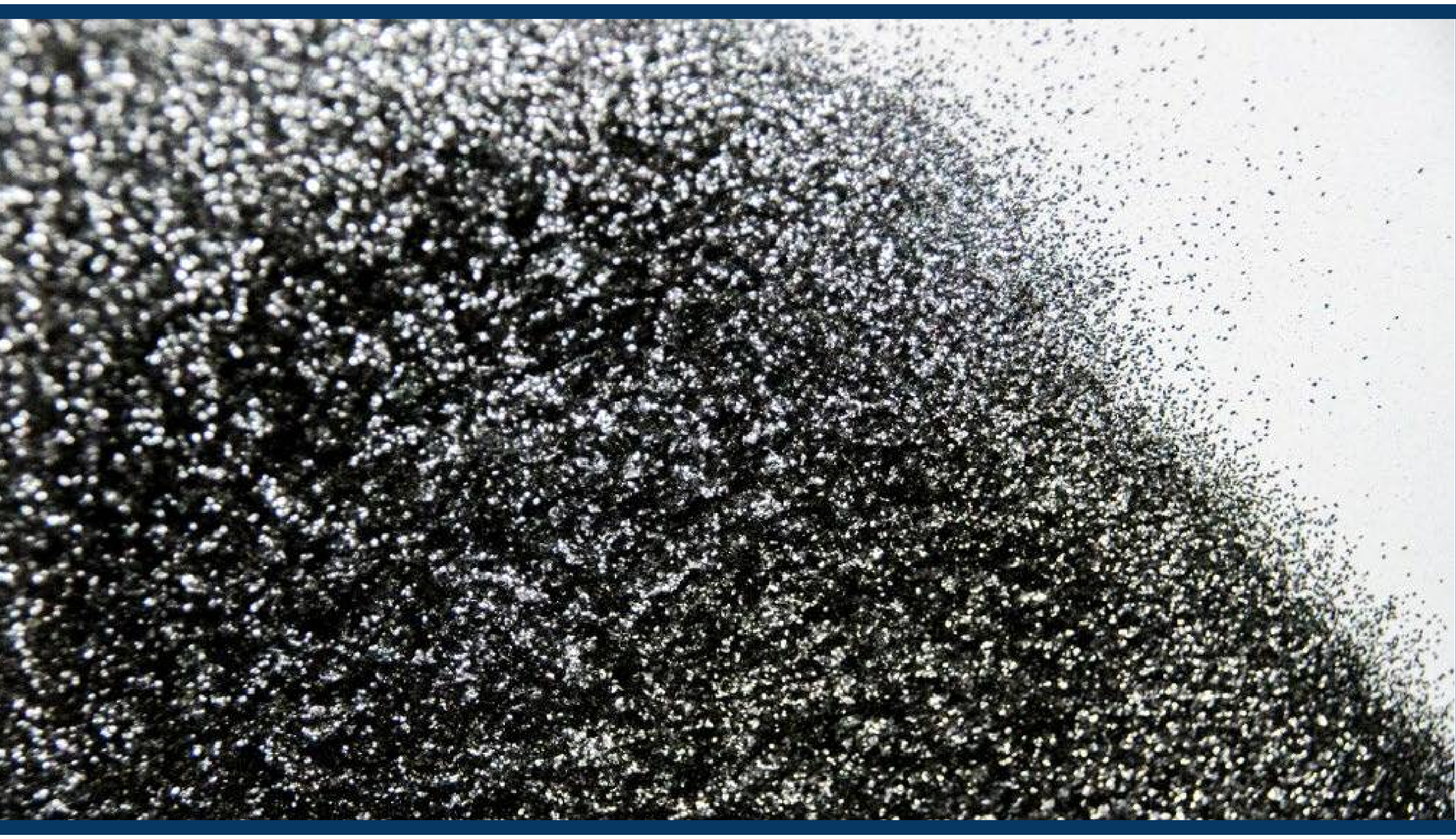
MRC GRAPHITE PTY LTD



Document No. MRCG-PRJ-ENV-PLN-0004

MUNGLINUP GRAPHITE PROJECT

INLAND WATERS

MANAGEMENT PLAN

Prepared by Integrate Sustainability

integrate SUSTAINABILITY

environment ■ safety ■ community

Document Control

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Rev A	Integrate Sustainability Pty Ltd	Document prepared for EIA Assessment	5 June 2020
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Rev 3			
Rev 4			

Disclaimer

Corporate Endorsement

I hereby certify that to the best of my knowledge, the information contained within this Environmental Management Plan is true and correct, and addresses all the requirements of the Instructions on how to Prepare *Environmental Protection Act 1986* Part IV Environmental Management Plans.

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Position: Chief Executive Officer

Date: 6/11/2020

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Summary

The purpose of the Munglinup Inland Waters Management Plan (IWMP) is to support environmental referrals under the *Environmental Protection Act 1986* and *Biodiversity and Conservation Act 1999* for the Munglinup Graphite Project (the Project), proposed by MRC Graphite Pty Ltd. Table 1 presents a summary of this Management Plan including the completion criteria which is specific to the proposal and against which the environmental objectives are measured.

Table 1 Summary of the Hydrology and Hydrological Environmental Management Plan

Item	Description
Title of Proposal	Munglinup Graphite Project
Proponent Name	MRC Graphite Pty Ltd
Ministerial Statement Number	Not available at this point
Purpose of the Management Plan	This management plan is submitted in support of assessment under the *Environmental Protection Act 1986* and *Environmental Protection and Biodiversity Conservation Act 1999.* The purpose of this plan is to address the significant residual impacts to surface water and groundwater resources from the proposed project such as but not limited to the Munglinup River
Key Environmental Factors	Inland Waters
Objectives	*To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected*
Condition Clauses	Not Applicable
Key Provisions of the plan	Proposed management are in line with the EP Act and EPBC Act, to ensure biological diversity and ecological integrity are maintained. The key proposed provisions are: • Established a no activities buffer around the Munglinup River. • Natural flow channels will be maintained where possible, with engineered structures implemented to ensure the flow is maintained where diversions are required. • Monitoring equipment will be installed to record flow rates and water levels. • Contamination from mined and processed wastes will be contained by appropriately engineered infrastructure. • Comprehensive baseline monitoring. • Routine and opportunistic sampling and analysis of groundwater and surface water.

1. Context, Scope and Rationale

This Environmental Management Plan (EMP) for Inland Waters has been prepared to support environmental assessment under the *Environmental Protection Act 1986* and *Biodiversity and Conservation Act 1999* for the Munglinup Graphite Project (the Project) proposed by MRC Graphite Pty Ltd a wholly owned subsidiary of Mineral Commodities Limited (MRC).

This EMP has been prepared in accordance with the requirement of the *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA, 2020)

1.1. Proposal

The Munglinup Graphite Project (the Project) is a joint venture between MRC Graphite Pty Ltd (MRCG), the operator, and Gold Terrace Pty Ltd. The project is located 105km west of Esperance, 85km east of Ravensthorpe and 4km north of the town of Munglinup in the south coast region of Western Australia (Figure 1).

Figure 1 Project Location

Access to the Project is currently from the South Coast Highway and the local Mills and Reynolds Roads. The project is predominantly situated within Mining Reserve R24714 on M74/245, G74/9, L74/55 and L74/56. Graphite within the Project area has been identified, studied and historically mined by several companies over the last 100 years. The Project has a proposed maximum disturbance footprint of 350ha within a development envelope that covers 650ha. Past clearing onsite has been limited to historic shafts and exploration pads and drill lines, the majority of 350ha will be new disturbance.

The graphite deposits are proposed to be mined via open cut methods with multiple open cut pits mined over an estimated 10-15-year mine life. The locations of the proposed open pits are shown in Figure 2 along with associated infrastructure. Approximately 3.5 million tonnes of material (ore and waste) will be mined per annum, the project has a strip ratio of 5:1. Table 2 provides a breakdown of the disturbance associated with each proposed activity.

Table 2 Maximum Disturbance Footprint

Element	Footprint (ha)
Open Pit	63
Waste Rock Landform	120
Tailings Storage Facility	86
Supporting Infrastructure	11
Haul/LV Roads	40
Topsoil & Vegetation Stockpiles	30
Total Disturbance	**350**

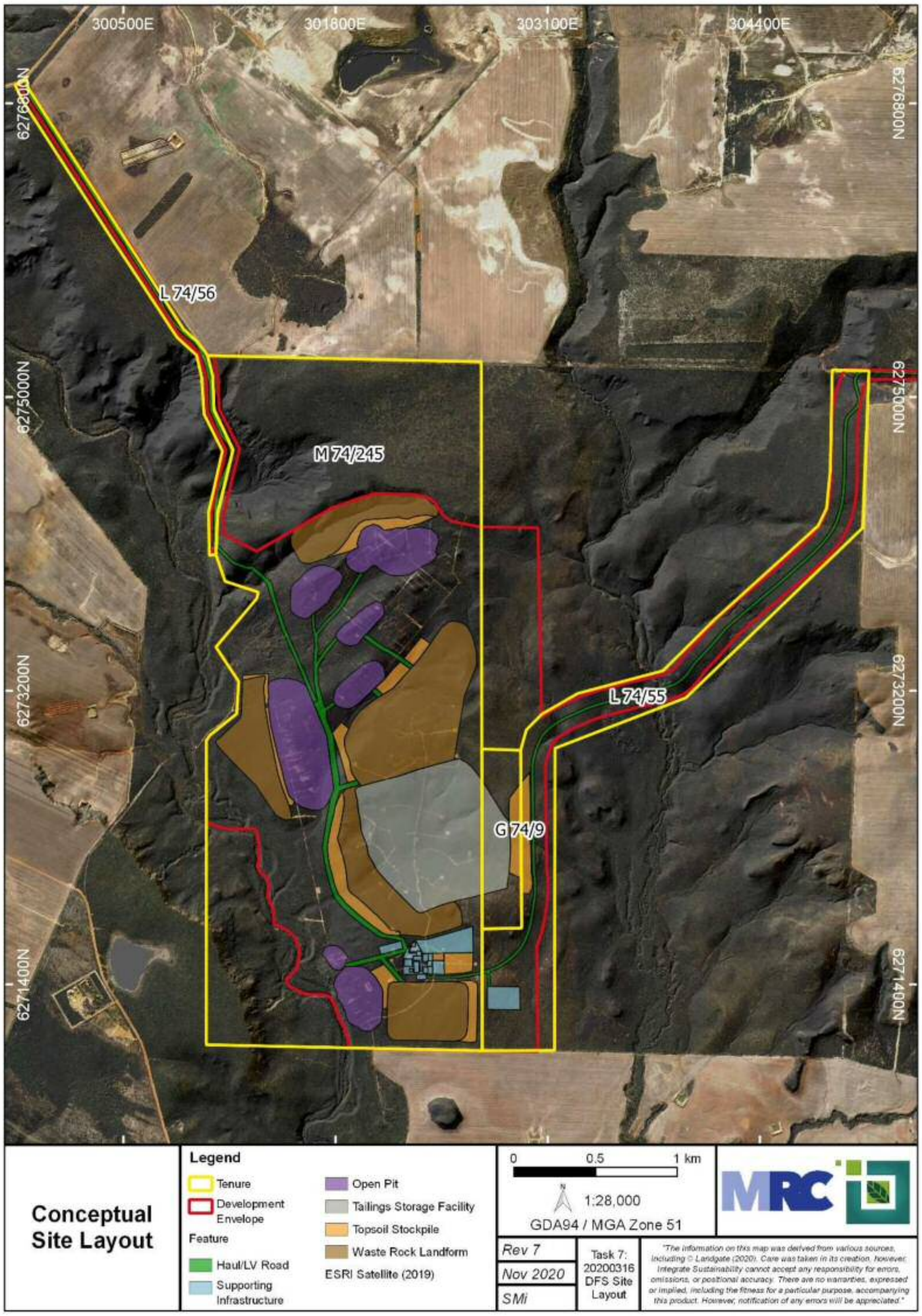

Figure 2 Project Development Envelope and Conceptual Site Layout

The open pits are anticipated to be mined by free dig however, some drill and blast activities may be required. Ore will be transported to a run-of-mine (ROM) pad located to the south-east on M74/245. Ore will then be processed through an onsite processing facility. The open pits are estimated to range in depth from 32m to 120m below ground level. The pits will extend below ambient groundwater levels (2.4 to 8m below ground level) (Rockwater, 2020b).

On-site stockpiling and processing will produce graphite via a crushing, grinding and flotation circuit operating on a 24/7 operation basis. The plant has a proposed annual throughput of up to 500kt per annum of ore, producing a peak of 80-85kt of graphite per year with disposal of up to 350kt of tailings per annum in a lined facility.

