RUMBLE RESOURCES LTD

Western Queen Project

Native Vegetation Clearing Permit Supporting Document

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1 Background

The Western Queen Project Application area is located approximately 75 kilometres west-south-west of Cue and 95 km north-west of Mt. Magnet, within the Shire of Yalgoo, in the Murchison region of Western Australia. It encompasses mining tenements M59/45 and M59/208 and miscellaneous tenement L59/40 (Figure 1). The majority of the two mining tenements have previously been disturbed by mining activities and associated infrastructure. Figure 2 shows the proposed layout of the site

1.1 IBRA Region

The Application area is situated within the Western Murchison (MUR2) subregion of the Murchison Bioregion as defined by the Interim Biogeographic Regionalisation of Australia (IBRA) (DCCEEW, 2020).

The Western Murchison comprises the northern parts of the Murchison Terrains of the Yilgarn Craton and is characterised by extensive hardpan washplains of fine-textured Quaternary alluvial and eluvial soils, with surfaces associated with the occluded drainage occurring throughout and mantling granitic and greenstone strata of the northern part of the Yilgarn Craton. The subregion contains the headwaters of the Murchison and Wooramel Rivers, which drain the subregion westwards to the coast.

The vegetation of the subregion is characterised by Mulga low woodlands, often rich in ephemerals (usually with bunch grasses), on outcrops with hummock grasslands on Quaternary sandplains, saltbush shrublands on calcareous soils and *Tecticornia* low shrublands on saline alluvia. The climate is arid, with bimodal rainfall that usually falls in winter. (Cowan, 2001).

Approximately 99.73% of the pre-European vegetation remains within the Murchison bioregion (Government of Western Australia, 2019).

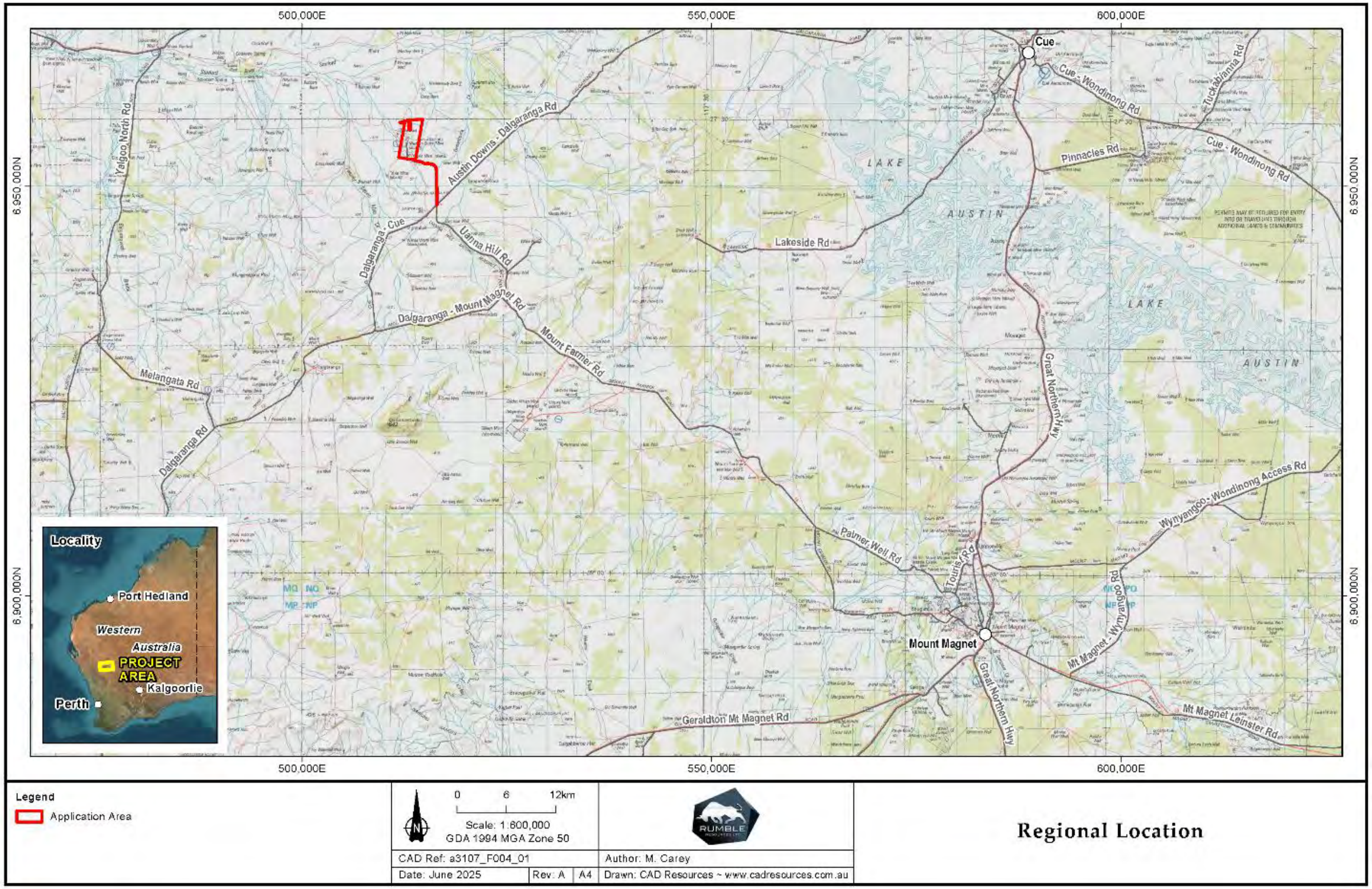

Figure 1 Western Queen Project NVCP Application Area.

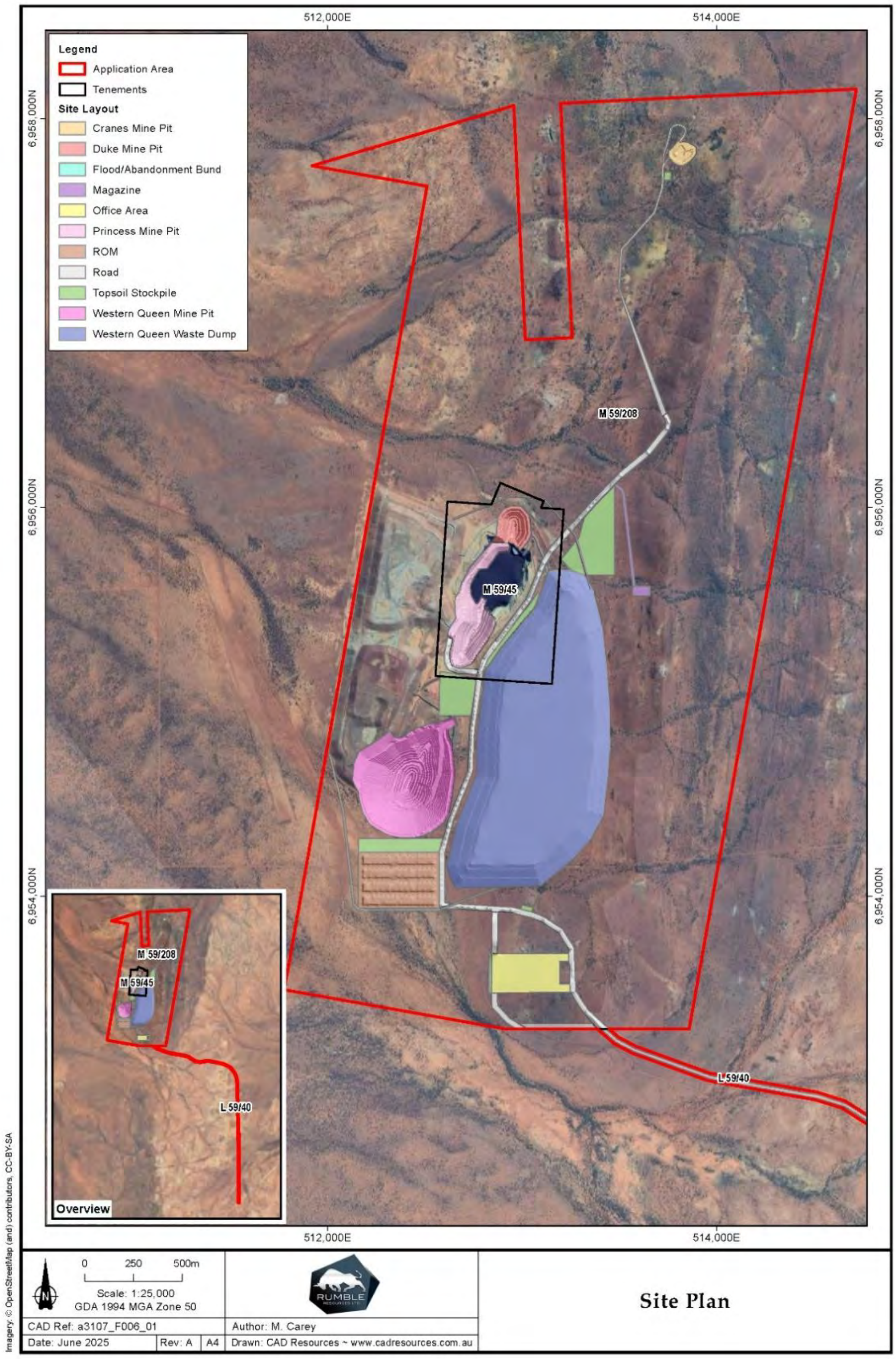

Figure 2 Western Queen NVCP Application Area and Proposed Layout of Western Queen Project

1.2 Flora and Vegetation

A Level 1 flora and vegetation survey was originally conducted by Outback Ecology (2012a) in April 2012 in part of the proposed Application area (Figure 3) (Appendix 1). A reconnaissance flora and vegetation survey was undertaken by Botanica in January 2025 throughout the remainder of the Application area (Figure 3) (Appendix 2).

1.2.1 Flora

The 2012 survey identified 80 plant taxa within the Application area and in areas directly adjacent (Outback Ecology, 2012a), whilst the 2025 survey identified 86 plant taxa within the area surveyed. These taxa represented 42 genera across 27 families, with the most diverse families being Fabaceae (19 species) Chenopodiaceae (12 species) and Scrophulariaceae (11 species). Dominant genera included *Acacia* (14 species), *Eremophila* (11 species), *Maireana* and *Ptilotus* (five species each). These are considered to be relatively low numbers for this area however, given the close proximity to current mining operations this is not considered unusual (Outback Ecology, 2012a).

