WATER MANAGEMENT PLAN
KEYSBROOK MINERAL SANDS PROJECT

KEYSBROOK, WESTERN AUSTRALIA

REVISION B SEPTEMBER 2015

PREPARED FOR

MZI RESOURCES

BY

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REVISION HISTORY

Revision	Date	Description	By	Check	Approved
Initial	March 2013	Original Approved WMP	MBS-AW	DoW, OEPA	DoW, OEPA
A	October 2013	Addendum 1 - Revised Appendix 1	Rockwater-MM	DoW	DoW
B	August 2015	Additions for Works Approval, Addendum merged with WMP.	MBS-MD		

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1. INTRODUCTION

MZI Resources Limited (MZI) plans to develop an open cut mineral sand mine and primary processing plant within an area of rural land near the small townships of Keysbrook and North Dandalup (Figure 1). The Project is known as the Keysbrook Mineral Sands Project (Keysbrook). The project area of 1,354 hectares is located on privately owned land, actively used for grazing.

A Public Environmental Review (PER) has been conducted for the project and was approved by the WA Minister for the Environment on 19 October 2009 via Ministerial Statement 810 and by the Federal Minister for the Environment on 16 February 2010. Details of the project may be found in the PER (MBS 2006). Other documents relevant to the PER process include the Report and Recommendations of the Environmental Protection Agency (EPA) (Bulletin 1269) and the Appeals Report against the recommendation of the EPA. Both documents are available on the EPA webpage.

1.1 PURPOSE

The Water Management Plan (WMP) addresses the requirements of Ministerial Statement 810, namely Condition 11-2 which outlines the required structure of the WMP. The purpose of this WMP is to ensure the abstraction of groundwater required for the implementation and operation of this project does not materially affect the quality or quantity of groundwater available to other users in the area, or adversely affect the health and condition of native vegetation and ecosystems in the area.

The WMP also outlines how the performance of the Keysbrook Project will be monitored and reported against the objectives and targets (Section 1.2) of this Management Plan.

1.2 OBJECTIVES AND TARGETS

The WMP objectives and targets for water management are outlined in Table 1.

Table 1: Water Management Objectives and Targets

Objective	Target
Abstraction of groundwater does not materially affect the quality of groundwater available to other users in the area.	Monitoring indicates groundwater remains fit for applicable beneficial uses.
Abstraction of groundwater does not materially affect the quantity of groundwater available to other users in the area.	Monitoring indicates the quantity of groundwater remains above that allocated to other users in the area.
Abstraction of water does not cause adverse, long term impacts to the water quality or levels of Conservation Category wetlands.	Monitoring indicates water quality and levels are within trigger levels.
Abstraction of groundwater does not adversely impact on the health and condition of native vegetation associated with Conservation Category wetlands.	Monitoring indicates no adverse, long term impact on native vegetation or groundwater dependant ecosystems.

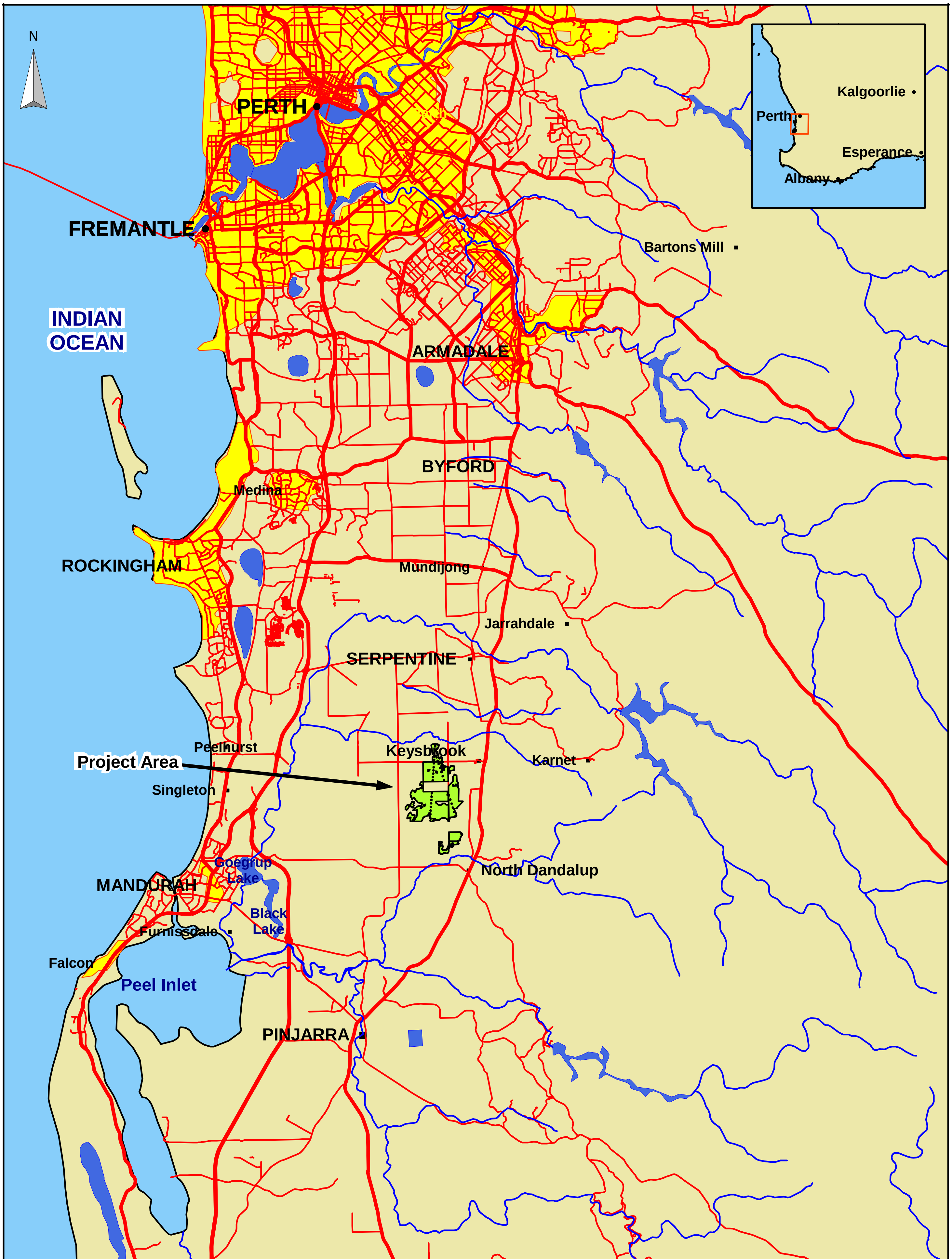
Objective	Target
To prevent or minimise any deterioration in surface water quality.	All stormwater runoff from HMC stockpiles and plant areas to pass through sediment control structures. All sewage wastewater treated in approved waste water systems. No effluent discharged to surface water. Quality of water leaving the project area within trigger levels.
Monitor surface and ground water quality.	All specified water monitoring carried out in accordance with monitoring procedures.
Comply with regulatory requirements.	Compliance with all statutory conditions on water management and monitoring at Keysbrook.

1.3 RELEVANCE TO OTHER PLANS

As a condition of approval of the Project, Ministerial Statement 810 also required the development of several other management plans. Plans that are directly relevant to the WMP include the Nutrient Management Plan and Acid Sulfate Soil Management Plan.

The Nutrient Management Plan (NMP) (MBS 2012a) outlines a program to monitor the nutrient levels within the mining area and identifies management actions should a trigger level be reached. The aim of the NMP is to minimise the export of nutrients from the mining area during operational and decommissioning phases of the project.

The Acid Sulfate Soil Management Plan (ASSMP) (MBS 2010) outlines the management strategies and procedures to assess and manage possible disturbance of acid sulfate soils associated with the operation. The objective of the plan is to ensure that all mining activities with the potential to disturb Acid Sulfate Soil materials are conducted in a manner to protect environmental values.



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Scale 1:400000
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MZI Resources Limited
Keysbrook
Mineral Sands Project

Location Plan

Figure 1

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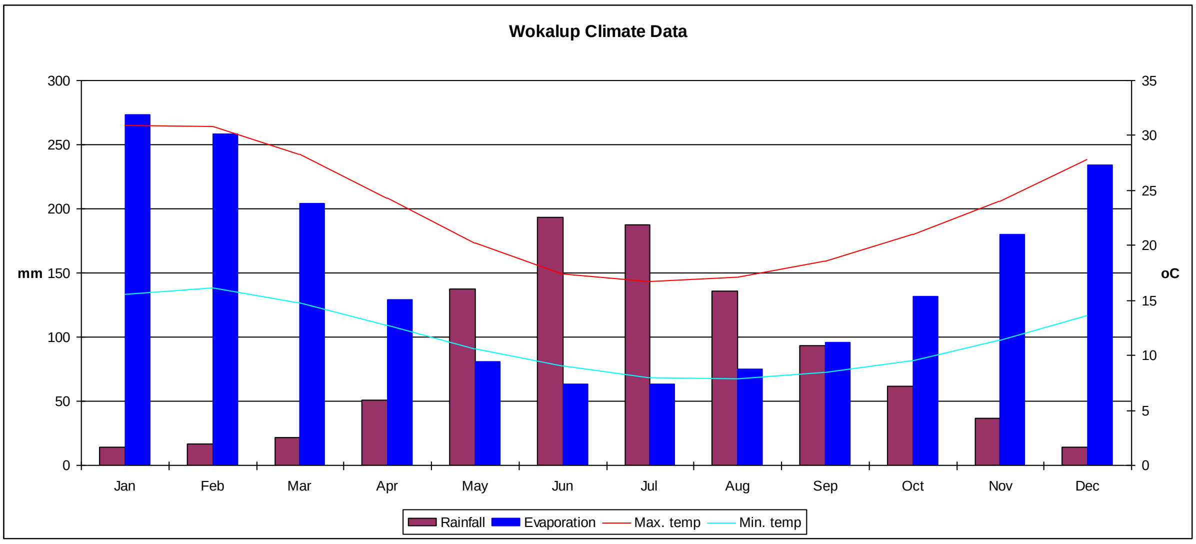
2. EXISTING ENVIRONMENT

2.1 CLIMATE

The Keysbrook area experiences a Mediterranean climate characterised by cool wet winters and warm to hot dry summers. The mine area lies between the 1,000 and 1,100 millimetres rainfall isohyets (Heddle *et al*., 1980).

The nearest meteorological monitoring station is located at Karnet, approximately nine kilometres to the east. This weather station is located on the Darling Scarp and experiences a slightly different climate to the mine area, with an annual average rainfall of 1,200 millimetres. The nearest meteorological monitoring station on the Swan Coastal Plain is located at the Medina Research Centre, about 28 kilometres north-west of the mine area, which has a 800 millimetre annual rainfall. Wokalup, although a further 80 kilometres south of Keysbrook, has an annual rainfall of 964 millimetres as shown in Chart 1. This is closer to Keysbrook's total than either Karnet or Medina. The average annual evaporation rate of approximately 1,800 millimetres exceeds the precipitation rate of 960 millimetres by a factor of about two to one.