MRCG proposes to place the processing waste in a single tailings storage facility (TSF) located in the south-east of M74/245 and partially on G74/9 between two ridges where the natural topography dips in a south-west direction. The TSF will utilise the two ridges to reduce total embankment fill requirements (KCB, 2018). The western perimeter of the proposed TSF site is approximately 500m from the Munglinup River. Tailings material from the rougher and cleaner flotation circuits will report to a tailings thickener before being pumped to the TSF.

The Project has an estimated water demand of 0.5GL/annum or up to 16.5L/second which will be used for dust suppression and processing. Preliminary results suggest that 50-75% of the water will be sourced from dewatering the pits and TSF decant water with the remainder coming from production bores (MRC Graphite Pty Ltd, 2018).

1.2. Scope and Objectives

This *Inland Waters Management Plan (IWMP)* applies to potential direct and indirect impacts of the implementation of the Munglinup Graphite Project on surface and groundwater within the project area. The objectives of the plan are to:

- Identify the key project aspects that have the potential to directly or indirectly impact inland waters.
- Describe what will be done to avoid or minimise adverse impacts to the inland water source.
- Describe the environmental outcomes that will adequately protect inland waters, consistent with the EPA policies and environmental objectives.
- Define how evidence will be collected to enable assessment of compliance with the criteria.

This IWMP applies to all phases of the project, including construction, operation, closure and rehabilitation.

1.3. Key Environmental Factors

This EMP specifically addresses the Environmental Protection Authority (EPA) Environmental Factor of Inland Waters. The EPA (EPA, 2018) defines the factor of Inland Waters as:

The occurrence, distribution, connectivity, movement and quantity (hydrological regimes) of inland water including its chemical, physical, biological and aesthetic characteristics (quality).

1.3.1. Proposed Activities

The activities that have the potential to affect the Inland Water environmental factors include:

- Abstraction of groundwater
- Dewatering of open cut pits or site following excessive rainfall
- Tailings Storage Facility and Waste Rock Landforms
- Access haul and LV roads

- Drainage diversions
- Land disturbance resulting in the alteration of surface water flows
- Use and storage of operational liquids such as processing reagents, chemicals, process liquor, and hydrocarbons.

1.3.2. Site-specific Environmental Value

The environmental values potentially impacted by the proposed operation are listed in Table 3.

Table 3 Key Environmental Factors, Activities and Values

Environmental Value	Potential Impacts	Duration
Munglinup River and Tributaries	• Loss of catchment area as a result of pits, the TSF and mining infrastructure. • Decreased water levels and flow rates due to groundwater abstraction which would otherwise feed into the Munglinup River • Increased sediment levels as a result of surface disturbance • Impact on cultural value of Munglinup River as a result of decreased quality and available water. • Impacted natural surface water flow channels as a result of placement of mining infrastructure.	Long term Temporary Temporary Temporary Long term
Clayhole Creek	• Construction of haul and LV roads may lead to erosion at crossings over Clayhole Creek resulting in decreased water levels and flow rates and increased sediment levels	Temporary
Water Dependent Ecosystems	• Reduced catchment areas could decrease the amount of water available for vegetation units identified as surface water dependent. • Reduced catchment areas could result in decreased groundwater recharge which along with groundwater abstraction could impact groundwater dependent ecosystems. • Impact to fauna that utilise water sources in the area.	Long term Long term Temporary
Aquifers	• Abstraction of groundwater will lead to decreased groundwater levels. • Potential for land disturbance and mining activities to result in contamination or increased sediment levels.	Temporary Long term
Surface Water and Groundwater Quality	• Potential for land disturbances to result in increased sediment levels or contamination. • Seepage from the waste rock landforms or TSF could lead to contamination. • Spills or leaks of contaminants on site (e.g. Hydrocarbons) could result in contamination.	Long term Long term Temporary
Cultural Significance of Munglinup River and Tributaries	• Decrease in water quality or levels as a result of contamination or surface disturbance there by affecting/ impacting of the Munglinup River.	Temporary

1.4. Condition Requirements

No conditions currently exist for the Project. This management plan is being submitted to support the environmental assessment currently underway under s38 of the *Environmental Protection Act 1986* and Part 9 of the *Environmental Protection and Biodiversity Conservation Act 1999.* MRCG has taken into consideration the environmental objectives set for *Inland Waters* and are committed to implementing the Project in a manner that meets these objectives.

1.5. Rationale and Approach

Results of baseline surveys and a number of assumptions and uncertainties inform the management approach for meeting the environmental objectives stated in Section 2.1. The identified management actions, management targets, monitoring and reporting objectives are aligned with the overall management approach.

1.5.1. Survey and Study Findings

A number of studies have been conducted to assess the hydrology and hydrogeological features of the Munglinup area. These surveys are listed in Table 4.

Table 4 Completed baseline studies for the Munglinup Graphite Project

Survey or study	Year
Rockwater. Munglinup Graphite Project, Groundwater Investigation, exploration drilling and test-pumping at Munglinup and Cowerup. Report to Gwalia Minerals NL	1990
AEMCO. Hydrogeological assessment for mine water supply. Report to Gold Terrace Pty Ltd	2017
AEMCO. Hydrogeological drilling results version A. Memorandum to MRC Graphite	2018
Wetland Research and Management. Munglinup Graphite Project Aquatic Values of the Munglinup River: Literature Review	2018
Wetland Research and Management. Munglinup Graphite Project Baseline Water Quality & Aquatic Fauna Survey of the Munglinup River	2018
Biota Environmental Sciences. Munglinup Graphite Project Subterranean Fauna Pilot Study	2018
Woodman Environmental. Peer Review of Consultant Report Level 2 Flora and Vegetation Assessment in the Munglinup Area	2018
Rockwater. Initial Desktop Hydrology Assessment for Proposed Mining Operation at Munglinup Graphite Project	2018
Rockwater. Munglinup Graphite Project Stage 1 Hydrogeological Assessment	2018
Rockwater. Munglinup Graphite Project DFS / Stage 2 Surface Water Review	2019
Rockwater. Munglinup Graphite Project DFS / Stage 2 Hydrogeological Assessment	2019
Rockwater. Munglinup Graphite Project Stage 3 Surface Water Review	2020
Rockwater. Munglinup Graphite Project Stage 3 Hydrogeology Assessment	2020

1.5.1.1. Climate

The Project is located on the South Coast in the Goldfields-Esperance Development region of Western Australia. The climate of this region is temperate Mediterranean with warm summers and mild to cool winters.

Temperatures and rainfall data were retrieved from the Bureau of Meteorology (BoM) weather recording station at Munglinup West (station number 012044) from 2002 to 2020. The mean annual monthly temperature maximum recorded at the station is 23.3°C and minimum is 10.6°C. On average the warmest month of the year is January with a mean maximum temperature of 29°C. July is the coolest month with a mean minimum temperature of 6.6°C. The mean annual rainfall is 450.8mm, with the lowest average monthly rainfall being 26.8mm in December, and the highest average monthly rainfall being 47.2mm in August (BoM, 2020). Figure 3 presents the typical climate information associated with the Munglinup West weather station. Average dam evaporation exceeds average rainfall in all months of the year by a factor of three (Luke, Burke, & O'Brien, 1988).

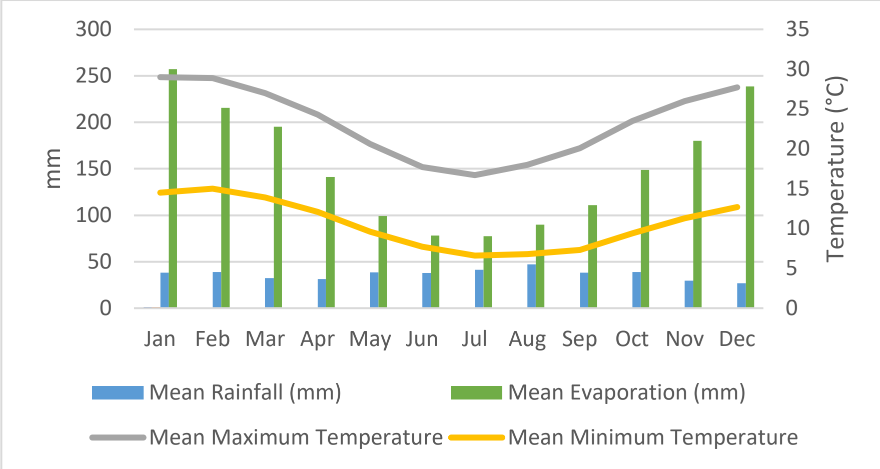

Figure 3 Mean Temperature and Rainfall Recorded at Munglinup West from 2002 to 2020 (BoM, 2020)

1.5.1.2. Topography

The Project is located within the Esperance Plains Interim Biogeographic Regionalisation of Australia (IBRA) zone and the Recherche (ESP2) IBRA Subregion. The ESP2 subregion is characterised by Quaternary coastal sandplains and dunes overlying Proterozoic gneiss and granite as well as Eocene and more recent coastal limestones (IBRA, 2001).

Broad level landscape mapping has been completed across Western Australia. The broader Munglinup area is located within the Stirling Province. The Project is within the Esperance Sandplain landscape mapping zone. The landforms of the area are level to gently undulating plains dissected by a number of short rivers flowing south to meet the ocean ((Purdie, Tille, & Schnoknecht, 2004).

The land surface within the vicinity of the Project is dominated by valleys and ridges associated with the Munglinup River. The lowest point of the land surface is 64m above sea level and rises to 158m (Figure 4) on ridges which occur outside the tenement boundary (ISPL, 2018). Within the tenement boundary the lowest point is 70m above sea level within the Munglinup River valley to the south west corner, with the highest feature rising to 130m above sea level along a small hill in the northern portion of the tenement. Across the surrounding area, slope angles are relatively flat with the greatest slope angle being 10°. The lowest slope angle is 0.2° and occurs primarily across the farmland area and along the plateaus. Slope angle are greatest within the valleys, particularly along the Munglinup River and its tributaries (ISPL, 2018).

1.5.1.3. Regional Hydrology

The project area lies within the Munglinup River catchment, a tributary of the Oldfield River. The Oldfield River basin has a catchment area of approximately 217,200ha (Gee, 1997). The Munglinup River catchment area is approximately 33,600ha at the confluence with the Oldfield River (Rockwater, 2020a).

Drainage across the project area tends southwards via Munglinup River and Clayhole Creek (Clayhole Creek is a tributary of the Munglinup River) (Figure 5). The Munglinup River originates on the sandplain north of the project area and connects with inflow from Clayhole Creek approximately 3km south of the project area. Together these rivers meet Oldfield River approximately 17km south of the project area and continue to flow towards the Southern Ocean.

The Munglinup River is ephemeral, flowing predominantly in the winter months. The corridor in which the river flows is well vegetated, with land surrounding the corridor being cleared for agricultural uses including cropping and grazing.