1.2.1.1 Conservation Significant Flora

The assessment of the DBCA Threatened and Priority flora database searches (DBCA, 2024), ALA (ALA, 2024) and Protected Matters Search Tool(DCCEEW, 2025) and previous relevant literature identified 22 significant flora species (one Threatened, four Priority 1, two Priority 2, 11 Priority 3 and four Priority 4) recorded within a 40 km radius of the survey area, with no significant flora species having previously been recorded in the Application area (Botanica 2025).

These taxa were assessed for distribution and known habitat to determine their likelihood of occurrence within the Application area. One Priority 4 taxon was identified as 'likely to occur' and three taxa were identified as 'possibly occurring' in the Application area. These taxa are summarised in Table 1.

Table 1. Significant flora potentially occurring within the Application area

Taxon	DBCA Priority	Description	Comments	Likelihood
Acacia speckii	Priority 4	Bushy, rounded shrub or tree, 1.5-3 m high. Rocky soils over granite, basalt or dolerite. Rocky hills or rises.	Within known range, habitat likely to be present.	Likely
Petrophile vana	Priority 1	Shrub, to 1.5 m high. Shallow, white, gritty clay-soil pockets, laterite. Breakaways.	Within known range, habitat may be present.	Possible
Eremophila simulans subsp. megacalyx	Priority 3	Shrub, 0.9-2 m high. Fl. violet, Aug to Sep.	Within known range.	Possible
Grevillea inconspicua	Priority 4	Intricately branched, spreading shrub, 0.6-2 m high. Fl. white/pink-white, Jun to Aug. Loam, gravel. Along drainage lines on rocky outcrops, creeklines.	At extreme of known range, habitat likely to be present.	Possible

One Priority 4 species, *Dodonaea amplisemina* was recorded in the Application area on rocky hills within vegetation associations 4 and 5 (Outback Ecology 2012a). A smaller occurrence was mapped at Relevé 5 on a low rocky rise on the northern edge of the proposed waste dump footprint within vegetation association 1 (disturbed) (Outback Ecology 2012).

No Threatened, Priority or otherwise significant flora species were recorded within the Application area during the Botanica (2025) survey.

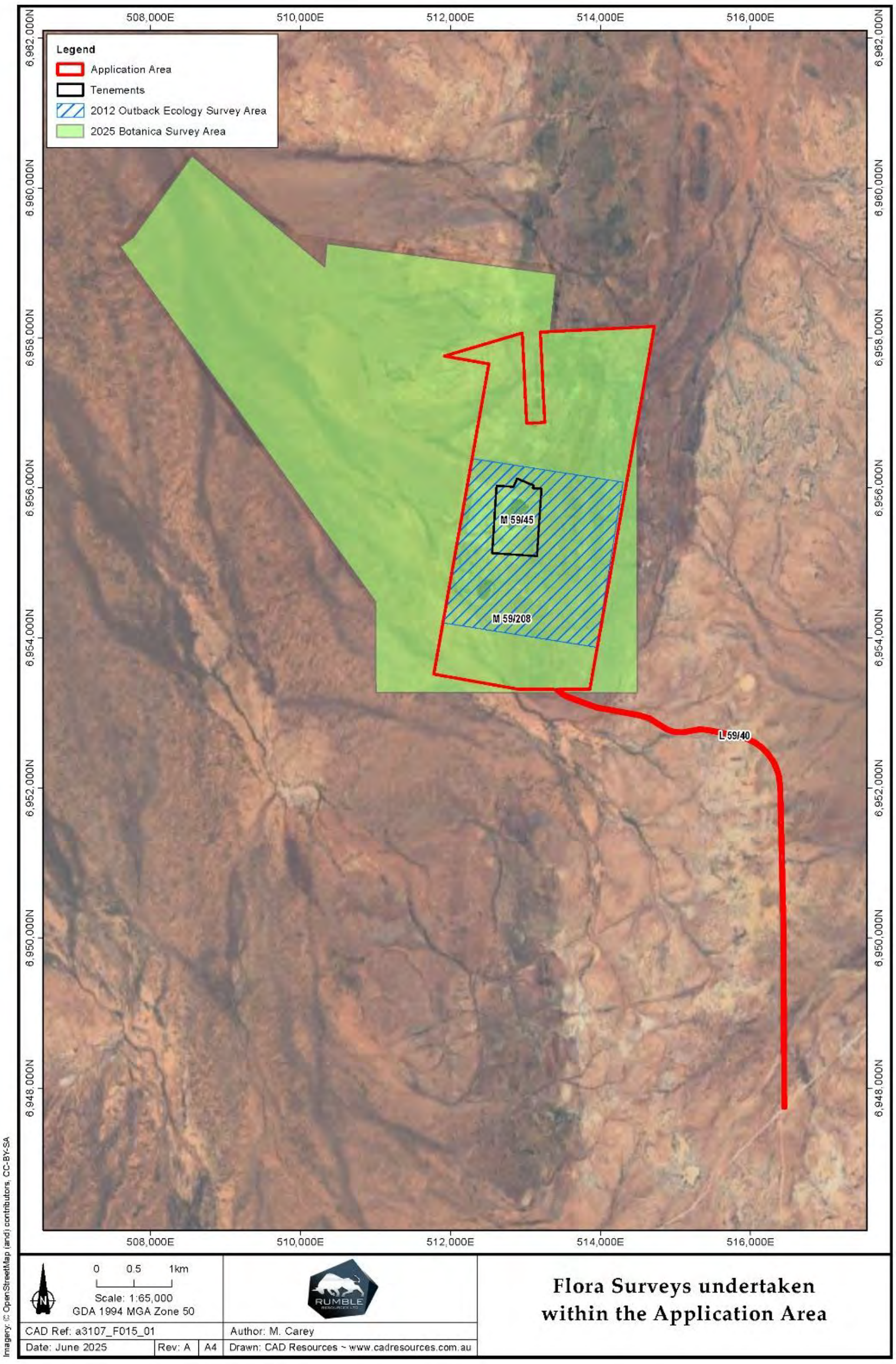

Figure 3 Flora and Vegetation Surveys undertaken within the Application Area

1.2.1.2 Introduced Flora (Weeds)

Two introduced flora species, **Cucumis myriocarpus* and **Solanum nigrum*, were recorded within the Application area (Outback Ecology, 2012a), however no introduced species were recorded by Botanica (2025).

Weeds have the potential to alter the biodiversity of an area, competing with native vegetation for available resources and making areas more fire prone. This can in turn lead to greater rates of infestation and further loss of biodiversity if the area is subject to repeated fires. Neither of these species are listed as 'Declared Plant' species under the *Biosecurity and Agriculture Management Act* 2007. Potential impacts to biodiversity as a result of the proposed clearing may be minimised by the implementation of a weed management condition.

1.2.2 Vegetation

1.2.2.1 Pre European Vegetation

In accordance with Beard (1990), the Murchison region is located in the Austin Botanical District within the Eremaean Province of WA.

Two Beard vegetation associations have been mapped within the Application area (**Error! Reference source not found.**):

- 18: Low woodland; mulga (*Acacia aneura*); and
- 39: Shrublands; mulga scrub.

Approximately 99.68% and 99.1% of Beard vegetation associations 18 and 39 remains within the Murchison bioregion respectively (Government of Western Australia 2019) (Table 2).

Areas retaining less than 30% of their pre-European vegetation extent generally experience exponentially accelerated species loss, while areas with less than 10% are considered "endangered" (EPA, 2000). Both vegetation associations retain >99% of their pre-European extent, and development within the survey area will not significantly reduce the current extent of these vegetation associations.

