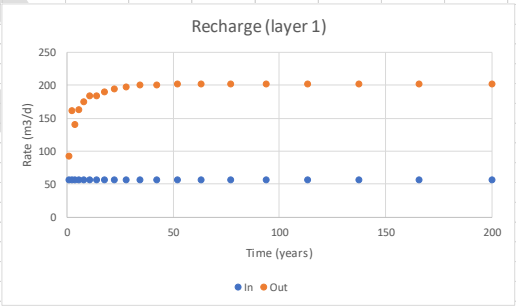


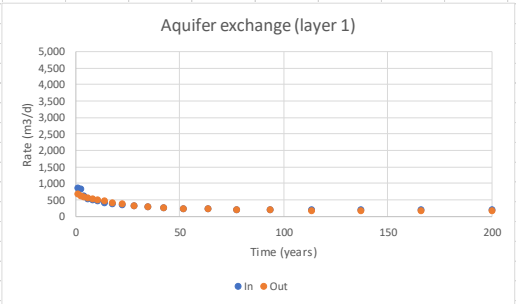


REcovery Period V6 - Layer 1

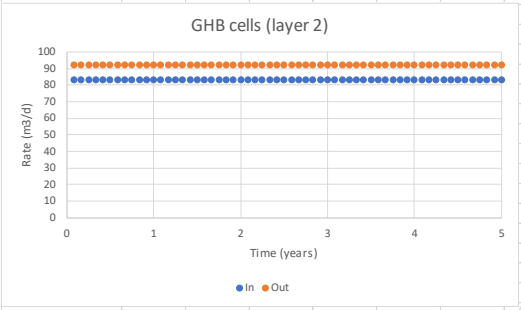


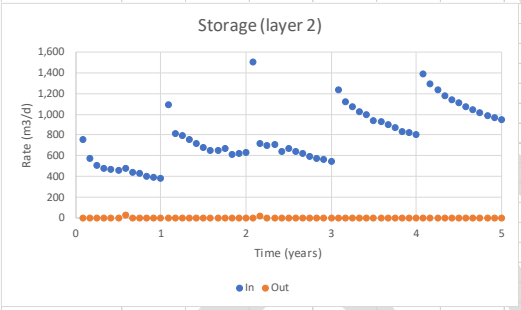


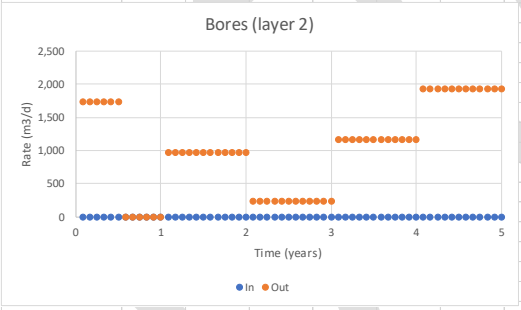


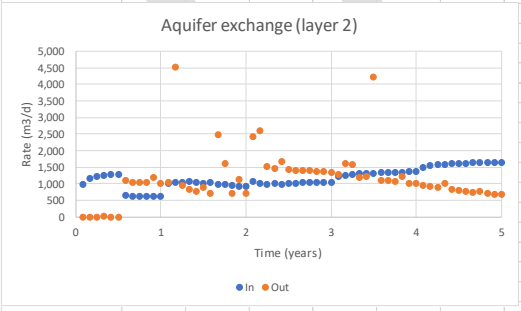


Mining Period V6 - Layer 2

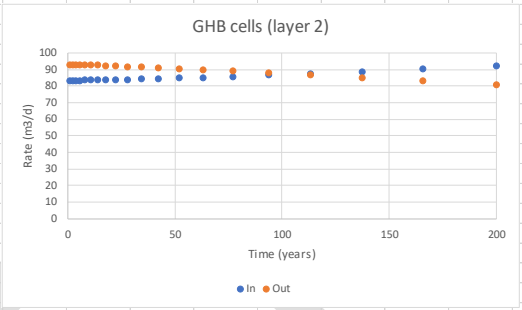


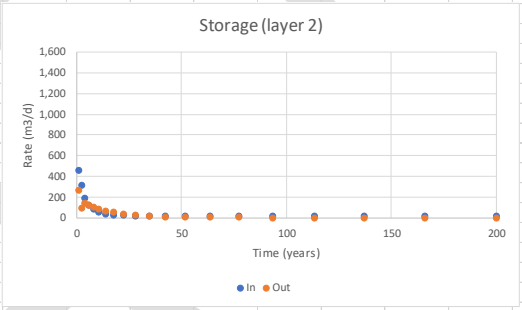


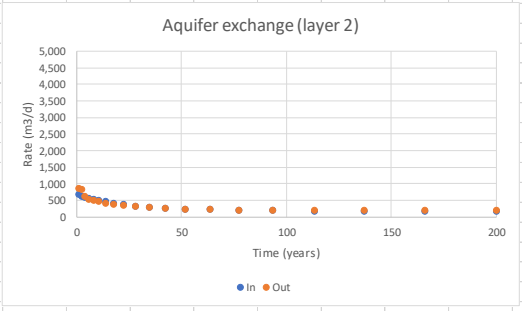




Recovery Period V6 - Layer 2







APPENDIX C
GROUNDWATER CHEMISTRY DATA

Parameter	Stock Guideline Value	Units	WB 2	WB 3	WB 7	WB 13	WB 9	WB 10	WB 11	WB 5	WB 6a
Salinity (TDS)*	<13,000	mg/L	33818	13945	20308	26601	22315	23328	25386	21352	29980
Calcium*	<1000	mg/L	1860	754	1150	1480	1050	1220	1290	1060	1490
Nitrate	<400	mg/L	0	0.09	0	0	0	0	0.01	0.05	0
Nitrite	<30	mg/L	0	0.11	0	0	0	0	0.01	1.44	0.54
Sulphate*	<1000	mg/L	2970	2360	2820	2810	3060	3320	3060	3190	3390
Aluminium	<5	mg/L									
Arsenic	<0.5	mg/L	0.062	0.099	0.083	0.034	0.029	0.028	0.036	0.012	0.082
Boron	<5	mg/L									
Cadmium	<0.01	mg/L	0	0.0002	0.0001	0.0006	0	0.0002	0.0002	0.0007	0.0019
Chromium	<1	mg/L	0	0.006	0	0	0	0	0	0	0.002
Cobalt	<1	mg/L	0.036	0.008	0.017	0.01	0.019	0.017	0.01	0.101	0.064
Copper*	<0.5	mg/L	0.009	0.057	0.015	0.021	0.204	0.587	0.026	0.218	0.057
Fluoride	<2	mg/L									
Lead	<0.1	mg/L	0.002	0.076	0.007	0.002	0	0	0	0.001	0.002
Mercury*	<0.002	mg/L	0	0	0.0031	0	0	0.004	0	0	0
Molybdenum	<0.15	mg/L									
Nickel	<1	mg/L	0.023	0.031	0.007	0.006	0.019	0.015	0.014	0.06	0.022
Selenium	<0.02	mg/L									
Uranium	<0.2	mg/L									
Zinc	<20	mg/L	0.042	1.13	0.081	0.009	0.029	0.028	0.011	0.278	0.043

Parameter	Stock Guideline Value	Units	WB 2	WB 3	WB 7	WB 13	WB 9	WB 10	WB 11	WB 5	WB 6a
Magnesium* (old guideline)	<600 (1992)	mg/L	922	337	508	736	452	543	626	548	750
Chloride	-	mg/L	18500	6500	9610	13900	11600	11900	13200	10400	15800
Sodium	-	mg/L	9390	3860	6030	7500	5990	6170	7040	5730	8420
Potassium	-	mg/L	131	76	116	81	41	67	39	300	38
Beryllium	-	mg/L	0	0	0	0	0	0.001	0.002	0	0.001
Barium	-	mg/L	0.031	0.062	0.026	0.028	0.023	0.027	0.032	0.073	0.033
Manganese	-	mg/L	3.24	1.02	2	3.16	1.77	2.09	3.92	3.02	3.5
Vanadium	-	mg/L	0	0.01	0.01	0	0	0.01	0.02	0	0
Total Anions	-	meq/L	584	234	331	454	393	408	438	363	519
Total Cations	-	meq/L	580	235	364	463	351	376	423	355	504
Ionic Balance	-	%	0.38	0.38	4.72	0.98	5.61	4.15	1.77	1.15	1.58
Total Hardness as CaCO3	-	mg/L	8430	3270	4950	6720	4490	5290	5810	4890	6820
Hydroxide Alkalinity as CaCO3	-	mg/L	0	0	0	0	0	0	0	0	0
Carbonate - Alkalinity as CaCO3	-	mg/L	0	0	10	0	0	0	0	0	0
calculated CO32- from CaCO3 alkalinity	-	mg/L	0	0	6	0	0	0	0	0	0

Parameter	Stock Guideline Value	Units	WB 2	WB 3	WB 7	WB 13	WB 9	WB 10	WB 11	WB 5	WB 6a
calculated HCO3- from CaCO3 alkalinity	-	mg/L	51.24	67.1	75.64	111.02	146.4	128.1	154.94	145.18	107.36
Bicarbonate Alkalinity as CaCO3	-	mg/L	42	55	62	91	120	105	127	119	88
Total Alkalinity as CaCO3	-	mg/L	42	55	72	91	120	105	127	119	88
pH	-	-	7.37	7.47	7.44	7.51	6.95	6.69	6.39	6.85	6.95
Electrical Conductivity @ 25°C	-	µS/cm	33700	14800	20800	27500	34600	36800	40100	33800	51400

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Suite 37, Level 4, 194 Varsity Parade
Varsity Lakes QLD 4227
Telephone (07) 5676 7602

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APPENDIX 2

Native Vegetation Clearance Report

Native Vegetation Clearance

Kalkaroo Copper Project
Temporary Camp

Data Report

Clearance under the *Native Vegetation Regulations 2017*

5/10/2022

Prepared by Ecosphere Ecological Solutions

Table of contents

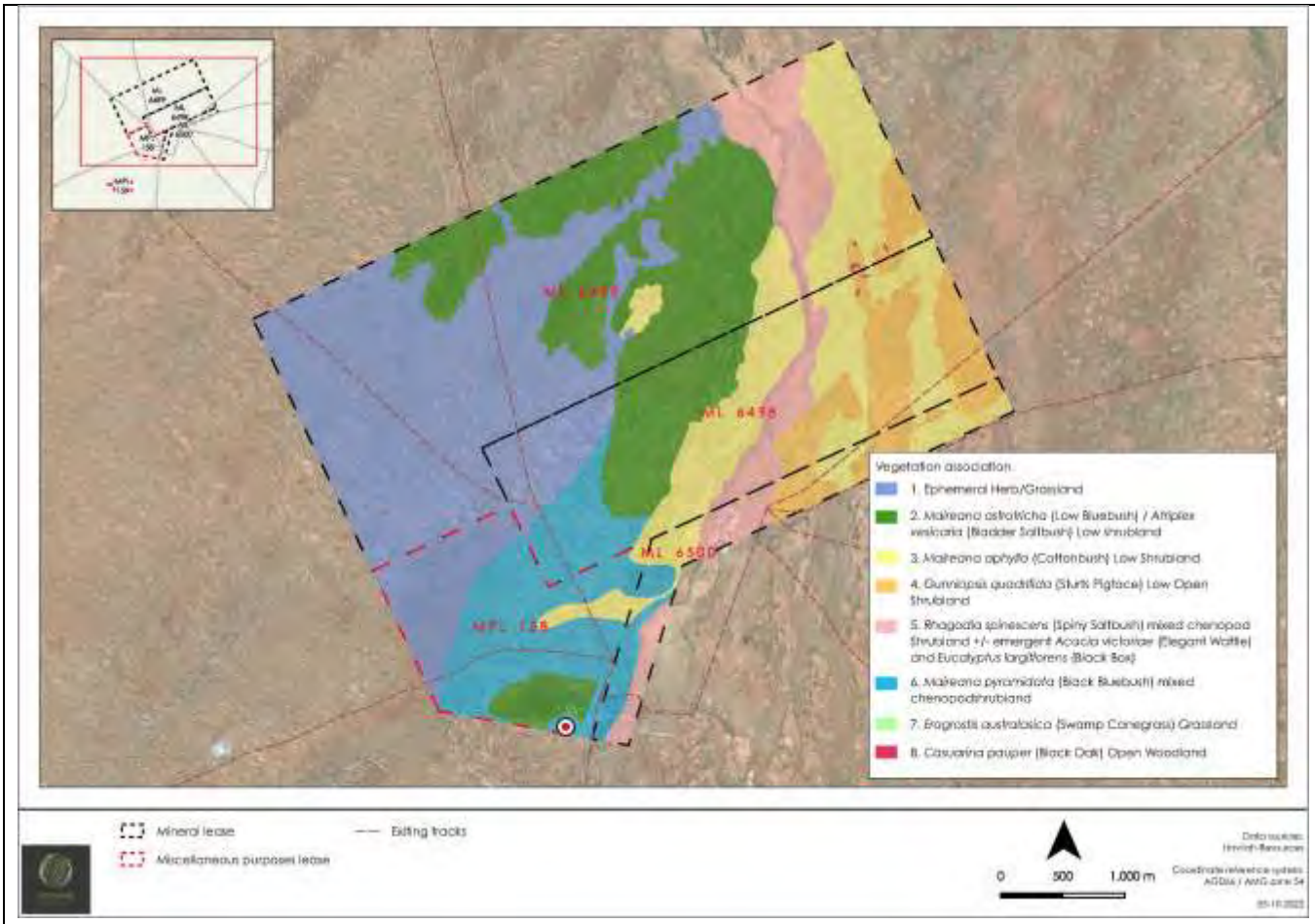
1. Application information

Application Details

Applicant:	Kalkaroo Copper Pty Ltd ML 6498 (497.5 ha) MPL 158 (248.8 ha)		
Key contact:	Dr. Chris Giles PO Box 3 Fullarton SA 5063 (08) 7111 3627		
Landowner:	Kalkaroo Pastoral Pty Ltd C/O Dr Chris Giles		
Site Address:	Kalkaroo Pastoral Lease Kalkaroo 1121 (534km2)		
Local Government Area:	PUA	Hundred:	N/A
Title ID:	Crown Lease CL 1285/21	Parcel ID	H834800 B1121

Summary of proposed clearance

Purpose of clearance	Clearance required for 30 drill pad sites, access tracks, a temporary 33-person camp and associated infrastructure.
Native Vegetation Regulation	Regulation 12(28) – Operations
Description of the vegetation under application	*Maireana astrotricha* (Low Bluebush) / *Atriplex vesicaria* (Bladder Saltbush) low shrubland.
Total proposed clearance - area (ha) and number of trees	13.337ha
Level of clearance	Level 4
Overlay (Planning and Design Code)	Remote areas.



Mitigation hierarchy	The avoidance of vegetation for this project is conducted through placing infrastructure in the areas of lowest condition and quality. The camp will be located immediately adjacent the existing Havilah camp on an area of *Maireana pyramidata* shrubland which is previously disturbed and very sparse.
SEB Offset proposal	Payment of $46,865.92

2. Purpose of clearance

2.1 Description

Clearance is required for the construction of 33 drill pad sites, an access track and a temporary 33-person camp (including carpark, storage area and spray area) associated with the Kalkaroo Copper-Gold Mine (Kalkaroo Copper Pty Ltd).

The Kalkaroo mine is located in north-eastern South Australia, approximately 90 km north-west of Broken Hill. Locally it is approximately 50 km north of the Mingary Siding on the transcontinental railway line and the Barrier Highway. Access is approximately five hours by road from Adelaide and approximately 75 minutes by road from Broken Hill, which is the nearest major centre.

Kalkaroo Copper will use open pit mining techniques to produce approximately 18,000 oz of gold and 1,430t of native copper concentrate per annum over an initial mine life of four years. Processing operations will use a conventional gold carbon in leach and gravity concentration plant to produce gold bars.

2.2 Background

Historically Kalkaroo was primarily used for pastoral activities (sheep grazing) with the wider area falling within the Kalkaroo Pastoral Lease (Kalkaroo Pastoral Pty Ltd). However, agricultural productivity is low, generally supporting only 12 sheep per square kilometre. The land on which the project is located was previously held under Crown Pastoral Lease by Uranium One Australia Pty Ltd (now Boss Energy) between 2007 and 2014 to operate the Honeymoon Uranium Mine. The property was destocked in October 2009 to encourage vegetative regrowth in a bid to secure topsoil and control dust. It is expected that after the completion of mining activities at Kalkaroo, and when it is safe to do so, the area will revert to pastoralism.

Mining tenements are an integral part of the local land use. The temporary camp is located within a miscellaneous purposes mining tenement (MPL 158 (248.8 ha)) for the purpose of mining related infrastructure. The drill pad sites, and associated access track, are located within a mining lease tenement (ML 6498 (497.5ha)) for the purpose of construction materials; metallic minerals.

2.3 General location map

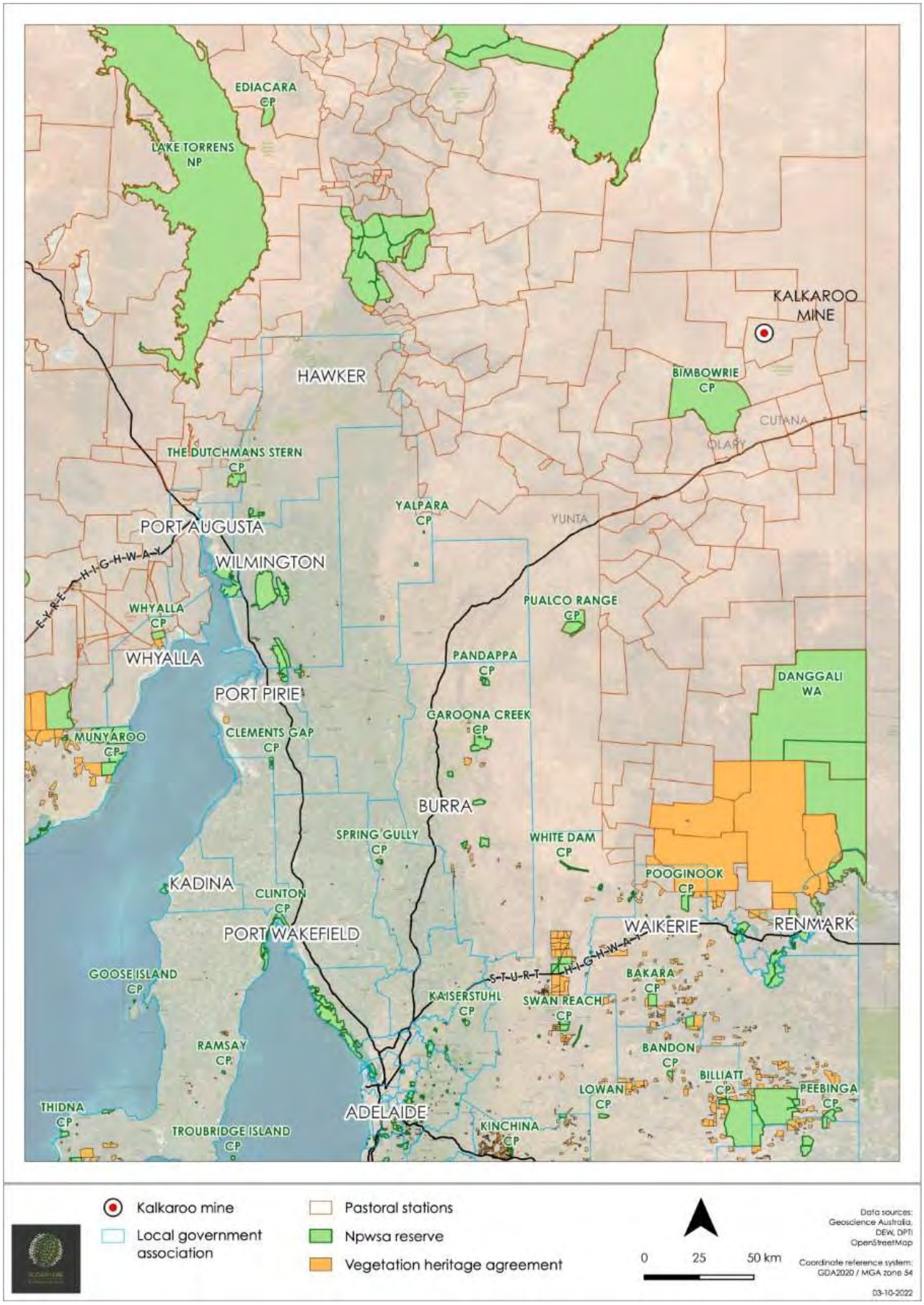


Figure 1. Location of the Kalkaroo Mine with regional context.

2.4 Details of the proposal

Figure 3. Camp layout.

Figure 2. Aerial view of the general camp location.