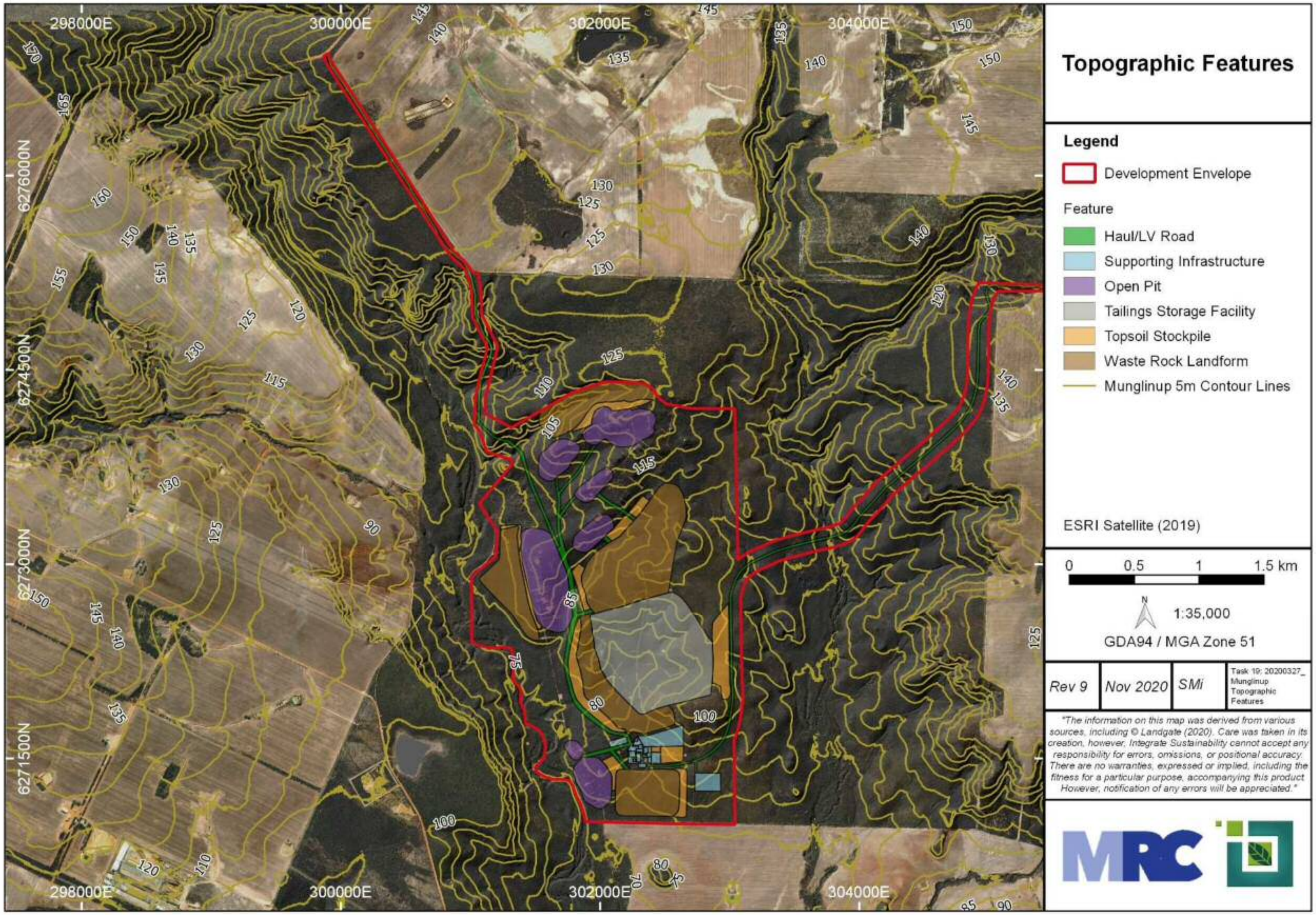

Figure 4 Munglinup Topography Features

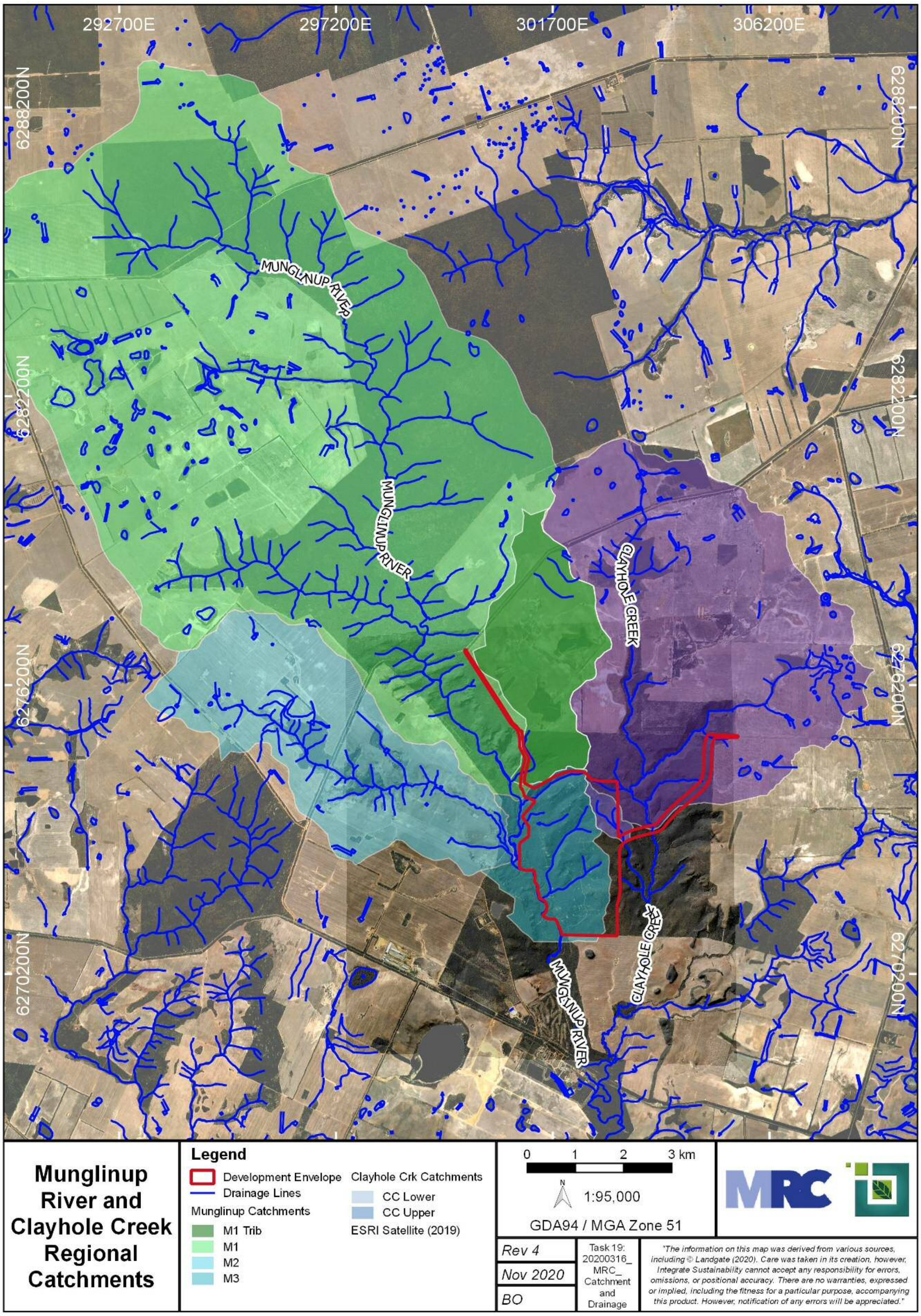

Figure 5 Regional Catchments and Drainage Line

1.5.1.4. Hydrogeology

The Ravensthorpe 1:250 000 Hydrogeological Map (Johnson, 1998) shows the Project includes alluvium and minor colluvium, which contain minor local aquifers, granite gneiss and migmatite, which contain very minor local aquifers with brackish to saline groundwater (Rockwater, 2020b). The Ravensthorpe area is almost entirely underlain by fractured and weathered Archaean Proterozoic granite, gneiss and greenstone. The hydrogeology of the basement rocks is generally complex with groundwater occurrence restricted to joints, fractures and sections of the weathering profile; hence basement rocks are considered minor localised aquifers (Figure 6) (Johnson, 1998).

The Munglinup catchment has a very high run-off during storm events, due to the basement granitic-gneiss and weathered profile, although annual run-off is very low (approximately 1% of annual rainfall) indicating good moisture retention in the soils (AEMCO, 2017).

Historic groundwater drilling surrounding the Munglinup townsite from 1990 indicates that fine to coarse grained alluvium associated with the Munglinup River extends to depths of 19 to 36m and overlies amphibolitic or granitic bedrock (Rockwater, 2020b). Groundwater quality recorded within the Project area is typically brackish to hypersaline and forms locally minor aquifers (Rockwater, 2020b).

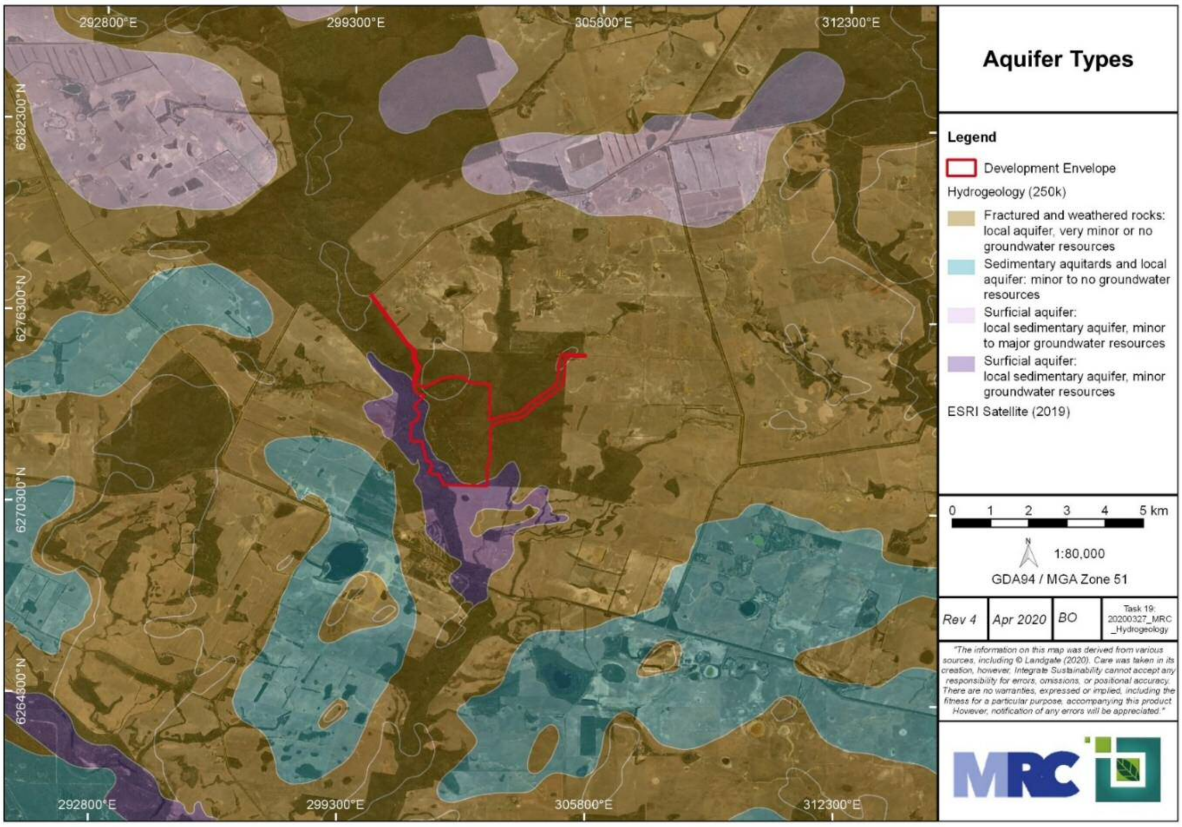

Figure 6 Aquifer Types in the Munglinup Area

1.5.1.5. Project Studies

Catchment Areas

The Hydrology Review conducted by Rockwater in 2020, reported that the excavation of pits and the construction of the tailings storage facility (TSF) will reduce the M3 catchment areas by approximately 31%, and is likely to reduce the flow into Munglinup River (Figure 7). However, as the affected sub-catchments are a minor proportion (3.6%) of the greater regional catchment area, it is unlikely that the proposed mining infrastructure will have a significant impact on the downstream Munglinup River flows (Rockwater, 2020a).

While some of Munglinup River tributaries, will be altered by the proposed Project, surface water will be diverted around the Project to the river or proposed creek crossing allowing the water to transverse similar drainage routes minimising impacts.

Clayhole Creek and its tributaries are not expected to be affected by the reduced catchment areas providing the proposed creek crossings do not restrict flows or cause erosion (Rockwater, 2020a).