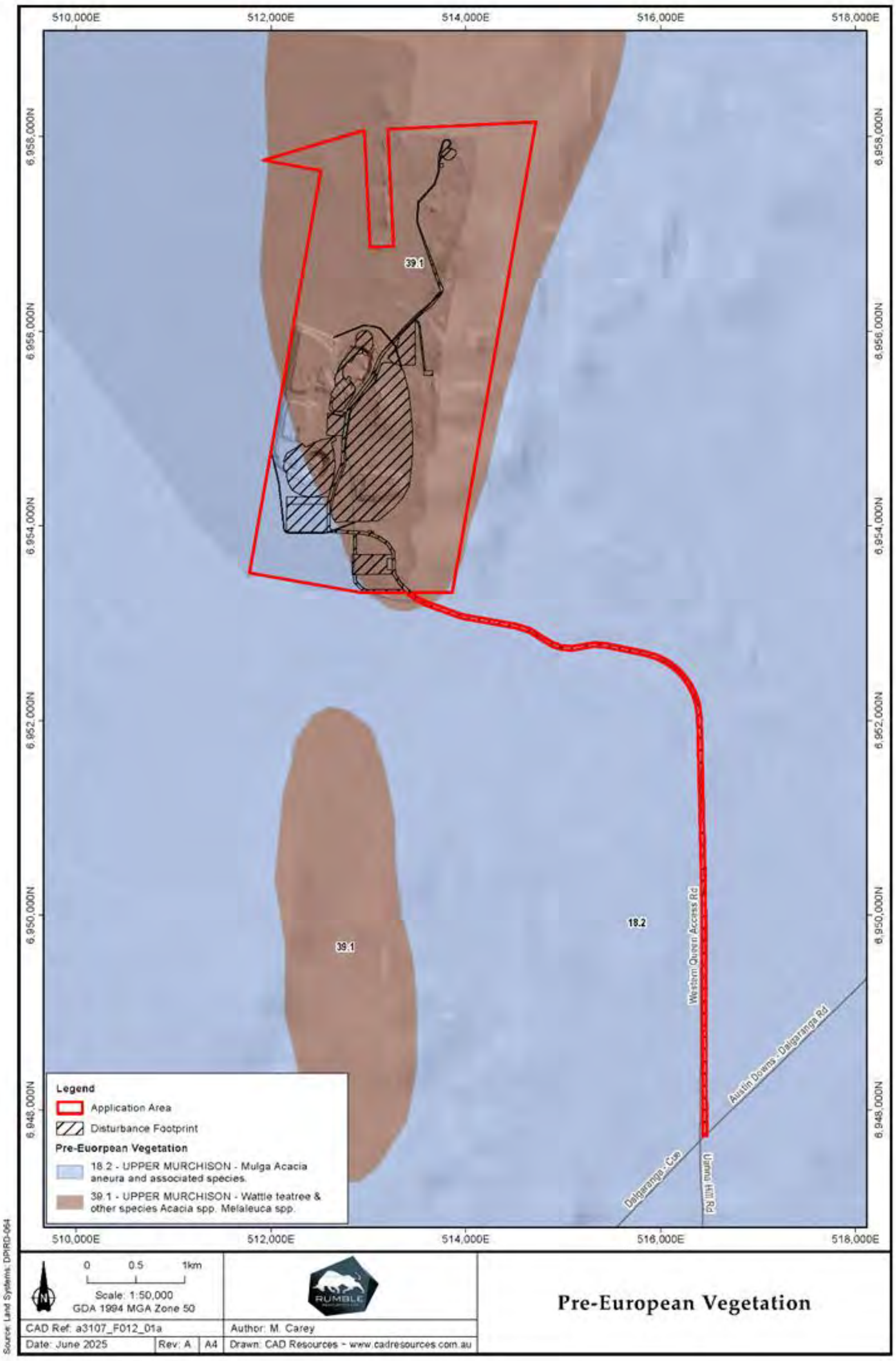

Figure 4 Pre-European Vegetation within the Application Area

Table 2 Pre-European Vegetation Association Extents for the State and Bioregion

	Pre-European area (ha)*	Current extent(ha)*	Remaining %*	Pre-European % in IUCN Class I-IV Reserves (and post clearing %)
IBRA Bioregion - Murchison	28,120,587	28,044,823	~99.73	~1.04
Beard vegetation associations - State				
18	19,892,306	19,843,148	~99.75	~2.13
39	6,613,567	6,602,578	~99.83	~7.24
Beard vegetation associations - Bioregion				
18	12,403,172	12,363,252	~99.68	~0.36
39	1,148,400	1,138,065	~99.10	~0.02

*Government of Western Australia (2019)

1.2.2.2 Local Vegetation

The 2012 survey identified six vegetation associations within part of the Application area (Outback Ecology,2012a), whilst the 2025 survey identified 11 broad-scale vegetation communities (Botanica 2025). Descriptions of the broad-scale vegetation communities and extents are provided in Table 3 and Table 4. The spatial extents of the vegetation communities are shown in Figure 5. Vegetation community descriptions and extents were determined from field survey results, aerial imagery interpretation and extrapolation of the communities. The survey found RP-AOW1 and DD-AFW1 were the most widespread vegetation in the project area, occupying 543.2 ha and 530.4 ha, respectively. Vegetation type DD-CS1 was the most restricted with 19.4 ha, however this was not recorded within the disturbance footprint.

None of the vegetation units described represented vegetation of conservation significance nor of local significance. Most of the units were associated with either the clay-loam plain, drainage depressions, rocky hillslopes or rocky plain landforms.

Table 3. Vegetation Communities within the Application Area as described by Botanica (2025)

Vegetation Code	Vegetation Group (VG), Landform (LF)	Vegetation Type	Image
CLP-AFW1 Area mapped: 268.8 ha	VG - Acacia Forests and Woodlands LF - Clay-loam plain	*Acacia incurvaneura* low open forest over *Acacia ramulosa* var *ramulosa* mid open shrubland over *Eremophila punicea* and *E. compacta* sparse low shrubland	
CLP-AOW1 Area mapped: 197.6 ha	VG - Acacia Forests and Woodlands LF - Clay-loam plain	*Acacia aptaneura* and/or *Acacia incurvaneura* low open woodland over *Acacia acuminata* mid open shrubland over *Ptilotus obovatus* and *Eremophila compacta* low sparse shrubland	
DD-AFW1 Area mapped: 532.3 ha	VG - Acacia Forests and Woodlands LF - Drainage depression	*Acacia incurvaneura*, *A. mulganeura*, *A. ramulosa* low open forest over *Acacia tetragonophylla*, *Eremophila punicea*, *Sida ectogama* mid open shrubland over *Atriplex bunburyana* and *Maireana pyramidata* low sparse chenopod shrubland	
DD-AFW2 Area mapped: 137.8 ha	VG - Acacia Forests and Woodlands LF - Drainage depression	*Acacia incurvaneura* low open forest over *Acacia tetragonophylla* and *Eremophila oppositifolia* mid open shrubland over *Atriplex bunburyana* and *Rhagodia eremaea* low sparse chenopod shrubland	

Vegetation Code	Vegetation Group (VG), Landform (LF)	Vegetation Type	Image
DD-AOW1 Area mapped: 384.3 ha	VG - Acacia Forests and Woodlands LF - Drainage depression	*Acacia aptaneura* low open woodland over *Eremophila exilifolia* and *Acacia tetragonophylla* low open shrubland over *Maireana triptera* and *M. pyramidata* low sparse chenopod shrubland	
DD-CS1 Area mapped: 19.4 ha	VG - Chenopod shrubland LF - Drainage depression	*Maireana pyramidata, M. georgei* and *M. triptera* low sparse chenopod shrubland	
DD-CS2 Area mapped: 105.2 ha	VG - Chenopod shrubland LF - Drainage depression	Low open shrubland of *Acacia tetragonophylla* over low sparse chenopod shrubland of *Maireana pyramidata*, *Enchylaena tomentosa* and *Maireana triptera*	
RH-AFW1 Area mapped: 79.6 ha	VG - Acacia Forests and Woodlands LF - Rocky hillslope	*Acacia aptaneura* and/or *Acacia incurvaneura* low open forest over *Eremophila latrobei* low sparse shrubland	

Vegetation Code	Vegetation Group (VG), Landform (LF)	Vegetation Type	Image
RH-AOW1 Area mapped: 299.7 ha	VG - Acacia Forests and Woodlands LF - Rocky hillslope	*Acacia aptaneura*, *A. grasbyi* and *A. tetragonophylla* low open woodland over *Eremophila fraseri* and *E. forrestii* subsp. *forrestii* low open shrubland over *Aristida contorta* low sparse tussock grassland	
RH-AOW2 Area mapped: 132.8 ha	VG - Acacia Forests and Woodlands LF - Rocky hillslope	*Acacia aptaneura* and *Acacia ramulosa* var. *linophylla* low open woodland over *Eremophila fraseri* or *Eremophila exilifolia* open shrubland over *Aristida contorta* low tussock grassland	
RP-AOW1 Area mapped: 543.2 ha	VG - Acacia Forests and Woodlands LF - Rocky plain	*Acacia pteraneura* and *Acacia grasbyi* low open woodland over *Senna artemisioides* subsp. *filifolia*, *Ptilotus rotundifolius* mid sparse shrubland over *Rhagodia drummondii*, *Maireana oppositifolia* low open chenopod shrubland	
Cleared Area mapped: 196.8 ha	N/A	Cleared	N/A

Table 4 Extent of Vegetation Communities within the Application Area as mapped by Botanica (23025)

Vegetation Community Code	Area surveyed (ha) A	Application Area (ha) B	Disturbance Footprint (ha) C	Vegetation Community within Area Surveyed (ha) D	Vegetation Community within Application Area (ha) E	Vegetation Community within Disturbance Footprint (ha) F	% of Vegetation Community within the Application Area which falls within the Disturbance Footprint
	2894.2	1010.5	205.0				
CLP-AFW1				268.5 (D/A=9.3%)	45.9 (E/B=4.5%)	5.80 (F/C=2.8%)	F/E=12.6%
CLP-AOW1				197.4 (D/A=6.8%)	2.14 (E/B=0.21%)	0 (F/C=0%)	F/E=0%
DD-AFW1				530.4 (D/A=18%)	53.4 (E/B=5.3%)	13.8 (F/C=0.03%)	F/E=25.8%
DD-AFW2				137.7 (D/A=4.7%)	85.0 (E/B=8.4%)	7.95 (F/C=3.9%)	F/E=9.4%
DD-AOW1				384.0 (D/A=13.3%)	70.9 (E/B=7.0)	8.7(F/C=4.2%)	F/E=12.2%
DD-CS1				19.4 (D/A=0.6%)	0 (E/B=0%)	0 (F/C=0%)	F/E=0%
DD-CS2				105.2 (D/A=3.6%)	0 (E/B=0)	0 (F/C=0%)	F/E=0%
RH-AFW1				79.5 (D/A=2.7%)	73.2 (E/B=7.2%)	0 (F/C=0%)	F/E=0%
RH-AOW1				299.4 (D/A=10.3%)	247.1 (E/B=24.4%)	10.8 (F/C=5.3%)	F/E=4.4%
RH-AOW2				132.8 (D/A=4.6%)	55.0 (E/B=5.4%)	9.5 (F/C=9.0%)	F/E=17.2%
RP-AOW1				543.2 (D/A=18.8%)	193.2 (E/B=19.1%)	62.4 (F/C=30.4%)	F/E=32.3%
Cleared				196.8 (D/A=6.8%)	178.1 (E/B=17.6%)	84.6 (F/C=41.3%)	F/E=47.5%