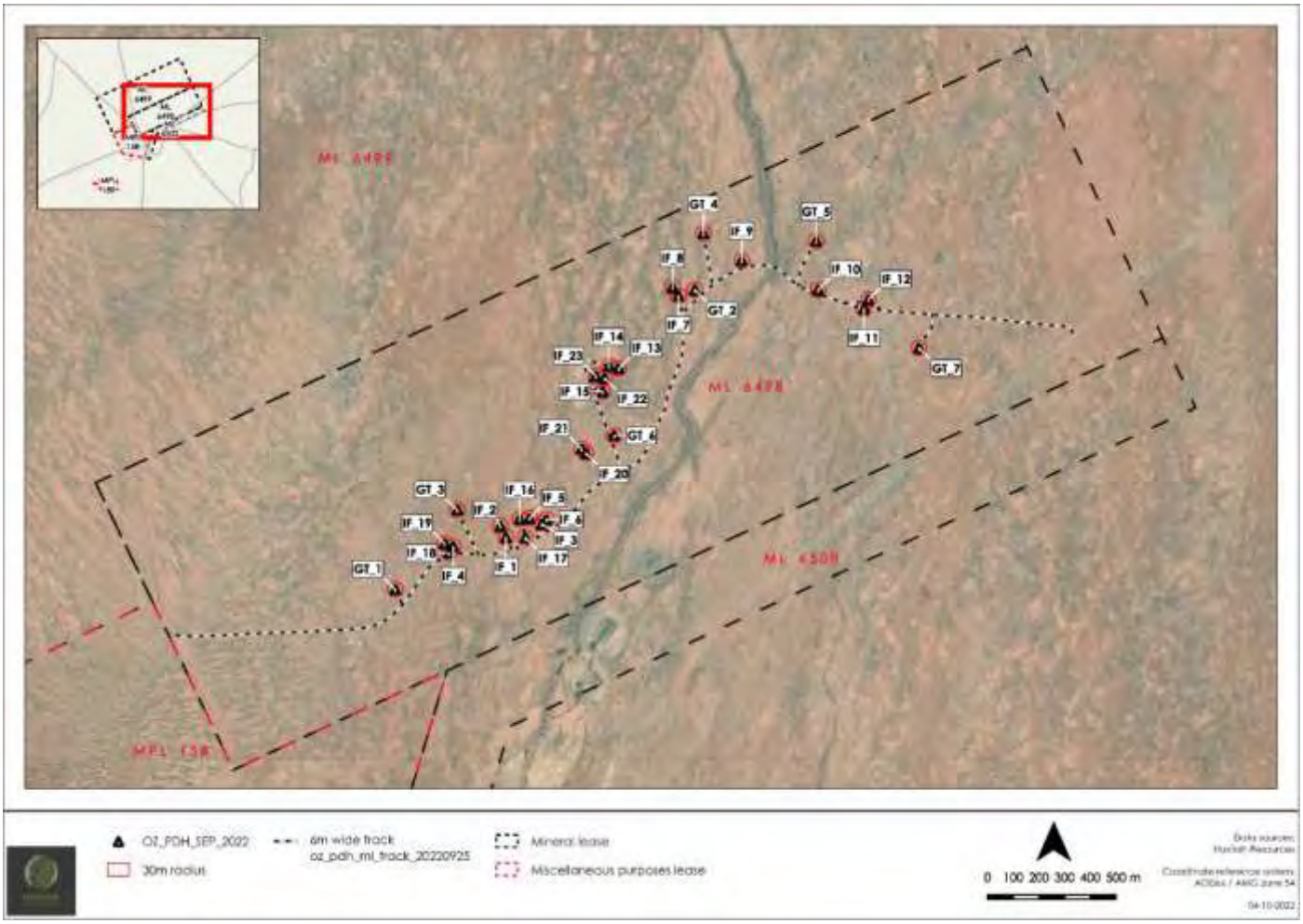


Figure 4. Drill pad sites and access track locations

2.5 Approvals **required** ***or*** **obtained**

Legislation	Summary	Relevance
Commonwealth		
Mining Act 1971 *To be amended to Statutes Amendment (Mineral Resources) Act 2019*, in 2021	The Mining Act regulates a wide range of activities, from initial exploration to locate potentially economic mineral deposits, through to the extraction of the mineral and its production into a useable commodity. It also includes the rehabilitation of the mine site once mining ends.	When determining conditions to attach to a mineral exploration or production licence, the Minister may consider any factors appropriate to a particular case, but must consider the protection of: • the natural beauty of the area that will be affected by the proposed *lease* or licence. • the flora and fauna of any natural environment or habitat in the area;
Environment Protection and Biodiversity Conservation Act 1999	To protect 'matters of national environmental significance' (MNES): • World Heritage properties • National Heritage properties • wetlands of international importance (Ramsar wetlands) • listed threatened species and ecological communities. • migratory species • Commonwealth marine areas • the Great Barrier Reef Marine Park • nuclear actions (including uranium mining).	Where an activity may trigger requirements of the EPBC Act, this legislation must be considered. Any action that has, will have, or is likely to have a significant impact on a matter of national environmental significance requires referral and approval. Significant penalties apply. To determine whether an action is likely to have a significant impact on a matter of national environmental significance, refer to the Significant Impact Guidelines (Commonwealth of Australia 2009) at: http://www.environment.gov.au/epbc/publications/pubs/nes-guidelines.pdf.
South Australia		
National Parks and Wildlife Act 1972	Allows for the protection of habitat and wildlife through the establishment of parks and reserves (both on land and in State waters); provides for the protection of native flora and fauna; identifies flora and fauna species considered to be of conservation significance (under Schedules 7, 8, and 9 of the Act); and provides for the use of approved wildlife through a system of permits allowing certain actions, i.e. keeping and selling (s.58), harvesting (s.60G), farming (s.60C), hunting (s.68A), releasing (s.55) and undertaking scientific research (s.53) on/of native fauna species, and for the taking of plants (s.49).	A person must not "take" a native plant, protected animal or the eggs of a protected animal without approval (s.48A). Significant penalties apply. To take a native plant means to remove the plant or part of the plant, from the place in which it is growing; or to damage the plant. To take a protected animal means to remove, hunt, catch, restrain, kill or injure an animal, or attempt to do so. A person may take non-prescribed plant species from private land with the consent of the owner; however, these species may also be covered under the *Native Vegetation Act 1991*. There are several non-complying activities in parks and reserves that result in penalty (parts 4-6).
Native Vegetation Act 1991	To preserve, enhance and manage the State's native vegetation; provide a regulatory framework to control clearance of vegetation; and provide incentives and assistance to landowners to encourage them to preserve and enhance native vegetation. The Act protects all native vegetation that naturally occurs, i.e., vegetation which has not been planted. This includes all naturally occurring local native plants, from small ground covers and native grasses to mallee	Persons wanting to clear native vegetation must apply for a permit from the Native Vegetation Council (NVC) (ss.7,14), unless exempt under the regulations. The NVC will consider the impacts of the proposed clearance and may grant consent, refuse consent or grant consent subject to certain conditions (s.29). A net environment benefit is generally conditional on an approval being granted. Significant penalties apply if a person clears native vegetation without the permission of the NVC (s.26). The NVC can also take civil enforcement proceedings in the District Court for an order that the native vegetation be re-instated (s.31).

	scrub and tall trees. It does not cover planted trees. Approval is required for the clearance of native vegetation. Clearance is defined as: • the killing or destruction of native vegetation • the removal of native vegetation • the severing of branches, limbs, stems or trunks of native vegetation. • the burning, poisoning and slashing of native vegetation. • any other substantial damage to native vegetation including activities such as the draining for the reclamation of wetlands or flooding of land, grazing land where stock have been excluded for more than ten years.	The Act also provides the opportunity for landholders to enter voluntarily "Heritage Agreement(s)" to ensure vegetation on private land is protected for perpetuity (s.23).
Landscape South Australia Act 2019	From July 1, 2020, the Landscape South Australia Act 2019 (LSA Act) replaced the Natural Resources Management Act 2004, as the key framework for managing the state's land, water, pest plants and animals, and biodiversity across the state.	Under the South Australian LSA Act landholders have a legal responsibility to manage declared pest plants and animals and prevent land and water degradation. A key priority of landscape boards is to support local communities and landowners to be solely responsible for sustainably managing their region's landscapes with an emphasis on land and water management, pest animal and plant control, and biodiversity. This includes providing greater funding and partnership opportunities with local community organisations to deliver on ground works and projects.
Planning, Development and Infrastructure Act 2016	The primary objects of the Act are to 'support and enhance the State's liveability and prosperity in ways that are ecologically sustainable, meet the needs and expectations and reflect the diversity of the State's communities. by creating an effective, efficient and enabling planning system' that: • facilitates development and the integrated delivery of infrastructure and the public realm; and • encourages community participation in setting planning policies and strategies.	The planning system plays an important role in the achievement of this outcome. Any proposed development involving the clearance of native vegetation requires separate approvals: (1) a development approval under the *Development Act 1993* (current for regional and metropolitan areas) or the Planning, Development and Infrastructure Act 2016 (current for Outback and Coastal Waters), and (2) a native vegetation clearance approval under the *Native Vegetation Act 1991*. To achieve better alignment, the Planning and Design Code introduces two new Overlays for native vegetation. The Overlays map out locations where the clearance of native vegetation should be avoided or minimised. Under the new planning system, two approvals will still be required but native vegetation considerations will also now be 'up-front' in the development application process. This change will better align the two approval processes, use the same information reports and ensure that design and siting to avoid and minimise the clearance of native vegetation is a fundamental part of the planning process.

2.5 Native Vegetation Regulation

Regulation 12(28) – Operations, to allow the clearance of native vegetation for operations authorised under a Mining Act or the *Petroleum and Geothermal Energy Act 2000*. Clearance must be incidental to operations authorised under a Mining Act or the *Petroleum and Geothermal Energy Act 2000*.

2.6 Development Application information (if applicable)

The P & D code zoning is listed as Remote areas.

3. Method

3.1 Desktop study

3.1.1 Protected Matters Search Tool (PMST) – EPBC Act

The online Protected Matters Search Tool was used to determine MNES under the EPBC Act relevant to the Project area (DoEE 2020). The PMST is maintained by the Commonwealth Department of Agriculture Water and the Environment (DAWE) and was used to identify flora and fauna species or ecological communities of national environmental significance that may occur or likely to have suitable habitat within the Project areas. Nationally threatened species potentially occurring within the sites were identified from this source.

3.1.2 Biological Database of South Australia (BDBSA) – NPW Act

A Biological Database of South Australian (BDBSA) Supertable search was obtained from the South Australian Department for Environment and Water (DEW) on 29th September 2022 to identify flora and fauna species previously recorded within a 5 km buffer around the Project area (DEW 2020). The BDBSA is comprised of an integrated collection of corporate databases which meet DEWNR standards for data quality, integrity, and maintenance. In addition to DEWNR biological data the BDBSA also includes data from partner organisations (Birds Australia, Birds SA, Australasian Wader Study Group, SA Museum, and other State Government Agencies). This data is included under agreement with the partner organisation for ease of distribution, but they remain owners of the data and should be contacted directly for further information.

3.1.3 Assessment of the likelihood of occurrence

The likelihood of each threatened flora and fauna species occurring within the Project areas was assessed. A likelihood of occurrence rating (Highly Likely / Known, Likely, Possible and Unlikely) was assigned to each threatened species identified in the desktop PMST and BDBSA search (Table 1).

Table 1. Criteria for the likelihood of occurrence of species within the Project area.

Likelihood	Criteria
Highly Likely/Known	Recorded in the last 10 years, the species does not have highly specific niche requirements, the habitat is present and falls within the known range of the species distribution or; The species was recorded as part of field surveys.
Likely	Recorded within the previous 20 years, the area falls within the known distribution of the species and the area provides habitat or feeding resources for the species.
Possible	Recorded within the previous 20 years, the area falls inside the known distribution of the species, but the area provides limited habitat or feeding resources for the species. Recorded within 20 -40 years, survey effort is considered adequate, habitat and feeding resources present, and species of similar habitat needs have been recorded in the area.
Unlikely	Recorded within the previous 20 years, but the area provides no habitat or feeding resources for the species, including perching, roosting or nesting opportunities, corridor for movement or shelter. Recorded within 20 -40 years; however, suitable habitat does not occur, and species of similar habitat requirements have not been recorded in the area. No records despite adequate survey effort.

3.2 Field Survey

The field survey was conducted in January 2021 by NVC accredited ecologist Andrew Sinel. The field survey included a vegetation survey and fauna assessment.

3.2.1 Vegetation survey

Methodology was conducted in accordance with NVC requirements, as outlined in the Rangelands Assessment Manual (NVC 2019). Background to the RAM method, and identification of landforms present within the tenements is presented below.

The NVC RAM has been developed for vegetation assessments undertaken for the NVC, including clearance or regulation application areas, potential and established SEB offset areas and Heritage Agreements. The method aligns the assessment of vegetation (and land) condition with the RAM developed by South Australian Arid Lands Landscape Management Region (SAAL) for the rapid assessment of pastoral properties in sheep and cattle country but is adapted for native vegetation assessments in arid rangelands throughout South Australia (NVC 2019).

Given the large scale of activities that occur in the rangelands, stratifying the landscape into homogeneous units is often difficult and time consuming. Vegetation compositions in the arid zone are largely driven by landform features, such as ridges, slopes or flats, which influence water redistributions in the landscape. Vegetation condition, however, is mainly driven by pastoral use (history of stock grazing). Information, such as pastoral grazing gradients, is available to assist with the division of the landscape based on these features before going into the field (NVC 2019).

3.2.2 Fauna survey

A focus of the on-ground fauna assessment was on avian species due to the availability of passive observations and low interference required as well as the overwhelming bias of avian species listed as threatened within the wider area. For more inconspicuous fauna species, opportunistic observations were recorded, or alternatively, the native vegetation within the project area buffer was assessed for fauna habitat value. Therefore, the likelihood of specific species occurring within the project footprint buffer was made based on the presence of suitable habitat and included:

- reviewing previous field survey results and database records.
- assessing the habitat value of the vegetation during the field survey to determine the fauna species likely to occur within the Project area; and
- highlighting any areas of significant fauna value.

4. Assessment Outcomes

4.1 Vegetation Assessment

General description of the vegetation, the site and matters of significance

The landscape consists of a level plain with extremely low relief across the tenements. The soils varied from heavy clay flats with minor gilgai and flood out areas occupied by ephemeral herbs and grass species through to sandy clay soils elevated less than 500mm and were occupied by larger perennial shrubs such as *Maireana*, *Atriplex* and *Gunniopsis*. These landforms were almost entirely devoid of trees due the extremely low relief. The plain is intersected by a shallow drainage channel which was differentiated from the surrounding landscape by emergent shrubs on the channel edges and flood terraces.

Details of the vegetation associates/scattered trees proposed to be impacted

Vegetation associations for the camp, drill pads and access tracks were adapted from Ecosphere (2021) and were comprised of six vegetation associations (Table 2). These were dominated chenopod shrublands. Vegetation within the lease areas have been historically in excellent condition because of the destocking of the lease since 2009 (Table 2, Figure 6 and Figure 7). A total of just over 13 hectares is earmarked for disturbance to construct the exploration camp and undertake the test drilling.

Table 2. Vegetation association summary.

Vegetation Association	Impacted Area (ha)
1. Ephemeral Herb/Grassland	0.068
2. *Maireana astrotricha* (Low Bluebush) / Atriplex vesicaria (Bladder Saltbush) Low shrubland	3.665
3. *Maireana aphylla* (Cotton-bush) Low Shrubland	8.458
4. *Gunniopsis quadrifida* (Sturt's Pigface) Low Open Shrubland	0.687
5. *Rhagodia spinescens* (Spiny Saltbush) mixed chenopod Shrubland +/- emergent *Acacia victoriae* (Elegant Wattle) and *Eucalyptus largiflorens* (Black Box)	0.076
6. *Maireana pyramidata* (Black Bluebush) mixed chenopod shrubland	0.383
Total	13.337

Vegetation Association 1	Ephemeral Herb/Grassland

General description	Occupying clay flats with minor gilgais hollows and slightly cracking clay. Very few perennial flora species present only as occasional				
Threatened species or community	No perennial flora community present. Not conservation significant.				
Landscape context score	1.16	Vegetation Condition Score	Ave. 26.17	Conservation significance score	1.10
Unit biodiversity Score	Ave. 33.39	Area (ha)	0.068	Total biodiversity Score	2.08

Vegetation Association 2	***Maireana astrotricha* (Low Bluebush) / *Atriplex vesicaria* (Bladder Saltbush) Low shrubland**

General description	Low open shrubland on very low relief sandy clay soils elevated very slightly above the surrounding clay gibber plain. Moderately productive zone with mixed shrubland persisting on low hummocks with higher species diversity.				
Threatened species or community	Not a conservation significant community.				
Landscape context score	1.16	Vegetation Condition Score	Ave. 41.90	Conservation significance score	1.10
Unit biodiversity Score	Ave. 52.86	Area (ha)	3.665	Total biodiversity Score	193.73

Vegetation Association 3	*Maireana aphylla* (Cottonbush) Low Shrubland

General description	Areas within flood terraces of the main ephemeral drainage line and other very shallow drainage depressions barely visible on surrounding plain as well as flood out zones and depressions adjacent to *Maireana astrotricha* shrublands. Highly productive zones following rainfall with high species richness and shrubs well established un-modified in most cases. Very transitional community without distinct boundaries between the surrounding shrublands.				
Threatened species or community	Not a conservation significant community.				
Landscape context score	1.16	Vegetation Condition Score	Ave. 41.00	Conservation significance score	1.10
Unit biodiversity Score	Ave. 52.32	Area (ha)	8.458	Total biodiversity Score	442.52

Vegetation Association 4	*Gunniopsis quadrifida* (Sturts Pigface) Low Open Shrubland

General description	Covered the higher elevation (approximately 50-100mm above plain level) sandy hummocks primarily on the eastern side of the drainage channel. Hard pan sand with mainly ephemeral annual species associated with shrubland. This community was also associated with Casuarina pauper clumps on the highest points of these communities.				
Threatened species or community	Not a conservation significant community.				
Landscape context score	1.16	Vegetation Condition Score	39.83	Conservation significance score	1.10
Unit biodiversity Score	50.83	Area (ha)	0.687	Total biodiversity Score	34.92

Vegetation Association 5	***Rhagodia spinescens* (Spiny Saltbush) mixed chenopod Shrubland +/- emergent *Acacia victoriae* (Elegant Wattle) and *Eucalyptus largiflorens* (Black Box)**

General description	This community was restricted to the immediate ephemeral drainage channel alignment and the lower sections of the terrace floodplain. Was observed in particularly good condition following good spring and early summer rainfall. High density of weed species present within the channel. Some emergence of *Eucalyptus largiflorens* (Black Box) alongside creek since removal of grazing with largest trees approximately 6-8m.				
Threatened species or community	Not a conservation significant community				
Landscape context score	1.16	Vegetation Condition Score	Ave. 40.23	Conservation significance score	1.10
Unit biodiversity Score	Ave 51.34	Area (ha)	0.076	Total biodiversity Score	3.90

Vegetation Association 6	*Maireana pyramidata* (Black Bluebush) mixed chenopod shrubland

General description	Present as patches of variable density and often more a mixed community than a dominant Maireana pyramidata community. Present on the southern section of a low slightly raised ridgeline running roughly parallel west of the ephemeral creek line.				
Threatened species or community	Not a conservation significant community.				
Landscape context score	1.16	Vegetation Condition Score	Ave. 42.63	Conservation significance score	1.10
Unit biodiversity Score	Ave. 54.40	Area (ha)	0.383	Total biodiversity Score	20.84

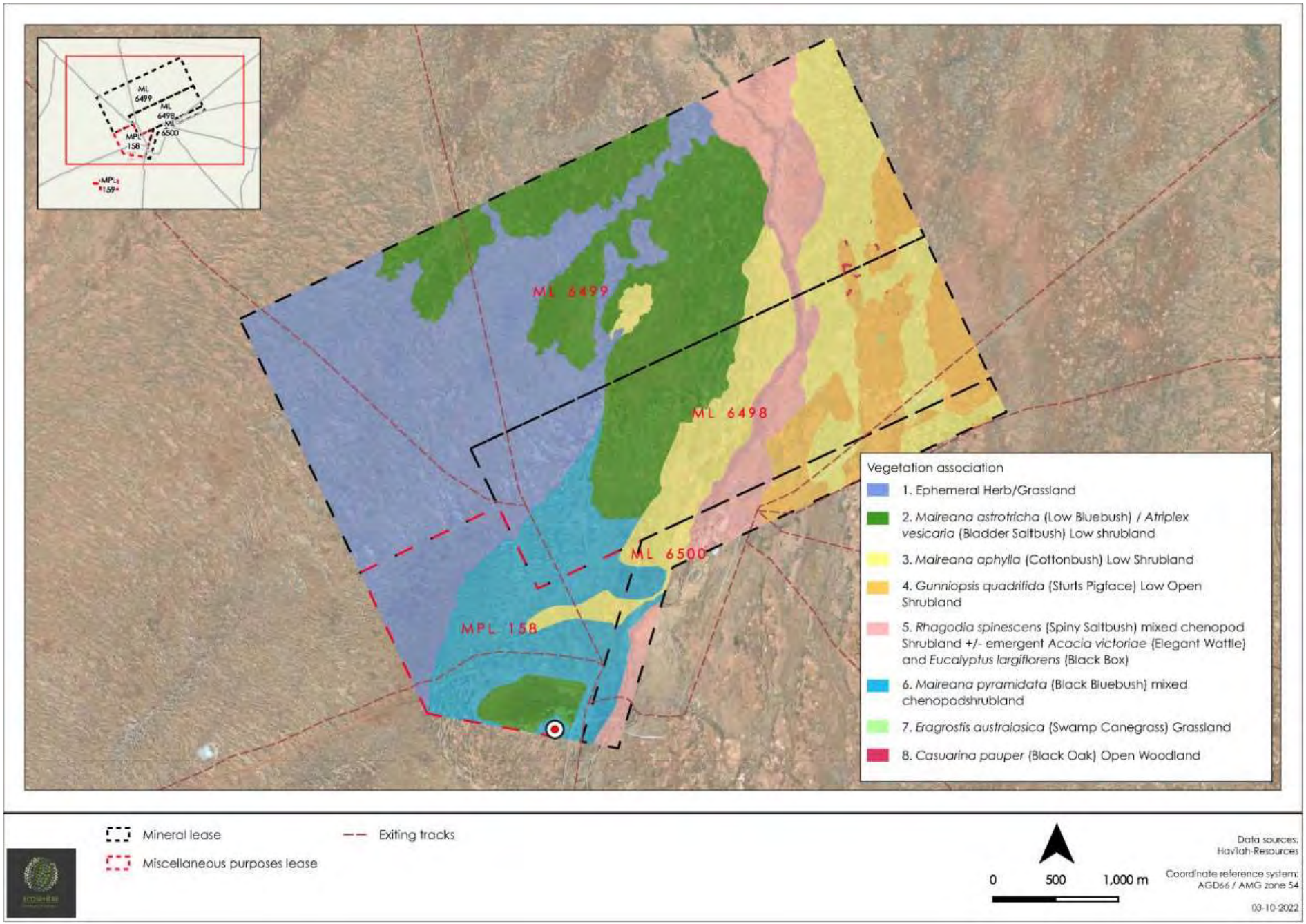


Figure 5. Vegetation associations across the wider project area.