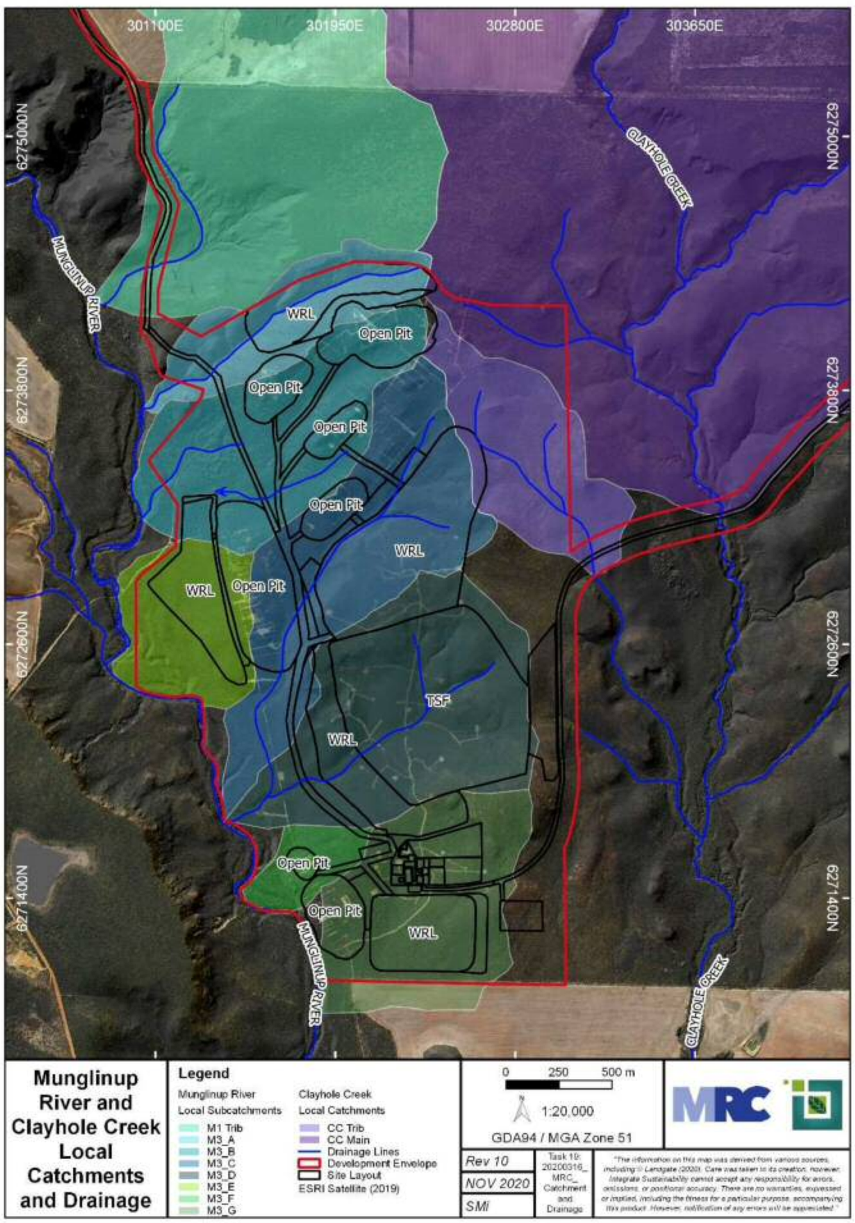

Figure 7 Local Catchments and Drainage Lines

Floods and Flow Regimes

Rockwater (2020a) identified four unnamed small tributaries that flow south-westwards into the Munglinup River, flowing across or in close proximity to the planned mine infrastructure. The proposed eastern access road alignment crosses two ephemeral drainage lines (Figure 8) – a small tributary and the main channel of Clayhole Creek (Rockwater, 2020a).

The surface water modelling undertaken by Rockwater (2020) found that even during a 1-in-100 ARI storm event the Project infrastructure is not expected to be adversely impacts by flood levels or behaviour associated with the Munglinup River channel. Due to the different timings of flow, the peak flow from Munglinup River at the project boundary is expected only to be reduced by 0.3% in comparison to pre-mining flows during a 1-in-100-year event (Rockwater, 2020a). A diversion drain will be required to divert surface water around key features as the proposed site layout obstructs the natural flow at the south-eastern boundary of Halberts Main Pit. Based on the natural topography, construction of a perimeter bund and diversion drain is recommended to protect Halberts Main Pit and maintain surface water flow to Munglinup River during and post-mining. Without a diversion drain, the flood water could dam on the east of the Halberts Main pit adjacent to the proposed haul road between the mining areas and the processing plant (Rockwater, 2020a).

The peak flows of Munglinup River are expected to be impacted greatest during the 1-in-5-year event with a 0.7% reduction in peak flow expected as a result of the reduced catchment areas. During minor flow events, flows will largely be derived from groundwater discharge to the river, rather than runoff, however there is potential that groundwater discharge may be reduced due to evaporative losses from the pits.(Rockwater, 2020a).

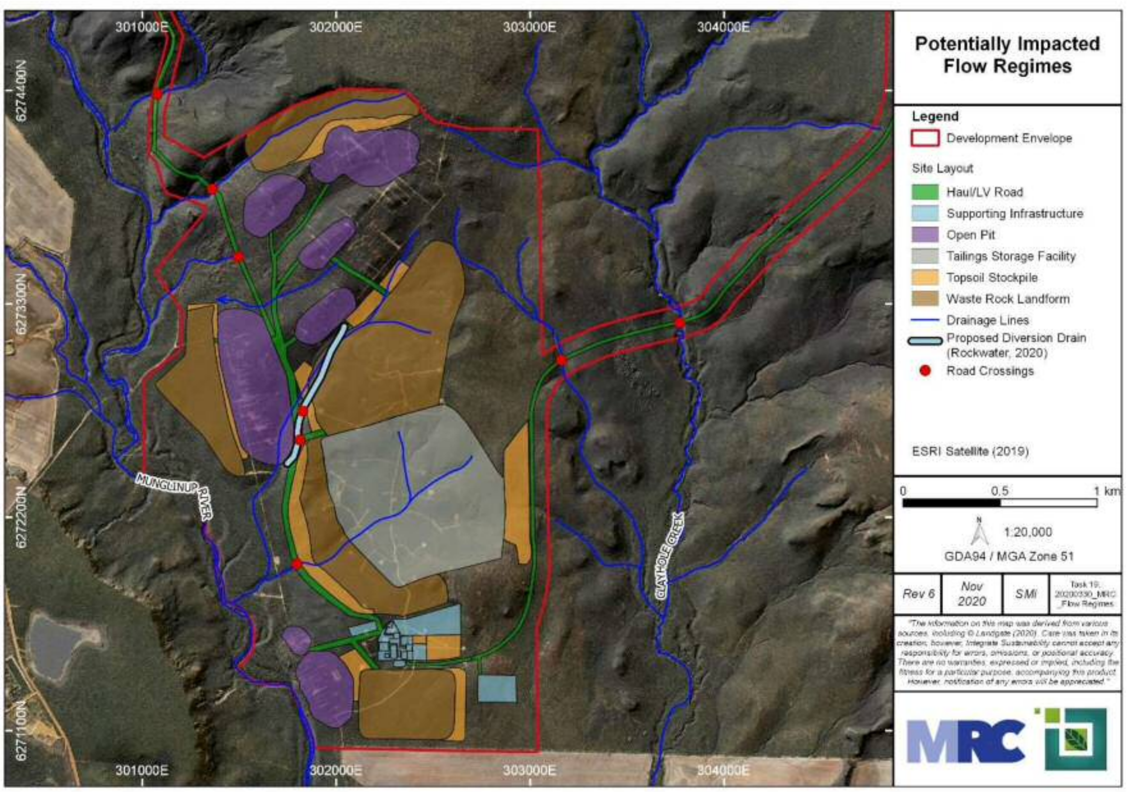

Figure 8 Potentially Impacted Flow Regimes

Groundwater Interaction

The project area includes alluvium and minor colluvium which contains minor local aquifers and granite and migmatite which contain very minor local aquifers with brackish to saline groundwater (Rockwater, 2020b). The results of the 2020 hydrogeological investigation showed that weathered gneissic rocks associated with the graphitic ore, and the adjoining host rocks, are moderately permeable along a northerly-trending linear zone in the western part of the project area, extending from north of Halberts Main pit to Halberts South (Rockwater, 2020b).

Standing groundwater levels from the bores within the project area, Munglinup town-site and WIR database, show that the regional groundwater levels follow the topography. Groundwater levels in the project area range from 1.82 to 41.08m bgl (68.83 to 94.1m AHD) (Figure 9) as shown in Appendix 1. Rockwater (2020b) concluded the water-table configuration indicates that the groundwater is flowing south-west towards the Munglinup River, and south towards the ocean (Rockwater, 2020b). Groundwater levels in the western bores (Figure 10) are similar to topographic levels along the Munglinup River, suggesting hydraulic connection between the river and the groundwater (Rockwater, 2020b). During floods, there is likely to be localised movement of water from the Munglinup River into rocks and sediments on the riverbanks, but generally the river would be a locus of groundwater discharge through flow to the river, and evapotranspiration.

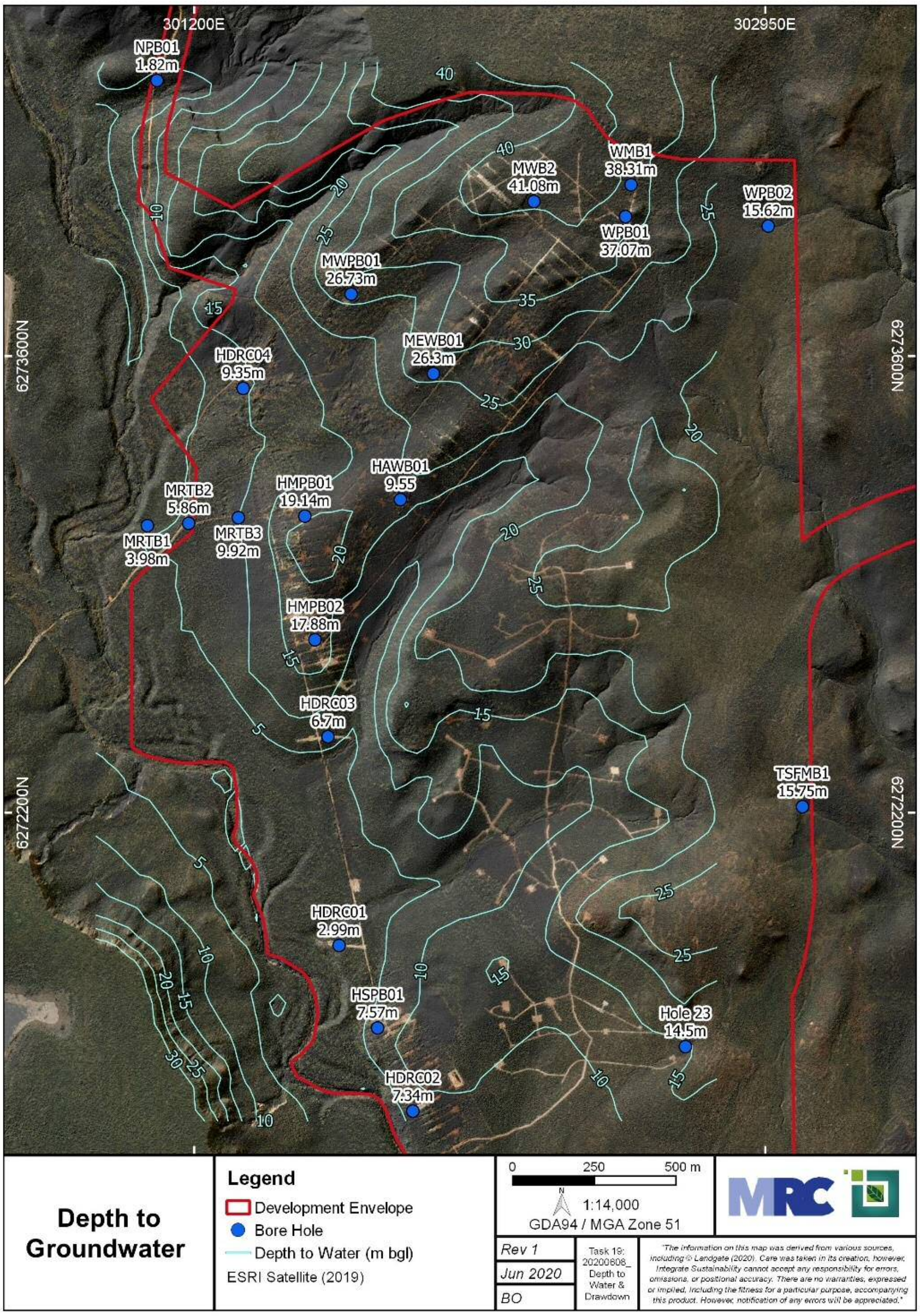

Figure 9 Groundwater Levels (m AHD)