Chart 1: Wokalup Climate Data

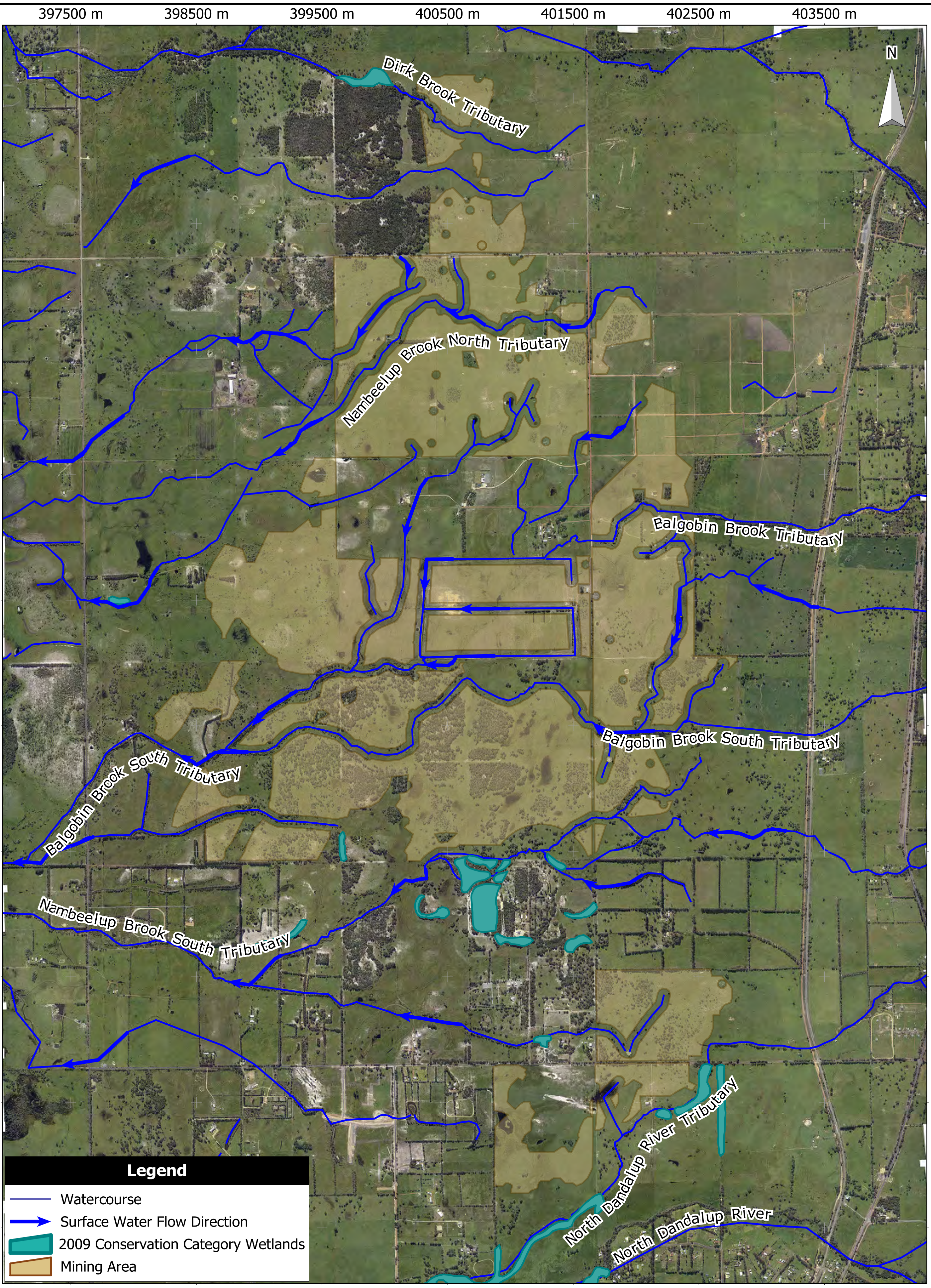


2.2 CONSERVATION CATEGORY WETLANDS AND NATIVE VEGETATION

Several Conservation Category wetlands are adjacent to the project area, but will not be directly disturbed by earthmoving activities (i.e. these wetlands will not be mined). The locations of these wetlands are shown on Figure 2.

Vegetation associated with the wetlands has been mapped by Bennet Environmental Consulting in 2005. The conservation category wetland to the south of the mine area is primarily Tall Open Scrub dominated by *Kunzea glabrescens* with scattered trees of *Banksia ilicifolia* over scattered low shrubs and sedges covering about 25 hectares. The Conservation Category wetland to the north of the mine area is primarily Low Open Forest of *Melaleuca* *preissiana* over Sedgeland and covers about four hectares. The condition varied between good and very good.

Approximately 180 hectares of native vegetation occurs across the project area. This ranges in condition from good to completely degraded. Ministerial Statement 810 requires that 75 hectares of this is set aside and protected in perpetuity. Additionally, there is a remnant area of native vegetation adjacent to the most northern mining areas that will not be cleared.



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Surface Drainage Locations

Figure 2

W:\Matilda Zircon\Keysbrook\04. Management Plans\WaterMP\WMP 2013\Drawings\Water Management Plan 2013.map 5/03/2013 F2: Watercourses Layout

2.3 SURFACE WATER RESOURCES

2.3.1 Catchment Information

At a regional level, all surface drainage ultimately flows to the Peel-Harvey estuary. Streams from the Darling Scarp and foothills flow through the mine area. Figure 2 shows surface drainage lines in the vicinity of the mine area.

The watercourses have been split into three categories:

- **Major Watercourses** - Peak flows of two to five cubic metres per second.

  These are Balgobin Brook and North Dandalup River Tributary.

- **Medium Watercourses** - Peak flows of one to two cubic metres per second.

  These are Dirk Brook Tributary, Nambeelup Brook North Tributary, Balgobin Brook South Tributary and Nambeelup Brook South Tributary. These water courses still have well defined creek channels.

- **Minor Watercourses** - Peak flows of less than one cubic metre per second.

  The minor watercourses are generally shallow and poorly defined. Diversion of these watercourses will be manageable with earthworks such as bunds and drains around mine pits.

Balgobin Brook is the main drainage feature that passes through the central portion of the project area. Approximately 80% of the project area is situated within this catchment. Balgobin Brook flows south-west into Nambeelup Brook, which flows to a series of major lakes (Black Lake and Goegrup Lake).

2.3.2 Stream Flow Information

Fifteen Department of Water (DoW) Stream Gauging Stations are located in and around the project area. Of these, only five stations have a useful period of record and similarity of catchment to the project area. These five stations are listed in Table 2.

Table 2: Stream Gauging Stations

Station No.	Watercourse Name	Station Name	Catchment Area (km^2)	Specific Mean Discharge ($m^3/s/km^2$)	Years of Record	Peak Discharge	Distance from Project (km)	Type
614005	Dirk Brook	Kentish Farm	35.19	0.007	30		5	Hills
614021	North Dandalup Tributary	Lewis Catchment	2.00	0.003	27	0.042	11	Hills
614013	Peel Drain	Hope Valley	10.35	0.005	23	0.66	25	Coastal Plain

Station No.	Watercourse Name	Station Name	Catchment Area (km^2)	Specific Mean Discharge (m^3/s/km^2)	Years of Record	Peak Discharge	Distance from Project (km)	Type
614030	Serpentine Drain	Dog Hill	469.7	0.005	27	18.44	10	Coastal Plain
614063	Nambeelup Brook	Kielman	114.95	0.006	5	0.969	10	Coastal Plain

The Nambeelup Brook stream gauging station is located about 10 kilometres downstream (south-west) of the mine area. Stream flow data was collected at this station from May 1990 to January 1995 and provides a record of flows in the catchment area. The gauging station has a catchment area of 114.95 square kilometres, meaning 78% of the gauging station's catchment area is within or upstream of the project area. The gauging station has recorded an average annual flow volume of 24,920 megalitres, and a mean peak annual discharge of 15.7 cubic metres per second. Annual average runoff depth is 216 millimetres. Flows are typically close to zero from January to April; high flows occur consistently from June to October. November, December and May are transitional months with flows varying from negligible to considerable from year to year?

2.3.3 Water Quality Information

Limited water quality information is available in the DoW's Water Information System (WIN) for a number of locations adjacent to the mining area. Seven monitoring locations with more than three water quality records are located within seven kilometres of the project area. Approximately 70 'one-off' samples have also been recorded within and adjacent to the project area.

The Statewide River Water Quality Assessment (DoW 2007) shows water quality data for Nambeelup Brook (Site 614063), located 10 kilometres downstream (south-west) of the project area was of neutral pH, with very high nitrogen and phosphorus concentrations and high turbidity. Water quality for Dirk Brook at Punrak Road (Site 6142593), located 6 kilometres downstream (east-northeast) of the project area was of neutral pH, with high nitrogen and phosphorus concentrations and high turbidity. This information is useful in that it shows water quality has been affected by historic and existing land uses prior to any mining taking place.

Field analysis using a hand held water quality meter to measure conductivity of water at 15 locations across the project area on 13 October 2005 provided ranges from 0.28 to 0.90 milliSiemens per centimetre (168 to 540 milligrams per litre) with a median of 0.6 milliSiemens per centimetre (360 milligrams per litre). This confirmed all surface water in the project area is fresh. The ANZECC (2000) guideline trigger value for salinity in lowland rivers of south-west Australia is 0.12 to 0.30 milliSiemens per centimetre, and for wetlands is 0.30 to 1.50 milliSiemens per centimetre. This means that the measured salinity was generally above the guideline for rivers in this region, but well within the guideline for wetlands.

2.4 GROUNDWATER RESOURCES

Two aquifers of the Perth Basin are relevant to the project. Firstly, the shallow Superficial Formation containing both the Bassendean Sand and Guildford Formation. The upper four to eight metres of the Bassendean Sand unit are moderately permeable material. In the mine area the water table in this aquifer ranges from zero to 10 metres below ground surface. There is zero to about two metres saturation above the base of the Bassendean Sand, depending on the season and the local aquifer geometry. This aquifer will be affected by the mining operations as it contains the mineral sand deposit and will therefore at times require localised dewatering.

Mining operations during the winter will result in the groundwater levels in the Bassendean Sand being temporarily lowered to the base of the unit, in and around individual mining cells. Water levels will start recovering as mining moves to new cells, excavated cells are backfilled, and rainfall recharges the reconstituted aquifer. Groundwater modelling (Rockwater, 2007) indicates that the impact will not extend much more than several hundred metres beyond the mine void and will be of a temporary nature (in the order of three to four months). The placement of wet tailings material in the adjacent previously mined area will also result in the artificial recharging of the local superficial aquifer.

The second relevant aquifer is the Leederville Formation extending to at least 130 metres below ground level. It will be utilised as a water source for the mining operation. Hydrological modelling shows that the expected pumping from two bores will after eight years impact groundwater levels in surrounding production bores to be less than 4 metres (Rockwater, 2007). The predicted impact on the upper superficial aquifer is less than 0.1 metres at the edge of any potentially groundwater sensitive wetlands.

Water salinities in the Superficial Formation range from 200 to 1,000 milligrams per litre total dissolved solids (TDS), while in the Leederville Formation they are generally less than 1,000 milligrams per litre TDS.

2.4.1 Superficial Aquifer

Mineral and exploration drilling data collected by MZI indicate that the thickness of Bassendean Sand in the mining area ranges from zero to eight metres, with an average of about 2.2 metres. The base of the Bassendean Sand broadly slopes down to the west in a similar manner to the ground surface contours. Data collected from production and monitoring bores within a four kilometre radius of the site indicate that thickness of the Superficial formation is variable, ranging between 10 and 15 metres.

A groundwater flow system bounded by the Serpentine River to the north and west, and the South Dandalup River in the south occurs in the Superficial aquifer; it is referred to as the Serpentine Area flow system (Davidson 1995). The water table here slopes from about 60 metres AHD near the Darling Scarp to about 10 metres AHD along the discharge boundaries formed by the Serpentine and South Dandalup rivers. Groundwater in the Superficial aquifer flows mainly westwards under the prevailing hydraulic gradient.

The Superficial aquifer in the Serpentine area acts as a recharge source for the underlying Leederville aquifer. Groundwater in the Superficial aquifer is derived from recharge resulting from direct rainfall on the ground surface and local stream runoff from ephemeral drainage networks flowing from the Darling Plateau. Recharge occurs mainly between May and September.

The groundwater resources in the Superficial Formation, as adopted by DoW, are as follows:

- Serpentine Groundwater Area – Keysbrook 1 and 2 Sub-areas:

  5.32 x 10^6 m^3/yr totals, with 2.24 x 10^6 m^3/yr currently allocated (42%). *
- Murray Groundwater Area – Nambeelup Sub-area:

  13.5 x 10^6 m^3/yr totals, with 1.31 x 10^6 m^3/yr currently allocated (9%). *

* These values are subject to change.

In the vicinity of the proposed mine area there are 25 licensed draw-points tapping the Superficial aquifer. Given that the aquifers are the Bassendean Sand – with only one to six metres of saturation generally, and the Guildford Formation of low permeability, the amounts of water available from individual locations are not very large. The most productive draw-points would be drains, dams or ditches of significant length.

2.4.2 Leederville Aquifer

In the Serpentine area, the Leederville aquifer is a multi-layered aquifer up to 130 metres thick, consisting of discontinuous interbedded sandstone, siltstone and shale of the Wanneroo and Mariginiup Members (of the Leederville Formation). Interfingering of the strata causes the aquifer to be locally confined by shale (Allen, 1981). The Keysbrook mine site is located within a recharge area for the Leederville and deeper Yarragadee aquifers. Both are in hydraulic connection with their respective overlying aquifer and there are downward hydraulic gradients. However, at some localities there are upwards heads from the Leederville to the Superficial aquifer. Thus as a rule the Leederville aquifer receives groundwater from the Superficial aquifer and transmits it mainly westwards. Downstream, some of the Leederville groundwater discharges into the Superficial and Rockingham aquifers.

The groundwater resources of the Leederville aquifer, as adopted by DoW, are as follows:

- Serpentine Groundwater Area – Keysbrook 1 and 2 Sub-areas:

  Leederville: 1.76 x 10^6 m^3/yr total, with 0.80 x 10^6 m^3/yr currently allocated (45%).*
- Murray Groundwater Area – Nambeelup Sub-area:
  - Upper Leederville: 4 x 10^6 m3/yr total, with 1.98 x 10^6 m^3/yr currently allocated (49%).*
  - Lower Leederville: 3 x 10^6 m3/yr total, with 1.1 x 10^6 m^3/yr currently allocated (36%).*

* These values are subject to change by the DoW

Within the Murray Groundwater area - Nambeelup sub-area, a green clay marker of about 5 to 10 metres in thickness, divides the Leederville aquifer into upper and lower units. Within this region, the upper Leederville aquifer, located along the western margin of the mining area, has an allocation limit of six gigalitres per annum, of which about 49% has been allocated. The lower Leederville aquifer has an allocation limit of three gigalitres per annum, of which about 36% has been allocated.