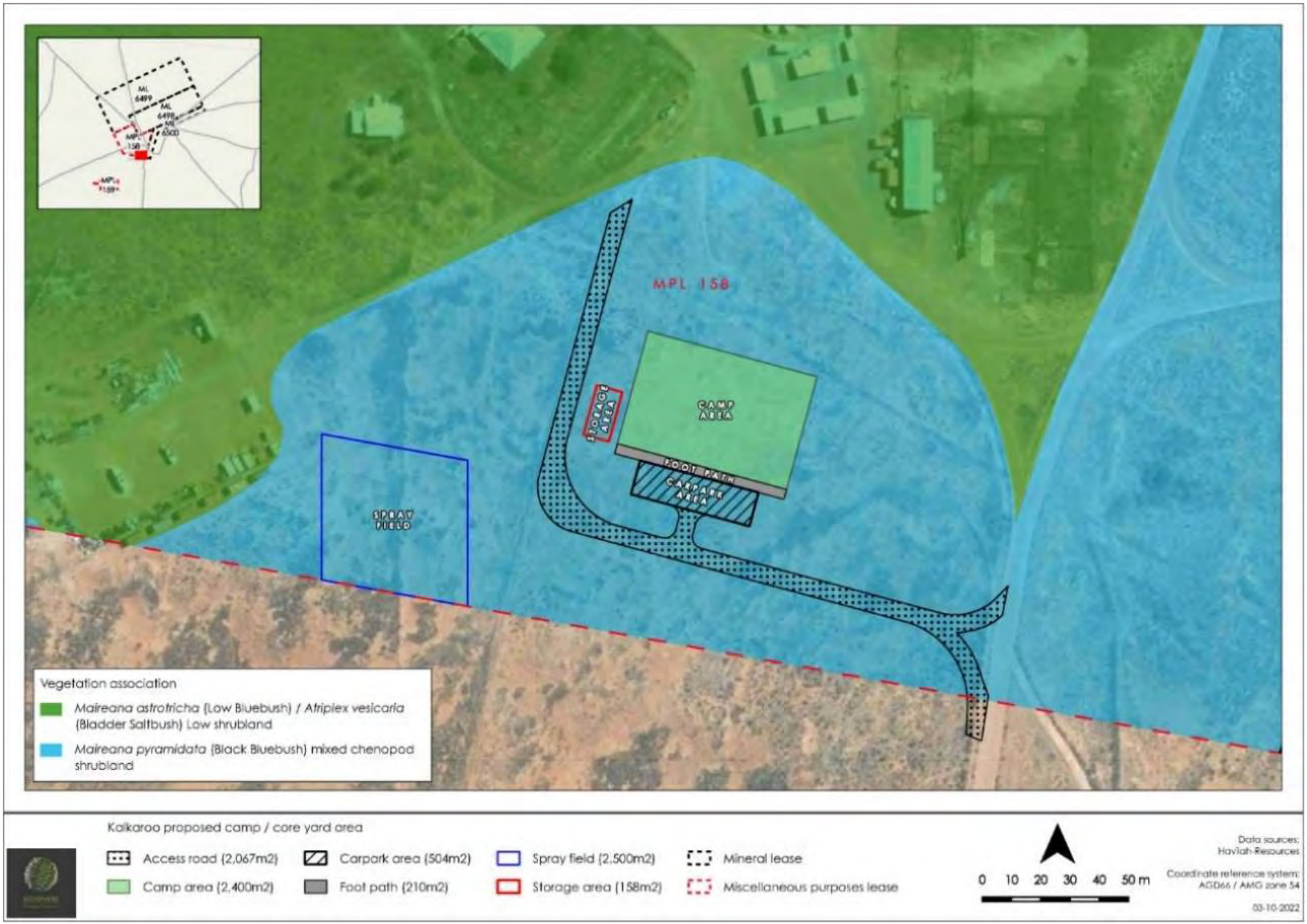


Figure 6. Vegetation associations within the camp location.

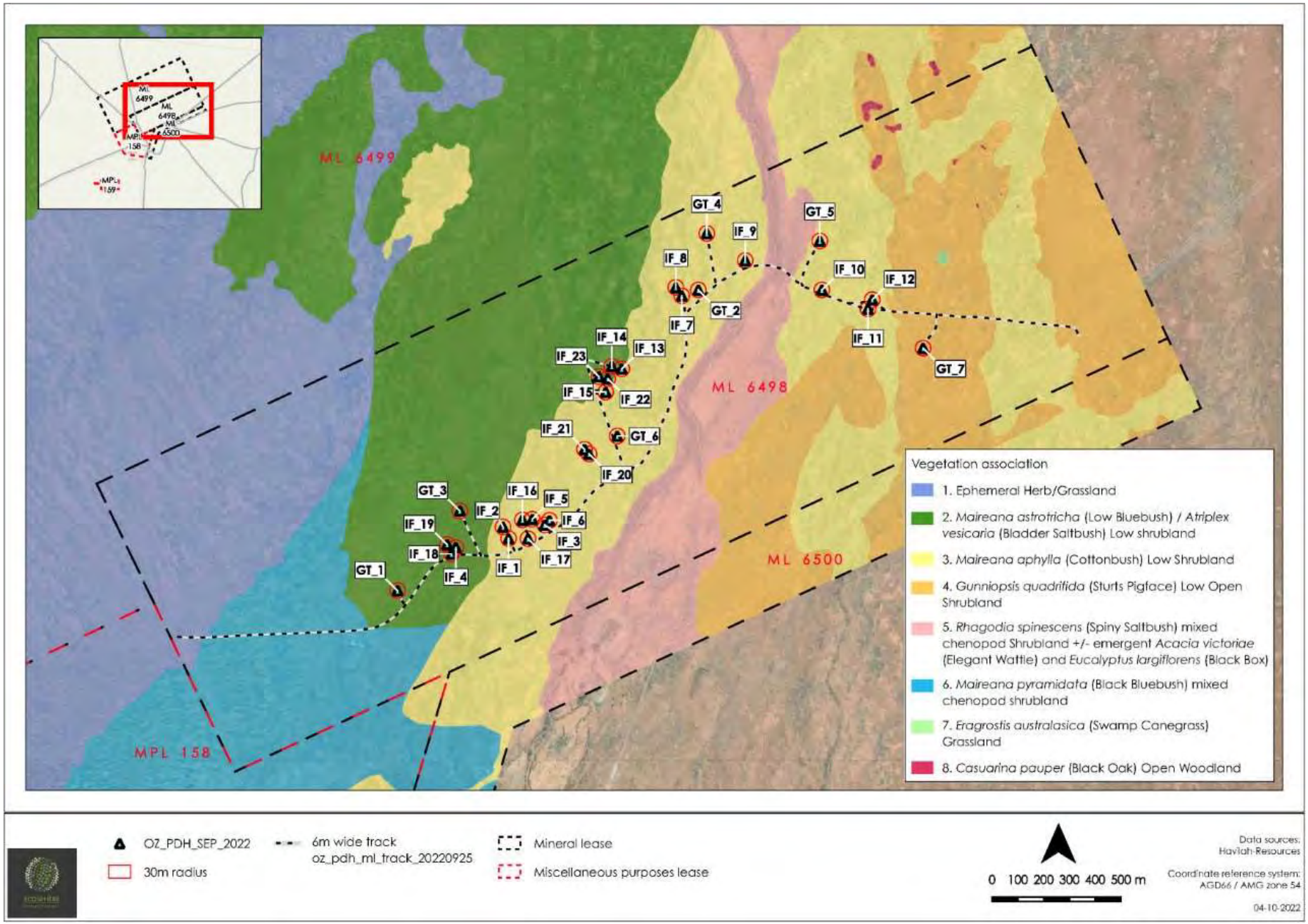


Figure 7. Vegetation associations surrounding the drill pad sites and access track.

Photo log

Drill pad area

Camp area 1

Camp area 2

4.2 Threatened Species assessment

4.2.1 Matters of National Significance

A total of 17 listed threatened species and 8 migratory species were identified by the EPBC Act PMST report as potentially occurring or having suitable habitat potentially occurring within 50km of the project area (Table 3) (DCCEEW 2022). The relevant MNES protected under the EPBC Act are discussed in detail below.

Table 3. EPBC Act PMST report results summary.

Search Area (5km Buffer)	Matters of National Environmental Significance	Identified within search area
	World Heritage Properties	0
	National Heritage Places	0
	Wetlands of International Importance (RAMSAR)	0
	Great Barrier Reef Marine Park	0
	Commonwealth Marine Area	0
	Listed Threatened Ecological Communities	0
	Listed Threatened Species	17
	Listed Migratory Species	8
	Other Matters Protected by the EPBC	
	Commonwealth Lands	2
	Commonwealth Heritage Places	0
	Listed Marine Species	13
	Whales and Other Cetaceans	0
	Critical Habitats	0
	Commonwealth Reserves Terrestrial	0
	Australian Marine Parks	0
	Habitat Critical to the Survival of Marine Turtles	0
	Extra Information	
	State and Territory Reserves	3
	Regional Forest Agreements	0
	Nationally Important Wetlands	0
	EPBC Act Referrals	2
	Key Ecological Features	0
	Biologically Important Areas	0
	Bioregional Assessments	0
	Geological and Bioregional Assessments	0

4.2.2 Threatened ecological communities.

No Threatened Ecological Communities (TEC) were found in the PMST as potentially occurring within 50 km of the project area.

4.2.3 Nationally threatened flora

Five flora species listed as threatened under the EPBC Act were identified in the PMST report as potentially occurring or having suitable habitat within the project area (Table 4). Two species of national conservation significance had historical records within 50km of the project area, *Acacia carneorum* (Needle Wattle) and *Codonocarpus pyramidalis* (Slender Bell-fruit). *Acacia carneorum* has a conservation rating of vulnerable under the EPBC Act and the NPW Act and has nearby records that occur on low dune rises. These have been historically degraded, but offsetting and protection of patches has allowed for significant regeneration of this species within the existing distribution. This species is known not to occur within the project area. *Codonocarpus pyramidalis* has a conservation rating of vulnerable under the EPBC Act and endangered under the NPW Act. The species is not known to occur in the project area.

4.2.4 State threatened flora.

Eight flora species of state conservation significance had historical records within 50km of the project site from the BDBSA. The likelihood of occurrence for all species identified in the BDBSA search is provided in Table 4. *Senecio gawlerensis* (Gawler Ranges Groundsel) has a record within the tenement area in association 5. This species was not observed during the flora assessment.

A list of all flora species with historical records within 50 km of the project area is in shown Appendix 2.

Table 4. Threatened flora species listed under the EPBC Act and NPW Act identified in the PMST (Source 5) and Naturemaps (Source 3) database searches within 50kmn of the project area.

Scientific Name	Common Name	EPBC Act	NP&W Act	Data Source	Date of last record	Species known habitat preferences	Likelihood of use for habitat - comments
Acacia carneorum	Needle Wattle	VU	V	3, 5	23/02/2019	Low dune rises.	Not present within project area however known patches nearby
Codonocarpus pyramidalis	Slender Bell-fruit	VU	E	3, 5	26/02/2019	Rock rises.	Unlikely, not present.
Frankenia plicata		EN	V	5		Hill slopes and rises.	Unlikely
Malacocera gracilis	Slender Soft-horns		V	3	2/09/1996	Dry shrubland or desert.	
Orobanche cernua var. australiana	Australian Broomrape		R	3	17/10/2010	Creeks, flood outs. Host plants present in creeks.	Highly likely
Pterostylis xerophila	Desert Greenhood	VU	V	5		Intact dry woodland.	
Rytidosperma laeve	Smooth Wallaby-grass		R	3	8/09/2007	Open plains.	Likely
Senecio gawlerensis	Gawler Ranges Groundsel		R	3	27/08/2008	Among rocky outcrops, usually toward the summit of hills and at other locations as well.	Highly likely
Swainsona fuscoviridis	Dark Green Swainson-pea		R	3	11/09/2008	Endemic to South Australia and confined to an area west of Broken Hill	Possible, located on Boolcoomatta
Swainsona murrayana	Slender Darling-pea, Slender Swainson, Murray Swainson-pea	VU	V	5		Woodland and grassland often associated with *Maireana* species.	Possible

Source; 1- BDBSA, 2 - AoLA, 3 – NatureMaps 4 – Observed/recorded in the field, 5 - Protected matters search tool, 6 – others

NP&W Act; E= Endangered, V = Vulnerable, R= Rare EPBC Act; Ex = Extinct, CR = Critically endangered, EN = Endangered; VU = Vulnerable

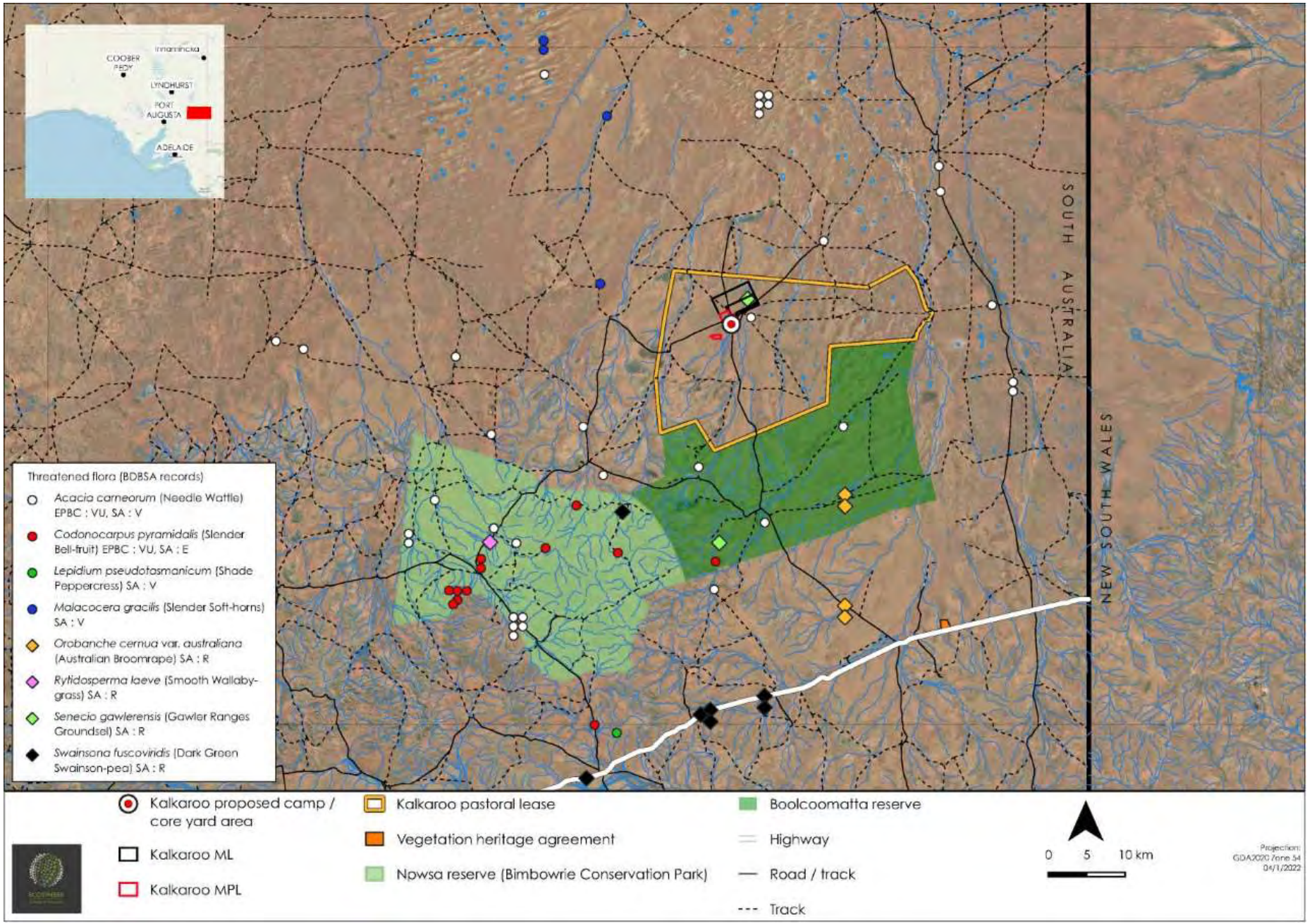


Figure 8. Threatened flora recorded within 50km of the project site.

4.2.5 Nationally threatened fauna

Twelve fauna species listed as threatened under the EPBC Act were identified in the PMST report as potentially occurring or having suitable habitat within 50km of the project area (Table 5). This included 7 bird, 4 mammal and 1 fish (fish were not included in Table 5 due to the terrestrial nature of the project location). Three species of national conservation significance had historical records within 50 km of the project area, *Notomys fuscus (*Dusky Hopping-mouse), *Pedionomus torquatus* (Plains-wanderer) and *Petrogale xanthopus xanthopus* (Yellow-footed Rock-wallaby).

The Dusky Hopping-mouse is considered likely to occur on the eastern extent of the tenement. The Dusky Hopping-mouse inhabits arid areas of Australia with sand dunes or sand plains with hummocks and water nearby. The species is predominantly restricted to the dune crests with only few observations of the species in the surrounding gibber or inter-dune swales and scalded areas. The Dusky Hopping-mouse does move across inter-dune clay flats within their home range (Moseby et al. 1999). After seasons of good rainfall, the species may occur in atypical habitat such as chenopod (e.g., Black Bluebush (*Maireana pyramidata*)) shrubland on gibber plains, Acacia shrubland and sandy creek lines (Waudby & How 2008). The Dusky Hopping-mouse undergoes significant population and occupation fluctuations, with density reductions or local extinction during dry periods.

Plains Wanderer could possibly occur within the project area based on BDBSA records and the availability of habitat. Boolcoomatta reserve has had numerous records since 2017 through visual sightings and acoustic recorders. This species is likely to occur on Kalkaroo at some period.

Although Yellow-footed Rock-wallaby were recorded within 50km of the project site, the species is highly unlikely to be present within the project site due to a lack of suitable habitat.

4.2.6 Migratory species

Eight migratory species listed under the EPBC Act were highlighted as potentially present within 50km of the project area. None of these species have been previously recorded (BDBSA) within the project area.

4.2.7 State threatened fauna.

Fifteen fauna species of state conservation significance had historical records from the NatureMaps BDBSA search within 50km of the project area (Table 5).
A list of all fauna species with records within 50 km of the Project area is shown in Appendix 3.

Table 5. Threatened fauna species and migratory listed under the EPBC Act and NPW Act identified in the PMST (Source 5) and BDBSA (Source 3) database searches with 50km of the project area.