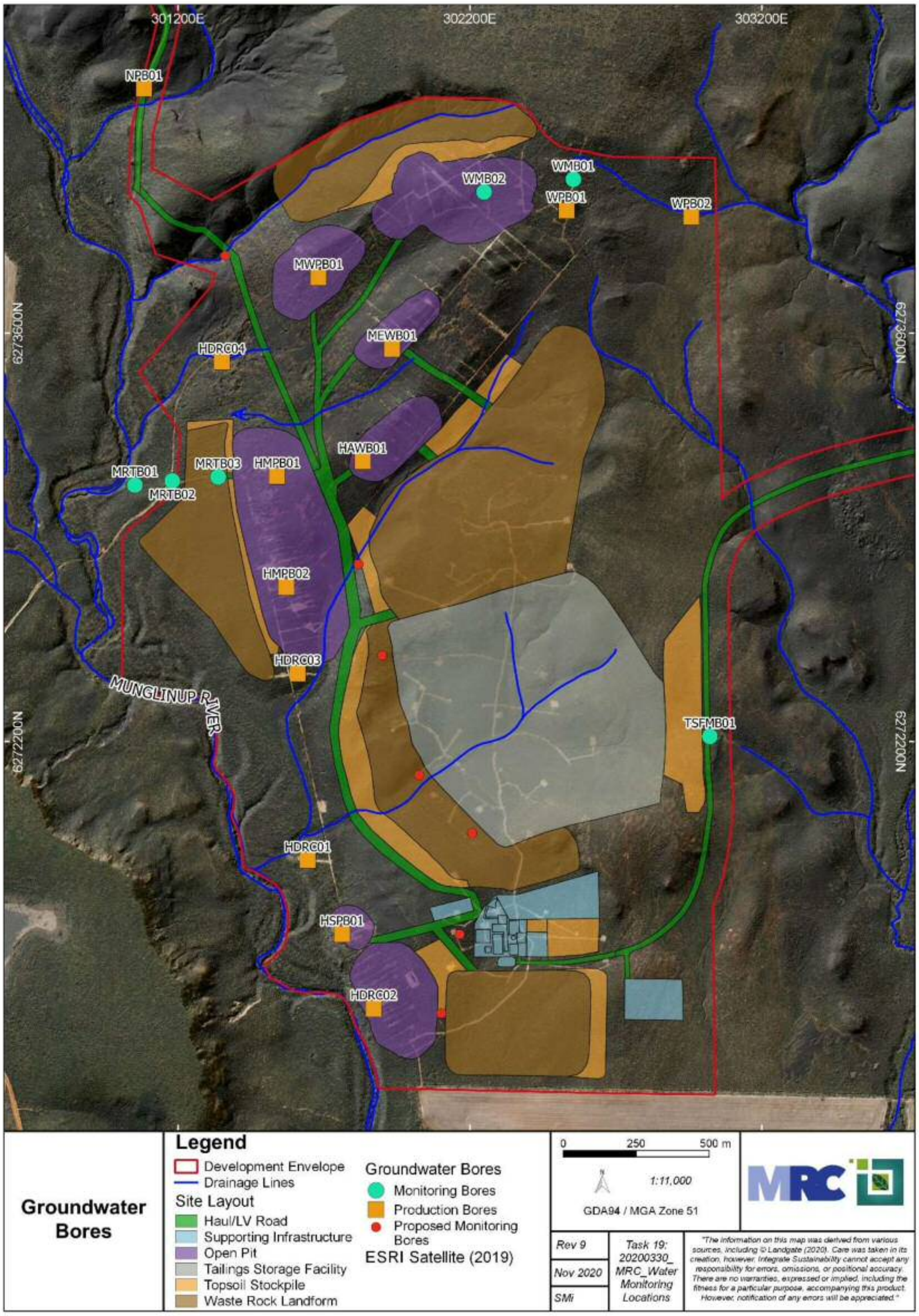

Figure 10 Groundwater Bores

The groundwater drawdown modelling conducted by Rockwater (2020b) suggested that at the end of mining over a period of 15 years, groundwater-level drawdowns of 1m (Figure 11) could extend up to 2km north, and 0.5km to 1.5km south of the mining area; 1 to 2km east to Clayhole Creek; and about 1.2 km west to the assumed aquifer boundary. This level of drawdown is not envisaged to have an impact on the local environment. In reality, geological boundaries are likely to limit the extent of drawdowns further, particularly across-strike of the mining area to the east and west.

Based on the 2020 work by Rockwater (2020b) it has been determined that there is similarity in composition of groundwater and surface water. This indicates that at low river flows, the river water is most likely derived from groundwater discharge, implying a hydraulic connection (Rockwater, 2020b). Pumping from bores and pit sumps will prevent some groundwater discharge to Munglinup River; and reduce river flows and ponded water volumes in the river, notably at times of low flow. The modelling results indicate that when there is water in the river, the rate of subsurface flow from the river back into the aquifer and moving towards bores and pits being dewatered would gradually increase from 233m^3/d in Year 1, to 265m^3/d in Year 12 when it would stabilise. These processes will reduce the accumulation of salt in the river due to evapotranspiration of groundwater discharge, and so are likely to reduce the salinity of water in the river during low flows (Rockwater, 2020b).

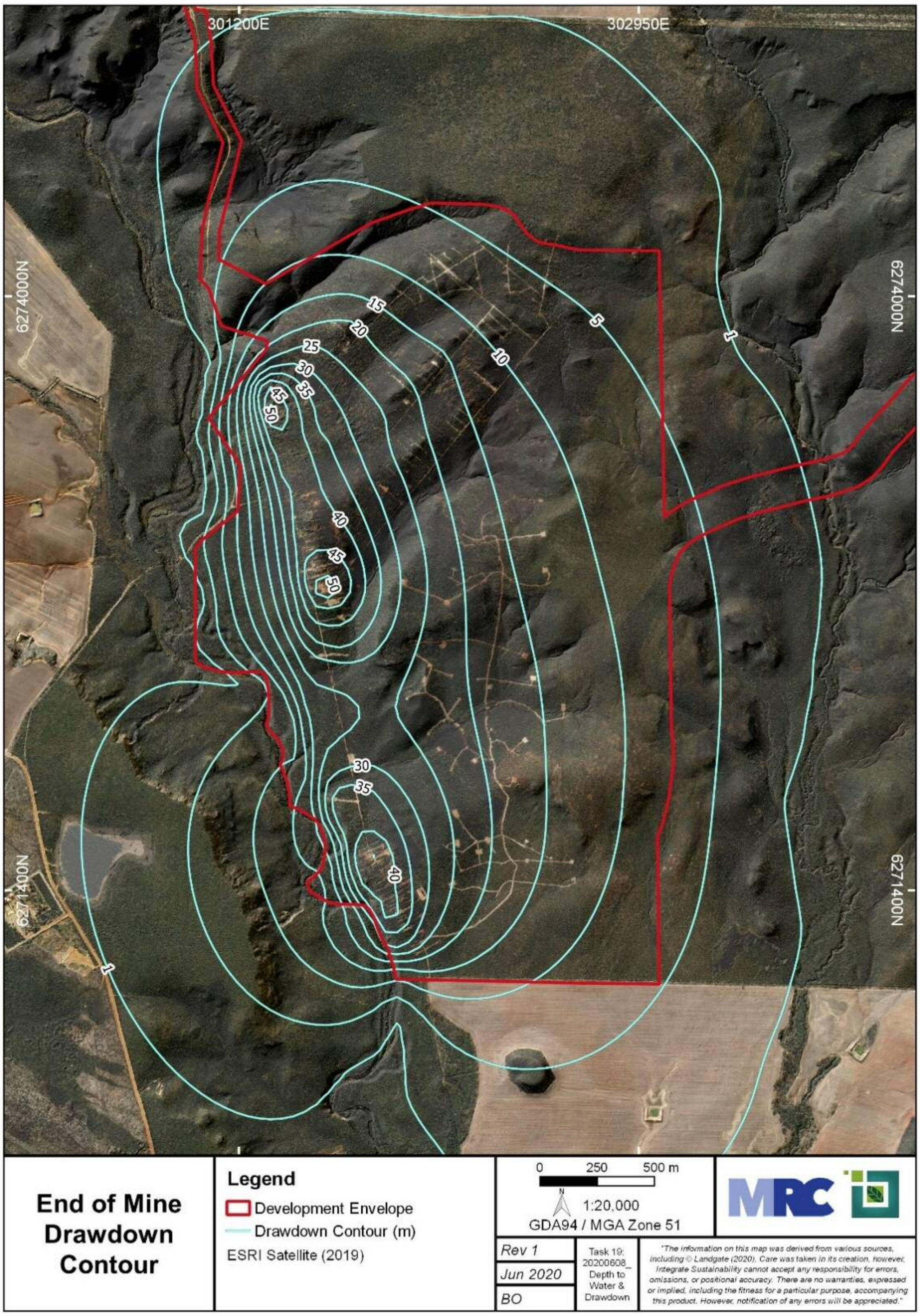

Figure 11 Predicted Drawdown Contours at the end of Mine Life

Surface and Groundwater Water Quality

Wetland Research and Management completed a baseline aquatic ecology assessment of the Munglinup River in April 2018. As part of this work baseline water quality sample were collected along the Munglinup River. These samples suggest the water quality of the Munglinup River can be considered saline, alkaline, clear and well oxygenated (WRM, 2018). Concentrations of heavy metals are mostly below the limit of detection and are not of ecological concern (WRM, 2018).

Chemical analysis of water from bores within the Project area by Rockwater (2020b) indicated the groundwater is highly saline, neutral to slightly alkaline (pH 6.6 to 7.71) and of a sodium chloride type with elevated magnesium and sulphate concentrations. Metals concentrations were low or below limits of detection with trace amounts of copper, nickel and manganese detected and iron generally high. Nitrogen and phosphorus were present at low concentrations (Rockwater, 2020b). Results of the chemical analysis conducted on the groundwater obtained from the project bores can be found in Appendix 2. The bore locations are shown in Figure 10.

Surface water samples were collected in April 2018 during a period of minimal rainfall and therefore represent the water quality of low flows in the river. An additional two samples were collected in May 2020. The results indicate that the Munglinup River water was highly saline, with salinity decreasing downstream from 20,000mg/L TDS to 13,000mg/L TDS. The highest salinity is very similar to groundwater salinities. The water was mainly alkaline (pH 8.0 to 8.4), with one location (MW01) determined as being slightly acidic (pH 6.8), and of a sodium chloride type, with elevated magnesium and sulphate. Metal concentrations were generally low or below reporting levels and nutrients concentrations were also low (Rockwater, 2020a; Rockwater, 2020b). Results of the chemical analysis conducted on the surface water can be found in Appendix 3. The sampling locations are shown in Figure 12.

Land disturbance activities associated with the Project have the potential to adversely affect the quality of surface water runoff, via sediment loads, increased concentrations of salts and other pollutants. As surface water and groundwater feeds into the Munglinup River this could lead to adverse impacts on the river. During construction an increase in sediment runoff and scour may occur as a result of ground disturbance and vegetation removal (Rockwater, 2020a).

If flows are reduced as a result of the Project, the runoff from local creeks are unlikely to increase sediment transport and scouring. There may however be increased sediment loads as a result of drainage infrastructure at proposed road locations crossing Clayhole Creek (Rockwater, 2020a).

Materials characterisation of waste rocks from the planned Halberts Main and Halberts South pit areas (ISPL, 2019) indicates that there is low risk of acidic conditions forming in the final voids, or for the movement of metals or sulphate at concentrations above background levels from the pit lakes into the surrounding groundwater. Geochemical analysis of tailings samples (KCB, 2018) indicates that the tailings will be potentially acid neutralising, and contain some metals of interest such as molybdenum and selenium. Any leachate penetrating the TSF liner could also contain elevated sulphate, but at concentrations similar to or below background levels. Waste rock in the Waste Rock Landform (WRL) is considered to generally be inert (Rockwater, 2020b).