2.4.3 Groundwater Areas

The mine area is located within the proposed Karnup – Dandalup Underground Water Pollution Control Area. The groundwater area has not been formally gazetted as a public water source protection area.

The project area has been allocated a policy use of P2. P2 source protection areas are defined to ensure that there is no increase in risk of pollution to the water source. They are declared over land where low intensity development already exists. P2 areas are managed in accordance with the principle of risk minimisation and so some development is allowed under specific guidelines (WRC, 2002).

2.4.4 Groundwater Monitoring Information

DoW has a number of groundwater monitoring bores in close proximity to the project area.

Two artesian monitoring bores, AM64 (site number 61415037) and AM66 (site number 61415027) immediately border the mining area and are approximately 350 metres in depth being constructed between 1980 and 1986. Monitoring data and details of licensed bores are held in the DoW database.

Table 3 provides information on four existing monitoring bores, referred to as the Lake Thompson monitoring bores, located around the project site. These were constructed in 1975 and have recorded water levels since that time.

Table 3: Lake Thompson Bores

Name	WIN Site ID	Location	Drilled Depth (m)
LT610	3089	Hopelands Road (west side of project).	22.0
LT670	3098	Readhead Road (south side of project).	15.5
LT570	3105	Elliott Road (north side of project).	22.0
LT620	3111	Westcott Road (East side of project).	24.0

Data from the Lake Thompson monitoring bores indicate that water levels range from 0.35 metres below ground level in winter to 3.2 metres below ground level in summer.

MZI has installed a number of groundwater monitoring bores and two potential production bores within and adjacent to the project area. Table 4 lists the bores installed to date.

Table 4: Bores Drilled by Project Team

Name	Aquifer	Monitoring Purpose	Drilled Depth (m)	Date Installed
KWT1A	Superficial	Impact on wetland	2.0	May 2007
KWT1B	Superficial	Impact on wetland	2.0	May 2007
KWT1C	Superficial	Impact on wetland	2.0	May 2007
KWT1D	Superficial	Impact on wetland	6.0	May 2007
KWT1E	Superficial	Impact on wetland	4.0	May 2007
KWT1F	Superficial	Impact on wetland	4.0	May 2007

Name	Aquifer	Monitoring Purpose	Drilled Depth (m)	Date Installed
KWT2A*	Superficial	GW abstraction	3.0	June 2012
KWT2B	Superficial	GW abstraction (previously Impact on wetland)	3.5	May 2007
KWT2C	Superficial	GW abstraction (previously Impact on wetland)	3.0	May 2007
KWT2D	Superficial	GW abstraction (previously Impact on wetland)	3.0	May 2007
KWT2E	Superficial	GW abstraction (previously Impact on wetland)	6.0	May 2007
KWT2F	Superficial	GW abstraction (previously Impact on wetland)	1.8	May 2007
KWT3A*	Superficial	GW abstraction	4.0	June 2012
KL1S	Superficial	GW abstraction	3.0	May 2007
KL1Obs	Leederville	GW abstraction	90.0	March 2007
KL2Obs	Leederville	GW abstraction	144.0	April 2007
KL3Obs	Leederville	GW abstraction	156.0	April 2007
KL1	Leederville	Abandoned production bore		May 2007
KL2P	Leederville	Production bore	144.0	April 2007
KL3P	Leederville	Production bore	150.0	May 2007
KL3	Leederville	GW abstraction	26.0	June 2012
KL4	Leederville	GW abstraction	31.0	June 2012
KL7	Leederville	GW abstraction	37.0	June 2012
KL8	Leederville	GW abstraction	25.0	June 2012
KS1	Superficial	Impact on other users	2.9	June 2012
KS2	Superficial	Impact on other users	2.8	June 2012
KS3	Superficial	Impact on other users	2.8	June 2012
KS4	Superficial	Impact on other users	2.9	June 2012
KS5	Superficial	Impact on other users	2.9	June 2012
KS6	Superficial	Impact on other users	2.9	June 2012
KS7	Superficial	Impact on other users	2.9	June 2012
KS8	Superficial	Impact on other users	2.8	June 2012
KS9	Superficial	Impact on other users	4.5	June 2012
KS10	Superficial	Impact on other users	2.8	June 2012
KS11	Superficial	Impact on other users	4.5	June 2012
KS12	Superficial	Impact on other users	5.8	June 2012
KS13	Superficial	Impact on other users	5.0	June 2012
KS14	Superficial	Impact on other users	4.5	June 2012
KS15	Superficial	Impact on other users	4.3	June 2012
KS16	Superficial	Impact on other users	4.0	June 2012
KS17	Superficial	Impact on other users	4.5	June 2012

Name	Aquifer	Monitoring Purpose	Drilled Depth (m)	Date Installed
KS18	Superficial	Impact on other users	4.5	June 2012
KS19	Superficial	Impact on other users	2.9	June 2012
KS20	Superficial	Impact on other users	3.0	June 2012
KS21	Superficial	Impact on other users	4.1	June 2012
KS22	Superficial	Impact on other users	2.9	June 2012

** Bores KWT2A and KWT3A are replacement for the two bores drilled previously in 2007*

2.4.5 Groundwater Quality

In the project vicinity, groundwater salinities in the Superficial aquifer range from 200 to 1,000 milligrams per litre Total Dissolved Solids (TDS) in the four Lake Thompson bores, although in the wider Serpentine area they range up to 2,700 milligrams per litre TDS. Higher-salinity groundwater is generally found near discharge areas of the aquifer. Partial analyses for water samples taken from the local Lake Thompson bores are given in Table 5. They show that colour, turbidity, and iron content vary strongly over the area, and locally one or more of these factors would determine that water from the Superficial aquifer was not suitable for some uses (e.g. potable supply) unless treated.

Table 5: Water Quality Data from Lake Thompson Bores

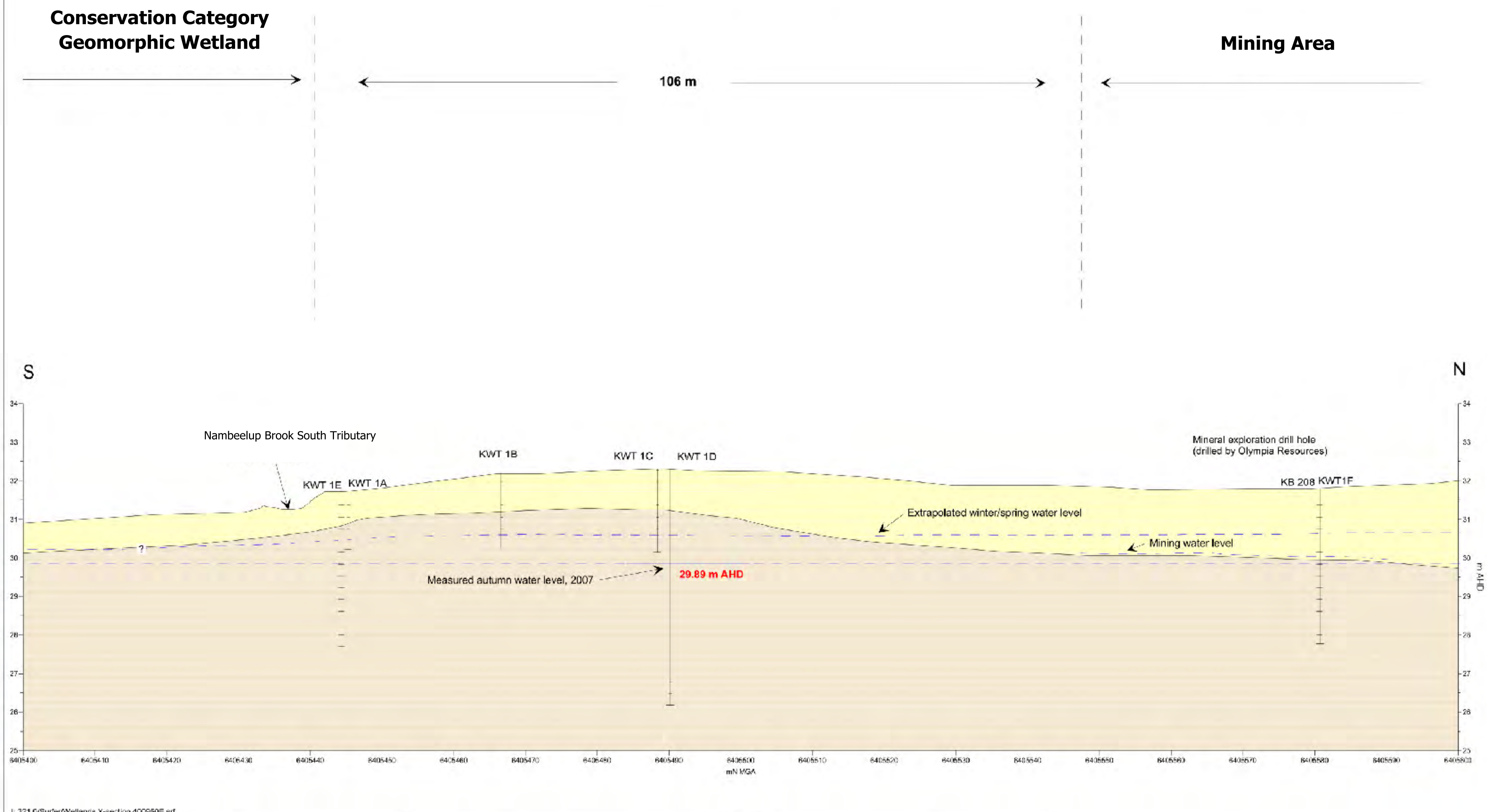
Bore	TDS (mg/L)	Colour (APHA)	Turbidity (APHA)	Fe (mg/L)	Free CO_2 (mg/L)	Comments
3105 (T 570)	180	<5	<10	0.64	66	After pumping 1 hr @ 16 m^3/day.
3089 (T610)	240	580	440	3.1	119	After pumping 1 hr @ 37 m^3/day.
3111 (T 620)	950	<10	1,800	5.6	159	After pumping 1 hr @ 37 m^3/day.
3098 (T 670)	300	70	330	19	56	After pumping 1 hr @ 16 m^3/day.

2.5 WETLAND HYDROLOGY

A number of shallow bores have been drilled (Rockwater, 2007) to assist in gaining a better understanding of the hydrological processes present in the wetland areas. The 2007 investigation focused on the Nambeelup Brook South Tributary wetlands and Balgobin Brook South Tributary (Figure 2) as these are closest to the proposed mining blocks. In both areas the drill logs showed that the Bassendean Sand unit (the formation that hosts the mineral deposit) is relatively thin (<1.5 metres) and underlain by more than 5 metres of the more argillaceous Guildford Formation. The Guildford Formation which has much lower permeability (0.001 to 2 metres/day) effectively impedes groundwater flow between the highly permeable Bassendean sands (5-10 metres/day) and deeper regional Leederville aquifer. Groundwater levels in the bores show that for much of the year the local water table is below the base of the Bassendean Sands and even with a one metre rise during the wet season is unlikely to reach the natural ground surface in the wetlands. This is illustrated diagrammatically in the hydrogeological cross-section Figure 3 taken from Rockwater (2007).

Drilling also suggests that a slight ‘ridge’ (divide) occurs in the Guildford Formation between the proposed mining area and the wetlands. The creek is located between the wetlands and the proposed mine dewatering area and will therefore act to counter any drop in the shallow (perched) water table. A further mitigating factor is that mine dewatering is only planned for the wetter winter months when surface drainages are known to recharge the wetlands. Subsequent groundwater level monitoring has confirmed the suspected seasonal groundwater level fluctuation in this shallow aquifer system.

The natural wetlands are therefore not considered groundwater dependent but rather surface water dependent. The wetlands are generally recharged during the wet season (winter) and sporadically during the rest of the year as a result of storm runoff and direct rainfall. The wetlands probably represent a source of recharge to the shallow groundwater system rather than the reverse.



LEGEND

Bassendean Sand

Guildford Formation (clayey sand to sandy clay)

27.0 m AHD Water level (16/5/2007)

Hole uncased

Hole cased, blank

Hole cased, slotted

Rockwater Pty Ltd

Figure 3: Hydrogeological Cross-section at the Nambeelup Brook South Tributary Wetlands (CCW 14472)

3. WATER USE IN OPERATIONS

3.1 POTABLE WATER

Potable water will be sourced from independent commercial suppliers. Potable water will be delivered to site in a water tanker and stored in a covered water tank. Water used for ablutions, irrigation and washdown will be sourced from the process supply.