Scientific Name	Common Name	EPBC Act	NP&W Act	Data Source	Date of last record	Species known habitat preferences	Likelihood of use for habitat - comments
Acanthiza iredalei	Slender-billed Thornbill		R	3	9/05/2006	Shrublands.	Unlikely
Actitis hypoleucos	Common Sandpiper	Mi	R	5		Migratory wetland species.	Unlikely
Amytornis modestus	Thick-billed Grasswren	VU		5		Dense chenopod shrubland with shrubs <1m.	Unlikely
Apus pacificus	Fork-tailed Swift	Mi		5		Aerial species.	Unlikely
Ardeotis australis	Australian Bustard		V	3	27/06/2018	Open plains and grasslands, nomadic.	Highly Likely
Aspidites ramsayi	Woma		R	3	1/02/1997	Variety of habitats including dunes, stony plains and creeks	Possible
Calidris acuminata	Sharp-tailed Sandpiper	Mi		5		Migratory Wetlands Species	Unlikely
Calidris ferruginea	Curlew Sandpiper	CR, Mi	E	5		Migratory wetland species.	Unlikely
Calidris melanotos	Pectoral Sandpiper	Mi	R	5		Migratory Wetlands Species	Unlikely
Emblema pictum	Painted Finch		R	3	1/03/2011	Lakes Eyre, Torrens and Frome and the Flinders Ranges. Variety of habitats, transient.	Likely
Falco hypoleucos	Grey Falcon	VU	R	5		Arid interior areas in variety of habitats, covers significant area.	Possible
Falco subniger	Black Falcon		R	3	5/03/2011	Variety of habitats, transient.	Highly Likely
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	Mi	R	5		Migratory Wetlands Species	Unlikely
Grantiella picta	Painted Honeyeater	VU	R	5		Forests and woodlands, strongly associated with mistletoe.	Unlikely
Hieraaetus morphnoides	Little Eagle		V	3	23/09/2006	Variety of habitats, transient.	Highly Likely
Lucasium steindachneri	Map Gecko		R	3	20/03/2017	Woodland forest and mallee.	Unlikely
Melanodryas cucullata	Hooded Robin		R	3	14/10/2010	Woodland.	Unlikely
Motacilla cinerea	Grey Wagtail	Mi		5		Migratory Terrestrial Species	Unlikely

Scientific Name	Common Name	EPBC Act	NP&W Act	Data Source	Date of last record	Species known habitat preferences	Likelihood of use for habitat - comments
Motacilla flava	Yellow Wagtail	Mi		5		Migratory Terrestrial Species	Unlikely
Myiagra inquieta	Restless Flycatcher		R	3	12/05/2006	Woodlands.	Unlikely
Neophema elegans elegans	Elegant Parrot		R	3	20/09/2006	Woodland open plains, Mallee.	Unlikely
Notomys fuscus	Dusky Hopping-mouse	VU	V	3, 5	1/05/2012	Consolidated dunes with shrub cover.	Possible
Nyctophilus corbeni	Corben's Long-eared Bat, South-eastern Long-eared Bat	VU	V	5		Mallee, Buloke, box eucalypt dominated community's box/ironbark/Cypress-pine vegetation.	Unlikely
Oxyura australis	Blue-billed Duck		R	3	12/05/2006	Transient, shallow dams.	Unlikely
Pedionomus torquatus	Plains-wanderer	CR	E	3, 5	9/05/2006	Open plains.	Likely
Petrogale xanthopus xanthopus	Yellow-footed Rock-wallaby	VU	SP	3, 5	20/09/2021	Large rock outcrops with crevices.	Possible
Petroica boodang boodang	Scarlet Robin		R	3	8/11/2012	Woodlands.	Unlikely
Pezoporus occidentalis	Night Parrot	EN	E	5		Spinifex and samphire shrubland.	Unlikely
Phaps histrionica	Flock Bronzewing		R	4	22/01/2021	Open plains	Known
Pseudomys australis	Plains Rat, Palyoora, Plains Mouse	VU	V	5		Stone covered plains and adjoining sandy plains.	Possible
Rostratula australis	Australian Painted Snipe	EN	E	5		Shallow, brackish or freshwater terrestrial wetlands, muddy margins and small, low-lying islands.	Unlikely

Source; 1- BDBSA, 2 - AoLA, 3 – NatureMaps 4 – Observed/recorded in the field, 5 - Protected matters search tool, 6 – others, 7 – field survey

NP&W Act; E= Endangered, V = Vulnerable, R= Rare

EPBC Act; Ex = Extinct, CR = Critically endangered, EN = Endangered; VU = Vulnerable; Mi = Migratory

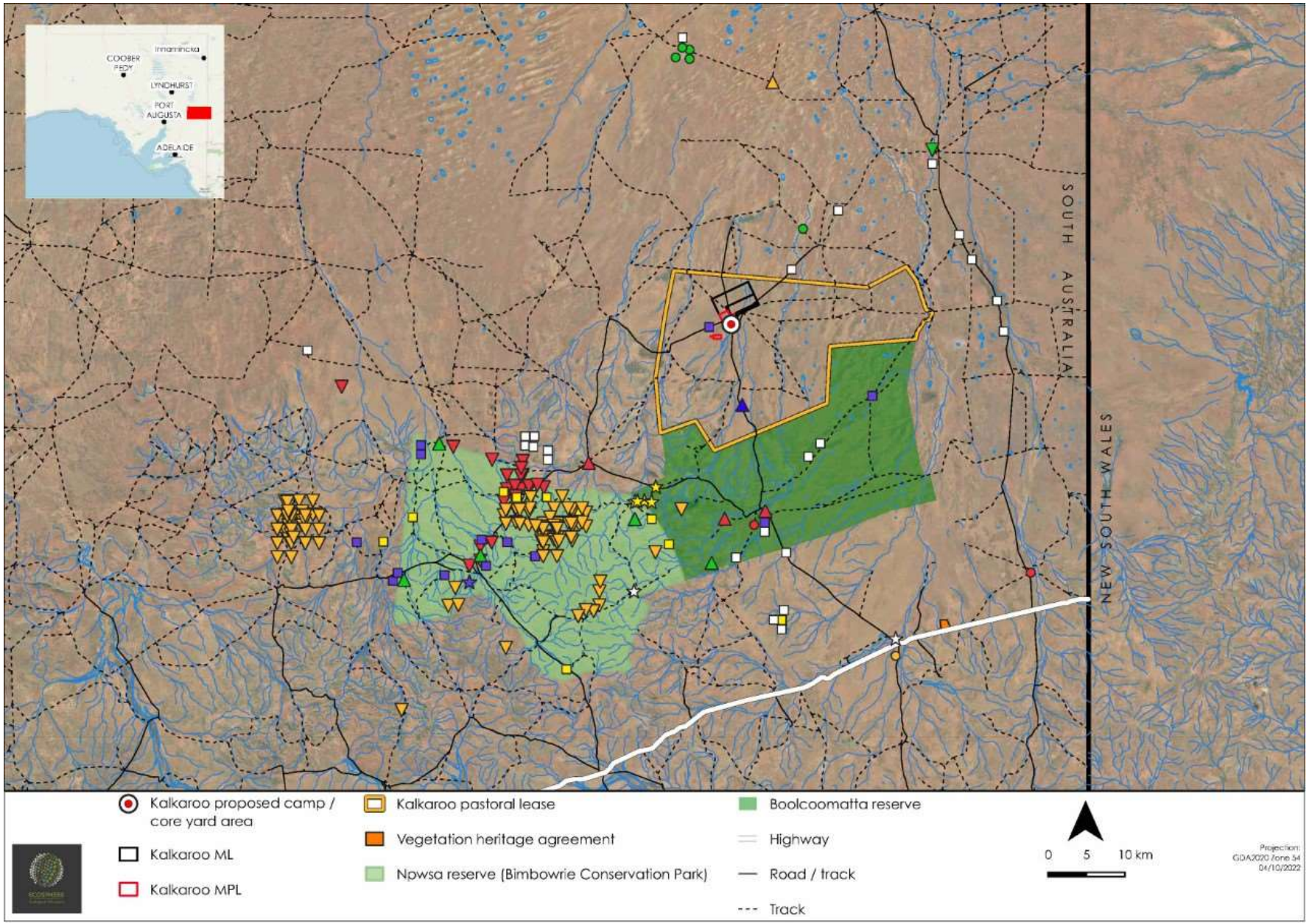

Innamincka
COOBER PEDY
LYNDHURST
PORT AUGUSTA
ADELAIDE
SOUTH AUSTRALIA
NEW SOUTH WALES
Kalkaroo proposed camp / core yard area
Kalkaroo ML
Kalkaroo MPL
Kalkaroo pastoral lease
Vegetation heritage agreement
Npwsa reserve (Bimbowrie Conservation Park)
Boolcoomatta reserve
Highway
Road / track
Track
0 5 10 km
Projection:
GDA2020 Zone 54
04/10/2022

Figure 9. Threatened fauna recorded within 50km of the project site.

4.3 Cumulative impact

When exercising a power or making a decision under Division 5 of the Native Vegetation Regulations 2017, the NVC must consider the potential cumulative impact, both direct and indirect, that is reasonably likely to result from a proposed clearance activity.

The vegetation footprints at this stage are broad and unlikely to be impacted to the full extent of the relevant ML / MPL. Vegetation within the MPL will be retained wherever possible within the camp layout rather than a complete full-scale scrape. However, there is likely to be additional clearance external to these footprints in the provision of access roads and infrastructure such as power and water. The use of existing access tracks will be incorporated into planning wherever possible in a bid to reduce the overall SEB requirement.

A construction environmental management plan CEMP will be supplied to minimise any indirect or cumulative impacts such as stormwater runoff, water treatment storage, dust management and general waste.

4.4 Address the Mitigation Hierarchy

When exercising a power or making a decision under Division 5 of the Native Vegetation Regulations 2017, the NVC must have regard to the mitigation hierarchy. The NVC will also consider, with the aim to minimize, impacts on biological diversity, soil, water and other natural resources, threatened species or ecological communities under the EPBC Act or listed species under the NP&W Act.

a) Avoidance – outline measures taken to avoid clearance of native vegetation

The avoidance of vegetation clearance is challenging in mining projects with the ore body extent as well as associated infrastructure requiring a determined footprint. The camp location has been refined to provide the minimum disturbance to high value vegetation while also reducing the length of access roads and associated infrastructure such as power and water.

b) Minimization – if clearance cannot be avoided, outline measures taken to minimize the extent, duration and intensity of impacts of the clearance on biodiversity to the fullest possible extent (whether the impact is direct, indirect or cumulative).

Kalkaroo Copper have minimised the clearance wherever possible. In order to manage indirect risks to vegetation a series of mitigation measures will be employed. Minimising and mitigation of risks to vegetation and the environment in general include the following:

- Management of storm water run-off from the landfills and operational areas by construction and maintenance of perimeter storm water cut-off bunds.
- All dams (and landfill) located and designed so as to maintain their integrity in the event of an AEP 72hr 1:100 year flood and 1:10 year wind conditions.
- Dust suppression measures for operational and disturbed areas such as stockpiles utilising water trucks.
- Maintenance of roads to minimise the build- up of fine particles that are susceptible to wind erosion.
- Minimising the extent of exposed areas susceptible to wind erosion.
- Using speed limits on roads used by mine traffic.
- Allowing natural rehabilitation of disturbed areas as they become available through surface preparation.
- Landfill to be progressively rehabilitated to minimise exposed rubbish so as to minimise litter and attraction to feral animals.
- Weed and pest management.
- Offsite vehicle hygiene measures.

c) Rehabilitation or restoration – outline measures taken to rehabilitate ecosystems that have been degraded, and to restore ecosystems that have been degraded, or destroyed by the impact of clearance that cannot be avoided or further minimized, such as allowing for the re-establishment of the vegetation.

The vegetation has been carefully managed since 2009 when the property was destocked. The vegetation within the pastoral lease has improved despite exceptionally high numbers of kangaroos which have also been managed through shooting for meat on lease. The presence of Boolcoomatta Bush Heritage reserve south of Kalkaroo has probably contributed to the numbers of Kangaroos present historically but have now reduced to manageable numbers following consecutive very dry years.

Offset areas excluding grazing from areas of the nationally vulnerable species Acacia carneorum (Purple wood Wattle) have been successful. Significant regeneration of this species has occurred within the fenced area and mature plants were observed in good health and flowering prolifically at the time of this survey.

The key environmental outcomes and associated benefits provided since the removal of cattle and/or sheep at Kalkaroo are as follows:

- Increase in the soil cover with soil surface disturbance reductions creating a more stable landscape through exclusion of domestic stock.
- Reduction in loss of flora species and increased resource accumulation around shrubs etc. trapping seed resources through decrease from herbivory and hoof erosion.
- Increased fauna species richness and abundance through retention of seed and food resources as well as increased cover values from lack of herbivory and trampling of the soil profile.
- Increase in understorey litter cover, resource accumulation under woodlands where cattle tend to congregate and rest.
- Increase in understorey perennial shrub cover and diversity through reduced herbivory of higher palatability new growth.
- Increase in regeneration and emergence of shrubs and woodland trees (*E. largiflorens* observed) through lack of trampling, plugging of creek fringes and reduced herbivory of emergent species.
- Increased seed production during growth periods with tips of shrubs and trees which produce flowers not being grazed off before maturation.
- Reduced erosion from cattle pads.
- Potential reduced new weed outbreaks from cattle new to area from other regions.

Other environmental benefits have been provided through active management including:

Feral animal control

Cats and foxes are controlled through targeted shooting and baiting programs. As an ongoing management practice, Kalkaroo Copper are invested in region wide control programs participating in landscape management board control programs.

Woody and targeted weed management

Weed species such as boxthorn have been controlled across the area.

Other weeds considered naturalised or ephemeral are more difficult to control however programs reducing the influence of species such as *Xanthium spinosum* (Bathurst Burr) and ensuring no establishment of species such as *Cenchrus ciliaris* (Buffel Grass) are ongoing.

Monitoring programs.

Monitoring programs are used to monitor access from neighbouring properties and are targeted to the boundary fence and dam locations. An onsite manager directs the frequency and timing of these.

The Kalkaroo Copper Project will have a monitoring program implemented to determine any unforeseen impacts and to ensure that management and mitigation measures employed are suitable and providing the intended outcomes.

The monitoring program will follow a Before-After Control-Impact Paired Series (BACIPS). This is probably the best-known and most powerful approach to detect and quantify human interventions on ecosystems. In BACIPS designs, impact and control sites are sampled simultaneously before (as a baseline survey) and after an intervention. For each sampling survey conducted before or after, the difference in the sampled response variable (e.g., density/cover) is

calculated. It is proposed that a predetermined plot is assessed for perennial species cover and density. Preferably, 10 repeats of control / impact sites are required as a sample size making 5x2 plots the most accurate and repeatable biological survey method. It would be determined that impact plots are located within 1km of operational zones control sites greater than 5km from operational areas. See **Table 6** below for list of provisional monitoring sites.

Table 6. Provisional list of flora monitoring locations.

Name	Type	Easting	Northing
KALCON01	Control	448796	6492471
KALCON02	Control	450197	6491363
KALCON03	Control	452287	6493072
KALCON04	Control	459458	6491856
KALCON05	Control	457707	6490522
KALCON06	Control	457799	6487723
KALCON07	Control	457961	6484035
KALCON08	Control	456836	6484791
KALCON09	Control	453531	6482399
KALCON10	Control	449647	6485777
KALIMP01	Impact	454188	6486373
KALIMP02	Impact	452075	6486986
KALIMP03	Impact	451366	6489968
KALIMP04	Impact	452880	6490468
KALIMP05	Impact	452835	6491451
KALIMP06	Impact	455272	6491159
KALIMP07	Impact	456086	6490199
KALIMP08	Impact	456398	6489387
KALIMP09	Impact	456361	6488521
KALIMP10	Impact	455500	6488283

d) Offset – any adverse impact on native vegetation that cannot be avoided or further minimized should be offset by the achievement of a significant environmental benefit that outweighs that impact.

4.5 Principles of Clearance (Schedule 1, *Native Vegetation Act 1991*)

The Native Vegetation Council will consider Principles 1(b), 1(c) and 1(d) when assigning a level of Risk under Regulation 16 of the Native Vegetation Regulations. The Native Vegetation Council will consider all the Principles of clearance of the Act as relevant, when considering an application referred under the *Planning, Development and Infrastructure Act 2016*.

Principle of clearance	Considerations
Principle 1a - it comprises a high level of diversity of plant species	Relevant information The vegetation present is not considered to be overly diverse for an arid environment and is probably reflective of a history of overgrazing in the Kalkaroo area. The floristic diversity from a perennial specie perspective is low and the homogeneity of the landscape supports this.
	Assessment against the principles Not at variance.
	Moderating factors that may be considered by the NVC N/A
Principle 1b - significance as a habitat for wildlife	Relevant information The area is likely to support a significant diversity of fauna species including species of national and state conservation significance. Threatened Fauna Score – 0.1 (>0.05 is seriously at variance)
	Assessment against the principles Seriously at variance: All six vegetation associations.
	Moderating factors that may be considered by the NVC
Principle 1c - plants of a rare, vulnerable or endangered species	Relevant information
	Assessment against the principles Not at variance
	Moderating factors that may be considered by the NVC N/A
***Principle 1d - the vegetation comprises the whole or part of a plant community that is Rare, Vulnerable or endangered*:**	Relevant information No conservation significant vegetation associations were present within the project area.
	Assessment against the principles Not at variance
	Moderating factors that may be considered by the NVC N/A

Principle 1e - it is significant as a remnant of vegetation in an area which has been extensively cleared.	Relevant information The vegetation is not significant as a remnant with the two relevant sub regions both having 100% remnancy. Total Biodiversity Score - 697.99
	Assessment against the principles At Variance: All six associations.
	Moderating factors that may be considered by the NVC
Principle 1f - it is growing in, or in association with, a wetland environment.	Relevant information The project area is not growing in association with a wetland environment.
	Assessment against the principles Not at variance
	Moderating factors that may be considered by the NVC N/A
Principle 1g - it contributes significantly to the amenity of the area in which it is growing or is situated.	Relevant information The vegetation within the project area is primarily flat plain and during dry periods a significant portion of the area is bare soil. While all vegetation contributes to the amenity of the area the vegetation within the project area is not theoretically of high amenity value being very consistent with the surrounding area and very well represented within the region.
	Assessment against the principles Not at variance
	Moderating factors that may be considered by the NVC N/A

4.6 Risk Assessment

Determine the level of risk associated with the application

Total clearance	No. of trees	n/a
	Area (ha)	13.337
	Total biodiversity Score	697.99
Seriously at variance with principle 1(b), 1(c) or 1 (d)		1b
Risk assessment outcome		Level 4

4.7 NVC Guidelines

Provide any other information that demonstrates that the clearance complies with any relevant NVC guidelines related to the activity.

5. Clearance summary

Clearance Area(s) Summary table

Block	Site	Species diversity score	Threatened Ecological community Score	Threatened plant score	Threatened fauna score	UBS	Area (ha)	Total Biodiversity score	Loss factor	Loadings	Reductions	SEB Points required	SEB payment	Admin Fee
1	1		1	0	0.1	30.63	0.068	2.08	1			2.19	$132.56	$7.29
1	2		1	0	0.1	52.86	3.665	193.73	1			203.42	$12,329.74	$678.14
1	3		1	0	0.1	52.32	8.458	442.52	1			464.65	$28,163.60	$1,549.00
1	4		1	0	0.1	50.83	0.687	34.92	1			36.67	$2,222.44	$122.23
1	5		1	0	0.1	51.34	0.076	3.90	1			4.10	$248.33	$13.66
1	6		1	0	0.1	54.4	0.383	20.84	1			21.88	$1,326.02	$72.93
						Total	13.337	697.99				732.89	$44,422.68	$2,443.25

Totals summary table

	Total Biodiversity score	Total SEB points required	SEB Payment	Admin Fee	Total Payment
Application	697.99	732.89	$44,422.68	$2,443.25	$46,865.92

Economies of Scale Factor	0.11
Rainfall (mm)	206

6. Significant Environmental Benefit

A Significant Environmental Benefit (SEB) is required for approval to clear under Division 5 of the *Native Vegetation Regulations 2017*. The NVC must be satisfied that as a result of the loss of vegetation from the clearance that an SEB will result in a positive impact on the environment that is over and above the negative impact of the clearance.

ACHIEVING AN SEB

Indicate how the SEB will be achieved by ticking the appropriate box and providing the associated information:

☐ Establish a new SEB Area on land owned by the proponent.

☐ Use SEB Credit that the proponent has established. Provide the SEB Credit Ref. No. _____

☐ Apply to have SEB Credit assigned from another person or body. The application form needs to be submitted with this Data Report.

☐ Apply to have an SEB to be delivered by a Third Party. The application form needs to be submitted with this Data Report.

☒ Pay into the Native Vegetation Fund.

PAYMENT SEB

If a proponent proposes to achieve the SEB by paying into the Native Vegetation Fund, summary information must be provided on the amount required to be paid and the manner of payment:

Payment amount: $46,865.92 (includes $44,422.68 SEB payment and $2,443.25 admin fee).