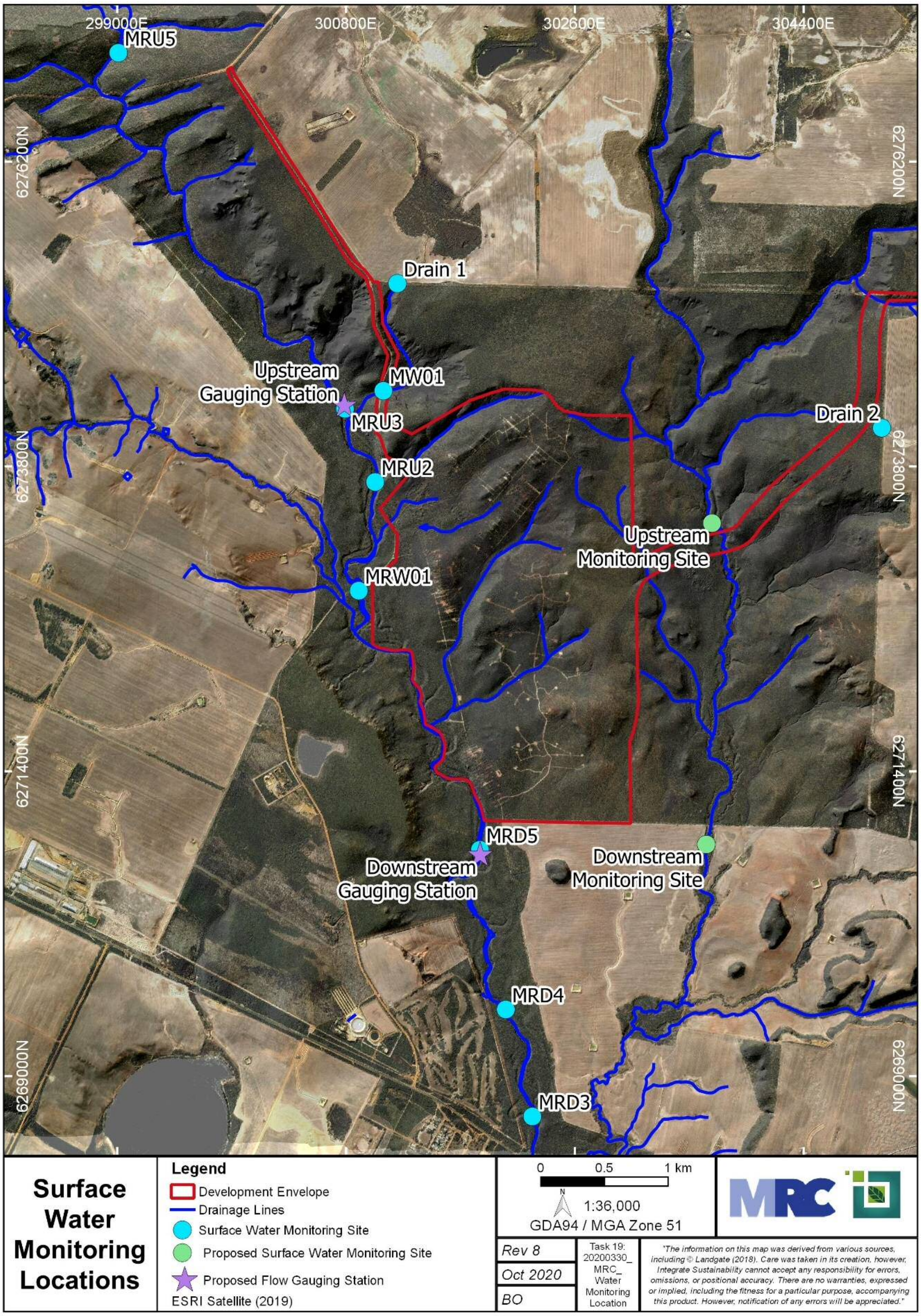

Figure 12 Surface Water Monitoring Locations

Groundwater and Surface Water Dependent Ecosystems

A report by Woodman Environmental (2020) states that four vegetation units (VUs) mapped along drainage lines in the project area are likely to be dependent on surface water flows, and are possibly dependent to some extent on groundwater. The results of subsequent hydrogeological investigations were provided to Woodman Environmental in April 2020, and the following conclusion was made by that organisation: "In summary it appears unlikely that any of the VUs recorded in the Study Area rely upon the local groundwater table for survival, rather utilising soil stored moisture from rainfall as their primary source of water during drier months. In particular, those VUs that occur higher in the landscape such those that comprise the Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia TEC (Endangered – EPBC Act) are situated where the water table is located well in excess of 10m from the ground surface and therefore are not groundwater dependent" (Woodman Environmental, 2020; Rockwater, 2020b).

Aquatic and Subterranean Fauna

Fauna surveys commenced in the project area in 2015. Aquatic fauna surveys have been conducted by Biota Environmental Sciences (Biota) and Wetland Research Management (WRM). Key information relating to Aquatic and Subterranean fauna are summarised below.

Aquatic Invertebrates

Spot sampling by WRM (2018) confirmed a relatively low density of macroinvertebrates of the Munglinup River. No state or federal listed macroinvertebrate species of conservation significance was recorded. The majority of macroinvertebrate taxa recorded from Munglinup River pool habitats were considered salt-tolerant, common, and ubiquitous species with distributions extending across the South Coast bioregion (WRM, 2018; Biota, 2018). Of the species identified the majority were found both up and downstream of the Project in the Munglinup River. None of the species recorded exclusively in the reach of the Munglinup River downstream of the project area are considered rare or restricted, with distributions of these species likely in local or regional saline systems (WRM, 2018).

Troglofauna and Stygofauna

During the pilot survey undertaken by Biota (2018) did not record any troglofauna or stygofauna in the project area. In two locations groundwater monitoring showed an initial increase in conductivity with depth, which then plateaued, indicating the presence of a comparatively fresh water layer over a more brackish deeper layer. Where haloclines occur, there is potential for different stygofauna species to inhabit the different groundwater habitats. Despite this the study concluded that the subsurface geology within the study area does not constitute suitable subterranean fauna habitat, resulting in a low likelihood of subterranean fauna occurrence. Based on drill log data it is unlikely that the rock types present in the study area represent habitat for troglofauna or stygofauna. The shallow depth of water in the southern parts of the study area further limits the likelihood of inhabitable strata for troglofauna. (Biota, 2018).

River Reliant Vertebrates

WRM (2018) identified a total of three fish species in the project area, none of which are listed for conservation significance or are endemic to the region. No native or introduced crayfish species were observed or recorded. There were no sightings of the Rakali, *Hydromys chrysogaster,* during surveying, and it is considered unlikely that the Munglinup River would be able to support a population, due to a lack of food sources and high predation pressure from introduced pests (WRM, 2018).

No long neck turtles or native frogs were observed or caught during the field survey. One species of turtle, *Chelodina colliei* is known to occur close to the study area, however it is unlikely that the Munglinup River would provide a suitable permanent habitat for this species, due to elevated salinity and the presence of high-level predators (WRM, 2018). Frog species were not specifically targeted during the survey, but 14 species of native amphibian are known to occupy the south-eastern Wheatbelt region. None of these species are listed as threatened or priority fauna in WA. Despite records, it is believed that the Munglinup River would not provide suitable breeding habitat for any known frog species due to the elevated background salinity (WRM, 2018).

Three species of avian fauna were confirmed along the Munglinup River; the Pacific black duck, grey teal duck and the white-faced heron. None of these species are listed at state or federal level and all are considered to have a widespread distribution throughout south west Australia (WRM, 2018).

Water Requirements

The water balances (provided by Mondium, 2019) given below (Table 5) provides an estimate of the quantities of the water requirements including potable water for drinking and plant use; non-potable water for the plant; and water for dust suppression. (Rockwater, 2020b).

Table 5 Mine-Site Water Balance (Rockwater, 2020b)

Item	Average Demand (L/s) With TSF Water Return	Average Demand (L/s) Without TSF Water Return
Bore-water to RO Plant (Includes pumpage and dewatering bores)	3.61	13.33
RO Water Produced	2.89	10.7
Brine Produced	0.72	2.7
Plant Water Required	2.7	9.92
Potable Water Required	0.2	0.2
TSF Return Water	7.22	
Dust Suppression (Plant and Mining)	3.5 - 5	3.5 - 5
Additional Water for Dust Suppression	2.8 – 3.6	0..8 – 2.3
Total New (Bore) Water Required	**6.4 – 7.2**	**14.1 – 15.6**
Water Available	15.4 L/s in Year 1, decreasing to ~7 L/s (including additional water from bore WPB02, deepening NPB01, and surface water runoff)	

Average bore pumpage required from production bores and dewatering facilities once tailings return (decant + toe drain) water is available is indicated to range from 6.4 to 7.2 L/s, and will largely depend on net evaporation rates. Average bore pumpage requirements for each quarter are estimated to range from 6.4 L/s (July to September) to 7.2 L/s (January to April). The water balance does not include surface water that would accumulate in mine pits following rainfall or surface runoff directed into pits (Rockwater, 2020b).

The modelling results indicate that the seven bores will be able to produce about 1,330 m^3/d (15.4/s) in total, pumping continuously over the first year of pumping, and lower rates subsequently (Rockwater, 2020b). The bore pumpage/abstraction rate required once tailings return (decant) water is available is indicated to range from 6.4 to 7.2 L/s. Based on the plant requirements (Table 5), the current borefield should be sufficient to meet the predicted project water requirements (up to 1,350 m3/d, on start-up, and up to 620 m3/d subsequently). Also, additional water should be available when bore WPB02 is re-constructed, and bore NPB01 is deepened (Rockwater, 2020b). These two bores had a combined blow yield of ~6.5 L/s during construction.

These results suggest that pumping from the bores will largely dewater the pits, and that the pumping capacity of the bores will gradually decrease during the life of the mine due to interference drawdown effects (Rockwater, 2020b).

Other Groundwater Users

From baseline assessment completed and data compiled from public domain sources it has been suggested that no other groundwater users exist near the Project which are likely to be impacted by groundwater abstraction associated with the Project.

South Coast Rivercare has an interest in the quality of water in the Oldfield River catchment, which includes the Munglinup River; and DWER has the regulatory responsibility to manage all rivers in the State. The main parameters of concern are likely to be nutrients (nitrogen and phosphorus), suspended solids/turbidity, and dissolved oxygen (Rockwater, 2020a).

The Munglinup River (including tributaries) is of a cultural significance to the Esperance Nyungar and has recently be classified at a Register Aboriginal Site. The spiritual significance attached to the river directly reflects the importance of the river in past Aboriginal subsistence systems and its importance for regional ecology. Esperance Noongar culture attaches powerful spiritual beliefs to waterways which carry a set of binding principles for the management of the waterway (Applied Archaeology Australia Pty Ltd, 2018). As a result of the links between Esperance Nyungar and the waterways, the 2018 heritage survey made a number of recommendations for the management of the Munglinup River. Where appropriate these have been incorporated into the management actions within this plan (Table 7).

1.5.2. Key Assumptions and Uncertainties

It is assumed that the surveys and assessments conducted to date have accurately recorded the conditions of the groundwater and surface water environments both regionally and within the project area.

The assumptions made in the hydrology and hydrogeological assessment are:

- While hydrological assessments have been conducted and modelled it is noted that there was limited data available for the flow rates of Munglinup River, Clayhole creek and associated catchments. It is was therefore assumed the parameters utilised based on regional methods and nearby drainage data (Young River Catchment) are accurately sufficient.
- The groundwater modelling utilises some assumed parameters as well as measured parameters, and the full extent aquifer beyond the Project area is not known.
- It is assumed based on the information obtained by Woodman Environmental (2020) that some of the vegetation units occurring in the project area are dependent on surface water rather than groundwater.
- It is assumed that runoff from the waste rock landform will be similar to that under pre-mining conditions.
- Based on the modelling data it is assumed that Clayhole Creek and its tributaries will be unaffected provided the creek crossings do not restrict flows or cause erosion.
- It is assumed that the impacted areas will be the same during construction, operation and closure.

1.5.3. Management Approach

The management provisions set out in this document are based on a risk-based management approach. This management plan is developed around the mitigation hierarchy of avoid, minimise and rehabilitate to ensure that impacts to the key environmental factors are avoided or reduced to as low as reasonably practicable. Mitigation and management actions have been identified and prioritised using the information gathered from baseline surveys and other regional and local information within the public domain.

1.5.4. Rationale for Choice of Provisions

Development activities have the ability to impact environmental values associated with inland waters. This management plan has identified the potential activities that may influence water flows and cause contamination to both groundwater and surface waters.

Management-based provisions have been chosen for the Project in order to mitigate the impact of the proposed activities on inland waters. These management actions are informed by the results of the baseline surveys and the Project parameters. The Project aims to minimise the Project footprint over the operations lifetime. Management measures are based on:

- Survey outcomes, both local and regional
- Absence of GDEs or potential GDEs, but presence of surface water dependent ecosystems
- Groundwater drawdown impact to the environment
- Water quality impacts (groundwater or surface water) to the environment
- Proposed activities
- Consideration of inherent risk severity from a risk assessment
- Consideration of level of uncertainty
- Industry best practice
- Cultural significance of the Munglinup River

Management provisions have been chosen as surface disturbance and water usage is inevitable and therefore the decision has been to minimise the impact. It is believed that management-based provisions will be more suited to manage the inland water impacts on the environment as opposed to outcome-based provisions. This method has been adopted given the level of data available at the current stage of the project. This makes it easy to modify proposed site layouts thereby minimising the impact.

2. Environmental Management Plan Provisions

This section identifies the provisions that MRCG proposes to implement to ensure the protection of the surface and groundwater resources associated with the Project area.

2.1.1. Management Targets

Measurable management targets have been developed to ensure management actions are effective. If management targets are met, then impacts to Inland water will be minimised and the EPA's environment objective for Inland Waters will be achieved.

Management objectives, targets, actions and reporting are listed in Table 6 and Table 7. The 'Schedule' approach has not been used as this EMP only covered one environmental factor but can be adopted in future should it be required.

2.1.2. Monitoring

The following monitoring will be undertaken for this plan:

- Surface water quality sampling upstream and downstream of road crossing and channel diversions.
- Annual vegetation condition monitoring to occur upstream and downstream of the Project.
- Visual monitoring of drainage channels for erosion and sediment.
- Monthly abstraction volumes.
- Groundwater levels and quality.

Where there is evidence of management targets not being met, or a trigger value being breached management measures will be reviewed to prevent further declines.