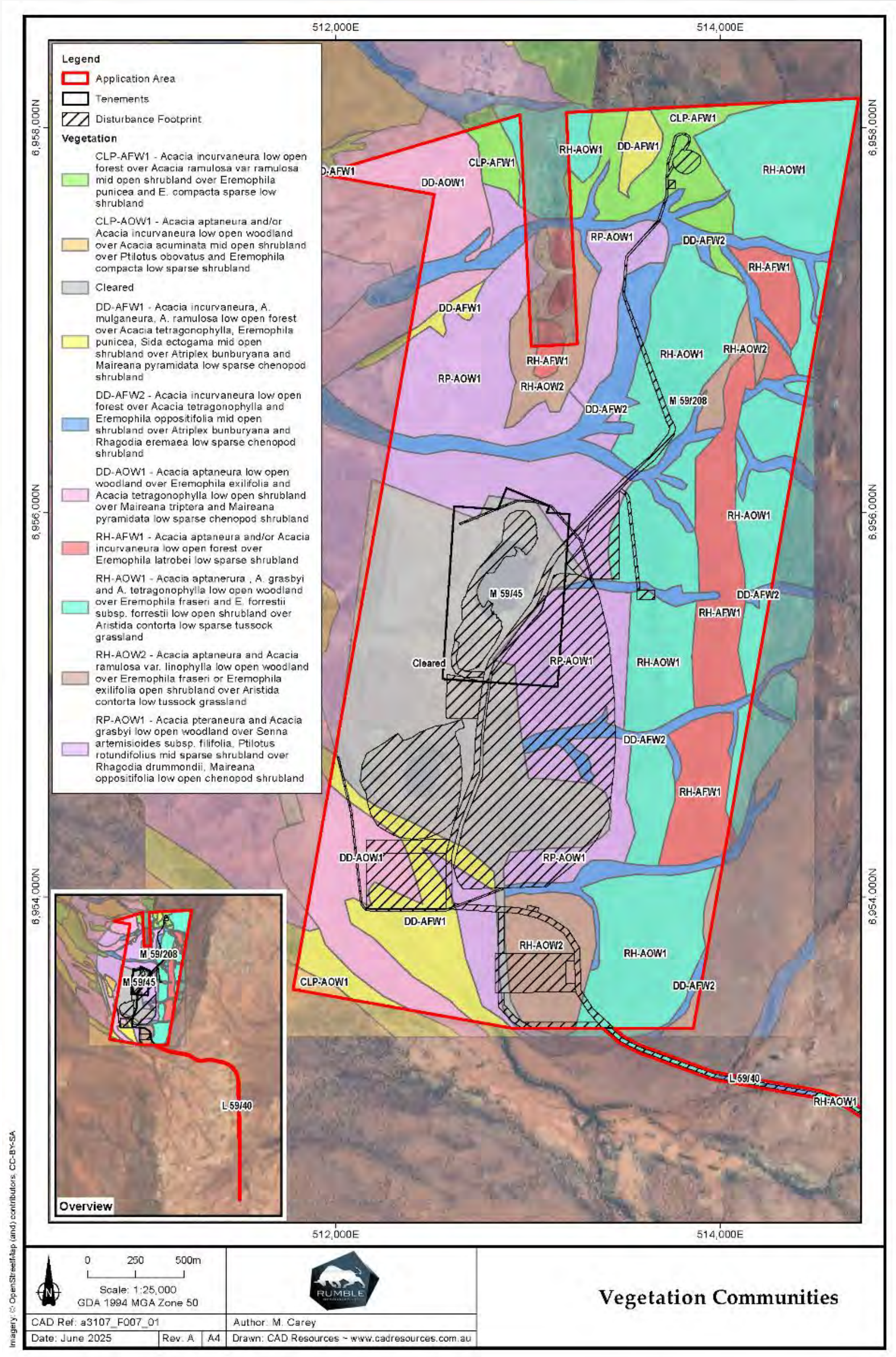

Figure 5 Vegetation Communities within the Application Area as mapped by Botanica (2025).

1.2.2.3 Vegetation Condition

The majority of the Application area, with the exception of the north-eastern portion of M 59/208 has been impacted to varying degrees by mining and grazing activities, particularly in more recent times by large numbers of goats. Based on the vegetation condition rating scale adapted from Keighery (1994) and Trudgen, (1988), vegetation within the survey area ranged in condition from 'Very Good' to 'Degraded' (Botanica 2025). Vegetation within the eastern third of the survey area was in much better condition than areas surrounding the existing waste dumps, pits and areas that had either been cleared for mining infrastructure or impacted by erosive processes such as fines leaching from the waste dump and other man-made landforms (Figure 6).

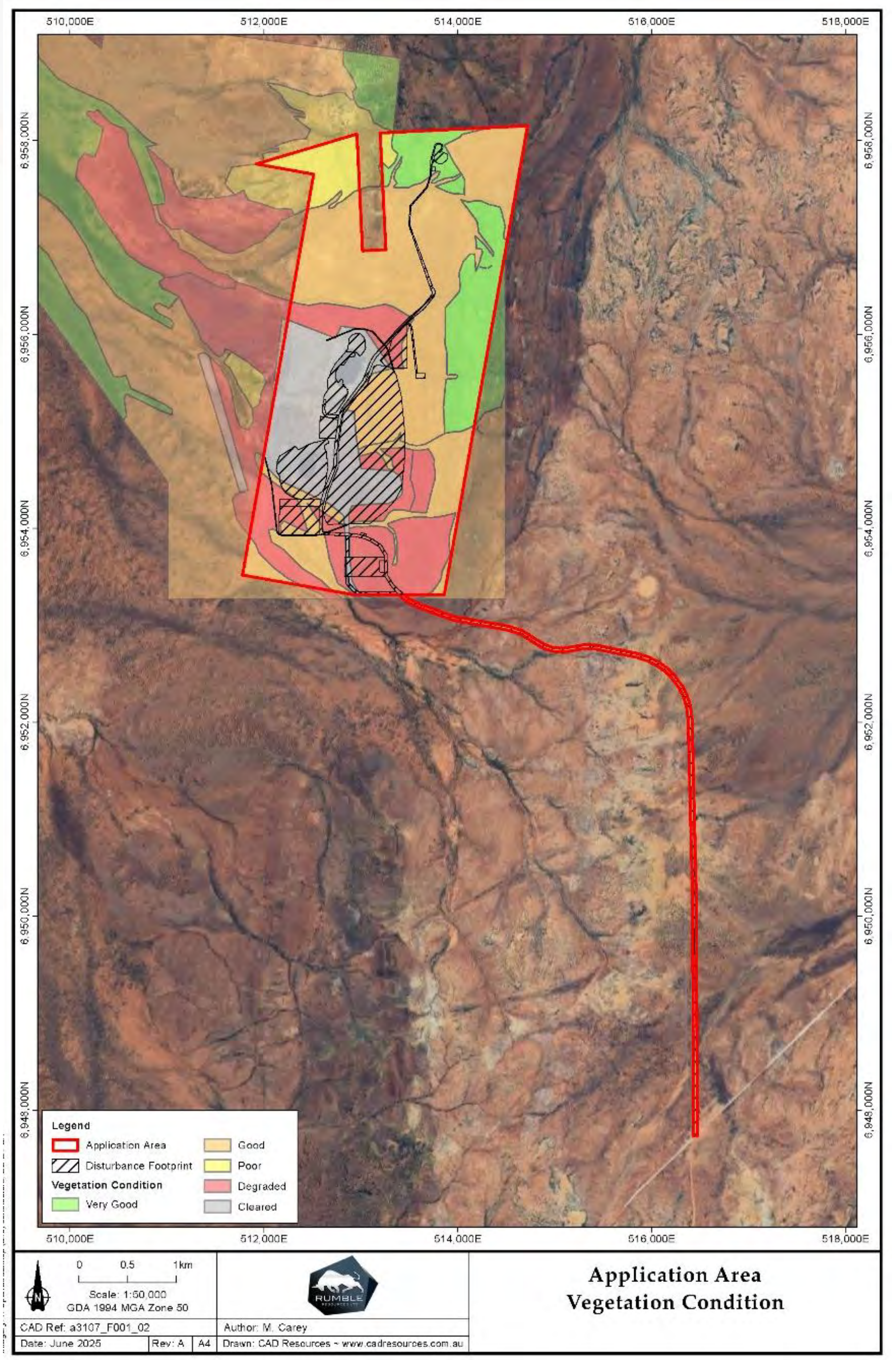

Figure 6 Vegetation condition within the Application Area as mapped by Botanica (2025).

1.2.2.4 Conservation Significant Vegetation

The Protected Matters Search Tools (DCCEEW, 2025) did not identify any Threatened Ecological Communities (TECs) as occurring within 40 km of the survey area.

The DBCA's Threatened Ecological Community List (State of Western Australia, 2023) does not list any TECs within the Shire of Yalgoo.

Analysis of the Priority Ecological Communities (PECs) within the Midwest region (DBCA, 2023) did not identify any significant vegetation assemblages as potentially occurring within the Application area.

Desktop studies (Outback Ecology 2012a) identified two Priority 1 PECs, 'Gabyon calcrete groundwater assemblage type on Moore palaeodrainage on Gabyon Station' and 'Meka calcrete groundwater assemblage on Murchison palaeodrainage on Meka Station' within 50 km of the Survey area (Outback Ecology, 2012a).

None of the vegetation communities mapped during either survey were analogous to any TECs or PECs and are widespread outside of the Application area, in the surrounding pastoral station (Outback Ecology 2012a; Botanica 2025).

1.3 Fauna

Desktop fauna surveys of the Application area and surrounds were conducted by both Outback Ecology (2012b) and Botanica (2025). Based on flora surveys conducted by Outback Ecology (2012a) and Botanica (2025), it was determined that the Application area encompasses modest variation in terms of broad fauna habitats, with the majority of habitats considered widespread and typical of the Western Murchison bioregion.

1.3.1 Fauna Habitats

Botanica (2025) identified five broad scale terrestrial fauna habitats based on vegetation and associated landforms within the Application area. These habitats include:

- Acacia forest and woodland on clay-loam plain
- Acacia forest and woodland in drainage depression
- Acacia forest and woodland on rocky hillslopes
- Acacia forest and woodland on rocky plain
- Chenopod shrubland on clay-loam plain

The disturbed / cleared area was not considered a fauna habitat.

Descriptions of the five fauna habitats are provided in Table 5 and extents of the mapped habitats are summarised in Table 6. The spatial extents of these habitats within the Application Area are shown on Figure 7.

The survey found 'Acacia forest and woodland in drainage depressions' was the most widespread habitat type in the surveyed area, occupying 1,052.1 ha, of which only 30.5 ha are within the disturbance footprint. The 'Chenepod shrubland on clay-loam plain' was the most restricted with 124.5 ha, however none of this habitat type is within the disturbance footprint.

All of the fauna habitats identified, with the exception of the 'Acacia forest and woodland on rocky plain', were described as being unsuitable for burrowing species (Botanica 2025).

The habitats within the Application area are common throughout the Western Murchison Bioregion and given the relatively small scale of the proposed clearing, approximately 205 ha, in previously disturbed or cleared areas and adjacent to existing mine operations, it is considered unlikely that the proposed clearing will significantly impact any conservation significant fauna species.