3.2 SEWERAGE

A biocycle sewerage system will be used for the processing plant site and administration office ablutions. This will be sited, designed and operated in compliance with the health requirements of the Health Department of Western Australia and the local Shire. The system treats sewage effluent before discharging treated water to a contained area, which will be elevated to ensure a minimum two metre separation distance to the water table is maintained. The limited size of the package treatment plant means that effluent volumes are expected to be small with minimal risk of potential impact much beyond the contained area.

Discharge of treated water will be conducted in accordance with Water Quality Protection Note 22 (WQPN22) provided by DoW (DoW, 2009). According to Table 1 of WQPN22, the Risk Category based on soil type and location is Category A. This restricts the annual application loadings of inorganic nitrogen and reactive phosphorus to 140 kilograms of nitrogen per hectare per year and 10 kilograms of phosphorus per hectare per year. Higher loadings are permissible if the water is used to irrigate pasture for hay production.

3.3 WATER DISCHARGE

The average daily process water use will be approximately 53 Megalitres. Modelled pit dewatering rates ranged from 134 – 2,397 kilolitres (3% to 45% of the average daily needs). Therefore, under normal circumstances there will be a significant water deficit that requires to be made up from bore water supply. Water storage capacities are based on the need to maximising water retention for reuse and 1:100 year ARI storm event design requirements. As a result there will be no necessity for routine discharge of surplus water to the environment.

However, to cater for the possibility that heavy rainfall events coincide with extended plant downtime, resulting in the Process Water Dam freeboard capacity being exceeded, the Health, Safety, Environment and Community (HSEC) Advisor shall ensure that a discharge licence is obtained from Department of Environment and Conservation (DEC). All surface water runoff from the processing area will be directed to pass through either the Process Water Dam or stormwater settling ponds to allow sediment to settle out prior to discharge.

The Process Water Dam will be situated near the primary processing plant. Excess water will flow over a lined spillway on the Process Water Dam to nearby watercourses. If monitoring results indicate it is necessary, the Site Manager will ensure additional sediment sumps are installed between the Process Water Dam and the creek line to further decrease turbidity of discharge water.

3.4 PROCESS WATER AND WATER BALANCE

The water requirement for mining and processing is estimated at 2,210 kilolitres per hour. Of this volume, approximately 1,140 kilolitres per hour is recycled within the process and 1,070 kilolitres per hour is added via pit inflow water or bore water. The site Process Water Dam, located near the primary processing plant, will have capacity to store 74,000 kilolitres.

Approximately 52% of the water will be recycled. This is achieved by discharging thickened tailings at about 45% solids density. Recovering surplus water during backfilling of mined areas will also occur and supplement pit dewatering providing an additional 38% make up water. Additional process water sourced from the production bores will only be used after these water resources have been fully utilised.

A basic water balance has been developed for the operation and is summarised in Table 6, Table 7, Table 8 and Table 9 below. A schematic diagram is presented in Figure 4.

Table 6: Water Inputs to Mine Water Circuit

Source	ML/year	GL/yr (@90% availability)
Mine Pit Dewatering (potentially*).	811	0.7
Production Bore extraction (potentially*).	1,181	1.1
Rainfall within mine catchment.	20	<0.1
Total	**2,012**	**1.8**

*Note: * Prediction based on hydrogeological modelling*

Table 7: Water Recovery within Mine Water Circuit

Source	ML/year	GL/yr (@90% availability)
From backfilled tailings.	6,723	6.1
Process Plant Thickener.	9,262	8.3
Total	**15,985**	**14.4**

Table 8: Mine Water Use

Water Use	ML/year	GL/yr (@90% availability)
In Pit Screening Plant.	11,722	10.5
Wet Concentrating Plant.	6,057	5.4
Dust Suppression.	176	0.1
Total	**17,955**	**16.0**

Table 9: Site Annual Water Balance

Units	Site Water Requirement	New Input Water	Amount Recycled
Per annum	18 GL	2.0 GL	16 GL
% of all water	100%	11%	89%

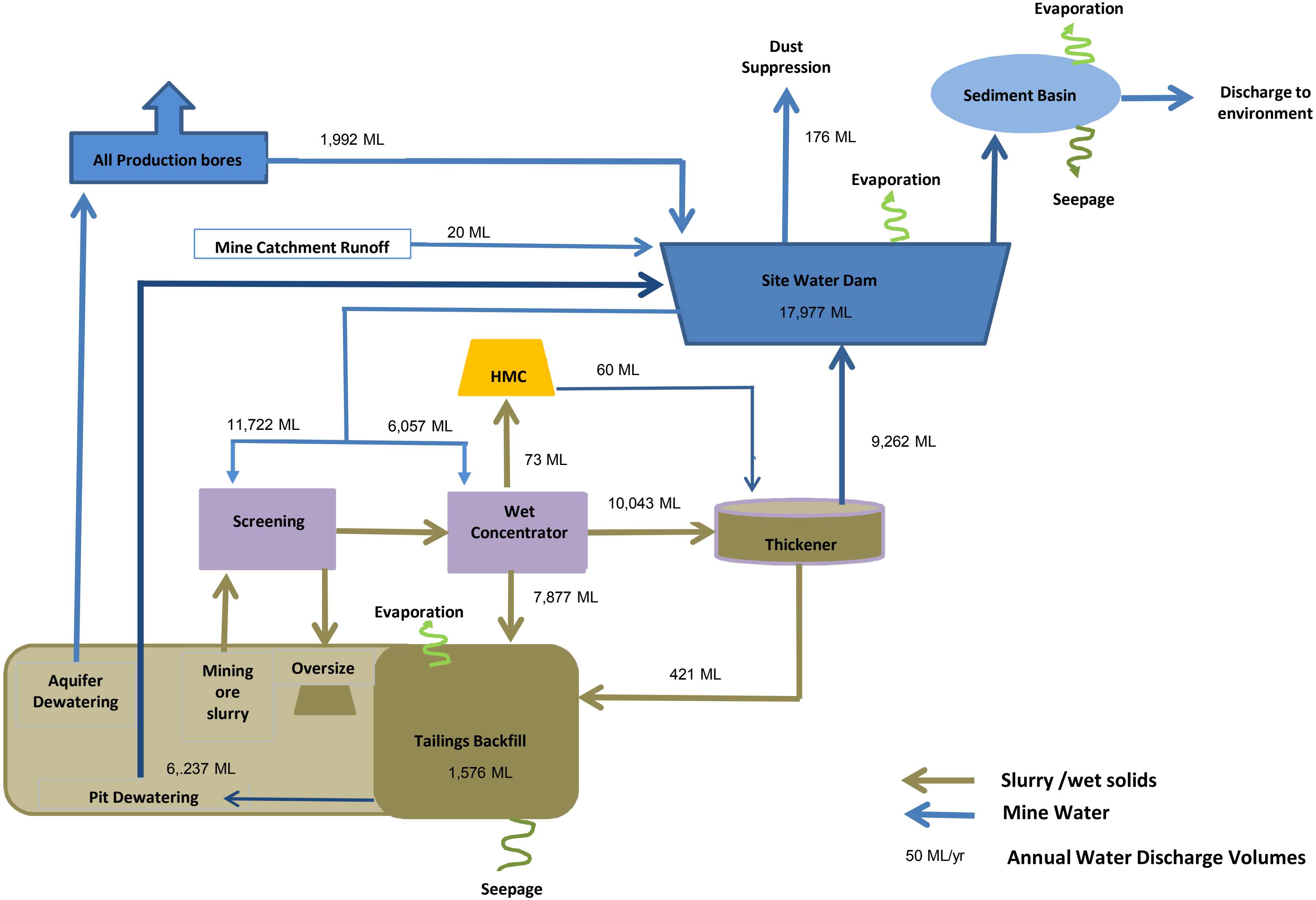


Figure 4: Schematic Water Budget

4. SURFACE WATER MANAGEMENT

4.1 POTENTIAL IMPACTS

The following issues could potentially arise from mining and processing operations in the absence of mitigation and management measures:

- Temporarily reducing surface water volume to watercourses by diverting runoff from operational areas for use in the process water circuit.
- Contaminating surface water by releasing contaminants associated with earthmoving, excavation and stockpiling. Potential contaminants include sediment and hydrocarbons from spills.
- Increase in acidity of surface waters through disturbance of acid sulfate soils.
- Contaminating surface water runoff from flow over stockpiles.
- Contaminating surface waters due to release of partially treated sewage effluent.
- Potential to spread Dieback disease through poorly planned surface water management.
- As a result of heavy rainfall events, there is the potential for increased turbidity off recently rehabilitated areas that are not yet fully stabilised.

4.2 MANAGEMENT MEASURES

Mining areas will have ring drains installed with a sump on the pad perimeter. Tails decant sumps will be installed in tailing areas within the mine void. Water from these sumps will be transferred to the process circuit.

The mine void will be bunded to prevent surface inflows from adjacent areas. V drains will be installed to divert surface flows around assets and operating areas. Surplus process water will pass through two settling ponds before discharge to the adjacent watercourse at the discharge point which will be rock armoured to prevent erosion.

The HSEC Advisor is responsible for ensuring the surface water quality monitoring program is undertaken as detailed in Appendix 1 and that water management infrastructure is monitored in accordance with Appendix 2 on a monthly basis and following significant rainfall events.

The Site Manager is responsible for ensuring diversion drains are constructed and maintained so that water re-enters natural drainage lines at a velocity and depth similar to the original channel to ensure minimum erosion potential. Surface water diversions shall also be designed such that runoff from Dieback infested areas does not enter Dieback free areas (see the Weed and Dieback Management Plan (MBS 2011) for further information).

Surface water runoff from infrastructure areas such as the primary processing plant and administration offices will be directed to settling ponds to allow sediment to drop out of suspension prior to discharge. The Site Manager is responsible for ensuring settling ponds are constructed to reduce turbidity to target trigger levels shown in Appendix 3 before release to the environment. The HSEC Advisor is responsible for ensuring monitoring of this water is undertaken.

Detailed designs of drainage diversions and water management infrastructure were referred to DoW before construction commenced. The Site Manager will ensure that if any significant changes to drainage diversions and water management infrastructure are planned then detailed designs will be referred to DoW prior to construction.

The process water pond will be managed to at all times have sufficient freeboard to contain the 1:100 year 72 hour storm.

Spills of hydrocarbons or other potential contaminants will be cleaned up immediately and reported to the supervisor and HSEC Advisor. The HSEC Advisor is responsible for ensuring any follow up actions or monitoring is undertaken.

If emergency discharges to surface water occur, they will be managed according to the emergency discharge procedure (Appendix 5).

During landform restoration, drainage will be re-established along original drainage lines as per the Rehabilitation Management Plan (RMP) (MBS 2012b). Contours of the restored landforms and drainage lines will be returned to as close as possible to pre-mining levels. The Site Manager will ensure restored landforms are treated as detailed in the RMP to minimise the risk of erosion.

5. CONSERVATION CATEGORY WETLANDS AND NATIVE VEGETATION

5.1 POTENTIAL IMPACTS

The following issues could potentially arise from mining operations in the absence of mitigation and management measures:

- Lowering of the water table in Conservation Category wetlands adjacent to the project area. Hydrological modelling of predicted drawdown has been completed (Rockwater 2007) which indicates there will be no impact on wetlands in the dry season but a minor impact is possible during winter and spring.
- Change to water quality in Conservation Category wetlands.
- Reduced health and condition of native vegetation.

5.2 MANAGEMENT MEASURES

5.2.1 Groundwater Monitoring

Groundwater levels and quality will be recorded at the monitoring bores located adjacent to the Conservation Category wetlands as shown on Figure 5 and detailed in Appendix 1. Figure 6 and Figure 7 provide a more detailed view of the monitoring bores in and around the two key wetland areas.

The presence or absence of standing surface water in the Conservation Category wetland adjacent to the project will be also be recorded monthly.

MZI commits to installation of three additional monitoring bores:

- One shallow wetland monitoring bore at wetland 14920, to be installed within the first 12 months of operations, or prior to mining operations being undertaken within 500 meters of the wetland (whichever comes first).
- One shallow wetland monitoring bore at wetland 14887, installed 12 months prior to mining lot 56, Elliott Road.
- One shallow wetland monitoring bore at a southern wetland (14635 or similar adjacent wetland), installed 12 months prior to mining south of Redheads Road. MZI will determine the exact location of the bore in liaison with landowners and the DoW.

The monitoring bore schedule will be reviewed and revised annually in consultation with the DoW and Office of the EPA to ensure that adequate monitoring bores are in place with regard to the mining schedule.

5.2.2 Wetland Vegetation Monitoring

MZI shall develop and implement a Wetland Vegetation Health Monitoring Programme which includes:

Pre-operational baseline survey and 6-monthly (spring and autumn) vegetation health assessments in Conservation Category Wetlands (UFI nos. 14472, 14473 and 14465) for the first 3 years of operations and ongoing annual assessment so long as MZI continue groundwater abstraction from the KLP2 and KLP3.