Table 6 EMP Values, Impacts and Outcomes

EPA factor and objectives:	*Inland waters* – to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected
Key environmental values:	• Munglinup River and tributaries • Clayhole Creek • Water Dependent Ecosystems • Aquifers • Surface and groundwater water quality • Cultural significance of the Munglinup River and Tributaries
Key impacts and risks:	• Impacts to the natural surface water flow as a result of placement, design and operation of mine pits and associated infrastructure • Impacts to Munglinup River and tributaries resulting from groundwater drawdown and alterations to surface water flows • Impacts to the quality of surface and groundwater as a result of disturbance, sedimentation, potential contamination and changes in surface hydrology • Impacts to water dependent ecosystems resulting from contamination and alterations to surface water flows
Outcome:	• Minimise impacts to surface water flow and flow regimes • Minimise drawdown impacts on the Munglinup River and aquifers • Minimise the levels of sediment in drainage channels, the Munglinup River and tributaries as a result of disturbance • Minimise contamination of surface water and groundwater • Minimise impacts on ecosystems • Ensure no impact to the cultural uses of Munglinup River and tributaries

Table 7 Management Based EMP Provisions

Management actions	Management targets	Monitoring	Reporting
Design • Establish a buffer zone of between 30 and 50m from the centre line of the Munglinup River to ensure the development minimizes impacts on the waterways • Minimise impacts of potentially dirty/impacted surface run-off in the Munglinup River by designing the operational surface water management system to ensure that releases of water from site via nominated points can be tested and controlled • Water supply studies have identified contingency water supply options (bore WPB02, deepening NPB01) in the area which can be considered should the need arise.	Minimise Impacts on the Munglinup River and aquifers Minimise contamination of surface water and groundwater as a result of mining activities Ensure no impact to the cultural uses of Munglinup River and tributaries	• Mine disturbance recorded and reviewed against buffer • Surface water and groundwater quality monitoring and assessment as per below. • Reflected in future documentation	Internal record keeping and reporting

Management actions	Management targets	Monitoring	Reporting
Construction and Infrastructure • Linear infrastructure will incorporate engineering structures (eg. Culverts, drains and diversion channels) to ensure natural surface water flows are maintained. • All drainage infrastructure will be designed in accordance with industry standard methodologies to mitigate sediment transport and erosion. • Where the access roads cross Munglinup River and Clayhole Creek floodways will be designed. • A diversion drain will be constructed at Halberts Main pit to direct flows from Catchment C around the pit. • Proposed mining infrastructure and facilities will be located at the top of local catchments to avoid interfering with drainage and surface water runoff. • The TSF will be engineered, constructed and will operate in accordance with DWER and DMIRS requirements.	Minimise sediment changes in drainage channels and the Munglinup River Minimise impacts to surface water flow and flow regimes	• Visual assessment of occur infrastructure to occur routinely and after flood events to identify leaks or if maintenance is required. • Borefield and pipeline will be routinely inspected to identify leaks or initiate repairs.	Internal record keeping and reporting
Drainage and Diversion Channels • Streamflow gauges installed to record flow rates on the Munglinup above and below the project • Sediment-laden runoff will be diverted to downstream sediment ponds to allow for the settling of sediments before the runoff is allowed to enter the receiving environment. • Limited modification to natural drainage channels. • Reducing scouring of the receiving creekline, by reducing flow velocity at the discharge point(s), where possible.		• Record streamflow level upstream and downstream (Figure 12) monthly during construction and operations. • Sedimentation monitoring upstream and downstream of road crossing and channel diversions. • Visual monitoring of drainage channels for erosion.	Annual Environmental Reports (DMIRS) Compliance Annual Report (DWER) Internal record keeping and reporting Laboratory analysis reports Survey/monitoring reports
Abstraction and Dewatering • Water meters will be installed on each abstraction and recovery point • Measuring monitoring data against groundwater model simulation and re-calibrate groundwater model as required to increase certainty in simulated drawdown. • Monitoring and controlling the groundwater abstracted and pit dewatering through implementation of an adaptive management plan.	Minimise drawdown impacts on the Munglinup River and aquifers	• Instantaneous pumping rate and meter readings are to be recorded weekly/monthly. • Pumping and rest water levels in each production bore and water levels in each monitoring bore will be recorded weekly/monthly. • Monitoring/recording water abstraction • Monitoring/recording water abstraction dewatering	Internal record keeping and reporting Annual Environmental Reports (DMIRS) Compliance Annual Report (DWER)

Management actions	Management targets	Monitoring	Reporting
Mine and Process Waste Containment • The TSF will be engineered, constructed and will operate in accordance with DWER and DMIRS requirements. • Perimeter bunds will be designed around the TSF to retain or redirect surface water runoff. • TSF will have a low permeability liner or base layer and tailings to be thickened prior to placement. • All potential contaminants such as hydrocarbons will be stored within an appropriately bunded area that has 110% capacity of the volume being storage in the tank or within a self-bunded tank. • No release of mine dewatering to the environment, all water recovered will be used for processing ore and dust suppression • Reliance on the dilution of streamflow leaving the project area as a result of the small project size in comparison to the Munglinup River catchment area. • Spill kits will be provided at strategic locations. • Establishment of additional monitoring bores.	Minimise contamination of surface water and groundwater as a result of mining activities Minimise sediment changes in drainage channels and the Munglinup River	• Surface water quality sampling will be conducted opportunistically following significant rainfall events or on a quarterly basis at a minimum of two sites along the Munglinup River (one upstream and one downstream) and up and downstream of the Clayhole Creek crossings. • Electrical conductivity and temperature of water discharged from each monitoring bore to be recorded weekly. • Groundwater monitoring will be required around the TSF and WRL to detect any potential contamination in the groundwater. • Water to be collected from each monitoring bore (Figure 10) monthly and the pH, electrical conductivity and temperature will be recorded • Water collected from each pump discharge and monitoring bore (Figure 10) annually and submitted to a NATA-registered laboratory for comprehensive water analysis.	Annual Environmental Reports (DMIRS) Compliance Annual Report (DWER) Internal record keeping and reporting Laboratory analysis reports Survey/monitoring reports

Management actions	Management targets	Monitoring	Reporting
Studies and Analysis • Periodically revisit geochemical characterisation of waste rock material to allow for appropriate management and storage. • Water samples to be tested by a NATA accredited laboratory and results compared against natural (pre-mining) variability and ANZECC guidelines for fresh and marine water quality (2000). • Comprehensive baseline and ongoing monitoring of surface water quality of the receiving creek-line, involving the aforementioned physical-chemical parameters, in order to assess and act on any potential threats to aquatic fauna. • Water samples to be tested by a NATA accredited laboratory and results compared against natural (pre-mining) variability. • Establishment of additional monitoring bores between TSF and Munglinup River.	Minimise contamination of surface water and groundwater as a result of mining activities Minimise impact on surrounding ecosystems	• Groundwater flow rates are to be monitored adjacent to Munglinup River upstream from the project site (control) and at project site. • Monitoring of peak water levels of the Munglinup River against long term averages. • Groundwater levels to be monitored at project bores and Munglinup River with results compared to pre-mining. • Water to be collected from each monitoring bore (Figure 10) monthly and the pH, electrical conductivity and temperature will be recorded and annually for comprehensive water analysis.	Annual Environmental Reports (DMIRS) Compliance Annual Report (DWER) Internal record keeping and reporting Laboratory analysis reports Survey/monitoring reports
Stakeholder Engagement • Ongoing communication with Esperance Tjaltjraak Native Title Aboriginal Corporation (ETNTAC)	Ensure no impact to the cultural uses of Munglinup River and tributaries	• Stakeholder engagement talks with ETNTAC	Internal record keeping and reporting
Future Developments • Additional groundwater monitoring bores will be installed as per recommendations given in the stage 3 groundwater report. • Implementation of Mined Waste and Process Waste Management Plans. • Spill management procedures will be implemented.	Minimise contamination of surface water and groundwater as a result of mining activities	• Developed as required	Internal record keeping and reporting

2.1.3. Reporting

This plan sets out the reporting requirements relating to the implementation of the Plan. Reporting includes:

- Preparation of the Annual Environmental Report (AER) to be submitted to the appropriate regulatory authorities. The AER will include monitoring results and trends as compared to trigger and threshold criteria.
- Provision of data (annually) from monitoring programs to relevant regulatory authorities.
- In the event that a management target is exceeded (or not met), the relevant regulatory authorities will be notified within 7 days of identification of the exceedance, including threshold contingency actions which have been implemented due to the exceedance of threshold criteria.

3. Adaptive management and review of the EMP

Given the potential for impacts to local groundwater, surface water, the Munglinup River and tributaries, and water dependent ecosystems, the management approach will remain adaptive. The following approach will be adopted:

- Monitoring data will be evaluated and compared to baseline and reference site data on an annual basis (or more frequently in some instances) in a process of adaptive management to verify whether or not responses to the impact are the same or similar to predictions;
- Monitoring data will be compared to the modelled simulated drawdown and surrounding groundwater environment as a component of the annual review process to verify whether or not responses to the impact are the same or similar to predictions; and
- Revision through consideration of incidents and associated investigations, or when management actions are not as effective as predicted or as result of change management.

The Inland Waters Management Plan will be reviewed and revised under the following conditions:

- If monitoring results indicate that management targets are not being achieved;
- If new information is discovered during construction, operations or closure;
- Where any significant changes to project design or operation have occurred; and
- Where it has been longer than 12 months since the last revision.

4. Stakeholder Consultation

Early engagement has allowed MRCG to understand the community in which they are working and identify key stakeholders that will be impacted by or impact the Project, including:

- State Government
- Federal Government
- Local Government
- Non-governmental organisations and interested parties
- Adjoining landowners and local communities eg Munglinup
- Traditional Owners (ETNTAC)

MRCG is committed to open and transparent communication with its stakeholders throughout the life of the Project from development approval through to construction, operation and mine closure. Ongoing stakeholder consultation has been underway since February 2018. Key engagements to date which have discussed matters relating to inland waters have been included in Table 8.

Table 8 Summary of Stakeholder Engagement

Theme	Stakeholder	Date	Comment
TSF Overflow	Department of Mines, Industry Regulations & Safety	Feb 2018	Due to the typical annual rainfall plus with significant rain event, the proponent will need to ensure the design and operations of the TSF will need to focus on rainwater management to prevent overtopping or limit seepage.
	Shire of Esperance	Feb 2018	Tailings consideration is being given to in pit tailings following discussion of recent flooding events
TSF Seepage	Department of Mines, Industry Regulations & Safety	Feb 2018	Due to the typical annual rainfall plus with significant rain event, the proponent will need to ensure the design and operations of the TSF will need to focus on rainwater management to prevent overtopping or limit seepage.
	Land owners and Community Members	Aug 2018	Tailings dam construction – a query was raised about whether the tailings dam would be pvc lined and what steps would be taken to ensure that tailings would not be released into the Munglinup River Catchment
TSF Management	EPA	Oct 2018	The EPA raised concerns about the management of tailings and kerosene in the tails. The EPA raised concerns about the management of tailings and kerosene in the tails. The EPA raised questions regarding the scenarios under which discharge to the river may be required.
Groundwater Management	EPA	Oct 2018	Work is currently underway to understand the groundwater aspects at the site. Currently all groundwater is likely to be sourced onsite for use within the plant.
	Local Environmental Action Forum	Oct 2018	Information was provided on the current water bore and drilling work being undertaken to gain a more comprehensive understanding of the groundwater at the site – given the potential that groundwater will be sourced onsite for use in the processing plant.
	Goldfields Esperance Development Commission	May 2019	A question was raised regarding the best process to move forward given the contention around the Munglinup River tributaries which are listed as registered sites after review of the joint letter from MRCG and ETNTAC.
	Great Southern Development Commission		
	Minister for Regional Development		
	Shire of Esperance		
	Shire of Ravensthorpe		
	City of Albany		
	Southern Ports Authority		
	First Quantum Minerals		
	ACH Minerals		
	Galaxy Resources		

Water Recycling/Disposal	Shire of Esperance	Feb 2018	Water disposal strategy, where practical all water will be recycled through the plant and water would only be released from site under emergency rain events.
	Esperance Tjaltjraak Native Title Aboriginal Corporation	Feb 2018	Tailings management and advising if tailings will be hazardous Wetlands and possible discharge to the Munglinup River should not be hazardous or have downstream impacts
Lack of Studies	Department of Mines, Industry Regulations & Safety	Feb 2018	To date no onsite groundwater and surface water assessment has been completed, it is hoped that an adequate groundwater supply can be obtained from the mining areas, preventing the need for offsite supplies
	Goldfields Esperance Development Commission	Jul 2018	MRCG outlined the substantial work currently underway in order to complete background studies.
	Shire of Ravensthorpe		
	Shire of Esperance	Aug 2018	
	Esperance Chamber of Commerce and Industry		
	Southern Ports Authority		
	Esperance Tjaltjraak Native Title Aboriginal Corporation	Sep 2018	
	Esperance Shire	Sep 2019	The meeting with ETNTAC focussed on MRCG's approach to the environmental processes and the need to undertake further hydrology work in consideration of the EPA requirements and concerns raised by ETNTAC elders in April 2019, as well as ensuring that MRCG made an appropriate commitment to aboriginal economic and employment development
	ETNTAC		
	GEDC		
	ECCI		
	Tori Castledine – Office of Colin de Grussa		
	MLC/Peter Rundle MLA		
Cultural Significance	Esperance Tjaltjraak Native Title Aboriginal Corporation	Jun 2018	Agreement of cultural monitors for work relating to the TSF access track, TSF test pits and turkeys nest.
	Department of Land and Heritage	Nov 2018	A question was raised regarding the best process to move forward given the contention around the Munglinup River tributaries which are listed as registered sites after review of the joint letter from MRC and ETNTAC.