Table 5. Main terrestrial fauna habitats within the Application Area as mapped by Botanica (2025).

Fauna Habita	Representative Fauna Attributes	Possible Occurring Significant Species	Example Image
Acacia forest and woodland on clay-loam plain	Ground not especially suited to burrowing species. Moderate diversity vegetation strata supporting avifauna assemblage. Low vegetation density and low leaf litter.	Grey Falcon, *Falco hypoleucos*	
Acacia forest and woodland in drainage depression	Ground not suited to burrowing species. Moderate diversity vegetation strata supporting avifauna assemblage. Moderate vegetation density and moderate leaf litter.	Malleefowl, *Leipoa ocellata* Grey Falcon, *Falco hypoleucos* Southern Whiteface, *Aphelocephala leucopsis*	
Acacia forest and woodland on rocky hillslopes	Ground not suited to burrowing species. Low diversity vegetation strata Low vegetation density and low leaf litter	Grey Falcon, *Falco hypoleucos*	

Fauna Habita	Representative Fauna Attributes	Possible Occurring Significant Species	Example Image
Acacia forest and woodland on rocky plain	Ground suited to burrowing species. Moderate diversity vegetation strata supporting avifauna assemblage Moderate vegetation density and low to moderate leaf litter	Malleefowl, *Leipoa ocellata* Grey Falcon, *Falco hypoleucos* Southern Whiteface *Aphelocephala leucopsis*	
Chenopod shrubland on clay-loam plain	Ground not particularly suited to burrowing species. Low diversity vegetation strata Low vegetation density and low leaf litter	N/A	
Cleared	N/A	N/A	N/A

Table 6 Extents of the fauna habitats within the mapped area.

Fauna Habitat	Area surveyed (ha) A	Application Area (ha) B	Disturbance Footprint (ha) C	Fauna Habitat within Area Surveyed (ha) D	Fauna Habitat within Application Area (ha) E	Fauna Habitat within Disturbance Footprint (ha) F	% of Fauna Habitat within the Application Area which falls within the Disturbance Footprint
	2894.2	1010.5	205.0				
Acacia forest and woodland on clay-loam plain				465.9 (D/A=16%)	48.1 (E/B=4.7%)	5.80 (F/C=2.8%)	F/E=12%
Acacia forest and woodland in drainage depression				1052.1 (D/A=36%)	209.3 (E/B=20.7%)	30.5 (F/C=14.9%)	F/E=14.6%
Acacia forest and woodland on rocky hillslopes				511.7 (D/A=17.7%)	375.4 (E/B=37.1%)	20.3 (F/C=10%)	F/E=5.4%
Acacia forest and woodland on rocky plain				543.2 (D/A=18.8%)	193.2 (E/B=19.1%)	62.4 (F/C=30.4%)	F/E=32.3%
Chenopod shrubland on clay-loam plain				124.5 (D/A=4.3%)	0	0	0
Cleared (Previously Disturbed)				196.8 (D/A=6.8%)	178 (E/B=17.6%)	84.6 (F/C=41.3%)	F/E=47.5%

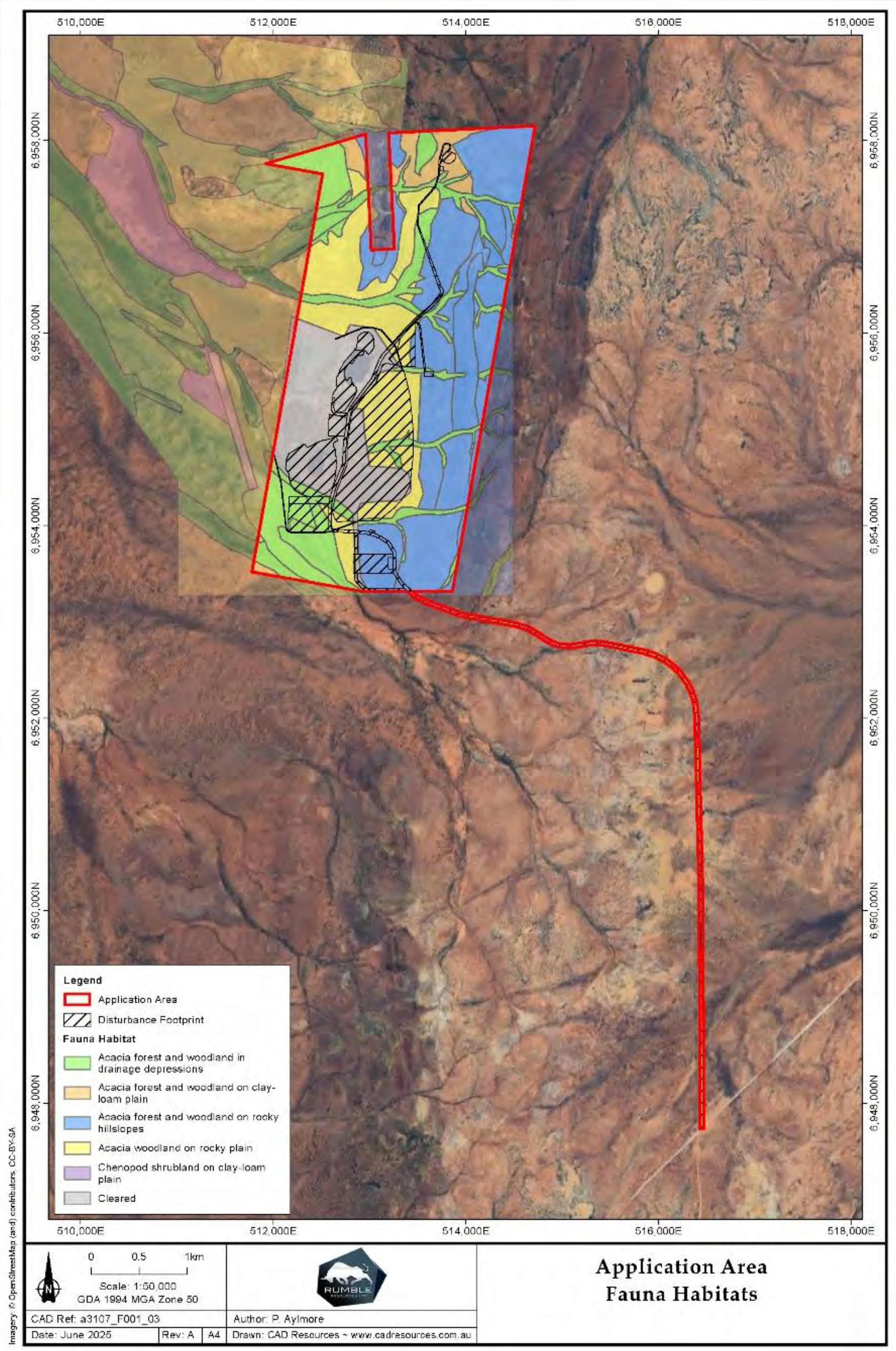

Figure 7 Fauna Habitats within the Application Area as mapped by Botanica (2025).

1.3.2 Conservation Significant Fauna

From the likelihood of occurrence assessment based on habitat and distribution data obtained from publicly available databases (Botanica 2025), three conservation significant species Mallefowl (*Leipoa ocellata*) (EPBC Act and BC Act: Vulnerable), Rainbow bee-eater (*Merops ornatus*) (EPBC Act: Migratory) and Southern Whiteface (*Aphelocephala leucopsis*) (EPBC Act and BC Act: Vulnerable) are assessed as "Possibly utilising the survey area at some time". Descriptions of their preferred habitats and likelihood of occurrence are provided in Table 7. There was either no evidence of the species (nesting mounds, diggings, tracks or scats in the case of the Malleefowl) nor were they observed during the survey.

Table 7. Potentially occurring significant fauna within the Application Area (Botanica 2025).

Species	Conservation Status			Habitat Description	Assessment	Likelihood
	EPBC Act	BC Act	DBCA Priority			
Malleefowl, *Leipoa ocellata*	VU	VU	-	Scrublands and woodlands dominated by mallee and wattle species (Department of the Environment, 2025). Malleefowl are known to avoid open areas and instead select habitat where vegetation of two to four metres in height is prevalent (i.e. ~ 50% cover or greater) and provides adequate cover (Benshemesh et al. 2007).	Few regional records, suitable habitat may be present.	Possible
Southern Whiteface, *Aphelocephala leucopsis*	VU	VU	-	The Southern Whiteface occur across most of mainland Australia south of the tropics, from the north-eastern edge of the WA wheatbelt, east to the Great Dividing Range. Habitat includes a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. These areas are usually in habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains. Critical habitat includes relatively undisturbed open woodlands and shrublands with an understorey of grasses and/or shrubs, habitat with low tree densities and an herbaceous understory litter cover which provides essential foraging habitat and living and dead trees with hollows and crevices which are essential for roosting and nesting.	Within known range, but vegetation is unlikely to support breeding or optimal foraging habitat due to extensive impacts to vegetation. May occasionally visit but unlikely to significantly utilize the area.	Possible
Rainbow Bee-eater *Merops ornatus*	Migratory	-	-	This species is distributed across much of mainland Australia, and occurs on several near-shore islands. It is not found in Tasmania, and is thinly distributed in the most arid regions of central and Western Australia.	May occur as occasional vagrants but unlikely to significantly utilise habitat within the area.	Possible

It should be noted that while habitats onsite for one or more of the conservation significant species listed are considered possibly suitable, some or all may be marginal in extent/quality and therefore the fauna species considered as possibly occurring may in fact only visit the area for short periods as infrequent vagrants (Botanica 2025).

1.3.3 Short Range Endemics

A review of relevant literature and database searches by Outback Ecology (2012b) revealed that 12 terrestrial Short Range Endemic (SRE) invertebrate species including the conservation significant species Shield-backed trapdoor spider (*Idiosoma nigrum*) (Vulnerable and Endangered) have been recorded within the region surrounding the Application area. Of these species, all have low potential to occur in the Application area except for the mygalomorph spider *Eucyrtops* `MYG131`. The species *Eucyrtops* `MYG131` is considered to have a medium potential to occur based on the proximity of the collection record to the Application area and the potential for similar habitats to occur within the Application area. The habitat where *Eucyrtops* `MYG131` was collected is unlikely to be restricted in the landscape (Outback Ecology 2012b).