Pre-operational baseline survey and vegetation health assessments in Conservation Category Wetlands (UFI nos.) 7603, 7604, 7617 and 14920. Ongoing monitoring of vegetative health at these wetlands would only be triggered by an unacceptable decline in water levels at bores KWT3A, KS9, KS8 and KWT1A-1F to the north, or by an identified decline in health of wetland vegetation in wetlands 14472, 14473 and 14465. The baseline survey provides a pre-mining dataset for comparison with any future vegetation monitoring and trigger levels will be set following an assessment of baseline water and vegetation data, in line with accepted methods used for studies of GDE on the Swan Coastal Plain (e.g. Froend et al. 2004).

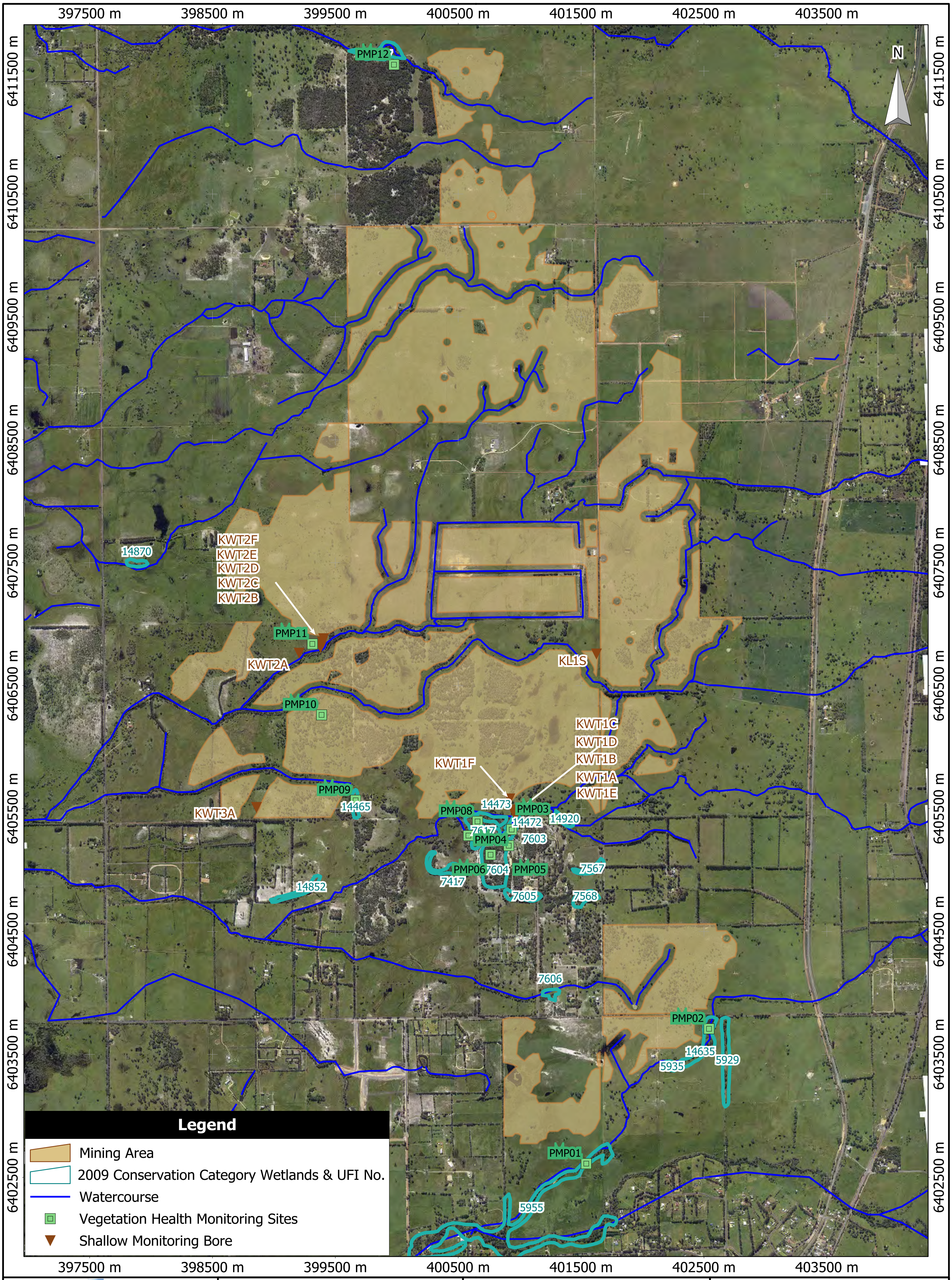
Baseline survey and 6-monthly (spring and autumn) vegetation health assessments in Conservation Category Wetland UFI 14887, with the baseline conducted 12 months prior to mining of lot 56, and monitoring continuing for one year post completion of mining this area.

Baseline survey and 6-monthly health assessments at two proposed sites in wetlands south of the southern mine area along Redhead Road. Although there is not planned to be any dewatering in this area, the baseline study should be conducted prior to commencement of mining so that these sites can provide reference data for trends in regional vegetation condition. Monitoring will continue for one year post completion of mining this area.

The locations shown on Figure 5 and detailed in Appendix 1 will be used to assess the vegetation and condition of vegetation, with these locations to be reviewed or altered if necessary in consultation with the DoW.

If monitoring shows a breach of trigger groundwater levels, water quality or a decline in vegetation health within a Conservation Category wetland, the HSEC Advisor is responsible for reporting this to the General Manager and Site Manager. The Site Manager will ensure an investigation into the cause is instigated. If deemed necessary by the General Manager, mining in the pit nearest the wetland will be suspended until the results of the investigation are known. If the investigation shows beyond all scientific doubt that the water level or quality changes can be attributed to mining activity, and that vegetation health may suffer should MZI continue to operate as per the current mining schedule, MZI shall investigate contingency measures to maintain water levels and vegetation health.

If necessary the impacted wetland can be recharged with mine dewatering discharge. MZI shall evaluate such opportunities in liaison with the DoW.



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Wetland Health Monitoring Locations

Figure 5

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Wetland Health Monitoring Locations
Northern Bore Cluster

Figure 6

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Wetland Health Monitoring Locations
(Southern Bore Cluster)

Figure 7

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6. GROUNDWATER MANAGEMENT

6.1 POTENTIAL IMPACTS

Potential exists for the following groundwater quality and quantity issues to occur:

- Lowering of localised groundwater levels as a result of dewatering and/or pumping from project water-supply bores in the Leederville aquifer. Hydrological modelling of predicted drawdown has been completed (Rockwater 2007) including calculation of cones of depression during mining and water level recovery post mining. The modelling indicates the impact will be minor and short term.
- Backfilling of completed pits with 45% slurry causing localised recharge of groundwater.
- Changes to groundwater quality due to hydrocarbon spills within active pits.
- Changes in groundwater quality due to altered levels and flows.
- Changes in groundwater quality due to disturbance of acid sulfate soils.
- Changes in groundwater quality following mining during the period of recovery of the water table.
- Changes in groundwater quality and quantity may impact other users in the area and lead to complaints.

6.2 MANAGEMENT MEASURES

Abstraction of groundwater will be kept to the minimum required for the project. The water table will not be lowered further than the bottom of the pit, corresponding to the base of the Bassendean Sands.

The HSEC Advisor will be responsible for ensuring the water monitoring program outlined in Section 8.2 is carried out. Where monitoring indicates a decrease in water quality or quantity, the HSEC Advisor is responsible for reporting this to the Site Manager.

To ensure complaints from other groundwater users in the area are dealt with in an effective and timely manner, a system for logging, actioning and following up on groundwater related complaints will be incorporated into the overall complaints management system for the project. The HSEC Advisor will be responsible for managing this system. The HSEC Advisor is responsible for reviewing, actioning and closing out complaints received.

Where it has been identified that the water quantity or quality of other groundwater users has been adversely affected by the mining operation such that it is no longer available in the same quantities or can no longer be used for its originally intended purpose, the General Manager will instigate measures to provide an alternative water source. This may include providing a supply of water from the process water bores or arranging for water to be provided to the user by tanker.

The General Manager will be responsible for ensuring that potential changes to localised groundwater levels are considered during mine scheduling, particularly when potential changes may occur during critical agricultural periods such as pasture or crop growth. Groundwater monitoring results from previous mining areas will be assessed to ascertain likely drawdown impacts in the Superficial aquifer and compared with the Rockwater (2007) hydrogeological model predictions. The General Manager will be responsible for:

- Discussing with potentially affected landowners their short term land management plans to determine whether cropping or pasture activities are planned to be undertaken adjacent to mining areas and if so for what duration.
- Determining whether a change to the mining or dewatering activities is required to be implemented to minimise potential impacts during the critical growth period.
- Determining whether compensatory actions are required to be implemented i.e. provision of alternate water supply if monitoring shows that impacts are being realised or maintenance or replacement of any adversely impacted groundwater bore.

7. HYDROCARBON MANAGEMENT

7.1 POTENTIAL IMPACTS

The use of hydrocarbons on site may lead to the following impacts:

- Contamination of surface waters due to hydrocarbon spills.
- Contamination of groundwater due to hydrocarbon spills.

7.2 MANAGEMENT MEASURES

It is the responsibility of all employees and contractors to ensure spills are contained and cleaned up immediately. All spills are to be reported via MZI's internal incident reporting system.

The Site Manager will ensure that the following management measures are established to reduce the risk of hydrocarbon spills to the environment:

- Hydrocarbon storage areas and workshops will be constructed near the primary processing plant in elevated locations.
- Hydrocarbon contaminated runoff will be treated prior to discharge. Washdown of equipment will result in the production of contaminated wastewater. Washdown will be done on hardstand areas, (either limestone roadbase or concrete) and directed to a triple interceptor or plate separator.

The Site Manager will ensure the following management measures are implemented:

- A register of all hazardous materials on site is developed and maintained. This will document the hazardous material name, location, approximate volume, storage method and where applicable, disposal method for the substance and containers.
- The storage of hydrocarbons will be designed to comply with AS 1940:2004. Generally this will mean they are to be stored in either self bunded (double lined) bulk tanks or in bunded compounds.
- Hydrocarbon wastes generated by the operation will be transported off-site to licensed waste disposal facilities.
- Hazardous materials will be brought to the site in bulk packaging wherever possible. This practice will minimise the number of containers and reduce the risk of spillage.
- Major mechanical servicing and overhauling of mining equipment will be done off-site. Routine equipment and vehicle servicing activities including washdown will be conducted on impermeable surfaces.

The Site Manager will ensure the following management measures are implemented:

- Within the mine pit, where the pit floor will be within the minimum two metre groundwater separation zone recommended by the DoW (DoW, 2009), the screening plant and all transfer pumps will be electrically powered where possible. Where this is not possible, all pumps and generators will be placed within impermeable bunds.
- There will be no storage of hydrocarbons on the floor of the mine pit. Hydrocarbons within the mine pit will be limited to that contained in mobile equipment.
- Portable pumps or generators used to power water recovery pumps will be located above the pit, on natural ground level where possible and placed within impermeable bunds.
- Spill kits will be placed in strategic locations within operational areas and on board service vehicles. All staff will be trained in the use of these kits.

8. MONITORING

8.1 RAINFALL

Rainfall is measured automatically by the site weather station. The information is automatically downloaded onto computer and stored as an electronic file. The HSEC Advisor is responsible for ensuring the weather station is operational and for filing electronic and hardcopy data. The Environmental Officer is responsible for reviewing weather station data.

8.2 WATER MONITORING

8.2.1 Surface Water

To ensure that negative impacts to surface water quality are prevented or minimised, and background water quality is understood, a surface and discharge water monitoring program will be implemented and will be updated as necessary.

Indicative surface water quality monitoring sites are shown on Figure 8 and detailed in Appendix 1. Appendix 2 provides an inspection checklist for monitoring of site water management infrastructure.

Two levels of surface quality water monitoring will occur:

- Regular laboratory analysis monitoring.
- Opportunistic monitoring.

8.2.1.1 Regular Laboratory Analysis Monitoring

The HSEC Advisor will collect samples monthly, when streams are flowing, for laboratory analysis to allow a more complete understanding of water quality. This in turn will allow refinement of management strategies and trigger levels over time.

Monitoring will be undertaken for all surface water sites (indicative sites are listed in the schedule in Appendix 1).