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Appendix 1

Table 9 is an excerpt of the *Hydrogeological Assessment* completed by Rockwater in 2020. Table 9 displays a summary of exploration drilling and bore construction data compiled between 2018 and 2020.

Table 9 Summary of Exploration Drilling and Bore Construction 2018 to 2020 (Rockwater, 2020b)

Bore	Location	(GPS)		Casing ID (mm)	Elevation (m AHD)	TD (m)	Slots (m bgl)	Water Level		Aquifer Depth (m bgl)	Max Airlift Yield (m^3/d)	Status
		mE	mN					m bgl	m AHD			
Hole 23	South Exploration	302705.33	6271482.82	–	85.93	85	–	14.5	71.43	48-63	–	Water Exploration
TSFMB1	East TSF	303063.91	6272218.37	81	91.95	143	30.0 to 140.0	15.75	76.20	93-142	–	Tailings Monitoring Bore
WPB01	Whites East	302521.81	6274027.65	154.2	120.14	95	18.0 to 96.5	37.07	83.07	65-102	155.52	Whites Production Bore
WPB02	Whites East	302958.86	6273998.47	154.2	108.46	95	30.6 to 90.6	15.62	92.84	20-29, 70-95	112.32	Whites Production Bore
WMB1	Whites East	302538.69	6274125.16	81	120.88	113	18.0 to 93.0	38.31	82.57	32-36, 71-83	69.12	Whites Monitoring Bore
WMB2	Whites South	302240.95	6274074.04	81	123.17	120	18.0 to 120.0	41.08	82.09	78-114	–	Whites Monitoring Bore
NPB01	North Production	301085.92	6274445.06	154.2	94.44	78	+0.6 to 47.6	1.82	92.62	6-32, 38-78	129.6	North Production Bore
MRTB1	West Halberts Main	301056.71	6273080.19	81	81.62	30	2.8 to 26.4	3.98	77.64	3-30	–	Munglinup River Transect Bore
MRTB2	West Halberts Main	301182.97	6273087.01	81	83.34	50	6.8 to 49.3	5.86	77.48	27-50	103.68	Munglinup River Transect Bore
MRTB3	West Halberts Main	301335.39	6273104.60	81	87.03	55	9.45 to 44.85	9.92	77.11	14-33, 43-55	1.728	Munglinup River Transect Bore
HSPB01	Halberts South	301762	6271540	154.2	76.4*	61	11.7-59.7	7.57	68.83	30, 60	430	Production Bore
MWPB01	McCarthy West	301681	6273790	154.2	105.8*	66	17.7-65.7	26.73	79.07	42, 66	130	Production Bore
HMPB01	Halberts Main	301539	6273109	154.2	97.3*	103.5	36-102	19.14	78.16	45, 95-100	85	Production Bore
HMPB02	Halberts Main	301570	6272730	154.2	93.3*	102	11.7-59.7, 84-90	17.88	75.42	19-24, 50, 75-90	520	Production Bore
HDRC01	Nth Halberts Sth	301644	6271793	100	74.8*	54	48-54?	2.99	71.81	NR	>=1,300	Reconstruction Rqd.
HDRC02	Halberts South	301870	6271285	100	76.2*	69	63-69?	7.34	68.86	NR	>=1,300	Reconstruction Rqd.
HDRC03	Halberts Main	301610	6272433	100	82.2*	72	66-72?	6.7	75.5	NR	1,300	Prod. Bore Abd.
HDRC04	Nth Halberts Main	301350	6273501	100	88.1*	66	60-66?	9.35	78.75	NR	1,700	Reconstruction Rqd.
MEWB01	McCarthy East	301933	6273546	None	107.1*	54	–	26.3	80.8	–	0	Expln. Hole Abd.
HAWB01	Harris	301832	6273160	None	95.7*	60	–	9.55	86.15	–	<0.2	Expln. Hole Abd.

Appendix 2

Table 10 is an excerpt of the *Hydrogeological Assessment* completed by Rockwater in 2020. Table 10 displays the results of the chemical analysis completed on eight groundwater samples in March to May 2020.

Table 10 Results of chemical analysis, Bores and Drain Samples (Rockwater, 2020b)

Parameter	Limits of Reporting	Unit	TSFMB1 17/3/20	WPB01 15/3/20	NPB01 1/5/20	WMB1 18/3/20	WMB2 18/3/20	MRTB1 14/3/20	MRTBB2 16/3/20	MTRB3 16/3/20
pH Value	0.01	pH Unit	7.33	7.51	7.71	7.29	7.15	7.45	7.74	7.57
Electrical Conductivity @ 25°C	1	µS/cm	37000	34200	7470	35400	36900	31100	30000	35600
Total Dissolved Solids @180°C	10	mg/L	27600	24300	4420	25700	26200	21800	22100	26200
Total Hardness as CaCO3	1	mg/L	4650	3850	507	4040	4060	3450	3510	3810
Hydroxide Alkalinity as CaCO3	1	mg/L	<1	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	1	mg/L	<1	<1	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	1	mg/L	1180	708	158	893	977	480	473	524
Total Alkalinity as CaCO3	1	mg/L	1180	708	158	893	977	480	473	524
Sulphate as SO4	1	mg/L	1720	1890	327	1660	1410	1480	1390	1560
Chloride	1	mg/L	13200	12000	2180	11100	12900	10700	10500	12400
Calcium	1	mg/L	297	310	35	254	291	216	207	187
Magnesium	1	mg/L	950	746	102	828	809	708	726	811
Sodium	1	mg/L	7270	6650	1390	7390	7430	6340	5900	6910
Potassium	1	mg/L	147	147	37	152	157	119	138	150
Aluminium	0.01	mg/L	0.51	<0.05	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	0.001	mg/L	<0.005	<0.005	<0.001	0.008	<0.005	0.005	<0.005	<0.005
Cadmium	0.0001	mg/L	<0.0005	<0.0005	<0.0001	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	0.001	mg/L	0.037	<0.005	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005
Lead	0.001	mg/L	<0.005	<0.005	<0.001	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	0.001	mg/L	3.2	1.76	0.033	2.02	16.4	16.6	1.32	2.85
Selenium	0.01	mg/L	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05	<0.05	<0.05

Parameter	Limits of Reporting	Unit	TSFMB1	WPB01	NPB01	WMB1	WMB2	MRTB1	MRTBB2	MTRB3
			17/3/20	15/3/20	1/5/20	18/3/20	18/3/20	14/3/20	16/3/20	16/3/20
Zinc	0.005	mg/L	<0.025	0.043	0.006	0.148	0.103	<0.025	<0.025	<0.025
Iron	0.05	mg/L	2.75	8.3	<0.05	16	65.6	46.6	4.78	2.61
Mercury	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
Reactive Silica	0.05	mg/L	57.6	64.4	45.9	46.1	52.2	25.9	55.5	68.3
Ammonia as N	0.01	mg/L	0.04	0.02	0.12	<0.01	<0.01	0.23	0.01	0.01
Nitrite as N	0.01	mg/L	<0.02	<0.05	<0.01	<0.01	<0.05	<0.05	<0.01	<0.01
Nitrate as N	0.01	mg/L	<0.02	<0.05	0.03	0.01	<0.05	<0.05	0.01	<0.01
Nitrite + Nitrate as N	0.01	mg/L	<0.01	<0.01	0.03	0.01	0.02	0.01	0.01	<0.01
Total Kjeldahl Nitrogen as N	0.1	mg/L	1.7	<0.1	0.9	5.3	1.4	2.0	0.5	1.2
Total Nitrogen as N	0.1	mg/L	1.7	<0.1	0.9	5.3	1.4	2.0	0.5	1.2
Total Phosphorus as P	0.01	mg/L	146	0.15	0.04	0.5	2.06	0.22	0.22	0.12
Reactive Phosphorus as P	0.01	mg/L	61.1	<0.01	0.04	0.02	0.2	<0.10	<0.01	0.01
Total Anions	0.01	meq/L	432	392	71.5	366	413	342	334	393
Total Cations	0.01	meq/L	413	370	71.5	406	408	348	330	380
Ionic Balance	0.01	%	2.22	2.9	0.06	5.26	0.54	0.82	0.65	1.58

Appendix 3

Table 11 is an excerpt of the *Hydrological Review* completed by Rockwater in 2020. Table 11 displays the results of the chemical analysis completed on six surface water samples from the Munglinup river in April 2018.

Table 11 Results of chemical analysis, Munglinup River Samples (Rockwater, 2020a)

Parameter	Limits of Reporting	Unit	MRU5 10/4/18	MRU3 10/4/18	MRU2 10/4/18	MRD5 11/4/18	MRD4 11/4/18	MRD3 11/4/18	MRW01 1/5/20	MW01 1/5/20
Aluminium	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	2.08
Alkalinity	1	mg/L	279	336	324	291	235	244	312	41
Arsenic	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	<0.005
Boron	0.02	mg/L	4.9	5	4.9	5	4	3.9	5.62	7.3
Barium	0.002	mg/L	0.092	0.085	0.085	0.087	0.076	0.078	0.018	0.078
Carbonate	1	mg/L	16	<1	<1	<1	<1	<1	<1	<1
Calcium	0.1	mg/L	244	207	203	193	162	165	172	235
Cadmium	0.0001	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0005	<0.0005
Chloride	1	mg/L	12000	11200	10800	10200	8350	7950	11900	8940
Cobalt	0.0001	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.005	0.013
Chromium	0.0005	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.005	<0.005
Copper	0.0001	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.005	<0.005
Elect. Cond.	0.2	mS/m	3670	3380	3310	3090	2550	2390	33900	26200
Iron	0.005	mg/L	0.021	0.019	0.081	0.017	0.05	0.1	<0.25	<0.25
Bicarbonate	1	mg/L	308	409	394	352	287	297	190	25
Hardness	1	mg/L	3900	3400	3400	3100	2500	2500	2970	2600
Potassium	0.1	mg/L	159	149	147	140	112	109	148	134
Magnesium	0.1	mg/L	800	699	701	636	513	497	618	488
Manganese	0.001	mg/L	0.069	0.2	0.18	0.16	0.17	0.2	<0.005	8.57
Molybdenum	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	<0.005
Ammonium-N	0.01	mg/L	<0.01	<0.01	0.04	0.01	<0.01	<0.01	0.18	0.93
Nitrite-N	0.01	mg/L	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.15	0.48
Nitrate-N	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	0.02
Nox-N	0.01	mg/L	<0.01	<0.01	0.02	<0.01	<0.01	<0.01	0.2	0.5
Total N	0.01	mg/L	1.6	1.2	1.5	1.1	1.2	1.4	0.5	7.1
Sodium	0.1	mg/L	7440	7010	6930	6760	4960	4850	6710	5260

Parameter	Limits of Reporting	Unit	MRU5	MRU3	MRU2	MRD5	MRD4	MRD3	MRW01	MW01
			10/4/18	10/4/18	10/4/18	11/4/18	11/4/18	11/4/18	1/5/20	1/5/20
Nickle	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.005	0.015
Hydroxide	1	mg/L	<1	<1	<1	<1	<1	<1	ND	ND
Total P	0.005	mg/L	0.026	0.047	0.049	0.017	0.014	0.014	0.86	0.56
Lead	0.0001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005	<0.005
Sulphur	0.1	mg/L	660	620	610	580	460	450	806	950
Sulphate-S	0.1	mg/L	1980	1850	1820	1740	1380	1330	1870	2270
Selenium	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.05	<0.05
Silicon	0.05	mg/L	0.39	3.2	2.7	3.7	3.6	3.2	8.73	12.3
Strontium	0.002	mg/L	2.8	2.4	2.3	2.4	2	2	2.12	2.63
TDS (calc)	5	mg/L	20000	19000	18000	17000	14000	13000	23100	18000
TSS	1	mg/L	8	9	11	10	5	8	<5	784
Turbidity	0.5	NTU	<0.5	3.6	4.8	5.2	3.6	3.9	1.2	326
Uranium	0.0001	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.005	<0.005
Vanadium	0.0001	mg/L	0.0015	0.0037	0.0015	0.0028	0.0028	0.0021	<0.05	<0.05
Zinc	0.001	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.025	<0.025
pH	0.1		8.4	8.2	8	8.3	8.1	8.1	8.16	6.76