It is possible that additional SRE species also occur within the Application area however in the absence of a systematic study following substantial rainfall, any estimate of likelihood of occurrence is speculative. Potential terrestrial invertebrate SRE habitat within the Application area is limited to the Drainage Line and Stony Rise habitats (Outback Ecology 2012b).

1.3.4 Subterranean Fauna

Outback Ecology undertook a desktop assessment of the potential for subterranean fauna to occur in the vicinity of the Application area (Outback Ecology 2012c). The main objectives of the desktop assessment were to:

- characterise the subterranean habitat within the area, in terms of geology and hydrogeology;
- review the potential influence of local geology and hydrogeology on the prospect of subterranean fauna existing within the Application area;
- determine the likelihood of subterranean fauna occurring within the Application area;
- assess the risk of the proposed mining operation to subterranean fauna; and
- recommend if additional work (eg. a pilot survey) is required (Outback Ecology 2012c).

To address the objectives, literature reviews and database searches were undertaken to characterise the subterranean fauna and potential habitat of the area (Outback Ecology 2012c).

The assessment identified that there was relatively limited subterranean fauna in the search region compared to other areas in the Murchison, although this is likely to be at least partly due to the lower survey effort in the north-western Murchison region compared to the north-eastern Murchison. The Murchison region's stygofauna assemblages are closely associated with calcrete habitats that coincide with ancient palaeodrainage systems.

The Application area is located in an elevated area more than ten kilometres away from the nearest identified palaeochannel and does not contain any calcrete habitats. Hydrogeological investigations indicate minimal fracturing of the bedrock, with a limited aquifer characterised by low hydraulic conductivity. It is considered unlikely that any unique stygofauna assemblage or species are restricted to the Application area, and no further assessment of stygofauna within the Application area is considered necessary (Outback Ecology 2012c).

The Murchison region's troglofauna assemblages are less well documented than for stygofauna. However, troglofauna species have been recorded from alluvial deposits and fractured and weathered rock habitats in the surrounding region. The limited geological information available for the Application area indicates that potentially suitable habitat could be hosted in the alluvial and weathered rock strata. However, this regolith type is extensive and appears contiguous with the Application area in the surrounding region. Therefore, it is unlikely that any discrete habitat suitable for troglofauna is restricted to only within the Application area. It is considered unlikely that any unique troglofaunal assemblage or species are restricted to the Application area, and no further assessment of troglofauna is considered necessary (Outback Ecology 2012c).

1.4 Land Systems, Geomorphology and Erosion Potential

The Application area lies within the Murchison Province, located in the inland Mid-west and northern Goldfields between Three Springs, the Gascoyne River, Wiluna, Cosmo Newberry and Menzies. The landscape consists of hardpan wash plains and sandplains (with some stony plains, hills, mesas and salt lakes) on the granitic rocks and greenstone of the Yilgarn Craton. Soils include red loamy earths, red sandy earths, red shallow loams, red deep sands and red-brown hardpan shallow loams (with some red shallow sands and red shallow sandy duplexes). Vegetation is typified by mulga shrublands with spinifex grasslands (and some bowgada shrublands, eucalypt woodlands and halophytic shrublands) (Tille, 2006).

The Murchison Province is further divided into soil-landscape zones, with the Application area located within the Yalgoo Plains Zone (273). The Yalgoo Plains Zone is comprised of hardpan wash plains (with some sandplains, stony plains, mesas and granite outcrops) on granitic rocks (with some greenstone) of the Yilgarn Craton (Murchison Domain). Soils consist of red loamy earths and red shallow loams (often with hardpans) with red deep sands and red shallow sands and some red shallow sandy duplexes. Vegetation is typified by mulga (*Acacia aneura*) shrublands with bowgada (*A. ramulosa*) shrublands, with some halophytic shrublands. This zone is located in the south-western Murchison from Paynes Find to Cue and Twin Peaks Station (Tille, 2006).

In accordance with soil landscape system mapping data (Government of Western Australia, 2022), the soil landscape zones are divided into soil landscape systems, with the Application area located within three soil landscape systems: Challenge, Gabanintha and Jundee, with the majority of the Application area falling within the Gabanintha land system.

Detailed descriptions of the land systems are provided in Table 8 and the spatial extents of these systems within Application area are shown in Figure 8.

Table 8. Soil landscape systems within the Application area

Soil Landscapes System	Description
Challenge System	Gently undulating gritty and sandy surfaced plains, occasional granite hills, tors and low breakaways, supporting acacia shrublands and occasional halophytic shrublands. Two units within this land system are slightly susceptible to erosion (Payne et al., 1998).
Gabanintha System	Greenstone ridges, hills and footslopes supporting sparse acacia and other mainly non-halophytic shrublands. The stone mantles provide protection against erosion over most of this land system except for in one unit which is slightly susceptible to erosion (Payne et.al., 1998).
Jundee System	with ironstone gravel mantles supporting mulga shrublands (Payne et al., 1998). Alterations to natural sheet flows can initiate soil erosion and cause water starvation and consequent loss of vigour in vegetation downslope (Payne et al., 1998).

All land systems have slight potential for soil erosion with alteration of natural sheet flow being a cause in the Jundee land system. Potential erosion impacts as a result of the proposed clearing may be minimised by the implementation of a staged clearing condition and a watercourse management condition.

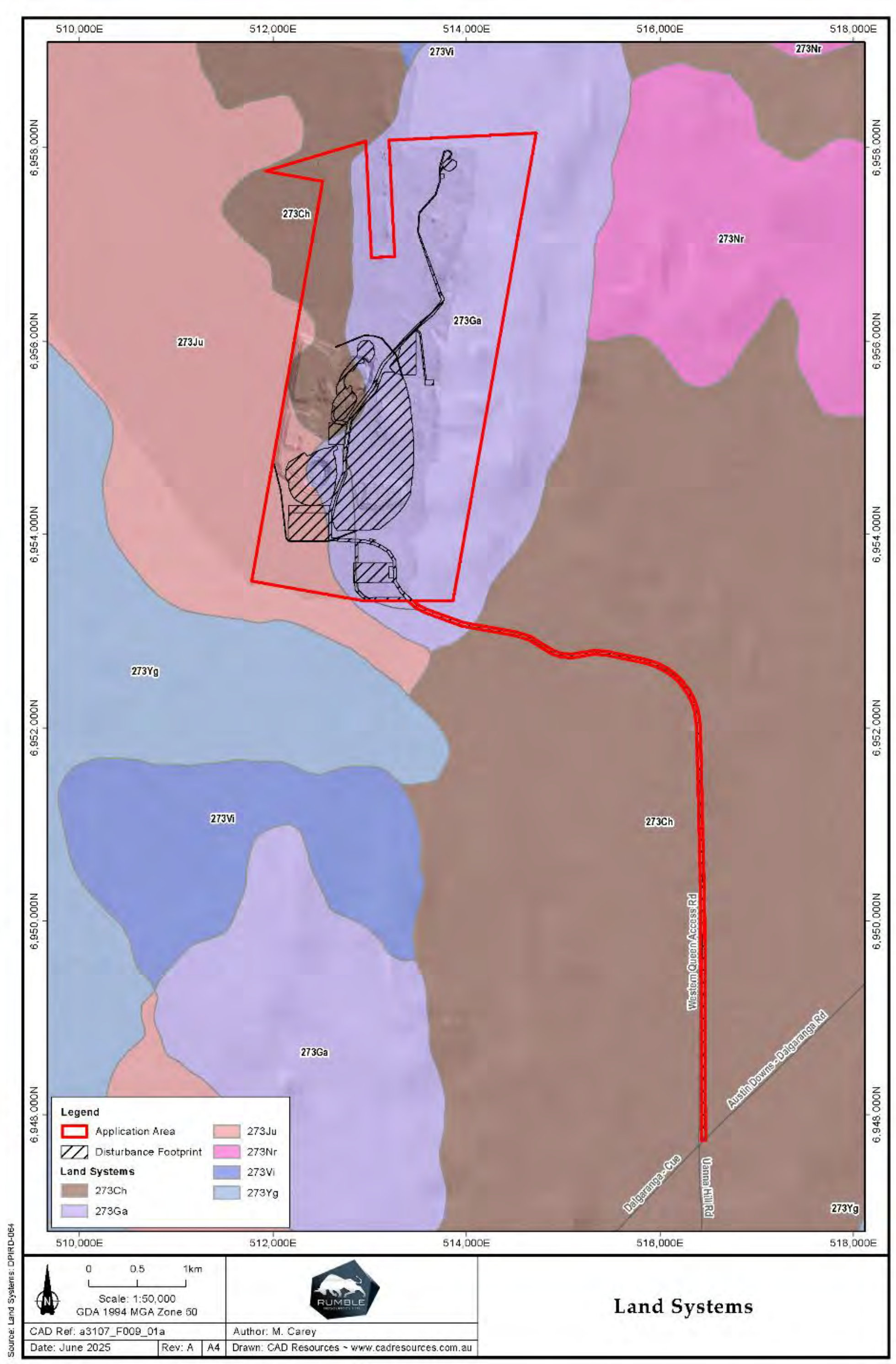

Figure 8 Soil Landscape Systems within the Application Area.

1.5 Conservation Reserves

The Application area is not located within a proposed or gazetted conservation reserve. The nearest conservation reserve is the Dalgaranga and Noongal National Reserve located approximately seven kilometres south of the Application area.

1.6 Surface and Groundwater /Wetlands and Watercourses

According to available databases, the Application area is not located within a Public Drinking Water Source Area (PDWSA). The nearest PDWSA is the Mount Magnet Water Reserve located approximately 70 kilometres south-east of the Application area (Government of Western Australia 2025).

The Application area is located within the Murchison River surface water catchment area which covers approximately 10,380,649 ha. According to the Geoscience Australia database (2015), there are no permanent wetlands or ephemeral water bodies within the Application area. There are several minor ephemeral drainage channels within the Application area, which drain northwest to the Sanford River a tributary of the Murchison River. There are two main streams within the catchment that are each about 2.5 km in length. The northern stream has a catchment area of 150 ha and is currently diverted around the existing Western Queen South Pit (AECOM 2025a, Appendix 3).