7. Appendices

Appendix 1. Bushland, Rangeland or Scattered Tree Vegetation Assessment Scoresheets associated with the proposed clearance and SEB Area (to be submitted separately in Excel format)

Appendix 2. Flora Species List

Scientific Name	Common Name	Date of last record
Abutilon fraseri (NC)	Dwarf Lantern-bush	27/08/1996
Abutilon halophilum	Plains Lantern-bush	20/09/2006
Abutilon leucopetalum	Desert Lantern-bush	25/09/2006
Abutilon otocarpum	Desert Lantern-bush	17/11/2011
Abutilon sp.	Lantern-bush	24/09/2006
Acacia aneura complex	Mulga	3/11/2010
Acacia aneura var. (NC)	Mulga	3/03/2011
Acacia aneura var. aneura	Mulga	24/02/2019
Acacia aneura var. aneura (NC)	Mulga	26/09/2006
Acacia ayersiana var. latifolia (NC)	Broad-leaf Mulga	27/08/1996
Acacia beckleri (NC)	Beckler's Rock Wattle	27/08/1996
Acacia beckleri ssp.	Beckler's Rock Wattle	21/09/2006
Acacia beckleri ssp. beckleri	Beckler's Rock Wattle	14/09/2010
Acacia calamifolia	Wallowa	21/04/2005
Acacia carneorum	Needle Wattle	23/02/2019
Acacia colletioides	Veined Wait-a-while	26/11/2004
Acacia continua	Thorn Wattle	24/02/2019
Acacia oswaldii	Umbrella Wattle	19/10/2010
Acacia tetragonophylla	Dead Finish	24/02/2019
Acacia victoriae ssp.	Elegant Wattle	17/10/2014
Acacia victoriae ssp. victoriae	Elegant Wattle	8/09/2007
Actinobole uliginosum	Flannel Cudweed	19/10/2010
Ajuga australis	Australian Bugle	26/08/1996
Alectryon oleifolius ssp. canescens	Bullock Bush	23/02/2019
Alyogyne huegelii (NC)	Native Hibiscus	3/03/2011
Alyssum linifolium	Flax-leaf Alyssum	28/08/2008
Amyema gibberula var. gibberula	Twin-flower Mistletoe	19/09/2006
Amyema linophylla ssp. orientalis	Casuarina Mistletoe	22/04/2005
Amyema maidenii ssp. maidenii	Pale-leaf Mistletoe	19/09/1995
Amyema miquelii	Box Mistletoe	18/04/2005
Angianthus brachypappus	Spreading Angianthus	30/03/1997
Angianthus tomentosus	Hairy Angianthus	10/09/2008
Anthosachne scabra	Native Wheat-grass	24/09/2006
Arabidella glaucescens		10/09/2008
Arabidella nasturtium	Yellow Cress	10/09/2008
Arabidella procumbens	Creeping Cress	9/09/2008
Arabidella trisecta	Shrubby Cress	10/09/2008
Argemone ochroleuca ssp. ochroleuca	Mexican Poppy	30/10/2015
Aristida contorta	Curly Wire-grass	12/11/2012
Aristida holathera var. holathera	Tall Kerosene Grass	21/04/2005
Aristida nitidula	Brush Three-awn	12/11/2012
Aristida obscura	Brush Three-awn	18/10/2010
Aristida sp.	Three-awn/Wire-grass	4/07/1995
Arthropodium minus	Small Vanilla-lily	1/10/1995
Asphodelus fistulosus	Onion Weed	24/05/2007
Astrebla pectinata	Barley Mitchell-grass	3/03/2011

Atriplex acutibractea ssp. acutibractea	Pointed Saltbush	19/04/2005
Atriplex angulata	Fan Saltbush	24/09/2014
Atriplex eardleyae	Eardley's Saltbush	15/10/2010
Atriplex holocarpa	Pop Saltbush	7/11/2012
Atriplex intermedia		23/09/2014
Atriplex limbata	Spreading Saltbush	23/09/2014
Atriplex lindleyi ssp.	Baldoo	12/11/2012
Atriplex lindleyi ssp. conduplicata	Baldoo	22/09/2006
Atriplex lindleyi ssp. inflata	Corky Saltbush	24/09/2006
Atriplex lindleyi ssp. lindleyi	Baldoo	7/11/2012
Atriplex nummularia ssp.	Old-man Saltbush	4/08/1995
Atriplex pseudocampanulata	Spreading Saltbush	4/08/1995
Atriplex semibaccata	Berry Saltbush	19/04/2005
Atriplex sp.	Saltbush	13/10/2010
Atriplex spongiosa	Pop Saltbush	17/10/2010
Atriplex stipitata	Bitter Saltbush	18/10/2010
Atriplex velutinella	Sandhill Saltbush	29/08/2008
Atriplex vesicaria	Bladder Saltbush	7/11/2019
Atriplex vesicaria ssp. (NC)	Bladder Saltbush	17/03/2001
Austrostipa acrociliata	Graceful Spear-grass	26/08/1996
Austrostipa elegantissima	Feather Spear-grass	25/09/2006
Austrostipa nitida	Balcarra Spear-grass	12/11/2012
Austrostipa nodosa	Tall Spear-grass	8/09/2007
Austrostipa scabra ssp. falcata	Slender Spear-grass	21/09/2006
Austrostipa scabra ssp. scabra	Rough Spear-grass	23/09/2006
Austrostipa sp.	Spear-grass	21/10/2010
Austrostipa trichophylla		21/09/2006
Blennodia canescens	Native Stock	15/10/2010
Blennodia pterosperma	Wild Stock	20/10/2010
Boerhavia dominii (NC)	Tar-vine	7/11/2012
Boerhavia schomburgkiana (NC)	Schomburgk's Tar-vine	24/09/2006
Boerhavia sp.	Tar-vine	13/10/2010
Brachyscome ciliaris var. ciliaris	Variable Daisy	5/08/1995
Brachyscome ciliaris var. lanuginosa	Woolly Variable Daisy	12/11/2012
Brachyscome dentata	Lobe-seed Daisy	10/09/2008
Brachyscome lineariloba	Hard-head Daisy	22/04/2005
Brachyscome sp.	Native Daisy	10/11/2012
Brassica tournefortii	Wild Turnip	21/05/2007
Bromus arenarius	Sand Brome	18/10/2010
Bromus rubens	Red Brome	19/09/1995
Bulbine alata	Winged Bulbine-lily	20/04/2005
Bulbine semibarbata	Small Leek-lily	18/10/2010
Bulbine sp.	Bulbine-lily	21/10/2010
Calandrinia calyptrata	Pink Purslane	19/10/2010
Calandrinia eremaea	Dryland Purslane	19/09/2006
Callitris glaucophylla	White Cypress-pine	21/04/2005
Callitris sp.	Native Pine	7/04/2005
Calocephalus platycephalus	Western Beauty-heads	26/09/1995
Calotis cymbacantha	Showy Burr-daisy	2/09/1996
Calotis hispidula	Hairy Burr-daisy	21/10/2010
Calotis plumulifera	Woolly-headed Burr-daisy	10/09/2008
Calotis sp.	Burr-daisy	10/11/2012
Carrichtera annua	Ward's Weed	7/11/2019
Carthamus lanatus	Saffron Thistle	7/11/2012
Cassinia laevis ssp. laevis	Curry Bush	6/08/2008
Casuarina pauper	Black Oak	22/02/2019
Cenchrus ciliaris	Buffel Grass	13/05/2011

Cenchrus clandestinus	Kikuyu	21/05/2007
Centaurea melitensis	Malta Thistle	13/10/2007
Centaurea sp.	Centaury	13/10/2010
Centipeda cunninghamii	Common Sneezeweed	18/10/2010
Centipeda minima (NC)	Spreading Sneezeweed	5/08/1995
Centipeda sp.	Sneezeweed	26/08/1996
Centipeda thespidioides (NC)	Desert Sneezeweed	21/07/1995
Chamaesyce drummondii (NC)	Caustic Weed	22/04/2005
Cheilanthes austrotenuifolia	Annual Rock-fern	21/04/2005
Cheilanthes lasiophylla	Woolly Cloak-fern	21/04/2005
Cheilanthes sieberi ssp.	Narrow Rock-fern	20/04/2005
Cheilanthes sieberi ssp. sieberi	Narrow Rock-fern	20/04/2005
Chenopodium auricomum	Golden Goosefoot	26/09/2006
Chenopodium curvispicatum	Cottony Goosefoot	22/04/2005
Chenopodium desertorum ssp.	Desert Goosefoot	19/10/2010
Chenopodium murale	Nettle-leaf Goosefoot	23/05/2007
Chenopodium nitrariaceum	Nitre Goosefoot	23/09/2006
Chloris pectinata	Comb Windmill Grass	3/03/2011
Chrysocephalum apiculatum	Common Everlasting	14/09/2010
Chrysocephalum apiculatum (NC)	Common Everlasting	8/09/2007
Chrysocephalum semipapposum	Clustered Everlasting	6/08/2008
Citrullus amarus	Bitter Melon	23/05/2007
Citrullus colocynthis	Colocynth	23/05/2007
Codonocarpus pyramidalis	Slender Bell-fruit	26/02/2019
Compositae sp.	Daisy Family	13/10/2010
Convolvulaceae sp.	Bindweed Family	10/11/2012
Convolvulus clementii (NC)		20/09/2006
Convolvulus erubescens (NC)	Australian Bindweed	2/09/1996
Convolvulus microsepalus	Small-flower Bindweed	23/09/2006
Convolvulus remotus	Grassy Bindweed	7/11/2012
Convolvulus sp.	Bindweed	2/09/1996
Crassula colorata var.	Dense Crassula	5/08/1995
Crassula colorata var. acuminata	Dense Crassula	18/09/2006
Crassula sieberiana ssp. tetramera (NC)	Australian Stonecrop	28/08/1996
Crassula sp.	Crassula/Stonecrop	19/09/1995
Crassula tetramera	Australian Stonecrop	18/09/2006
Cucumis myriocarpus ssp. myriocarpus	Paddy Melon	23/05/2007
Cucurbitaceae sp.	Melon Family	7/11/2019
Cullen australasicum	Tall Scurf-pea	26/08/1996
Cullen cinereum	Annual Scurf-pea	20/09/2006
Cullen graveolens	Native Lucerne	28/08/1996
Cymbopogon ambiguus	Lemon-grass	12/11/2012
Cymbopogon sp.	Lemon Grass	26/09/2006
Cynanchum viminale ssp. australe	Caustic Bush	26/09/2006
Cyperus alterniflorus	Umbrella Flat-sedge	11/11/2012
Cyperus gymnocaulos	Spiny Flat-sedge	20/04/2005
Cyperus pygmaeus	Pygmy Flat-sedge	26/09/1995
Dactyloctenium radulans	Button-grass	3/03/2011
Datura ferox	Long-spine Thorn-apple	23/05/2007
Daucus glochidiatus	Native Carrot	20/10/2010
'dead Eucalyptus' camaldulensis var. camaldulensis		7/04/2005
Dichanthium sericeum ssp.	Silky Blue-grass	28/08/1996
Dichanthium sericeum ssp. sericeum	Silky Blue-grass	29/07/2010
Digitaria brownii	Cotton Panic-grass	25/09/2006
Dissocarpus biflorus var.	Two-horn Saltbush	18/10/2010
Dissocarpus biflorus var. biflorus	Two-horn Saltbush	22/04/2005
Dissocarpus fontinalis		28/08/2008

Dissocarpus paradoxus	Ball Bindyi	21/10/2010
Dissocarpus sp.		7/11/2019
Dittrichia graveolens	Stinkweed	7/06/2007
Dodonaea lobulata	Lobed-leaf Hop-bush	12/11/2012
Dodonaea viscosa ssp.	Sticky Hop-bush	7/04/2005
Dodonaea viscosa ssp. angustissima	Narrow-leaf Hop-bush	6/11/2019
Duma florulenta	Lignum	22/09/2006
Dysphania cristata	Crested Crumbweed	24/09/2014
Dysphania pumilio	Small Crumbweed	21/04/2005
Echinochloa colona	Awnless Barnyard Grass	9/04/1999
Echium plantagineum	Salvation Jane	21/10/2010
Einadia nutans ssp.	Climbing Saltbush	19/10/2010
Einadia nutans ssp. nutans	Climbing Saltbush	22/09/2006
Enchylaena tomentosa var.	Ruby Saltbush	8/11/2018
Enchylaena tomentosa var. tomentosa	Ruby Saltbush	12/11/2012
Enneapogon avenaceus	Common Bottle-washers	12/11/2012
Enneapogon cylindricus	Jointed Bottle-washers	12/11/2012
Enneapogon nigricans	Black-head Grass	21/10/2010
Enneapogon polyphyllus	Leafy Bottle-washers	26/06/2011
Enneapogon sp.	Bottle-washers/Nineawn	17/10/2010
Enteropogon acicularis	Umbrella Grass	21/09/2006
Enteropogon ramosus	Umbrella Grass	12/11/2012
Enteropogon sp.	Umbrella Grass	8/11/2012
Eragrostis australasica	Cane-grass	26/06/2011
Eragrostis barrelieri	Pitted Love-grass	29/07/2010
Eragrostis dielsii	Mulka	7/11/2012
Eragrostis eriopoda	Woollybutt	2/09/1996
Eragrostis falcata	Sickle Love-grass	26/08/2008
Eragrostis leptocarpa	Drooping Love-grass	30/03/1997
Eragrostis setifolia	Bristly Love-grass	7/11/2018
Eragrostis sp.	Love-grass	7/11/2012
Eragrostis trichophora	Hairyflower Lovegrass	22/04/2013
Eragrostis xerophila	Knotty-butt Neverfail	28/08/1996
Eremophila alternifolia	Narrow-leaf Emubush	21/09/2006
Eremophila deserti	Turkey-bush	7/11/2012
Eremophila duttonii	Harlequin Emubush	12/11/2012
Eremophila freelingii	Rock Emubush	21/04/2005
Eremophila glabra ssp.	Tar Bush	2/09/1996
Eremophila latrobei ssp.	Crimson Emubush	4/07/1995
Eremophila longifolia	Weeping Emubush	22/02/2019
Eremophila maculata ssp.	Spotted Emubush	7/04/2005
Eremophila maculata ssp. maculata	Spotted Emubush	26/09/2006
Eremophila oppositifolia ssp.	Opposite-leaved Emubush	4/07/1995
Eremophila sp.	Emubush/Turkey-bush	21/09/2006
Eremophila sturtii	Turpentine Bush	12/11/2012
Eriochiton sclerolaenoides	Woolly-fruit Bluebush	9/11/2012
Erodium aureum		29/08/2008
Erodium cicutarium	Cut-leaf Heron's-bill	29/08/2008
Erodium crinitum	Blue Heron's-bill	18/10/2010
Erodium cygnorum	Blue Heron's-bill	18/10/2010
Erodium cygnorum ssp. cygnorum (NC)	Blue Heron's-bill	27/08/1996
Erodium cygnorum ssp. glandulosum (NC)	Clammy Heron's-bill	2/09/1996
Erodium janszii	Clammy Heron's-bill	29/08/2008
Eucalyptus camaldulensis ssp.	River Red Gum	7/04/2005
Eucalyptus camaldulensis ssp. camaldulensis	River Red Gum	25/09/2006
Eucalyptus camaldulensis ssp. minima	River Red Gum	23/09/2006
Eucalyptus camaldulensis var. camaldulensis (NC)	River Red Gum	21/04/2005

Eucalyptus largiflorens	River Box	23/09/2006
Eucalyptus porosa	Mallee Box	20/04/2005
Eucalyptus socialis ssp.	Beaked Red Mallee	22/04/2005
Euchiton sphaericus	Annual Cudweed	2/10/1995
Euphorbia drummondii (NC)		12/11/2012
Euphorbia parvicaruncula	Rough-seeded Spurge	28/08/2008
Euphorbia sp.	Spurge	16/10/2010
Euphorbia stevenii	Bottletree Spurge	10/09/2008
Euphorbia tannensis ssp. eremophila	Desert Spurge	19/04/2005
Exocarpos aphyllus	Leafless Cherry	19/09/2006
Exocarpos sparteus	Slender Cherry	25/09/2006
Frankenia crispa	Hoary Sea-heath	28/08/1996
Frankenia serpyllifolia	Thyme Sea-heath	18/11/2011
Fumaria densiflora	Dense Fumitory	20/09/2006
Fumaria indica	Indian Fumitory	29/08/2008
Galium murale	Small Bedstraw	26/08/1996
Geijera linearifolia	Sheep Bush	21/04/2005
Geococcus pusillus	Earth Cress	6/08/2008
Glaucium flavum	Horned Poppy	25/09/2006
Glinus oppositifolius	Slender Carpet-weed	26/09/1995
Glossostigma diandrum	Two-anther Mud-mat	23/10/2008
Glycine clandestina var. (NC)	Twining Glycine	27/08/1996
Glycine rubiginosa	Twining Glycine	20/04/2005
Gnaphalium polycaulon	Indian Cudweed	26/09/1995
Gnephosis arachnoidea	Spidery Button-flower	7/11/2012
Gnephosis eriocarpa	Native Camomile	19/09/2006
Gnephosis sp.		21/10/2010
Gnephosis tenuissima	Dwarf Golden-tip	22/09/2006
Goodenia fascicularis	Silky Goodenia	10/09/2008
Goodenia fascicularis (NC)	Silky Goodenia	8/09/2007
Goodenia glauca	Pale Goodenia	13/10/2007
Goodenia havilandii	Hill Goodenia	2/10/1995
Goodenia pinnatifida	Cut-leaf Goodenia	20/09/2006
Goodenia pusilliflora	Small-flower Goodenia	2/09/1996
Goodenia sp.	Goodenia	13/10/2010
Gramineae sp.	Grass Family	21/04/2005
Gunniopsis quadrifida	Sturt's Pigface	7/11/2019
Gypsophila tubulosa	Annual Chalkwort	19/04/2005
Hakea leucoptera ssp. leucoptera	Silver Needlewood	3/03/2011
Haloragis sp.	Raspwort	4/08/1995
Harmsiodoxa blennodioides	Hairy-pod Cress	28/08/2008
Harmsiodoxa brevipes var.	Short Cress	2/09/1996
Harmsiodoxa brevipes var. brevipes	Short Cress	2/09/1996
Helianthus annuus	Sunflower	13/10/2007
Heliotropium europaeum	Common Heliotrope	19/04/2005
Heliotropium supinum	Creeping Heliotrope	26/09/1995
Herniaria cinerea	Rupturewort	20/10/2010
Hibiscus krichauffianus	Velvet-leaf Hibiscus	16/10/2010
Hordeum glaucum	Blue Barley-grass	23/09/2006
Hyalosperma demissum	Dwarf Sunray	2/09/1996
Hyalosperma semisterile	Orange Sunray	14/09/2010
Hypochaeris glabra	Smooth Cat's Ear	21/09/2006
Indigofera australis ssp. australis	Austral Indigo	24/02/2019
Indigofera helmsii	Helm's Indigo	27/08/1996
Isoetes muelleri	Mueller's Quillwort	19/10/2010
Isoetopsis graminifolia	Grass Cushion	27/08/1996
Isolepis marginata	Little Club-rush	2/10/1995

Isotoma petraea	Rock Isotome	26/09/2006
Lamarckia aurea	Toothbrush Grass	20/09/1995
Leichhardtia australis	Native Pear	25/09/2006
Leiocarpa leptolepis	Pale Plover-daisy	16/03/2001
Leiocarpa semicalva ssp.	Hill Button-bush	4/07/1995
Leiocarpa semicalva ssp. semicalva	Scented Button-bush	28/08/2008
Leiocarpa tomentosa	Woolly Plover-daisy	3/03/2011
Leiocarpa websteri	Narrow Plover-daisy	12/11/2012
Lemooria burkittii	Wires-and-wool	11/09/2008
Lepidium africanum	Common Peppercress	8/04/1998
Lepidium fasciculatum	Bundled Peppercress	10/09/2008
Lepidium oxytrichum	Green Peppercress	2/09/1996
Lepidium papillosum	Warty Peppercress	10/09/2008
Lepidium phlebopetalum	Veined Peppercress	24/09/2006
Lepidium rotundum	Veined Peppercress	4/08/1995
Lepidium sp.	Peppercress	19/09/1995
Leptochloa digitata	Umbrella Cane-grass	30/03/1997
Leptorhynchos baileyi	Bailey's Buttons	19/09/1995
Leucochrysum molle	Hoary Sunray	20/09/1995
Leucochrysum stipitatum	Salt-spoon Daisy	15/09/2010
Limonium lobatum	Winged Sea-lavender	10/10/2007
Loranthaceae sp.	Mistletoe Family	19/09/1995
Lotus cruentus	Red-flower Lotus	21/10/2010
Lycium ferocissimum	African Boxthorn	4/06/2007
Lysiana exocarpi ssp. exocarpi	Harlequin Mistletoe	12/11/2012
Lysiana sp.	Mistletoe	5/08/1995
Lysiana subfalcata	Northern Mistletoe	23/09/2006
Lysimachia arvensis	Pimpernel	21/04/2005
Maireana aphylla	Cotton-bush	7/11/2019
Maireana appressa	Pale-fruit Bluebush	17/10/2014
Maireana astrotricha	Low Bluebush	7/11/2019
Maireana brevifolia	Short-leaf Bluebush	24/09/2014
Maireana ciliata	Hairy Fissure-plant	25/09/2014
Maireana eriantha	Woolly Bluebush	27/08/1996
Maireana georgei	Satiny Bluebush	17/10/2014
Maireana integra	Entire-wing Bluebush	7/11/2019
Maireana microcarpa	Swamp Bluebush	10/09/2008
Maireana pyramidata	Black Bluebush	7/11/2019
Maireana radiata	Radiate Bluebush	18/10/2010
Maireana sedifolia	Bluebush	16/10/2010
Maireana sp.	Bluebush/Fissure-plant	6/11/2019
Maireana trichoptera	Hairy-fruit Bluebush	25/06/2011
Maireana turbinata	Top-fruit Bluebush	20/10/2010
Maireana villosa	Silky Bluebush	28/08/2008
Malacocera albolanata	Woolly Soft-horns	20/09/2006
Malacocera biflora	Two-flower Soft-horns	2/09/1996
Malacocera gracilis	Slender Soft-horns	2/09/1996
Malacocera tricornis	Goat-head Soft-horns	7/11/2019
Malva parviflora	Small-flower Marshmallow	15/10/2010
Malva preissiana (NC)	Australian Hollyhock	21/09/2006
Malvastrum americanum var. americanum	Malvastrum	20/09/2006
Marrubium vulgare	Horehound	24/05/2007
Marsilea drummondii (NC)	Common Nardoo	4/08/1995
Medicago minima	Little Medic	20/09/2006
Medicago polymorpha	Burr-medic	23/09/2006
Medicago sativa	Lucerne	21/10/2008
Medicago sp.	Medic	17/10/2014