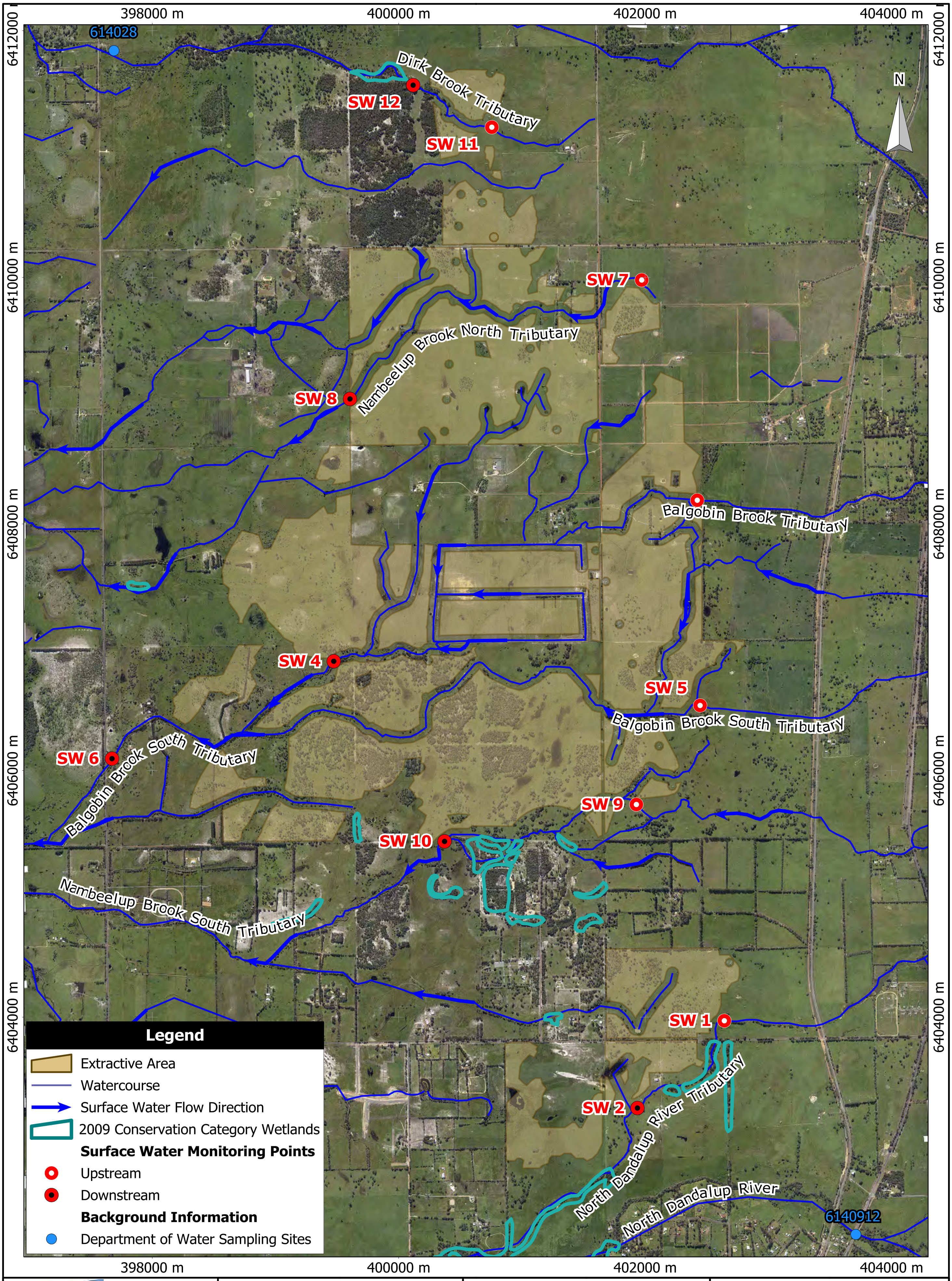
The HSEC Advisor shall undertake monthly monitoring of the volume of water extracted from pit sumps. Water recovered from pit sumps shall report to the process water ponds. The HSEC advisor shall monitor the water quality in the process water dam as specified in Appendix 1.

8.2.1.2 Opportunistic Monitoring

To provide a greater understanding of water quality on site it is necessary to collect samples from areas with flows which are too irregular to be effectively monitored on a regular basis.

Water samples will be collected opportunistically by the HSEC Advisor from areas with irregular flows such as overflow from the Process Water Dam. This will include turbidity measurements. Opportunistic sampling will be undertaken to provide information on quality response to a range of hydrologic events.

Opportunistic samples may also be collected in response to *in situ* monitoring indicating trigger levels are being exceeded.



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Surface Water Monitoring Locations

Figure 8

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8.2.2 Groundwater

Groundwater monitoring will be undertaken by the HSEC Advisor in accordance with the site's groundwater monitoring procedure. Groundwater monitoring bores have been installed to evaluate changing groundwater levels and allow early detection of any change in water quality as a result of mining-related activities (Table 4).

Groundwater monitoring site locations are detailed in the Groundwater Monitoring Procedure. Water samples shall be collected from these locations at the frequency identified in the Groundwater Monitoring Schedule of the Groundwater Monitoring Procedure and analysed for the parameters listed in the Water Analysis Schedule of the Groundwater Monitoring Procedure.

These schedules provide generally for monthly monitoring of static water levels and quarterly collection of water samples from selected bores for laboratory quality analysis. Samples for laboratory quality analysis will also be collected monthly for a period of six months prior to planned mining in that area adjacent to respective groundwater monitoring bores.

Indicative groundwater monitoring locations are shown on Figure 9 and detailed in Appendix 1. The proposed purpose for the monitoring bore dictates the monitoring frequency and type of analysis to be done. These can be summarised as follows:

1. Impact of groundwater abstraction from the two established production bores on the local Leederville Aquifer – Bores KL2P, KL3P, KL3, KL4, KL7, KL8, KL1 Obs, KL2 Obs and KL3 Obs. Several of these bores are positioned between the projects production bores and neighbouring privately owned bores operating in the same aquifer.
2. Possible impact of groundwater abstraction at the two established production bores on the local Superficial Aquifer - KWT2A, KWT3A, and KL1S. These bores are in close proximity to the production bores. The key purpose is to monitor any water table response.
3. The four existing DoW bores in the area will continue to function as monitoring sites. These are labelled T610(3089), T670(3098), T570(3105) and T620(3111) on Figure 9.
4. Twenty two additional shallow monitoring bores have been installed in the superficial aquifer near to the mining area boundary – Bores KS1 to KS22 as shown in Figure 9. The locations of these bores are based on the location of other bores used by adjacent landowners. The bores will be monitored prior to commencing any mine dewatering.. The primary purpose is to monitor any water table response.
5. Two suites of five and six shallow monitoring bores have been installed at two sites adjacent to areas identified as wetlands. They are numbered KWT1A–1F and KWT2B–2F. Due to changes to the planned mine schedule, mining adjacent to the wetland monitored by the latter set of bores is no longer planned and these bores will now be used to monitor the impact of groundwater extraction in close proximity to site production bore. Locations are shown in Figure 9. The suites comprise three or four "shallow" bores between two and four meters in depth, and one "deep" bore six meters in depth. The primary purpose is to monitor any water table response.

6. Groundwater bores on neighbouring properties may be monitored for water level and quality subject to agreement being reached with individual landowners. The locations of such bores will be added to the monitoring schedule contained in Appendix 1 after agreements are reached.

Additional bores may be constructed once operations have commenced based on observed impacts during initial dewatering activities. MZI have also committed to installation of three additional monitoring bores at wetlands. The final monitoring network design will be based on field measurement rather than conceptual models.

Samples collected under Schedule B (Appendix 1) will be sent to a NATA accredited laboratory for analysis. Analysis results will be entered into the MZI Water Monitoring Database and the hard copy laboratory results filed in the Water Monitoring File by the HSEC Advisor.

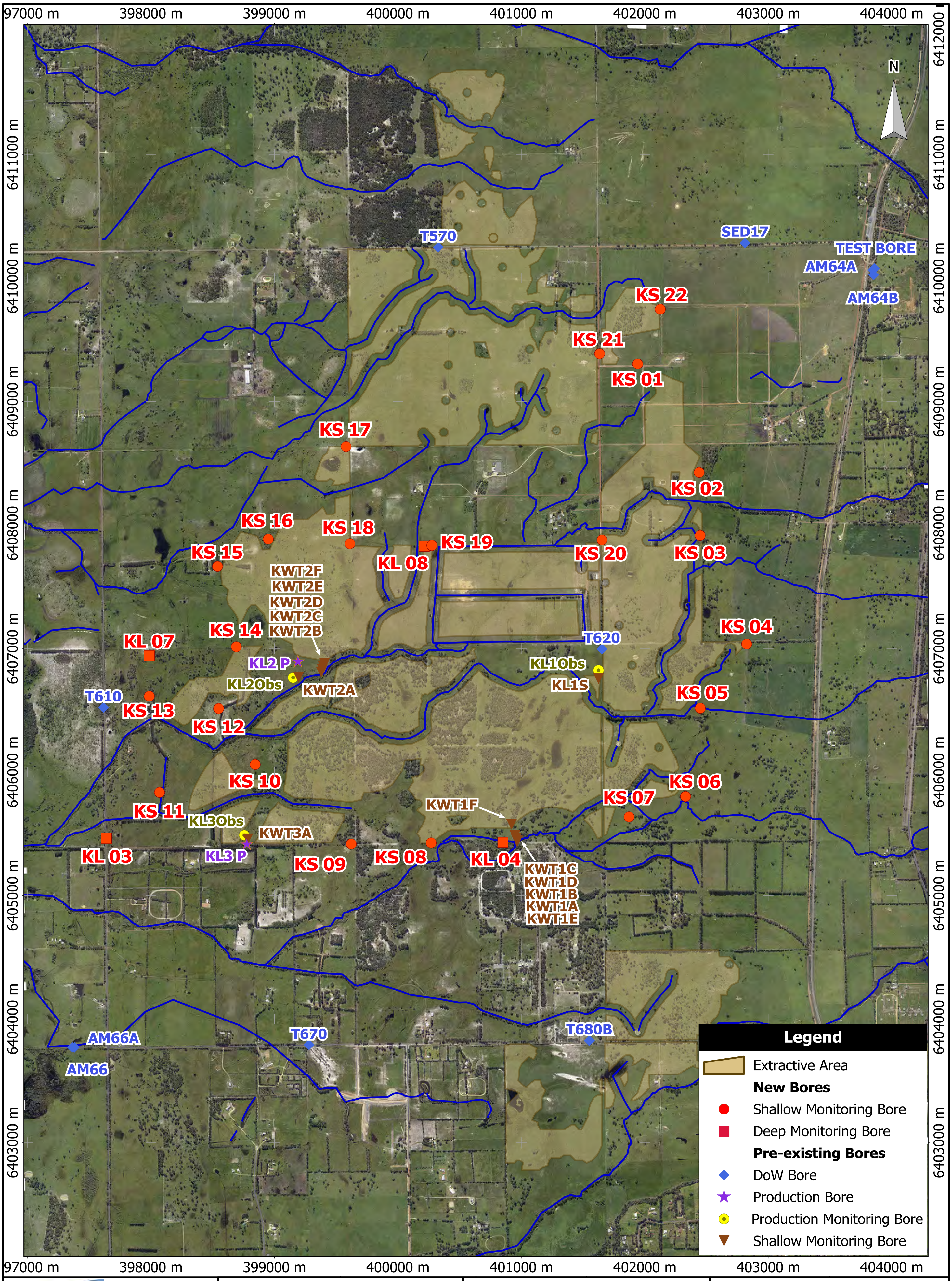
Monitoring of the groundwater quality will continue until such time that groundwater levels have recovered to within five percent of pre-mining levels following cessation of operations.

8.3 VEGETATION MONITORING

In addition to the Wetland Vegetation Health Monitoring Programme, Photographic monitoring points will be established at the two remnant vegetation areas within the project area. These are shown on Figure 5 as PMP10 and PMP11 and detailed in Appendix 1. These sites are subject to change.

On a six monthly basis (September and March), the HSEC Advisor will take photographs at each of these photographic monitoring points such that vegetation change can be assessed as per the Photographic Monitoring Programme. The health of the vegetation within a 20 metre by 20 metre quadrat, centred on the monitoring point, will also be assessed according to the form provided in Appendix 4.

Monitoring shall be carried out while those pits within one kilometres of the photographic monitoring point are active. Monitoring shall begin at the scheduled monitoring period prior to mining and until groundwater levels in the area return to pre-mining levels.



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Groundwater Monitoring Locations

Figure 9

8.4 TRIGGER LEVELS

Trigger Levels for each of the analysed water quality parameters are specified in Appendix 3. In most cases, trigger values are based on:

- Differences between upstream and downstream surface water nutrient concentrations exceeding 10% (if the measured concentration is more than twenty times the reporting limit for the method).
- Surface water physio-chemical water quality parameters outside the range of the mean value plus or minus three standard deviations based on historical data.
- Differences between downstream groundwater nutrient concentrations for the current and previous samplings exceeding 10% (if the measured concentration is more than twenty times the reporting limit for the method).
- Groundwater physio-chemical water quality parameters outside the range of the mean value plus or minus three standard deviations based on historical data.

Contaminant Levels are specified for four different categories: DoW's Lake Thompson Monitoring Bores, drinking water, lowland stream freshwater and stock water for cattle. Limits for the protection of 95% of species are used as the Keysbrook site is classified as moderately to slightly disturbed using the ANZECC (2000) criteria.