Groundwater is generally contained in a fractured aquifer comprising weathered Archaean saprolitic rocks. Historical groundwater quality testing from the local area near the Western Queen South Pit shows brackish water with average total dissolved solids (TDS) of 1,030 mg/L and a neutral to slightly alkaline pH ranging from 7.3-7.55 (AECOM 2025b, Appendix 4).

Groundwater Dependent Ecosystems (GDEs) includes biological assemblages of species such as wetlands or woodlands that use groundwater either opportunistically or as their primary water source. For the purposes of this report, a GDE is defined as any vegetation community that derives part of its water budget from groundwater and must be assumed to have some degree of groundwater dependency. In accordance with the BoM Atlas of Groundwater Dependent Ecosystems (BoM, 2025a) database, there are three potential terrestrial GDEs within the Application area, all of which are categorised as low potential (Table 9). There are no potential aquatic GDEs within the Application area (Figure 9). The Botanica (2025) survey of the Application area did not identify any significant vegetation assemblages and concluded there was a low risk of potential terrestrial GDEs in the adjacent floodplain areas.

Given the current depth of the water table there are likely no groundwater dependent ecosystems within or near the Application area that will be directly or indirectly affected by any changes in hydrology.

Table 9. Potential GDEs of the Application area (BoM 2025a)

Geomorphology	Potential	Vegetation Description
Sandplains and hardpan wash plains with outgoing drainage and salt lakes, broken by ridges of metamorphic rocks and granite.	Low	Low breakaways with saline gravelly lower plains supporting predominately halophytic low shrublands.
		Salt lakes with extensively fringing saline plains, dunes and sandy banks, supporting low halophytic shrublands and scattered tall acacia shrublands.
		Distributary alluvial fans and wash plains supporting Mulga - chenopod shrublands.

The flora and vegetation surveys of the Application area conducted by Outback Ecology (2012a) and Botanica (2025) identified vegetation communities associated with ephemeral drainage lines. These vegetation communities recorded on drainage depressions have been described as 'Acacia forests and woodlands' are not considered to be Groundwater Dependent Ecosystems (GDEs) and whilst locally variable, are relatively widespread throughout the Murchison bioregion (Botanica 2025).

Average annual rainfall is low at approximately 300 millimetres (BoM 2025b); therefore, surface water flow is likely to be low during normal seasonal rains. Furthermore, as the Application area experiences an average annual evaporation rate of 3,600 millimetres (BoM 2025b), during normal rainfall events, surface water within the Application area is likely to evaporate quickly and removal of vegetation is unlikely to contribute to a rising saline water table.

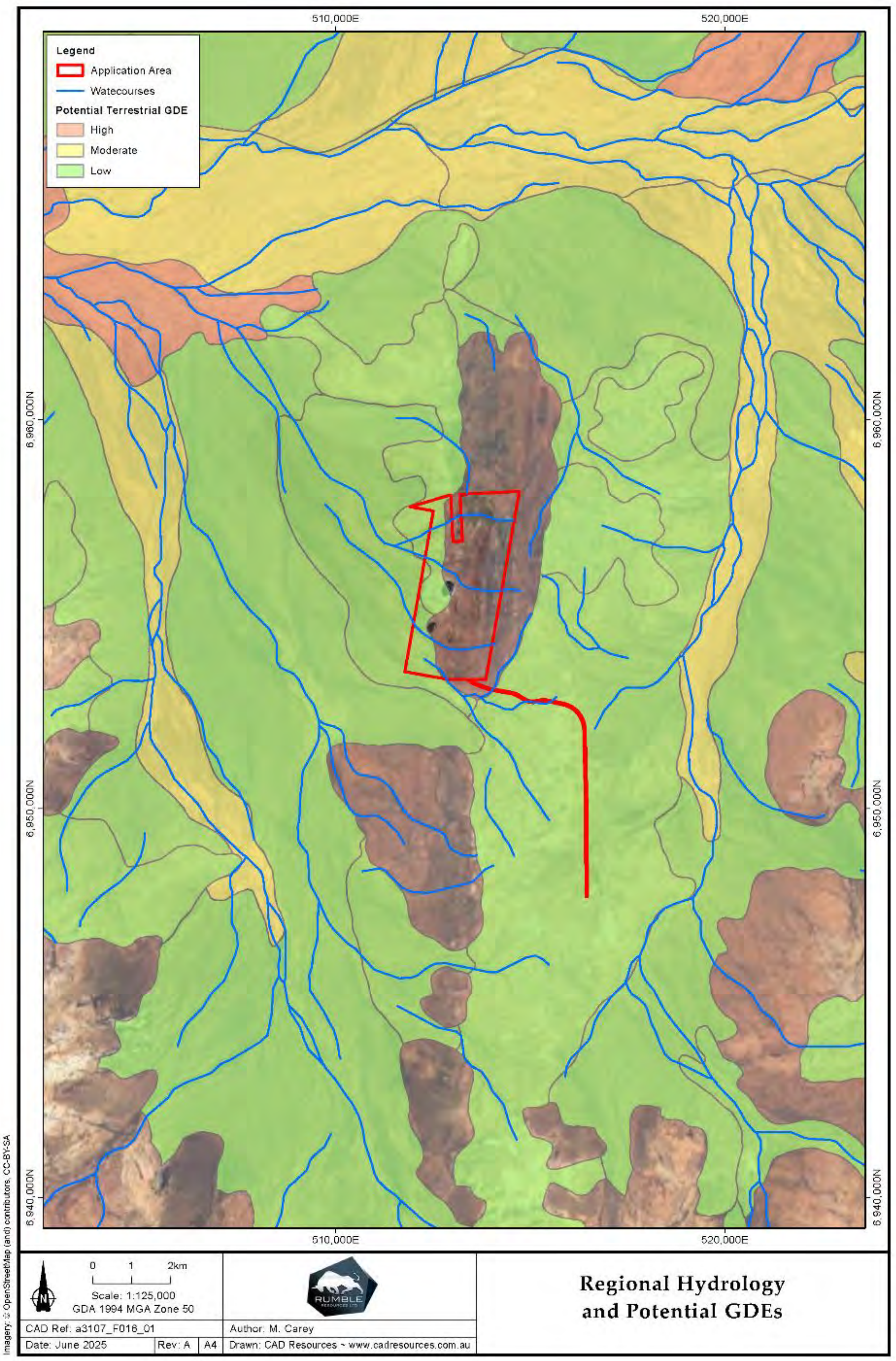

Figure 9. Regional Hydrology and Potential GDEs within the Application Area (BoM 2025a).

2 Assessment against the 10 Clearing Principles

Clearing Principle	Assessment
(a). Native vegetation should not be cleared if it comprises a high level of biological diversity.	The vegetation of the Application area has been described as being dominated by *Acacia* shrublands (Outback Ecology 2012, Botanica 2025). No Threatened or Priority Ecological Communities were identified as potentially occurring within the Application area and none of the vegetation types mapped and described are listed as Threatened or Priority Ecological Communities (Outback Ecology 2012; Botanica 2025). The 2012 survey identified 80 plant taxa within the Application area and in areas directly adjacent (Outback Ecology, 2012a), whilst the 2025 survey identified 86 plant taxa within the area surveyed. These are considered to be relatively low numbers for this area however, given the close proximity to current mining operations this is not considered unusual (Outback Ecology, 2012a). The assessment of the DBCA Threatened and Priority flora database searches (DBCA, 2024), ALA (ALA, 2024) and Protected Matters Search Tool (DCCEEW, 2025) and previous relevant literature identified 22 significant flora species (one Threatened, four Priority 1, two Priority 2, 11 Priority 3 and four Priority 4) recorded within a 40 km radius of the survey area, with no significant flora species having previously been recorded in the Application area (Botanica 2025). One Priority 4 taxon, *Acacia speckii,* was identified as 'likely to occur' and three taxa, *Petrophile vana* (P1), *Eremophila simulans subsp. megacalyx* (P3) and *Grevillea inconspicua* (P4) were identified as 'possibly occurring' in the Application area. One Priority 4 species, *Dodonaea amplisemina* was recorded in the Application area on rocky hills during the Outback Ecology (2012) survey. Larger populations of *Dodonaea amplisema* were found in areas of rocky hills outside of the Application area (Outback Ecology, 2012a). This type of habitat is not present within the Application area (Outback Ecology, 2012a); therefore it is considered unlikely that *Dodonaea amplisema* would occur elsewhere in the Application area. No Threatened or Priority flora species were identified within the Application area during the Botanica (2025) survey. Priority flora species potentially present are not locally or regionally restricted and occur across multiple IBRA bioregions or subregions (Western Australian Herbarium, 1998-). Given the known records and distribution of these species, the proposed clearing is unlikely to have a significant impact on the conservation status of Priority flora potentially present. Two introduced flora species, **Cucumis myriocarpus* and **Solanum nigrum*, have been recorded within the application area (Outback Ecology, 2012a). Weeds have the potential to alter the biodiversity of an area, competing with native vegetation for available resources and making areas more fire prone. This can in turn lead to greater rates of infestation and further loss of biodiversity if the area is subject to repeated fires. Neither of these species are listed as 'Declared Plant' species under the *Biosecurity and Agriculture Management Act* 2007. No weed species were recorded during the Botanica (2025) field survey. None of the flora species or vegetation communities recorded are listed as Threatened at a National or State level.