Melaleuca lanceolata	Dryland Tea-tree	21/04/2005
Melilotus indicus	King Island Melilot	13/10/2007
Menkea crassa	Fat Spectacles	17/11/2011
Mesembryanthemum sp.	Iceplant	13/10/2010
Millotia greevesii ssp.		2/09/1996
Millotia greevesii ssp. greevesii var. greevesii (NC)	Creeping Millotia	19/09/1995
Minuria annua	Annual Minuria	28/08/1996
Minuria cunninghamii	Bush Minuria	7/11/2018
Minuria denticulata	Woolly Minuria	10/09/2008
Minuria integerrima	Smooth Minuria	10/09/2008
Minuria leptophylla	Minnie Daisy	3/03/2011
Muehlenbeckia sp.	Lignum	4/08/1995
Myoporum montanum	Native Myrtle	19/09/2006
Myoporum platycarpum ssp.	False Sandalwood	8/11/2012
Myoporum platycarpum ssp. platycarpum	False Sandalwood	22/04/2005
Myriocephalus pluriflorus	Inland Woolly-heads	10/09/2008
Nicotiana velutina	Velvet Tobacco	21/04/2005
Nitraria billardierei	Nitre-bush	7/04/2005
Olearia pimeleoides	Pimelea Daisy-bush	12/11/2012
Olearia pimeleoides ssp. (NC)	Pimelea Daisy-bush	21/09/2006
Omphalolappula concava	Burr Stickseed	21/10/2010
Onopordum acaulon	Horse Thistle	26/08/1996
Orobanche cernua var. australiana	Australian Broomrape	17/10/2010
Osteocarpum acropterum var.	Bonefruit	24/09/2014
Osteocarpum acropterum var. acropterum	Tuberculate Bonefruit	28/08/2008
Osteocarpum dipterocarpum	Two-wing Bonefruit	10/11/2012
Osteocarpum salsuginosum	Inland Bonefruit	20/04/2005
Oxalis perennans	Native Sorrel	29/08/2008
Oxalis perennans/exilis	Native Oxalis	20/09/2006
Panicum decompositum var. decompositum	Native Millet	1/03/2011
Panicum sp.	Panic/Millet	21/11/2011
Parietaria debilis (NC)	Smooth-nettle	4/07/1995
Parkinsonia aculeata	Jerusalem Thorn	10/09/2009
Paspalidium sp. (NC)	Summer-grass	4/07/1995
Philotheca linearis	Narrow-leaf Wax-flower	27/08/1996
Phlegmatospermum cochlearinum	Downy Cress	14/09/2010
Pimelea microcephala ssp.	Shrubby Riceflower	21/10/2010
Pimelea microcephala ssp. microcephala	Shrubby Riceflower	9/11/2012
Pimelea simplex ssp.	Desert Riceflower	16/10/2010
Pimelea simplex ssp. continua	Desert Riceflower	13/09/2010
Pimelea simplex ssp. simplex	Desert Riceflower	21/04/2005
Pimelea sp.	Riceflower	17/10/2010
Pimelea trichostachya	Spiked Riceflower	12/11/2012
Pittosporum angustifolium	Native Apricot	12/11/2012
Plagiobothrys plurisepaleus	White Rochelia	10/09/2008
Plantago bellardii	Hairy Plantain	20/04/2005
Plantago drummondii	Dark Plantain	16/10/2010
Plantago hispida	Hairy Plantain	19/04/2005
Plantago sp.	Plantain	20/10/2010
Podolepis aristata ssp. auriculata	Grey Copper-wire Daisy	26/08/2008
Podolepis capillaris	Wiry Podolepis	16/10/2010
Polycarpon tetraphyllum	Four-leaf Allseed	18/09/2006
Pomax umbellata	Pomax	21/09/2006
Portulaca oleracea	Common Purslane	13/10/2010
Prostanthera striatiflora	Striated Mintbush	24/02/2019
Pterocaulon sphacelatum	Apple-bush	10/11/2012
Ptilotus incanus/obovatus	Silver Mulla Mulla	20/09/1995

Ptilotus nobilis ssp.		13/10/2010
Ptilotus nobilis var. (NC)	Yellow-tails	21/10/2010
Ptilotus obovatus	Silver Mulla Mulla	12/11/2012
Ptilotus obovatus (NC)	Silver Mulla Mulla	20/09/2006
Ptilotus sp.	Mulla Mulla	17/10/2014
Ptilotus spathulatus	Pussy-tails	19/10/2010
Pycnosorus pleiocephalus	Soft Billy-buttons	2/09/1996
Ranunculus pentandrus var. platycarpus	Smooth Buttercup	14/09/2010
Reichardia tingitana	False Sowthistle	12/11/2012
Rhagodia parabolica	Mealy Saltbush	18/09/2006
Rhagodia spinescens	Spiny Saltbush	7/11/2019
Rhagodia ulicina	Intricate Saltbush	28/08/2008
Rhodanthe corymbiflora	Paper Everlasting	15/10/2010
Rhodanthe floribunda	White Everlasting	24/09/2006
Rhodanthe microglossa	Clustered Everlasting	20/10/2010
Rhodanthe moschata	Musk Daisy	23/09/2006
Rhodanthe polygalifolia	Milkwort Everlasting	20/09/2006
Rhodanthe pygmaea	Pigmy Daisy	21/10/2010
Rhodanthe sp.	Everlasting	17/10/2010
Rhodanthe stricta	Slender Everlasting	10/09/2008
Rhodanthe uniflora	Woolly Daisy	22/10/2008
Ricinus communis	Castor Oil Plant	21/05/2007
Roepera crenata	Notched Twinleaf	4/07/1995
Roepera iodocarpa	Violet Twinleaf	24/09/2006
Roepera sp.	Twinleaf	10/09/1995
Rostraria pumila	Tiny Bristle-grass	18/10/2010
Rumex crispus	Curled Dock	16/03/2001
Rumex vesicarius	Rosy Dock	4/07/1995
Rytidosperma caespitosum (NC)	Common Wallaby-grass	24/09/2006
Rytidosperma laeve	Smooth Wallaby-grass	8/09/2007
Rytidosperma setaceum	Small-flower Wallaby-grass	12/11/2012
Rytidosperma sp.	Wallaby-grass	21/10/2010
Salsola australis	Buckbush	12/11/2012
Salvia verbenaca var.	Wild Sage	12/11/2012
Salvia verbenaca var. verbenaca	Wild Sage	7/06/2007
Salvia verbenaca var. vernalis	Wild Sage	7/11/2012
Santalum acuminatum	Quandong	10/11/2012
Sarcozona praecox	Sarcozona	7/11/2019
Schenkia australis	Spike Centaury	26/09/1995
Schinus molle	Pepper-tree	24/05/2007
Schismus arabicus	Arabian Grass	15/10/2010
Schismus barbatus	Arabian Grass	9/11/2012
Schismus sp.		17/10/2010
Schoenia ramosissima	Dainty Everlasting	2/09/1996
Scleranthus pungens	Prickly Knawel	14/09/2010
Scleroderma sp.		25/09/2006
Sclerolaena birchii	Galvanised Burr	3/03/2011
Sclerolaena brachyptera	Short-wing Bindyi	12/11/2012
Sclerolaena convexula	Tall Bindyi	19/04/2005
Sclerolaena cuneata	Tangled Bindyi	24/09/2006
Sclerolaena decurrens	Green Bindyi	8/11/2012
Sclerolaena deserticola	Desert Bindyi	25/09/2014
Sclerolaena diacantha	Grey Bindyi	17/10/2014
Sclerolaena divaricata	Tangled Bindyi	7/11/2012
Sclerolaena eriacantha	Silky Bindyi	20/10/2010
Sclerolaena glabra	Smooth Bindyi	24/09/2006
Sclerolaena holtiana	Holt's Bindyi	3/08/1995

Sclerolaena intricata	Tangled Bindyi	20/10/2010
Sclerolaena lanicuspis	Spinach Bindyi	25/09/2014
Sclerolaena limbata	Pearl Bindyi	24/09/2014
Sclerolaena obliquicuspis	Oblique-spined Bindyi	25/09/2014
Sclerolaena patenticuspis	Spear-fruit Bindyi	24/09/2014
Sclerolaena sp.	Bindyi	19/10/2010
Sclerolaena tricuspis	Three-spine Bindyi	12/11/2012
Sclerolaena uniflora	Small-spine Bindyi	9/09/1995
Sclerolaena ventricosa	Salt Bindyi	12/11/2012
Sebaea ovata	Yellow Sebaea	2/10/1995
Senecio anethifolius (NC)	Feathery Groundsel	27/08/1996
Senecio anethifolius ssp.	Feathery Groundsel	10/11/2012
Senecio anethifolius ssp. anethifolius	Feathery Groundsel	9/11/2012
Senecio anethifolius ssp. brevibracteolatus	Feathery Groundsel	8/11/2012
Senecio gawlerensis	Gawler Ranges Groundsel	27/08/2008
Senecio glossanthus (NC)	Annual Groundsel	2/09/1996
Senecio gregorii	Fleshy Groundsel	2/09/1996
Senecio lanibracteus	Inland Shrubby Groundsel	23/10/2008
Senecio magnificus	Showy Groundsel	10/11/2012
Senecio pinnatifolius (NC)	Variable Groundsel	2/09/1996
Senecio quadridentatus	Cotton Groundsel	10/11/2012
Senecio sp.	Groundsel	7/11/2019
Senna artemisioides ssp.	Desert Senna	7/11/2019
Senna artemisioides ssp. filifolia	Fine-leaf Desert Senna	13/10/2010
Senna artemisioides ssp. petiolaris		7/11/2019
Senna artemisioides ssp. petiolaris (NC)	Flat-stalk Senna	22/04/2005
Senna artemisioides ssp. quadrifolia	Four-leaf Desert Senna	3/03/2011
Senna artemisioides ssp. X artemisioides	Silver Senna	7/11/2019
Senna artemisioides ssp. X coriacea	Broad-leaf Desert Senna	19/09/2006
Senna artemisioides ssp. X sturtii	Grey Senna	3/03/2011
Senna artemisioides ssp. zygophylla	Twin-leaf Desert Senna	23/03/2006
Setaria constricta	Knotty-butt Paspalidium	27/08/1996
Setaria jubiflora	Warrego Summer-grass	29/03/1997
Sida corrugata var.	Corrugated Sida	16/10/2010
Sida fibulifera	Pin Sida	8/11/2012
Sida intricata	Twiggy Sida	7/11/2019
Sida petrophila	Rock Sida	12/11/2012
Sida rohlenae ssp. rohlenae	Shrub Sida	18/11/2011
Sida sp.	Sida	17/10/2010
Sida trichopoda	High Sida	19/11/2011
Silene apetala	Sand Catchfly	21/04/2005
Sisymbrium erysimoides	Smooth Mustard	19/10/2010
Sisymbrium irio	London Mustard	17/03/2001
Solanum chenopodinum	Goosefoot Potato-bush	28/06/2007
Solanum elaeagnifolium	Silver-leaf Nightshade	12/11/2012
Solanum ellipticum (NC)	Velvet Potato-bush	12/11/2012
Solanum lithophilum/quadriloculatum		27/08/1996
Solanum mauritianum	Wild Tobacco Tree	24/05/2007
Solanum nigrum	Black Nightshade	29/08/2008
Solanum petrophilum	Rock Nightshade	28/08/2008
Solanum petrophilum (NC)	Rock Nightshade	12/11/2012
Solanum quadriloculatum	Plains Nightshade	18/10/2010
Solanum retroflexum		3/08/1995
Solanum sp.	Nightshade/Potato-bush	6/11/2019
Solanum sturtianum	Sturt's Nightshade	10/11/2012
Sonchus oleraceus	Common Sow-thistle	7/11/2019
Sonchus sp.	Sow-thistle	13/10/2010

Sorghum halepense	Johnson Grass	16/03/2001
Spergularia diandra	Lesser Sand-spurrey	13/10/2007
Spergularia media	Coast Sand-spurrey	28/08/2008
Spergularia sp.	Sand-spurrey	21/04/2005
Sphaeromorphaea littoralis	Spreading Nut-heads	26/09/1995
Sporobolus actinocladus	Ray Grass	9/11/2012
Sporobolus sp.		18/10/2010
Stellaria filiformis	Thread Starwort	18/04/2005
Stenopetalum lineare	Narrow Thread-petal	6/08/2008
Stenopetalum lineare (NC)	Narrow Thread-petal	22/04/2005
Suaeda australis	Austral Seablite	18/09/2006
Swainsona formosa	Sturt Pea	14/09/2010
Swainsona fuscoviridis	Dark Green Swainson-pea	11/09/2008
Swainsona phacoides	Dwarf Swainson-pea	18/10/2010
Swainsona sp.	Swainson-pea	19/09/1995
Swainsona stipularis	Orange Swainson-pea	13/09/2010
Swainsona swainsonioides	Downy Swainson-pea	13/09/2010
Tamarix aphylla	Athel Pine	27/03/2007
Tecticornia indica ssp. leiostachya	Brown-head Samphire	19/04/2005
Tecticornia pergranulata ssp. pergranulata	Black-seed Samphire	19/04/2005
Tecticornia sp.	Samphire	7/04/2005
Tecticornia tenuis	Slender Samphire	20/10/2010
Tetragonia eremaea	Desert Spinach	20/10/2010
Tetragonia sp.	False Spinach	16/10/2010
Tetragonia tetragonoides	New Zealand Spinach	12/10/2010
Teucrium racemosum	Grey Germander	17/10/2010
Themeda triandra	Kangaroo Grass	30/03/1997
Thysanotus baueri	Mallee Fringe-lily	12/11/2012
Thysanotus sp.	Fringe-lily	21/10/2010
Tragus australianus	Small Burr-grass	20/09/1995
Tribulus eichlerianus	Eichler's Caltrop	29/03/1997
Triodia irritans	Spinifex	19/04/2005
Triodia sp.	Spinifex	19/04/2005
Tripogonella loliiformis	Five-minute Grass	16/10/2010
Triraphis mollis	Purple Plume Grass	25/06/2011
Vittadinia cuneata var.	Fuzzy New Holland Daisy	22/09/2006
Vittadinia cuneata var. cuneata	Fuzzy New Holland Daisy	17/10/2014
Vittadinia cuneata var. morrisii	New Holland Daisy	28/08/2008
Vittadinia dissecta var. hirta	Dissected New Holland Daisy	18/04/2005
Vittadinia eremaea	Desert New Holland Daisy	28/08/1996
Vittadinia gracilis	Woolly New Holland Daisy	12/11/2012
Vittadinia sp.	New Holland Daisy	12/11/2012
Vittadinia sulcata	Furrowed New Holland Daisy	12/11/2012
Wahlenbergia communis	Tufted Bluebell	12/11/2012
Wahlenbergia gracilenta	Annual Bluebell	18/10/2010
Wahlenbergia queenslandica		25/09/2006
Wahlenbergia sp.	Native Bluebell	4/07/1995
Wahlenbergia stricta ssp. stricta	Tall Bluebell	14/09/2010
Wahlenbergia tumidifructa	Swollen-fruit Bluebell	25/09/2006
Wurmbea citrina	Green-flower Nancy	14/09/2010
Wurmbea dioica ssp. dioica (NC)	Early Star-lily	27/08/1996
Xanthium spinosum	Bathurst Burr	23/05/2007
Zygophyllum ammophilum (NC)	Sand Twinleaf	19/09/1995
Zygophyllum iodocarpum (NC)	Violet Twinleaf	2/09/1996

Appendix 3. Fauna Species List

Scientific Name	Common Name	Date of last record
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	21/10/2010
Acanthiza apicalis	Inland Thornbill	28/02/2011
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	9/11/2012
Acanthiza iredalei	Slender-billed Thornbill	9/05/2006
Acanthiza uropygialis	Chestnut-rumped Thornbill	17/11/2011
Accipiter cirrocephalus cirrocephalus	Collared Sparrowhawk	8/11/2012
Accipiter fasciatus fasciatus	Brown Goshawk	19/11/2005
Accipiter sp.	sparrowhawks and goshawks	21/09/2006
Aegotheles cristatus cristatus	Australian Owlet-nightjar	26/05/2007
Amytornis modestus	Thick-billed Grasswren	7/05/2006
Anas castanea	Chestnut Teal	30/03/2005
Anas gracilis gracilis	Grey Teal	4/03/2011
Anilios bicolor	Southern Blind Snake	25/09/2006
Anilios bituberculatus	Rough-nosed Blind Snake	8/10/2019
Antaresia stimsoni	Stimson's Python	18/03/2005
Anthus australis	Australian Pipit	11/11/2012
Aphelocephala leucopsis leucopsis	Southern Whiteface	11/10/2010
Aquila audax audax	Wedge-tailed Eagle	11/11/2012
Ardeotis australis	Australian Bustard	27/06/2018
Artamus cinereus	Black-faced Woodswallow	12/11/2012
Artamus leucorynchus	White-breasted Woodswallow	9/05/2006
Artamus personatus	Masked Woodswallow	18/09/2006
Artamus superciliosus	White-browed Woodswallow	27/08/1996
Aspidites ramsayi	Woma	1/02/1997
Austronomus australis	White-striped Free-tailed Bat	9/04/2012
Aythya australis	Hardhead	10/11/2012
Barnardius zonarius	Australian Ringneck	19/11/2011
Bos taurus	Cattle (European Cattle)	14/04/2019
Cacatua sanguinea gymnopis	Little Corella	19/10/2010
Cacomantis pallidus	Pallid Cuckoo	11/05/2006
Calamanthus campestris	Rufous Fieldwren	12/11/2012
Canis lupus dingo	Dingo	24/04/2019
Canis sp.		21/05/2005
Capra hircus	Goat (Feral Goat)	24/04/2019
Carduelis carduelis britannica	European Goldfinch	7/05/2006
Certhionyx variegatus	Pied Honeyeater	16/11/2005
Chalcites basalis	Horsfield's Bronze Cuckoo	18/10/2010
Chalcites osculans	Black-eared Cuckoo	20/09/2006
Chalinolobus gouldii	Gould's Wattled Bat	10/04/2012
Charadrius sp.		26/05/2007
Charadrius veredus	Oriental Plover	14/11/2005
Chenonetta jubata	Maned Duck	26/05/2007
Cheramoeca leucosterna	White-backed Swallow	12/11/2012
Cincloramphus cruralis	Brown Songlark	17/11/2011
Cincloramphus mathewsi	Rufous Songlark	21/11/2005
Cinclosoma cinnamomeum	Cinnamon Quailthrush	19/11/2011
Circus approximans	Swamp Harrier	4/03/2011

Circus assimilis	Spotted Harrier	5/03/2011
Columba livia	Feral Pigeon	25/05/2005
Coracina maxima	Ground Cuckooshrike	28/05/2005
Coracina novaehollandiae	Black-faced Cuckooshrike	21/10/2010
Corvus bennetti	Little Crow	26/09/2006
Corvus coronoides	Australian Raven	12/11/2012
Corvus mellori	Little Raven	12/05/2006
Corvus orru cecilae	Torresian Crow	4/03/2011
Corvus sp.	Crows	23/04/2019
Coturnix pectoralis	Stubble Quail	16/11/2011
Cracticus nigrogularis nigrogularis	Pied Butcherbird (MM)	18/11/2011
Cracticus torquatus leucopterus	Grey Butcherbird	19/11/2011
Cryptoblepharus australis	Desert Wall Skink	3/10/2019
Cryptoblepharus cf plagiocephalus (NC)	Desert Wall Skink	3/09/1996
Cryptoblepharus sp.		8/04/2012
Ctenophorus modestus	Swift Rock Dragon	12/11/2012
Ctenophorus nuchalis	Central Netted Dragon	5/10/2019
Ctenophorus pictus	Painted Dragon	23/11/2017
Ctenophorus sp.		20/11/2005
Ctenotus leonhardii	Common Desert Ctenotus	20/03/2017
Ctenotus olympicus	Saltbush Ctenotus	27/09/2021
Ctenotus orientalis	Spotted Ctenotus	9/04/2012
Ctenotus regius	Eastern Desert Ctenotus	30/09/2021
Ctenotus schomburgkii	Sandplain Ctenotus	30/09/2021
Ctenotus sp.		14/11/2011
Ctenotus spaldingi	Eastern Striped Skink	23/11/2017
Ctenotus strauchii	Short-legged Ctenotus	23/11/2017
Ctenotus taeniatus	Eyrean Ctenotus	4/09/1996
Cygnus atratus	Black Swan	13/08/1996
Daphoenositta chrysoptera pileata	Black-capped Sittella	14/10/2010
Delma tincta	Excitable Delma	16/11/2005
Dicaeum hirundinaceum hirundinaceum	Mistletoebird	26/05/2007
Diplodactylus conspicillatus (revised)	Variable Fat-tailed Gecko	6/10/2019
Diplodactylus furcosus	Ranges Stone Gecko	15/10/2010
Diplodactylus tessellatus	Tessellated Gecko	29/09/2021
Dromaius novaehollandiae	Emu	23/04/2019
Egernia striolata	Eastern Tree Skink	8/04/2012
Elanus axillaris	Black-shouldered Kite	17/11/2005
Elseyornis melanops	Black-fronted Dotterel	7/05/2006
Emblema pictum	Painted Finch	1/03/2011
Eolophus roseicapilla	Galah	20/04/2019
Epthianura albifrons	White-fronted Chat	9/11/2012
Epthianura aurifrons	Orange Chat	10/11/2012
Epthianura tricolor	Crimson Chat	21/10/2010
Equus caballus	Horse (Brumby)	28/08/1996
Eremiascincus phantasmus	Ghost Skink	5/03/2011
Eremiascincus richardsonii	Broad-banded Sandswimmer	30/09/2021
Eurostopodus argus	Spotted Nightjar	15/11/2011