Specific physico-chemical water quality trigger values will be established for each bore once sufficient monitoring data is available to determine statistically valid levels. The methodology is as per ANZECC (2000) (Appendix 3). Trigger values shall be reviewed and amended to reflect site data after 12 months of monitoring. An Excel based model has been established to automatically do these statistical calculations after each sampling run. The actual trigger value will change with every additional data point and revised trigger values will be submitted to the DoW and the OEPA for approval.

The exceedance of a Trigger Level for a specific parameter within the respective water quality category will activate an investigation into the use of that particular water type and the possible source of the elevated level.

Trigger Drawdown Values have been specified for groundwater levels in superficial aquifer and Leederville aquifer monitoring bores. These values have been determined by assessing modelled predictions of drawdown, the intent being that should water levels not react as per model assumptions, MZI shall investigate and respond to mitigate the potential for impacts to vegetation and other groundwater users in the region. Triggers, defined as AHD levels for each trigger bore, have been set using collected site summer water level data (the minimum annual levels) less a nominated and agreed drawdown value. Table 10 summarises the current Trigger Drawdown Values which when exceeded will prompt an investigation into the significance of the drawdown.

Table 10: Groundwater Trigger Drawdown Values

Bore ID	Bore Type	Coordinates (MGA)		Collar RL	Top of Casing	Trigger Drawdown (from min water level)	Trigger Water Level	
		m Easting	m Northings	(m AHD)	m agl	m	m AHD	m btoc
DEEP MONITORING BORES (LEEDERVILE AQUIFER)								
KL1 Obs	Monitoring, Leederville	401,625	6,406,792	34.00	0.57	3.0	26.80	7.20
KL2 Obs	Monitoring, Leederville	399,186	6,406,766	27.64	0.44	10.0	15.77	11.87
KL3 Obs	Monitoring, Leederville	398,778	6,405,465	26.10	0.63	15.0	10.11	15.99
KL 3	Monitoring, Leederville	397,639	6,405,465	21.95	0.40	3.0	17.16	4.79
KL 4	Monitoring, Leederville	400,850	6,405,429	31.75	0.42	3.0	23.41	8.34
KL 7	Monitoring, Leederville	397,986	6,406,940	24.15	0.40	3.0	18.37	5.78
KL 8	Monitoring, Leederville	400,213	6,407,829	31.74	0.40	3.0	26.12	5.62
SHALLOW MONITORING BORES (SUPERFICIAL AQUIFER)								
KL1S	Shallow Monitoring	401,628	6,406,792	33.86	0.43	0.8	31.43	2.43
KWT1A	Monitoring, Superficial	400,968	6,405,442	32.22	0.44	0.3	NA[1]	
KWT1B	Monitoring, Superficial	400,956	6,405,464	32.41	0.36	0.3	NA[2]	
KWT1C	Monitoring, Superficial	400,948	6,405,487	32.57	0.39	0.3	NA[1]	
KWT1D	Monitoring, Superficial	400,948	6,405,488	32.70	0.59	0.3	29.60	3.10
KWT1E	Monitoring, Superficial	400,965	6,405,441	32.37	0.58	0.3	29.93	2.44
KWT1F	Monitoring, Superficial	400,920	6,405,579	32.25	0.47	0.3	29.39	2.86
KWT2B	Monitoring, Superficial	399,380	6,406,810	28.16	0.64	0.8	NA[2]	
KWT2C	Monitoring, Superficial	399,387	6,406,832	28.43	0.72	0.8	25.48	2.95
KWT2D	Monitoring, Superficial	399,395	6,406,854	28.40	0.65	0.8	25.47	2.93
KWT2E	Monitoring, Superficial	399,395	6,406,856	28.28	0.49	0.8	25.86	2.42
KWT2F	Monitoring, Superficial	399,404	6,406,883	28.72	0.59	0.8	NA[1]	
KS 1	Monitoring, Superficial	401,942	6,409,304	37.79	0.40	0.8	NA[2]	
KS 2	Monitoring, Superficial	402,440	6,408,426	38.90	0.40	0.8	NA[2]	
KS 3	Monitoring, Superficial	402,448	6,407,915	38.19	0.40	0.8	35.54	2.65
KS 4	Monitoring, Superficial	402,825	6,407,036	39.51	0.45	0.8	NA[1]	
KS 5	Monitoring, Superficial	402,449	6,406,517	37.08	0.45	0.8	NA[1]	
KS 6	Monitoring, Superficial	402,330	6,405,802	36.79	0.40	0.8	33.63	3.16
KS 7	Monitoring, Superficial	401,872	6,405,637	35.26	0.40	0.8	NA[2]	
KS 8	Monitoring, Superficial	400,269	6,405,426	29.91	0.40	0.8	27.53	2.38
KS 9	Monitoring, Superficial	399,622	6,405,417	28.21	0.40	0.8	25.26	2.95
KS 10	Monitoring, Superficial	398,844	6,406,061	25.95	0.40	0.8	23.27	2.68
KS 11	Monitoring, Superficial	398,069	6,405,835	23.50	0.42	0.8	21.00	2.50
KS 12	Monitoring, Superficial	398,548	6,406,514	27.52	0.40	0.8	23.40	4.12
KS 13	Monitoring, Superficial	397,986	6,406,614	23.80	0.40	0.8	21.17	2.63
KS 14	Monitoring, Superficial	398,691	6,407,014	26.06	0.30	0.8	23.58	2.48
KS 15	Monitoring, Superficial	398,539	6,407,665	26.35	0.46	0.8	23.50	2.85

Bore ID	Bore Type	Coordinates (MGA)		Collar RL	Top of Casing	Trigger Drawdown (from min water level)	Trigger Water Level	
		m Easting	m Northings	(m AHD)	m agl	m	m AHD	m btoc
KS 16	Monitoring, Superficial	398,950	6,407,886	28.01	0.37	0.8	25.47	2.54
KS 17	Monitoring, Superficial	399,580	6,408,635	31.25	0.40	0.8	28.57	2.68
KS 18	Monitoring, Superficial	399,611	6,407,849	30.69	0.40	0.8	28.13	2.56
KS 19	Monitoring, Superficial	400,275	6,407,835	31.77	0.40	0.8	29.16	2.61
KS 20	Monitoring, Superficial	401,653	6,407,879	34.78	0.40	0.8	32.02	2.76
KS 21	Monitoring, Superficial	401,634	6,409,387	37.74	0.40	0.8	33.68	4.06
KS 22	Monitoring, Superficial	402,125	6,409,747	37.79	0.40	0.8	NA[2]	
KWT 2A	Monitoring, Superficial	399,195	6,406,770	27.54	0.40	1.2	NA[2]	
KWT 3A	Monitoring, Superficial	398,784	6,405,459	25.79	0.40	1.2	23.04	2.75

1 Water level previously below base of bore
2 Appropriate trigger level below base of bore

8.5 MANAGEMENT RESPONSE TO TRIGGER LEVEL EXCEEDANCES

Exceedance of pre-determined water quality Trigger Levels serves only as an indicator of changes in water quality. An appropriate management response is to review the water quality data and identify potential causes for the change, which may include natural variation, sampling and laboratory errors, chemical spills or mining activities. The objective of the management response is to ensure that contaminant levels are not exceeded and water quality parameters return to levels below Trigger Levels (or if scientifically justified the Trigger Levels are reviewed in consultation with DoW).

A typical sequence of management responses to exceedance of a Trigger Level is outlined below:

- Review recent sampling data to determine whether the exceedance is a random event or continuation of a trend (at least three consecutive anomalous readings).
- Review water quality data to determine if the exceedance is localised or widespread.
- Submit additional sample(s) to the laboratory to confirm the original results.
- Review recent mining activities and incidents to determine whether or not the exceedance is linked to mining operations.
- Evaluate the significance of the exceedance. This may require independent assessment of the data by a water quality specialist or hydrogeologist in the case of water levels.
- Undertake additional water and soil sampling to identify the source and extent of contamination.
- Provide reports of significant exceedances and subsequent investigations to appropriate stakeholders (Section 11).

- Plan and implement appropriate remediation or prevention strategies and improvements to ongoing water management measures.
- Continue monitoring to confirm the effectiveness of implemented remediation or prevention strategies and improvements.

Continued exceedance after implementation of appropriate remediation strategy will trigger site inspection/investigation by relevant Government Department to determine follow-up action to be taken by Mine.

9. RESPONSIBILITIES

9.1 GENERAL MANAGER

The General Manager is responsible for:

- Determine if mining needs to be modified to avoid impacts to Conservation Category Wetlands.
- Instigate measures to provide an alternative water source where it has been identified that the water quality or quantity of other groundwater users has been adversely affected by the mining operation.

9.2 MINING MANAGER

The Mining Manager is responsible for ensuring:

- Ensure that groundwater abstraction, mine dewatering and process water use volumes are routinely collected such that an annual site water balance can be prepared.
- Settling ponds are constructed to reduce turbidity to target trigger levels before release of water to the environment.
- Diversion drains are constructed prior to mining commencing in an area so that water re-enters natural drainage lines at a velocity and depth similar to the original channel to ensure minimum erosion potential.
- Appropriate engineering designs for all drainage diversions and water management infrastructure are prepared ahead of construction. Once constructed water management infrastructure comply with approved design drawings.
- Surface water diversions are designed such that runoff from Dieback infested areas does not enter Dieback free areas.
- Cause(s) of trigger level exceedance are investigated.
- Within the mine pit, where the pit floor will be within the minimum two metre groundwater separation zone, the screening plant and all transfer pumps are electrically powered.
- There is no storage of hydrocarbons on the floor of the mine pit.
- Self bunded portable pumps or generators used to power water recovery pumps are located above the pit, on natural ground level where possible.
- Ensure drainage paths are restored to pre-mining conditions and landform restoration is undertaken in accordance with the RMP.
- Hydrocarbon storage areas and workshops are constructed near the primary processing plant in elevated locations.
- Hydrocarbon contaminated runoff is treated prior to discharge.
- Washdown is undertaken on hardstand areas, (either limestone roadbase or concrete) and directed to a triple interceptor or plate separator.

- A register of all hazardous materials on site is developed and maintained. This will document the hazardous material name, location, approximate volume, storage method and where applicable, disposal method for the substance and containers.
- Hydrocarbon storage areas are designed to comply with AS 1940:2004. Generally this will mean they are to be stored in either self bunded (double lined) bulk tanks or in bunded compounds.
- Hydrocarbon wastes generated by the operation are transported off-site to licensed waste disposal facilities.
- Hazardous materials are brought to the site in bulk packaging wherever possible. This practice will minimise the number of containers and reduce the risk of spillage.
- Major mechanical servicing and overhauling of mining equipment is done off-site.
- Routine equipment and vehicle servicing activities including washdown are conducted on impermeable surfaces.
- Reviewing Annual Environmental Reports prior to submission.
- Preparation and submission of annual borefield/aquifer review as per DoW Licence conditions.
- Ensure that waste water treatment plant monitoring data is routinely submitted to the Health Department of Western Australia as per operating licence conditions.

9.3 HSEC ADVISOR

The HSEC Advisor is responsible for:

- In the event that the freeboard capacity of the Process Water Dam is likely to be exceeded, a discharge licence is obtained from DEC.
- In the case of unforeseen spillage from the Process Water Dam (extreme climatic conditions), initiate water quality monitoring at point of discharge and downstream creek sampling point. Notify DEC and DoW within 24 hours.
- Undertaking water and vegetation monitoring, collecting samples and sending samples for laboratory analysis.
- Establishing Photographic Monitoring Points.
- Ensure follow up actions and monitoring is undertaken after contaminant spills as required.
- Where monitoring results show trigger levels are exceeded, reporting this to the Site Manager.
- Ensuring the weather station is operational.
- Reviewing weather station data.
- Filing laboratory water analysis results.
- Reviewing laboratory results of water analysis.
- Reviewing, actioning and closing out complaints received.
- Preparing quarterly internal reports.
- Preparing the Annual Environmental Report.

10. RECORD KEEPING

Records relevant to this WMP are listed in Table 11.

Table 11: Water Management Records to be Kept at Keysbrook

Record	Responsibility
NATA Laboratory groundwater bore sample analysis.	HSEC Advisor
NATA Laboratory surface water sample analysis.	HSEC Advisor
Production bore flow meter readings.	HSEC Advisor
MZI Groundwater Bore Monitoring Record Sheets.	HSEC Advisor
MZI Surface Water Monitoring Record Sheets.	HSEC Advisor
WWTP water quality results	HSEC Advisor
Rainfall records.	HSEC Advisor
Annual Environmental Reports.	Site Manager
Aquifer Review Reports.	Site Manager
Accident/Incident reports and investigation reports.	Site Manager
Exceedance of Trigger Levels and Corrective Actions.	Site Manager
MZI Site Water Management Inspection Checklist.	HSEC Advisor
Quarterly internal reporting for Management.	HSEC Advisor

11. REVIEW AND REPORTING

The HSEC Advisor is responsible for ensuring that all monitoring results are reviewed within one week of receipt from the laboratory to ensure regulatory conditions or internal trigger values are not exceeded. Where exceedances are detected, the HSEC Advisor will inform the Site Manager who will then ensure an investigation report is prepared to determine the cause and actions implemented if remedial action is necessary. This will follow the procedure outlined in Section 8.5.