Eurystomus orientalis	Oriental Dollarbird	18/02/2000
Falco berigora berigora	Brown Falcon	11/11/2012
Falco cenchroides cenchroides	Nankeen Kestrel	12/11/2012
Falco longipennis murchisonianus	Australian Hobby	22/11/2005
Falco subniger	Black Falcon	5/03/2011
Felis catus	Domestic Cat (Feral Cat)	24/04/2019
Fulica atra australis	Eurasian Coot	10/11/2012
Gavicalis virescens	Singing Honeyeater	12/11/2012
Gehyra lazelli	Southern Rock Dtella	12/11/2012
Gehyra sp.		26/05/2005
Gehyra variegata (NC)	Tree Dtella	9/04/2012
Gehyra variegata complex		30/08/1996
Gehyra versicolor	Eastern Tree Dtella	8/10/2019
Gelochelidon macrotarsa	Australian Tern	18/09/1996
Geopelia cuneata	Diamond Dove	8/03/2019
Geopelia placida placida	Peaceful Dove	4/03/2011
Grallina cyanoleuca cyanoleuca	Magpielark	18/10/2010
Gymnorhina tibicen	Australian Magpie	14/04/2019
Heteronotia binoei	Bynoe's Gecko	29/09/2021
Hieraaetus morphnoides	Little Eagle	23/09/2006
Hirundo neoxena neoxena	Welcome Swallow	15/11/2011
Lalage tricolor	White-winged Triller	21/11/2005
Leggadina forresti	Central Short-tailed Mouse (Forrest's Mouse)	5/03/2011
Leporillus sp.	stick-nest rats	26/05/2005
Lerista labialis	Eastern Two-toed Slider	3/03/2011
Lerista muelleri	Dwarf Three-toed Slider	16/11/2005
Lerista punctatovittata	Spotted Slider	4/10/2019
Lerista sp.		20/11/2005
Lerista timida	Dwarf Three-toed Slider	6/10/2019
Lialis burtonis	Burton's Snake-lizard	20/03/2017
Limnodynastes tasmaniensis	Spotted Marsh Frog	24/11/2005
Liopholis inornata	Desert Skink	7/10/2019
Lucasium byrnei	Gibber Gecko	23/11/2017
Lucasium damaeum	Beaded Gecko	11/11/2012
Lucasium steindachneri	Map Gecko	20/03/2017
MACROPODIDAE sp.	kangaroos	24/04/2019
Macropus (Osphranter) robustus	Euro	22/04/2019
Macropus (Osphranter) rufus	Red Kangaroo	22/04/2019
Macropus fuliginosus	Western Grey Kangaroo	18/04/2019
Macropus giganteus	Eastern Grey Kangaroo	26/09/2006
Macropus sp.		19/10/2010
Malacorhynchus membranaceus	Pink-eared Duck	11/05/2006
Malurus assimilis assimilis	Purple-backed Fairywren	8/11/2012
Malurus cyaneus leggei	Superb Fairywren (Mainland SA)	20/10/2010
Malurus leucopterus leuconotus	White-winged Fairywren	12/11/2012
Malurus sp.	fairywrens	25/09/2006
Malurus splendens melanotus	Black-backed Fairywren (MM)	15/11/2005

Manorina flavigula	Yellow-throated Miner	12/11/2012
Manorina flavigula flavigula	Yellow-throated Miner (central eastern, mid-North, YP, FR)	5/08/2020
Melanodryas cucullata	Hooded Robin	14/10/2010
Melopsittacus undulatus	Budgerigar	17/11/2011
Menetia greyii	Dwarf Skink	30/09/2021
Merops ornatus	Rainbow Bee-eater	19/10/2010
Microcarbo melanoleucos melanoleucos	Little Pied Cormorant	25/05/2005
Milvus migrans affinis	Black Kite	4/03/2011
Mirafra javanica	Horsfield's Bush Lark	21/10/2010
Morethia adelaidensis	Adelaide Snake-eye	20/03/2017
Morethia boulengeri	Common Snake-eye	4/10/2019
Morethia sp.		26/05/2005
Mormopterus petersi	Inland Free-tailed Bat	10/04/2012
Mormopterus planiceps	Southern Free-tailed Bat	8/04/2012
Mormopterus sp.		24/09/2006
Muridae sp.		13/10/2010
Mus musculus	House Mouse	27/09/2021
Myiagra inquieta	Restless Flycatcher	12/05/2006
Neobatrachus pictus	Burrowing Frog	17/10/2010
Neobatrachus sp.		23/11/2005
Neobatrachus sudellae	Sudell's Frog	2/09/2021
Neophema elegans elegans	Elegant Parrot	20/09/2006
Neophema sp.	Neophema parrots	30/08/1996
Neopsephotus bourkii	Bourke's Parrot	23/05/2005
Nephrurus levis	Common Knob-tailed Gecko	29/09/2021
Ninox boobook	Australian Boobook	7/05/2006
Northiella haematogaster (NC)	Bluebonnet (Eastern and Naretha)	19/11/2011
Notomys fuscus	Dusky Hopping-mouse	1/05/2012
Nycticorax caledonicus australasiae	Nankeen Night Heron	22/05/2005
Nyctophilus geoffroyi	Lesser Long-eared Bat	10/04/2012
Nymphicus hollandicus	Cockatiel	5/03/2011
Ocyphaps lophotes lophotes	Crested Pigeon	12/04/2019
Oreoica gutturalis	Crested Bellbird	17/11/2011
Oryctolagus cuniculus	Rabbit (European Rabbit)	24/04/2019
Ovis aries	Sheep (Feral Sheep)	14/04/2019
Oxyura australis	Blue-billed Duck	12/05/2006
Pachycephala rufiventris rufiventris	Rufous Whistler	8/11/2012
Pardalotus striatus substriatus	Striated Pardalote	8/11/2012
Passer domesticus domesticus	House Sparrow	19/10/2010
Pedionomus torquatus	Plains-wanderer	9/05/2006
Peltohyas australis	Inland Dotterel	11/05/2006
Petrochelidon ariel	Fairy Martin	26/09/2006
Petrochelidon nigricans	Tree Martin	8/11/2012
Petrogale sp.		19/10/2010
Petrogale xanthopus xanthopus	Yellow-footed Rock-wallaby	20/09/2021
Petroica boodang boodang	Scarlet Robin	8/11/2012
Petroica goodenovii	Red-capped Robin	20/10/2010

Phaps chalcoptera	Common Bronzewing	18/10/2010
Phylidonyris pyrrhopterus	Crescent Honeyeater	20/09/2006
Planigale gilesi	Giles' Planigale (Paucident Planigale)	8/10/2019
Planigale tenuirostris	Narrow-nosed Planigale	30/09/2021
Podargus strigoides	Tawny Frogmouth	20/10/2010
Pogona sp.		21/05/2005
Pogona vitticeps	Central Bearded Dragon	23/11/2017
Poliocephalus poliocephalus	Hoary-headed Grebe	10/11/2012
Pomatostomus ruficeps	Chestnut-crowned Babbler	16/04/2019
Pomatostomus superciliosus	White-browed Babbler	19/11/2011
Poodytes gramineus goulburni	Little Grassbird	13/08/1996
Psephotellus varius	Mulga Parrot	4/03/2011
Pseudechis australis	Mulga Snake	8/11/2012
Pseudomys bolami	Bolam's Mouse	30/09/2021
Pseudomys desertor	Desert Mouse	5/03/2011
Pseudomys hermannsburgensis	Sandy Inland Mouse	10/11/2012
Pseudonaja mengdeni	Gwardar	24/09/2006
Psophodes cristatus	Chirruping Wedgebill	12/11/2012
Ptilotula penicillata	White-plumed Honeyeater	12/05/2006
Purnella albifrons	White-fronted Honeyeater	23/09/2006
Pygopus schraderi	Eastern Hooded Scaly-foot	23/11/2017
Pyrrholaemus brunneus	Redthroat	12/11/2012
Rhipidura albiscapa	Grey Fantail	28/05/2005
Rhipidura leucophrys leucophrys	Willie Wagtail	19/11/2011
Rhynchoedura eyrensis	Eyrean Beaked Gecko	30/09/2021
Rhynchoedura ornata (NC)	Beaked Gecko	13/11/2012
Rhynchoedura ornata (revised)	Western Beaked Gecko	23/11/2017
Scotorepens balstoni	Inland Broad-nosed Bat	5/04/2012
Smicrornis brevirostris	Weebill	8/11/2012
Sminthopsis crassicaudata	Fat-tailed Dunnart	29/09/2021
Sminthopsis macroura	Stripe-faced Dunnart	2/10/2021
Sminthopsis murina	Common Dunnart	20/10/2010
Sminthopsis sp.		24/09/2006
Strophurus ciliaris	Northern Spiny-tailed Gecko	23/04/2018
Strophurus intermedius	Southern Spiny-tailed Gecko	30/09/2021
Struthidea cinerea cinerea	Apostlebird	16/03/2019
Sturnus vulgaris vulgaris	Common Starling	26/05/2005
Sugomel niger	Black Honeyeater	4/09/1996
Sus scrofa	Pig (Feral Pig)	27/03/2019
Suta spectablilis	Mallee Black-headed Snake	18/10/2014
Suta suta	Curl Snake	29/09/2021
Tachybaptus novaehollandiae novaehollandiae	Australasian Grebe	10/11/2012
Tachyglossus aculeatus	Short-beaked Echidna	7/10/2019
Tadarida sp.		27/05/2005
Taeniopygia guttata castanotis	Zebra Finch	12/11/2012
Tiliqua occipitalis	Western Bluetongue	8/11/2012
Tiliqua rugosa	Sleepy Lizard	9/11/2012
Tiliqua scincoides	Eastern Bluetongue	20/10/2010

Todiramphus pyrrhopygius	Red-backed Kingfisher	12/11/2012
Todiramphus sanctus sanctus	Sacred Kingfisher	21/05/2005
Tribonyx ventralis	Black-tailed Nativehen	10/05/2006
Turnix velox	Little Buttonquail	18/10/2010
Tympanocryptis lineata complex	Lined Earless Dragon	3/10/2019
Tympanocryptis petersi	Lined Earless Dragon	28/09/2021
Tympanocryptis sp.		23/11/2005
Tympanocryptis tetraporophora	Eyrean Earless Dragon	7/10/2019
Tyto javanica delicatula	Eastern Barn Owl	17/11/2011
Underwoodisaurus milii	Common Barking Gecko	19/11/2005
Vanellus miles	Masked Lapwing	26/05/2007
Vanellus tricolor	Banded Lapwing	4/03/2011
Varanus gouldii	Sand Goanna	4/10/2019
Varanus sp.	goannas	28/05/2005
Vespadelus baverstocki	Inland Forest Bat	10/04/2012
Vespadelus sp.		12/10/2010
Vulpes vulpes	Fox (Red Fox)	1/05/2012

Appendix 4. SEB Management Plan

Appendix 5. Copies of associated approvals

APPENDIX 3

Mineral Lease Schedule 2 and 6

MPL 158 and ML 6498-6500

SECOND SCHEDULE
MPL 158

SECOND SCHEDULE

ADDITIONAL CONDITIONS

Explanatory Note: A condition is a clause that imposes a restriction on a Mining Tenement.

INDEX TO SECOND SCHEDULE (ADDITIONAL CONDITIONS) Condition No.

Transparency

1. The Tenement Holder agrees to the Approved PEPR and any compliance reports and reportable incident reports, submitted in accordance with the Regulations, being made available for public inspection.

Notification of Cessation of Operations

2. Within thirty (30) days of becoming aware of any event or decision which is likely to give rise to the cessation of mining related activities for a period of more than seven (7) days and prior to the cessation of mining related activities, the Tenement Holder must notify the Director of Mines (or other authorised officer) in writing of the event or decision. The notice must specify the date upon which the mining related activities are expected to cease, or have ceased and an estimate of the period of cessation.

Decommissioning and Rehabilitation Plan

3. If the Tenement Holder decides to cease mining related activities or an event occurs that is likely to give rise to the permanent cessation of mining related activities, the Tenement Holder must develop a DRP and submit it to the Director of Mines (or other authorised officer) for approval within thirty (30) days of the decision or event (or such longer period as approved by the Director of Mines (or other authorised officer)).

4. The DRP must:

   4.1. Set out the activities and scheduling required for the carrying out of the rehabilitation works specified in the Approved PEPR;

   4.2. Be prepared in accordance with any guidelines provided by the Director of Mines (or other authorised officer).

5. The Tenement Holder must carry out decommissioning and rehabilitation in accordance with the approved DRP and the Approved PEPR.

6. If, in the opinion of the Director of Mines, mining operations have substantially ceased for a period of two (2) consecutive years, the Director of Mines may direct the Tenement Holder:

   6.1. To develop and submit a DRP (which must address the requirements of Second Schedule Condition 4) for approval within thirty (30) days of the direction or such longer period as the Director of Mines may allow; and/or

   6.2. To carry out decommissioning and rehabilitation in accordance with the approved DRP and the Approved PEPR.

Additional Information in the Program

7. In accordance with section 70B(2)(d) of the Act it is a condition of the grant of the Mining Tenement that a Proposed PEPR submitted in accordance with Part 10A of the Act must include reports from suitably qualified independent experts on the following matters:

   7.1. The effectiveness of the proposed strategies in the Proposed PEPR achieving the environmental outcomes identified the Proposed PEPR, including but not limited to reports from an Independent Hydrology Expert (i.e. for surface water management). All reports must include identification of any risks, assumptions and uncertainties associated with the relevant strategies.

   7.2. The capacity of the tenement holder to achieve compliance with the Act and the Proposed PEPR in light of its management systems, personnel, policies, procedures, practices and resources.

Other Legislation

8. The Tenement Holder must comply with all State and Commonwealth legislation and regulations applicable to the activities undertaken pursuant to this Licence including (but not limited to) the:

8.1. *Environment Protection and Biodiversity Conservation Act 1999;*

8.2. *Development Act 1993;*

8.3. *Planning, Development and Infrastructure Act 2016;*

8.4. *Dangerous Substances Act 1979;*

8.5. *National Parks and Wildlife Act 1972;*

8.6. *Natural Resources Management Act 2004;*

8.7. *Public and Environmental Health Act 1987;*

8.8. *Aboriginal Heritage Act 1988;*

8.9. *Heritage Places Act 1993;*

8.10. *Work Health and Safety Act 2012;*

8.11. *Environment Protection Act 1993;*

8.12. *Native Vegetation Act 1991;*

8.13. *Mines and Works Inspection Act 1920; and*

8.14. *Road Traffic Act 1961.*

SECOND SCHEDULE
ML 6498, ML 6499, ML 6500

SECOND SCHEDULE

ADDITIONAL CONDITIONS

Explanatory note: A condition is a clause that imposes a restriction on a Mining Tenement.

INDEX TO SECOND SCHEDULE (ADDITIONAL CONDITIONS) Condition No.

Tailings Storage Facility (TSF)

1. Provide verification reports compiled by a suitably qualified independent expert, against the design and plans that have been adopted for the TSF construction, operation and closure:

   1.1. For all stages of TSF construction;

   1.2. At an appropriate frequency for operations; and

   1.3. For closure of the TSF including the cover system.

   All verification reports will be made publically available and must be provided to the Director of Mines (or other authorised officer) prior to the initial placement of tailings in the TSF. Subsequent reports must be provided to the Director of Mines (or other Authorised Officer) within one (1) month of completion.

Surface Water

2. The Tenement Holder must ensure that any watercourse diversions are designed to (at a minimum):

   2.1. Incorporate natural features (including geomorphic and vegetation) present in the landscape and local watercourses;

   2.2. Maintain the existing hydrology and hydraulic characteristics of surface water systems;

2.3. Maintain sediment transport and water quality regimes that allow the watercourse diversion to be self-sustaining.

Transparency

3. The Tenement Holder agrees to the Approved PEPR and any compliance reports and reportable incident reports, submitted in accordance with the Regulations, being made available for public inspection.

Notification of Cessation of Operations

4. Within thirty (30) days of becoming aware of any event or decision which is likely to give rise to the cessation of mining operations for a period of more than seven (7) days and prior to the cessation of mining operations, the Tenement Holder must notify the Director of Mines (or other authorised officer) in writing of the event or decision. The notice must specify the date upon which the mining operations are expected to cease, or have ceased and an estimate of the period of cessation.

Decommissioning and Rehabilitation Plan (DRP)

5. If the Tenement Holder decides to cease mining operations or an event occurs that is likely to give rise to the permanent cessation of mining operations, the Tenement Holder must develop a DRP and submit it to the Director of Mines (or other authorised officer) for approval within thirty (30) days of the decision or event (or such longer period as approved by the Director of Mines (or other authorised officer)).

6. The DRP must:

6.1. Set out the activities and scheduling required for the carrying out of the rehabilitation works specified in the Approved PEPR;

6.2. Be prepared in accordance with any guidelines provided by the Director of Mines (or other authorised officer).

7. The Tenement Holder must carry out decommissioning and rehabilitation in accordance with the approved DRP and the Approved PEPR.

8. If, in the opinion of the Director of Mines, mining operations have substantially ceased for a period of two (2) consecutive years, the Director of Mines may direct the Tenement Holder:

8.1. To develop and submit a DRP (which must address the requirements of Second Schedule Condition 4) for approval within thirty (30) days of the direction or such longer period as the Director of Mines may allow; and/or

8.2. To carry out decommissioning and rehabilitation in accordance with the approved DRP and the Approved PEPR.

Additional Information in the Program

9. In accordance with section 70B(2)(d) of the Act it is a condition of the grant of the Mining Tenement that a Proposed PEPR submitted in accordance with Part 10A of the Act must include reports from suitably qualified independent experts on the following matters:

9.1. The effectiveness of the proposed strategies in the Proposed PEPR achieving the environmental outcomes identified in the Proposed PEPR, including but not limited to reports from:

9.1.1. An Independent tailings storage facility expert (i.e.: for TSF design, construction methodology and operation);

9.1.2. An Independent Hydrology Expert (i.e.: for Surface water management);

9.1.3. All reports must include identification of any risks, assumptions and uncertainties associated with the relevant strategies.

9.2. The capacity of the tenement holder to achieve compliance with the Act and the Proposed PEPR in light of its management systems, personnel, policies, procedures, practices and resources.

Other Legislation

10. The Tenement Holder must comply with all State and Commonwealth legislation and regulations applicable to the activities undertaken pursuant to this Mining Tenement including (but not limited to) the:

10.1. *Environment Protection and Biodiversity Conservation Act 1999*;

10.2. *Development Act 1993*;

10.3. *Planning, Development and Infrastructure Act 2016*;

10.4. *Dangerous Substances Act 1979*;

10.5. *National Parks and Wildlife Act 1972*;

10.6. *Natural Resources Management Act 2004*;

10.7. *Public and Environmental Health Act 1987*;

10.8. *Aboriginal Heritage Act 1988*;

10.9. *Heritage Places Act 1993*;

10.10. *Work Health and Safety Act 2012*;

10.11. *Environment Protection Act 1993*;

10.12. *Native Vegetation Act 1991*;

10.13. *Mines and Works Inspection Act 1920*; and

10.14. *Road Traffic Act 1961*.

SIXTH SCHEDULE
MPL 158

SIXTH SCHEDULE

ENVIRONMENTAL OUTCOMES

AND ASSOCIATED CRITERIA AND STRATEGIES PURSUANT TO
REGULATION 65 OF THE MINING REGULATIONS 2011

Explanatory Note: The Sixth Schedule of this Tenement Document sets out outcomes contemplated in regulation 65(2) of the Regulations, that the Tenement Holder is required to address in any program submitted in accordance with Part 10A of the Act. The Sixth Schedule may also specify requirements for strategies and criteria relevant to the outcomes set out in that Schedule.

INDEX TO SIXTH SCHEDULE Clause No.

Air Quality Outcome

1. The Tenement Holder must, during construction operation and post-completion, ensure that there are no adverse impacts to:

   1.1. public health; and/or

   1.2. public amenity;

   from air emissions and/or dust generated by mining related activities.

Air Quality Strategy

2. The Tenement Holder is required to address the following matter for the purpose of Regulation 65(2)(c) in relation to the Air Quality Outcome in Sixth Schedule Clause 1:

   2.1. Demonstrate progressive rehabilitation and stabilisation of disturbed areas undertaken throughout the life of mine to control dust emissions generated by wind erosion.

Noise Outcome

3. The Tenement Holder must, during construction and operation, ensure that there are no public nuisance impacts from noise emanating from the Land.

Waste Management Outcome

4. The Tenement Holder must, during construction, operation and post-completion ensure that no contamination of natural water drainage systems, streams and rivers, groundwater, land and soils occurs either on or off the Land resulting from permanent disposal or temporary storage of mine or waste material.

Waste Management Strategies

5. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Waste Management Outcome in Sixth Schedule Clause 4:

   5.1. Provide strategies as directed by any guidelines provided by the Director of Mines (or other authorised officer).

5.2. Provide strategies for the control of seepage through the WRD base, embankment and walls.

5.3. Provide the design, construction and maintenance of mine waste cover systems including, but not limited to, a detailed cover system design, construction methodology, cover system modelling and provision of a program of works for field trials and collection of site specific data to validate/calibrate the model(s).

5.4. Ensure all mine waste materials, infrastructure and landforms are geotechnically stable.

5.5. Ensure all domains have been rehabilitated in accordance with the design and closure strategies.

5.6. Ensure land is chemically stable.

5.7. Ensure no industrial or commercial wastes are left on the Land unless approved through other legislation.

5.8. Conduct trials of alternative cover systems conducted during operation to determine the optimum thickness, material properties and slope profiles (e.g. stepped or concave) for the WRD cover system.

Surface Water Outcomes

6. The Tenement Holder must during construction, operation and post-completion, ensure that there is no adverse impact on surface water quality and water dependent ecosystems as a result of contamination and sedimentation from mining related activities.

7. The Tenement Holder must during construction, operation and post-completion, ensure that no adverse impact to the quantity of surface water available to water dependent ecosystems (including permanent pools) and existing users, on and off the Land, caused by mining related activities.

Surface Water Strategies

8. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Surface Water Outcomes in Sixth Schedule Clauses 6 and 7:

8.1. The Tenement Holder must ensure no contaminated surface water leaves the Land as a result of mining related activities; and

8.2. The Tenement Holder must ensure that, apart from water contained in the pit void:

8.2.1. No contaminated surface water remains within the Land post-completion; and

8.2.2. No contamination of surface water occurs post-completion as a result of mining operations within the Land.

Groundwater Outcome

9. The Tenement Holder must during construction, operation and post-completion, ensure that there is no adverse impact to the quantity and quality of groundwater available to existing users as a result of mining related activities.

Groundwater Strategies

10. The Tenement Holder is required to address the following matters for the purposes of Regulation 65(2)(c) of the Regulations in relation to the Groundwater Outcome in Sixth Schedule Clause 9:

10.1 The Tenement Holder must provide a calibrated groundwater model.

10.1.1. The model must include modelling of mound development;

10.1.2. References must be provided for the sensitivity analyses undertaken on the groundwater model.

10.2. The Tenement Holder must establish a program for the establishment and ongoing calibration of the transient ground water model using data obtained from groundwater monitoring within the Proposed PEPR.

10.3. The Tenement Holder must establish a program for the ongoing calibration of the pit lake geochemistry and hydrogeological models using data obtained from operational monitoring to address any assumptions and uncertainty within the model.

10.4. The Tenement Holder must provide further explanation and evidence to support the conclusion that the sapprolite and sapprock material will behave as a porous media. If evidence cannot be provided the model must be updated to include a layer representing the sapprolite as an aquitard.

Groundwater Criteria

11. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(d) in relation to the Groundwater Outcome in Sixth Schedule Clause 9:

    11.1. Establish compliance groundwater monitoring bores either on the Land or at sensitive receptors that are of sufficient density and depth to detect movement of groundwater off the Land.

    11.2. Establish representative baseline water quality and quantity for groundwater within the Land and at sensitive receptors, with consideration of existing groundwater users.

Native Vegetation Outcome

12. The Tenement Holder must, during construction, operation and post-completion, ensure no loss of abundance or diversity of native vegetation on or off the Land through;

    12.1. clearance;
    12.2. dust;
    12.3. fire; or
    12.4. other damage;

    unless a significant environmental benefit has been approved in accordance with the relevant legislation.

Native Vegetation Criteria

13. Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(d) in relation to the Native Vegetation Outcome in Sixth Schedule Clause 12:

    13.1. Collect representative baseline data for native vegetation prior to commencement of mining related activities. The baseline data must include (but not limited to):

        13.1.1. The condition, abundance and diversity of native vegetation within the Land.

Weeds, Plants and Plant Pathogens Outcome

14. The Tenement Holder must, during construction, operation and post-completion, ensure no introduction of new species of weeds, pests (including feral animals) or plant pathogens, nor sustained increase in abundance of existing weeds or pests in the Land.

Weeds, Pests and Plant Pathogens Criteria

15. The Tenement Holder is required to address the following matter for the purpose of Regulation 65(2)(d) in relation to the Weeds, Plants and Plant Pathogens Outcome in Sixth Schedule Clause 14:

    15.1. Collect representative baseline data on the presence and abundance of weeds, pests and plant pathogens within the Land prior to commencement of mining related activities.

Fauna Outcome

16. The Tenement Holder must ensure during construction, operation and post-completion, that there are no native fauna injuries or deaths due to mining related activities that could have been reasonably prevented.

Soil Outcome

17. The Tenement Holder must, during construction, operation and post-completion ensure that the existing (pre-mining) soil quantity and quality is maintained.

Soil Strategies

18. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Soil Outcome in Sixth Schedule Clause 17:

    18.1. Strategies to achieve recovery of topsoil and subsoil from areas to be disturbed by mining related activities.

    18.2. Strategies for maintaining the quantity of stockpiled soil until such time that it is used for rehabilitation purposes.

18.3. Strategies that take into consideration the optimal soil stockpile heights.

18.4. Strategies for reinstatement of these soils so as to ensure achievement of the outcome.

18.5. An auditable record of soil movement including recovery, stockpiling and reinstatement.

18.6. Progressive rehabilitation would be implemented for all domains as soon as practicable.

Visual Amenity Outcome

19. The Tenement Holder must, during operation and post-completion ensure that the form, contrasting aspects and reflective aspects of mining operations are visually softened.

Visual Amenity Strategies

20. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Visual Amenity Outcome in Sixth Schedule Clause 19:

20.1. The Tenement Holder must ensure that all infrastructure is decommissioned and removed from the Land at completion unless the Director of Mines (or other authorised officer) has approved, in writing, for the infrastructure to remain;

20.2. Develop and implement strategies in consultation with affected parties for the management of visual amenity which should include (but not limited to):

20.2.1. Shape permanent mine landforms to soften the visual impact.

20.2.2. Prompt rehabilitation of disturbed areas once no longer required for mining related activities, utilising every available opportunity provided by the mine plan.

Traffic Outcome

21. The Tenement Holder must, during construction and operation, ensure that there are no traffic accidents involving the public at mine access points that could have been reasonably prevented by the Tenement Holder.

Traffic Strategy

22. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Traffic Outcome in Sixth Schedule Clause 21:

    22.1. Develop and implement strategies in consultation with affected parties to divert the proposed Kalkaroo Access Road away from Boolcoomatta Homestead.

Public Safety and Land Use Outcomes

23. The Tenement Holder must, during construction and operation, ensure that unauthorised entry to the site does not result in public injuries and or deaths that could have been reasonably prevented.

24. The Tenement Holder must demonstrate that post-completion, the risks to the health and safety of the public so far as it may be affected by mining related activities are as low as reasonably practicable.

25. The Tenement Holder must ensure that the Land is progressively and finally rehabilitated to support the future land use.

26. Before completion, the Tenement Holder must satisfy the Director of Mines (or other authorised officer) that where practicable, the pre-mining land use can be recommenced post- completion.

Heritage Outcome

27. The Tenement Holder must, in construction and operation, ensure that there is no disturbance to Aboriginal or European heritage sites, objects or remains unless it is authorised under the relevant legislation.

SIXTH SCHEDULE
ML 6498, ML 6499, ML 6500

SIXTH SCHEDULE

ENVIRONMENTAL OUTCOMES

AND ASSOCIATED CRITERIA AND STRATEGIES PURSUANT TO
REGULATION 65 OF THE MINING REGULATIONS 2011

Explanatory note: The Sixth Schedule of this Tenement Document sets out outcomes contemplated in regulation 65(2) of the Regulations, that the Tenement Holder is required to address in any program submitted in accordance with Part 10A of the Act. The Sixth Schedule may also specify requirements for strategies and criteria relevant to the outcomes set out in that Schedule.

INDEX TO SIXTH SCHEDULE **Clause No.**

Air Quality Outcome

1. The Tenement Holder must, during construction, operation and post-mine completion, ensure that there are no adverse impacts to:

   1.1. public health; and/or

   1.2. public amenity;

   from air emissions and/or dust generated by mining operations.

Air Quality Strategy

2. The Tenement Holder is required to address the following matter for the purpose of Regulation 65(2)(c) in relation to the Air Quality Outcome in Sixth Schedule Clause 1:

   2.1. Demonstrate that progressive rehabilitation and stabilisation of disturbed areas will be undertaken throughout the life of mine to control dust emissions generated by wind erosion.

Noise Outcome

3. The Tenement Holder must, during construction and operation, ensure that there are no public nuisance impacts from noise emanating from the Land.

Waste Management Outcome

4. The Tenement Holder must, during construction, operation and post-mine completion ensure that no contamination of natural water drainage systems, streams and rivers, groundwater, land and soils occurs either on or off the Land resulting from permanent disposal or temporary storage of mine or waste material.

Waste Management Strategies

5. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Waste Management Outcome in Sixth Schedule Clause 4:

    5.1. Determine a sulphur cut-off grade for PAF material through further testing for each waste rock unit.

    5.2. Provide block modelling of the sulphur distribution of all waste and ore to be mined for the purpose of determining the distribution and estimating the volume of NAF and PAF using the sulphur cut-off grade.

    5.3. Integrate the sulphur model with the geological model to provide confidence in the definition of PAF boundaries, potential zones of high neutralising capacity and potential geological controls on mineralisation.

    5.4. Provide procedures for regularly updating the models with new geological and sulphur assay data collected in the course of mine operations.

    5.5. Provide procedures for ensuring PAF and NAF boundaries derived from the sulphur cut-off and the sulphur block model are included in open pit mine plans.

    5.6. Provide procedures for assaying the sulphur content of waste and ore, produced during the course of mining, for verifying PAF and NAF information included in the open pit mine plans to provide a final check that all PAF and NAF materials have been correctly identified.

    5.7. Provide procedures and recording systems for selective mining of the identified PAF and NAF materials and their separate placement.

    5.8. Provide strategies as directed by any guidelines provided by the Director of Mines (or other authorised officer).

    5.9. Provide control and management strategies to mitigate impacts to receptors from the TSF.

    5.10. Ensure the design, construction, operation and closure of the TSF is prepared in accordance with, but not limited to, the most recent ANCOLD Tailings Dam Guidelines.

    5.11. Provide quality control arrangements for all stages of construction of the TSF including supervision by appropriately qualified and experienced persons, documented procedures, quality control testing and record keeping.

5.12. Provide a strategy to ensure deposition of tailings to the TSF ceases if the specified limits for freeboard height or supernatant pond dimensions are exceeded. If exceeded report this to the Director of Mines (or other Authorised Officer) within twenty-four (24) hours.

5.13. Provide strategies for the control of seepage through the TSF base, embankment and walls.

5.14. Provide strategies for achieving and maintaining design tailings discharge densities and tailings consolidation rates to ensure timely construction of the cover system post cessation of tailings deposition.

5.15. Provide tailings discharge density trigger limits and remedial actions to ensure design densities are achieved.

5.16. Provide a seepage detection program for monitoring seepage through the embankment and the base of the TSF.

5.17. Provide the design, construction and maintenance of the TSF and mine waste cover systems including, but not limited to, a detailed cover system design, construction methodology, cover system modelling and provision of a program of works for field trials and collection of site specific data to validate/calibrate the model(s).

5.18. Ensure that the WRD and TSF final landforms will be chemically and physically stable post-mine completion.

5.19. Ensure all mine waste materials, infrastructure and landforms are geotechnically stable.

5.20. Ensure all domains have been rehabilitated in accordance with the design and closure strategies.

5.21. Ensure land is chemically stable.

5.22. Ensure no industrial or commercial wastes are left on the Land unless approved through other legislation.

5.23. Conduct trials of alternative cover systems during operation to determine the optimum thickness, material properties and slope profiles (e.g. stepped or concave) for the WRD and TSF cover systems.

Surface Water Outcomes

6. The Tenement Holder must during construction, operation and post-mine completion, ensure that there is no adverse impact on surface water quality and water dependent ecosystems as a result of contamination and sedimentation from mining operations.

7. The Tenement Holder must during construction, operation and post-mine completion, ensure that no adverse impact to the quantity of surface water available to water dependent ecosystems (including permanent pools) and existing users, on and off the Land, caused by mining operations.

Surface Water Strategies

8. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Surface Water Outcomes in Sixth Schedule Clauses 6 and 7:

    8.1. The Tenement Holder must ensure no contaminated surface water leaves the Land as a result of mining operations; and

    8.2. The Tenement Holder must ensure that, apart from water contained in the pit void:

        8.2.1. No contaminated surface water remains within the Land post-mine completion; and

        8.2.2. No contamination of surface water occurs post-mine completion as a result of mining operations within the Land.

    8.3. The Tenement Holder must ensure that any watercourse diversion is designed to ensure that it will be effective in achieving any surface water outcomes, including, but not limited to:

        8.3.1. Incorporate natural features (including geomorphic and vegetation) present in the landscape and local watercourses;

        8.3.2. Maintain the existing hydrology and hydraulic characteristics of surface water systems;

        8.3.3. Maintain sediment transport and water quality regimes that allow the watercourse diversion to be self-sustaining.

Groundwater Outcome

9. The Tenement Holder must during construction, operation and post-mine completion, ensure that there is no adverse impact to the quantity and quality of groundwater available to existing users as a result of mining operations.

Groundwater Strategies

10. The Tenement Holder is required to address the following matters for the purposes of Regulation 65(2)(c) of the Regulations in relation to the Groundwater Outcome in Sixth Schedule Clause 9:

    10.1. The Tenement Holder must provide a calibrated groundwater model.

        10.1.1. The model must include modelling of groundwater mounding caused by the TSF operations;

        10.1.2. Adequacy of the current closure modelling approach is to be verified by:

            10.1.2.1. Providing volumes of groundwater extracted by the 'drain' cells representing the pit lake;

            10.1.2.2. Providing a comparison of the pit lake levels to the regional potentiometric surface immediately adjacent to the pit.

        10.1.3. References must be provided for the sensitivity analyses undertaken on the groundwater model.

    10.2. The Tenement Holder must establish a program for the establishment and ongoing calibration of the transient ground water model using data obtained from groundwater monitoring within the proposed PEPR.

    10.3. The Tenement Holder must establish a program for the ongoing calibration of the pit lake geochemistry and hydrogeological models using data obtained from operational monitoring to address any assumptions and uncertainty within the model.

    10.4. The Tenement Holder must provide further explanation and evidence to support the conclusion that the sapprolite and sapprock material will behave as a porous media. If evidence cannot be provided the model must be updated to include a layer representing the sapprolite as an aquitard.

Groundwater Criteria

11. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(d) in relation to the Groundwater Outcome in Sixth Schedule Clause 9:

    11.1. Establish compliance groundwater monitoring bores either on the Land or at sensitive receptors that are of sufficient density and depth to detect movement of groundwater off the Land.

    11.2. Establish representative baseline water quality and quantity for groundwater within the Land and at sensitive receptors, with consideration of existing groundwater users.

Native Vegetation Outcome

12. The Tenement Holder must, during construction, operation and post-mine completion, ensure no loss of abundance or diversity of native vegetation on or off the Land through;

    12.1. clearance;

    12.2. dust;

    12.3. fire; or

    12.4. other Damage;

    unless a significant environmental benefit has been approved in accordance with the relevant legislation.

Native Vegetation Criteria

13. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(d) in relation to the Native Vegetation Outcome in Sixth Schedule Clause 12:

    13.1. Collect representative baseline data for native vegetation prior to commencement of mine operations. The baseline data must include (but not limited to):

        13.1.1. The condition, abundance and diversity of native vegetation within the Land.

Weeds, Pests and Plant Pathogens Outcome

14. The Tenement Holder must, during construction, operation and post-mine completion, ensure no introduction of new species of weeds, pests (including feral animals) or plant pathogens, nor sustained increase in abundance of existing weeds or pests in the Land.

Weeds, Pests and Plant Pathogens Criteria

15. The Tenement Holder is required to address the following matter for the purpose of Regulation 65(2)(d) in relation to the Weeds, Pests and Plant Pathogens Outcome in Sixth Schedule Clause 14:

    15.1. Collect representative baseline data on the presence and abundance of weeds, pests and plant pathogens within the Land prior to commencement of mine operations.

Fauna Outcome

16. The Tenement Holder must ensure during construction, operation and post-mine completion, that there are no native fauna injuries or deaths due to mining operations that could have been reasonably prevented.

Soil Outcome

17. The Tenement Holder must, during construction, operation and post-mine completion ensure that the existing (pre-mining) soil quantity and quality is maintained.

Soil Strategies

18. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Soil Outcome in Sixth Schedule Clause 17:

    18.1. Strategies to achieve recovery of topsoil and subsoil from areas to be disturbed by mining operations.

    18.2. Strategies for maintaining the quantity of stockpiled soil until such time that it is used for rehabilitation purposes.

    18.3. Strategies that take into consideration the optimal soil stockpile heights.

    18.4. Strategies for reinstatement of these soils so as to ensure achievement of the outcome.

18.5. An auditable record of soil movement including recovery, stockpiling and reinstatement.

18.6. Progressive rehabilitation would be implemented for all domains as soon as practicable.

Visual Amenity Outcome

19. The Tenement Holder must, during operation and post-mine completion ensure that the form, contrasting aspects and reflective aspects of mining operations are visually softened.

Visual Amenity Strategies

20. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Visual Amenity Outcome in Sixth Schedule Clause 19:

20.1. The Tenement Holder must ensure that all infrastructure is decommissioned and removed from the Land at mine completion unless the Director of Mines (or other authorised officer) has approved, in writing, for the infrastructure to remain;

20.2. Develop and implement strategies in consultation with affected parties for the management of visual amenity which should include (but not limited to):

20.2.1. Shape permanent mine landforms to soften the visual impact.

20.2.2. Prompt rehabilitation of disturbed areas once no longer required for mining operations, utilising every available opportunity provided by the mine plan.

Traffic Outcome

21. The Tenement Holder must, during construction and operation, ensure that there are no traffic accidents involving the public at mine access points that could have been reasonably prevented by the Tenement Holder.

Traffic Strategy

22. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Traffic Outcome in Sixth Schedule Clause 21:

    22.1. Develop and implement strategies in consultation with affected parties to divert the proposed Kalkaroo Access Road away from Boolcoomatta Homestead.

Public Safety and Land Use Outcomes

23. The Tenement Holder must, during construction and operation, ensure that unauthorised entry to the site does not result in public injuries and or deaths that could have been reasonably prevented.

24. The Tenement Holder must demonstrate that post-mine completion, the risks to the health and safety of the public so far as it may be affected by mining operations are as low as reasonably practicable.

25. The Tenement Holder must ensure that the Land is progressively and finally rehabilitated to support the future land use.

26. Before mine completion, the Tenement Holder must satisfy the Director of Mines (or other authorised officer) that where practicable, the pre-mining land use can be recommenced post-mine completion.

Public Safety and Land Use Strategies

27. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(c) in relation to the Public Safety and Land Use Outcome in Sixth Schedule Clause 24:

    27.1. Develop strategies to ensure final landform design for the open pit void meets the outcome for protection of public safety post-mine completion and in the long term to address potential hazards including, but not limited to:

        27.1.1. The risk of falling;

        27.1.2. The risk of drowning;

        27.1.3. The risk of vehicle incident/accidents; and

        27.1.4. Ground instability.

Heritage Outcome

28. The Tenement Holder must, in construction and operation, ensure that there is no disturbance to Aboriginal or European heritage sites, objects or remains unless it is authorised under the relevant legislation.

Blasting Outcome

29. The Tenement Holder must, during construction and operation, ensure that there are no adverse impacts to:

    29.1. public safety;

    29.2. human comfort;

    29.3. third party property;

    29.4. adjacent land use; or

    29.5. other receptors;

    from airblast, flyrock and vibration caused by blasting.

Blasting Strategies

30. The Tenement Holder is required to address the following matters for the purpose of Regulation 65(2)(d) in relation to the Blasting Outcome in Sixth Schedule Clause 29:

    30.1. Develop strategies for the management of impacts from blasting, including the determination of blast exclusion zones, in accordance with relevant standards.

    30.2. A blasting protocol and blasting schedule will be developed in consultation with residents of land within and adjoining the Land to reflect the needs of the neighbouring land use practices.