An annual review of the WMP will be conducted. The review will:

- Examine all monitoring results and determine if amendments to the location, frequency and parameters are required.
- Identify priority stormwater management issues.
- Propose improvements to address priority issues identified.
- Define an implementation schedule for the identified improvements.

MZI will ensure the following internal and external environmental reports are prepared and distributed to the appropriate parties:

- An internal quarterly monitoring report will be prepared by the HSEC Advisor and submitted to the Site Manager. The report will summarise environmental management, monitoring activities and interpretation of the quarter's monitoring results. The report will contain information on the current environmental performance of the site and status of compliance with approval conditions.
- An Annual Environmental Report (AER) detailing environmental management and monitoring activities will be prepared by the HSEC Advisor and reviewed by the Site Manager for distribution to DoW, OEPA, the Shire of Serpentine-Jarrahdale, Shire of Murray and DEC.

The following monitoring results will be reported in the AER:

- All groundwater monitoring bore and surface water quality results.
- All groundwater monitoring bore standing water levels.
- Production bore abstraction volumes.
- Records (dates) of surplus water discharge, if this occurs.
- Result of wetland standing water level monitoring.
- Results of vegetation monitoring.

Results will be reported graphically where possible, and a standard graph format presented each year to allow for ease of comparison.

- An annual monitoring summary detailing all water abstraction, diversion and use will be prepared by the HSEC Advisor and reviewed by the Site Manager for distribution to DoW.
- Monthly waste water treatment works effluent quality data to be submitted quarterly to the Health Department of Western Australia. Summary of data to be included in AER.

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APPENDICES

APPENDIX 1:
SITE WATER MONITORING SCHEDULE

Site Water Monitoring Schedule				
	Weekly	**Monthly**	**Quarterly**	**Annually**
Operational Production Bores (KL2P & KL3P)				
Volumes		X		
Water Quality		Schedule A	Schedule B	
In-pit Sumps and Process Water Dam				
Volumes		X		
Water Quality		Schedule D	Schedule B Schedule C	
Production Monitoring Bores (KL2Obs & KL3Obs)				
Water Level	X (First 3 months)	X		
Water Quality		Schedule A		
Shallow Monitoring Bores (KS 1, 2, 3, 17, 21, 22)				
Water Level		X		
Water Quality		Schedule A		
Shallow Monitoring Bores (KS 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20)				
Water Level		X		
Water Quality		Schedule A	Schedule B Schedule C	
Wetland Monitoring Bores (KWT)				
Water Level	X (First 3 months)	X		
Water Quality		Schedule A	Schedule B	
Deep Monitoring Bores (KL)				
Water Level		X		
Water Quality		Schedule A	Schedule B	
DoW Monitoring Bores (T610, 670, 570, 620)				
Water Level			DoW Monthly SWL Data Review	
Water Quality				Schedule B
Surface Drainage Lines (SW 3, 4, 5, 6, 9 & 10)				
Water Quality		Schedule D & E During flow periods	Schedule B	

Vegetation health monitoring	
Wetland/GDE PMP1 – 09 & PMP12	Vegetation health monitoring programme in accordance with the Water Management Plan.
Remnant Vegetation Photographic Monitoring	Photographic Monitoring using Appendix 4.

Schedule A	**Schedule B**	**Schedule C**	**Schedule D**	**Schedule E**
Groundwater			**Surface Water**	
Field Based	**Laboratory Based**	**Laboratory Based**	**Field Based**	**Laboratory Based**
Standing Water Level pH Electrical Conductivity Total Dissolved Solids Temperature	pH Electrical Conductivity TDS Total Acidity Total Alkalinity Iron (Total and soluble) Manganese Major Ions (K, Ca, Na, Mg, HCO_3, Cl & SO_4) Aluminium Hardness ($CaCO_3$ equivalent)	Total Nitrogen, Nitrate Soluble Reactive Phosphate Total Phosphorus	pH Electrical Conductivity Total Dissolved Solids Temperature Turbidity	pH Electrical Conductivity Total Acidity Total Alkalinity TSS TDS Turbidity Total Phosphorus Nitrate Total Nitrogen

APPENDIX 2: SITE WATER MANAGEMENT INSPECTION CHECKLIST

SITE WATER MANAGEMENT INSPECTION CHECKLIST

Name (Print): ________________________

Date: ________________________

Inspection Areas	Description	Status Satisfactory (✓) or Action Required
Workshop / Admin		
Washdown bay	Freeboard in sump and wedge pit.	
	Oil water separator functioning; no hydrocarbons in third chamber.	
Drainage sumps	Inflow clear.	
Process Plant		
Drainage sumps	Inflow clear.	
	Return pumps (if fitted) tested.	
HMC stockpile pad	Drainage lines to containment sumps clear.	
Water Dam		
Eastern bund wall	Dam wall intact. Discharge drainage lines clear.	
Haul Roads		
Roadside drains	Drainage lines clear.	
Sediment sumps	Inflow clear.	
	Outflow spillway intact.	
Mining Area		
Drainage	Installed and free of blockages. No erosion to sides of drains.	
Sumps	Installed and operating effectively.	
Rehabilitation/Backfilled Areas		
General	No evidence of erosion.	

APPENDIX 3:
TRIGGER LEVELS AND CONTAMINANT LIMITS

Trigger Levels for Water Quality Monitoring at Keysbrook

Parameter	Trigger Level	Contaminant Limits				
		DoW Lake Thompson Monitoring Bores	Drinking Water Trigger Values	SW Australia Lowland Freshwater Ecosystems[1]	Stock Trigger Values	Potential Acid Sulfate Soils[2]
pH	Mean value plus (or minus) three standard deviations based on historical data.	7.3	6.5 - 8.5	6.5 - 8.0	6.5 - 8.5	
Electrical Conductivity			-	-	-	
Total Dissolved Solids		1,400	(500) mg/L		4,000 (cattle)	
Turbidity				15[1] NTU		
Total Acidity						18 mol H^+/Tonne (0.03%) See ASSMP Section 6.5
Total Alkalinity						To be determined.
Total Actual Acidity (TAA)						>60 mg/L (as $CaCO_3$) pH reducing trend >10 %
Iron (soluble)		28	(0.3) mg/L	-	none	
Manganese			0.5 mg/L	1.9 mg/L	none	
Chloride			(250) mg/L	-		
Sulfate			500 mg/L	-	1,000 mg/L	
Aluminum			0.2 mg/L	0.5 mg/L	5	
Hardness (CaCO3 equivalent)		280	(200) mg/L	-	none	
Nitrate	10% difference (if greater than 20 times the laboratory reporting limit).		50 mg/L	150 µg N L-1	400 mg/L	
Soluble reactive phosphate				65 µg P L-1		
Total nitrogen						
Total phosphorus						

1. Midrange of ANZECC 2000 default trigger value range of 10-20 NTU for Upland and Lowland rivers (Table 3.3.7).
2. Acid Sulfate Soil Management Plan.
() aesthetic trigger value.

Trigger Drawdown Values for Vegetation Health and Conservation Category Wetlands

Parameter	Trigger Drawdown Values
SWL at Conservation Category Wetland	0.3 metres or more lower than pre-mining annual average water level.
Vegetation Health	1 tree or shrub death. 10% decline in cover of herbaceous species.

Trigger Drawdown Values for Groundwater Levels *

Parameter	Trigger Drawdown Values
GWL in regional Leederville aquifer monitoring bores	>3 metres – increased observations. >5 metres - investigate cause. >7 metres – activate remediation measures.
GWL in Leederville aquifer monitoring bores alongside production bores	>6 metres – increased observations. >8 metres - investigate cause. >10 metres – activate remediation measures.
GWL in regional Superficial aquifer monitoring bores	>0.8 metres – increased observations. >1.2 metres - investigate cause.
GWL in Superficial aquifer monitoring bores alongside production bores	>1.2 metres – increased observations. >1.5 metres - investigate cause.

APPENDIX 4:
VEGETATION HEALTH ASSESSMENT FORM

VEGETATION HEALTH ASSESSMENT

Name (Print): ____________________

Date: ____________________

Photographic Monitoring Point (PMP): ____________________

Photographs Taken: ____________________

Parameter	Description	Result
% Herbaceous Cover	What percentage of the ground is covered by native grasses and herbs	
% Weed Species	What percentage of the ground is covered by weed species	
Recent Plant Deaths	Are there any dead plants within the quadrat? If so, how many?	
Plant Stress	Are there any dead branches or areas evident on trees or shrubs? If so, how many plants are effected?	
Insects	Is there evidence of insect pests on the leaves of trees and shrubs? If so is this Minor, Moderate or Severe?	

APPENDIX 5:
EMERGENCY DISCHARGE PROCEDURE

Keysbrook Mineral Sand Operation Emergency Discharge Procedure

1. Purpose

The purpose of this procedure is to define the actions required when emergency discharge of water to environmental surface water occurs at the Keysbrook Mineral Sand Operations.

2. Objectives

To minimise adverse environmental effects of discharges
To ensure correct reporting of discharges
To ensure adequate monitoring of discharges and response.

3. Responsibilities

Health Safety and Environment Manager
The Health, Safety and Environment Manager is responsible for ensuring the requirements of this procedure are met.

4. Definition

An emergency discharge is defined as any discharge to surface water that is not a licensed discharge under the site Environmental Licence or Works Approval.

Emergency discharge may be undertaken during inundation rainfall events for the purposes of asset protection and maintaining a safe work environment. Discharge may be by way of direct overflow of containment facilities or by facilitated pumping.

The licenced discharge of excess water from the process pond via the licensed discharge point and of treated sewage effluent to the designated effluent discharge area are not considered emergency discharges providing quality and quantities are within licensed limits.

Discharge of clean surface runoff intercepted by drains and diverted around operations is not considered emergency discharge.

5. Potential sources of discharge.

Potential sources of discharge are:

- Process water.
- Tailings decant water.
- Solar Pond decant water.

6. Actions to be taken in event of discharge.

6.1. Prevention and Reduction Measures

If an emergency discharge is identified as occurring or likely to occur, immediate action should be taken to prevent or minimise the discharge.
Actions taken will depend on the nature of the event but may include.

- Construction of temporary bunding or drains.

- Pumping water to the process circuit
- Shutting down pumps supplying the area discharging.

6.2. Recording.

If discharge occurs records should be kept of:

- Location of discharge.
- Time and duration of discharge event.
- Estimate of quantity discharge.
- Photographs of discharge.
- If the size and duration of the spill permit, opportunistic water samples should be taken of
  - Source of discharge
  - Receiving waters (upstream of discharge)
  - Receiving waters downstream of discharge.
- Water Samples should be analysed in accordance with Schedule C and Schedule D of the Water Monitoring Schedule (Appendix 1).

6.3 Reporting

Emergency discharges may trigger reporting requirements under *Section 72 of the Environmental Protection Act 1986*.

Discharges must be reported to DER as soon as practicable in accordance with the Waste Discharge or Pollutant Spill Reporting Guide.

http://www.der.wa.gov.au/your-environment/reporting-pollution/111-duty-to-notify-discharges-of-waste

Minor spills or discharges which are inconsequential in terms of pollution or environmental harm can be reported to the DER Industry Regulation Greater Swan Region Office.

Email: industry.regulation@der.wa.gov.au
Phone: 08 6467 5000,
Address: 181-205 Davy Street, Booragoon, Perth WA 6850

More serious spills or discharges must be reported to the DER in two stages.

1 **Verbal/electronic initial reporting.** Report to either the DER office as above or the Pollution watch line 1300 784 782.

2 **Written Formal Reporting.** Follow up written formal reporting by mail or fax is required to be done as soon as practical.
The report must contain the following details:

- The time and the address of the premises on or from which the discharge occurred and a map of the premises showing the location of the discharge.
- If the discharge of the waste was a result of the operation of equipment or otherwise, the name of the person operating the equipment or otherwise responsible for the discharge of the waste.

- The quantity of the waste discharged.
- Whether or not the discharge caused pollution and, if so, the nature and extent of the pollution.
- The action taken by the occupier of the premises to minimize the effect on the environment of the discharge of waste.
- Whether or not the waste involved in the discharge has been removed, dispersed, destroyed, disposed of or otherwise dealt with, and if so, the manner in which the waste was removed, dispersed, destroyed, disposed of or otherwise dealt with.

A form to assist with written reporting (Section 72 Waste Discharge Notification form) can be downloaded from the DER at http://www.der.wa.gov.au/your-environment/reporting-pollution/111-duty-to-notify-discharges-of-waste.