	According to the results of the ALA database search (ALA, 2024), a total of 208 terrestrial vertebrate fauna taxa have been recorded within 40 km of the survey area, consisting of 156 birds, ten mammal, 33 reptile and nine amphibian taxa (Botanica 2025). The desktop review identified 13 terrestrial vertebrate fauna species of conservation significance that have previously been recorded in the regional area1, some of which have the potential to occur in or utilise sections of the survey area at times. These species consisted of eight Threatened and seven migratory species (of which two are also listed as Threatened) under the EPBC Act (Botanica 2025). Based on vegetation and associated landforms identified during the flora and vegetation assessment, five broad scale terrestrial fauna habitats were identified as occurring within the survey area. It was determined that the Application area encompasses modest variation in terms of broad fauna habitats, with the majority of habitats considered widespread and typical of the Western Murchison bioregion. It should be noted that while habitats onsite for one or more of the species listed above are considered possibly suitable, some or all may be marginal in extent/quality and therefore the fauna species considered as possibly occurring may in fact only visit the area for short periods as infrequent vagrants. There was no evidence of significant fauna species observed during the survey (Botanica 2025). Based on the above, **the proposed clearing is not likely to be at variance to this Principle.**
(b). Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Botanica (2025) identified five broad scale terrestrial fauna habitats based on vegetation and associated landforms within the Application area. These habitats include: • Acacia forest and woodland on clay-loam plain • Acacia forest and woodland in drainage depression • Acacia forest and woodland on rocky hillslopes • Acacia forest and woodland on rocky plain • Chenopod shrubland on clay-loam plain All of the fauna habitats identified, with the exception of the 'Acacia forest and woodland on rocky plain', were described as being unsuitable for burrowing species. From the likelihood of occurrence assessment based on habitat and distribution data obtained from publicly available databases (Botanica 2025), three conservation significant species Mallefowl (*Leipoa ocellata*) (EPBC Act and BC Act: Vulnerable), Rainbow bee-eater (*Merops ornatus*) (EPBC Act: Migratory) and Southern Whiteface (*Aphelocephala leucopsis*) (EPBC Act and BC Act: Vulnerable) are assessed as "Possibly utilising the survey area at some time". There was either no evidence of the species (nesting mounds, diggings, tracks or scats in the case of the Malleefowl) nor were they observed during the surveys. It should be noted that while habitats onsite for one or more of the conservation significant species listed are considered possibly suitable, some or all may be marginal in extent/quality and therefore the fauna species considered as 'possibly occurring' may in fact only visit the area for short periods as infrequent vagrants (Botanica 2025). The habitats within the Application area are common throughout the Western Murchison Bioregion and given the relatively small scale of the proposed clearing in previously

<table>
<tr>
<td></td>
<td>disturbed areas and adjacent to existing mine operations, it is considered unlikely that the proposed clearing will significantly impact any conservation significant fauna species.

Based on the above, the proposed clearing is not likely to be at variance to this Principle.</td>
</tr>
<tr>
<td>(c). Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.</td>
<td>None of the vascular flora species recorded during the surveys are listed as Threatened or Declared Rare Flora at a National or State level. No DRF or Threatened species are listed to occur in the Murchison 2 bioregion and given the habitats present and levels of disturbance none are expected to occur in the Application area.

Based on the above, the proposed clearing is not likely to be at variance to this Principle.</td>
</tr>
<tr>
<td>(d). Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.</td>
<td>There are no known Threatened Ecological Communities (TECs) located within or in close proximity to the Application area.

The DBCA’s Threatened Ecological Community List (State of Western Australia, 2023) does not list any TECs within the Shire of Yalgoo.

None of the vegetation communities mapped during either survey were analogous to any TECs or PECs and are widespread outside of the Application area, in the surrounding pastoral station (Outback Ecology 2012a; Botanica 2025).

Based on the above, the proposed clearing is not likely to be at variance to this Principle.</td>
</tr>
<tr>
<td>(e). Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</td>
<td>The Application area falls within the Murchison Bioregion of the Interim Biogeographic Regionalisation for Australia (IBRA). The application area is broadly mapped as Beard vegetation association 39: Shrublands; Mulga shrub and a small area in the south-western corner as 18: Low woodland; mulga (Acacia aneura).

Approximately 99.1% and 99.68% of Beard vegetation associations 39 and 18 remains within the Murchison bioregion, respectively (Government of Western Australia, 2019). Therefore, the application area does not represent a significant remnant of native vegetation in an area that has been extensively cleared.

<table>
<tr><th></th><th>Pre-European area (ha)*</th><th>Current extent(ha)*</th><th>Remaining %*</th><th>Pre-European % in IUCN Class I-IV Reserves (and post clearing %)</th></tr>
<tr><td>IBRA Bioregion - Murchison</td><td>28,120,587</td><td>28,044,823</td><td>~99.73</td><td>~1.04</td></tr>
<tr><td colspan="5">Beard vegetation associations - State</td></tr>
<tr><td>18</td><td>19,892,306</td><td>19,843,148</td><td>~99.75</td><td>~2.13</td></tr>
<tr><td colspan="5">39</td></tr>
<tr><td>Beard vegetation associations - Bioregion</td><td></td><td></td><td></td><td></td></tr>
</table>

Based on the above, the proposal is not at variance to this Principle</td>
</tr>
</table>

(f). Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	There are no permanent watercourses or wetlands within the area proposed for clearing. Multiple drainage lines either pass through or are adjacent to the Application area. Most of the drainage lines in the region are ephemeral, only flowing briefly immediately following significant rainfall. The flora and vegetation surveys of the Application area conducted by Outback Ecology (2012a) and Botanica (2025) identified vegetation communities associated with ephemeral drainage lines. These vegetation communities recorded on drainage depressions have been described as 'Acacia forests and woodlands' are not considered to be Groundwater Dependent Ecosystems (GDEs) and whilst locally variable, are relatively widespread throughout the Murchison bioregion (Botanica 2025). **Based on the above, the proposal is not likely to be at variance to this Principle**.
(g). Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The Application area lies within the Jundee, Gabanintha and Challenge land systems, with the majority of the disturbance footprint lying within the Gabanintha land system. These land systems have been mapped and described in technical bulletins produced by the former Department of Agriculture (now the Department of Primary Industries and Regional Development, DPIRD). All land systems have slight potential for soil erosion with alteration of natural sheet flow being a cause in the Jundee land system. Potential erosion impacts as a result of the proposed clearing may be minimised by the implementation of a staged clearing condition and a watercourse management condition Based on the above, **the proposed clearing may be at variance to this Principle.**
(h). Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	There are no conservation areas within or in the vicinity of the application area. The nearest conservation reserve is the Dalgaranga and Noongal National Reserve located approximately seven kilometres south of the Application area. The proposed clearing is unlikely to impact on the environmental values of any conservation area. Based on the above, **the proposed clearing is not likely to be at variance to this Principle.**
(i). Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	There are no Public Drinking Water Source Areas within or in close proximity to the Application area. There are no permanent watercourses or wetlands within the proposed clearing area. Drainage lines in the region are ephemeral, only flowing briefly immediately following significant rainfall. The proposed clearing is unlikely to result in significant changes to surface water flows. The proposed clearing is unlikely to cause deterioration in the quality of underground water. Based on the above, **the proposed clearing is not likely to be at variance to this Principle.**

(j). Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The climate of the Murchison bioregion is semi-arid, with an average rainfall near the Application area of approximately 217.5 millimetres per year (BoM, 2025b). Drainage lines in the area are ephemeral, only flowing briefly immediately following significant rainfall during late summer and early autumn. There are no permanent water courses or waterbodies within the Application area. Seasonal drainage lines are common in the region and temporary localised flooding may occur briefly following heavy rainfall events. However, the proposed clearing is unlikely to increase the incidence or intensity of natural flooding events. Based on the above, **the proposed clearing is not likely to be at variance to this Principle.**

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APPENDIX 1

FLORA AND VEGETATION ASSESSMENT REPORT (OUTBACK ECOLOGY 2012)





Ramelius Resources Limited

Western Queen South Gold Project

Level 1 Vegetation and Flora Assessment

June 2012

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Level 1 Vegetation and Flora Assessment

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Final Report	Kelly Boxall	Jeni Alford	KB/JA	16/07/2012

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Executive Summary

Ramelius Resources Limited (Ramelius) is carrying out investigations to support a mining proposal for the Western Queen South Gold Project (the Project). Ramelius commissioned Outback Ecology to undertake a Level 1 Flora and Vegetation survey incorporating a literature review and a field component undertaken over three days in April 2012. The Project is located approximately 90 km north-west of Mt Magnet and 75 km west-south-west of Cue. The Study area comprises a proportion of tenements M59/08, M59/45 and L59/40 and covers approximately 460 ha.

The objectives of the Level 1 Flora and Vegetation survey were to:

- complete a desktop assessment to develop an inventory of flora species and vegetation communities previously identified within the Study are, or likely to be present within the Study area and its surrounds;
- assess the desktop findings in a regional context by comparison with available data from other localities within the bioregion;
- verify the results of the desktop study via a ground reconnaissance and undertake targeted searches for conservation significant flora, vegetation communities or habitat likely to support these, and groundwater dependent ecosystems;
- delineate and map vegetation communities and vegetation condition in the Study area;
- identify the potential impacts of the Project on the vascular flora and vegetation communities and their habitat within the Study area;
- provide management advice where any flora species of vegetation community of conservation significance is recorded within the Study area; and
- address whether it is likely that the proposed developments will be at variance with the ten clearing principles.

The desktop assessment incorporating a literature review and database searches determined that 12 Priority Flora species may occur in the Survey area but that it was highly unlikely that any Threatened Flora species (DRF), Threatened Ecological Communities (TEC) or Priority Ecological Communities (PEC) would occur there.

Six vegetation associations were mapped during the field survey of the Western Queen South Survey area and an area of historic mining disturbance was also mapped. None of the vegetation associations was analogous to any listed TECs or PECs. However the largely intact ephemeral flow lines, mapped as vegetation association 2, were considered to be of slightly higher conservation value than other associations as they are likely to provide refugia and corridors for local fauna. Vegetation association 4 was also considered to be of higher conservation value as it provided primary habitat for a Priority 4 Flora species *Dodonaea amplisemina*. This species was also recorded in small numbers in vegetation association 1 but on a very small (unmapped) low rocky hill near the northern edge of the proposed Waste Dump in Relevé 5.

A total of 80 vascular flora species were recorded in the Survey area and only one of these *Dodonaea amplisemina* was of conservation significance. The proportion of plant families represented in the Survey area was broadly analogous to that found in the wider bioregion and did not represent a particularly species rich assemblage. The Survey area has been historically impacted by mining and grazing and the overall vegetation condition ranged from Very Good to Completely Degraded with the majority of the vegetation being in Good Condition.

The Ten Clearing Principles were considered in relation to the proposal to clear 74.5 ha of land within the Survey area for a new waste dump, ore pad, topsoil stockpiles, turkeys nest dam and infrastructure. The proposal was considered not to trigger any of the principles that would preclude clearing, namely:

1. the floristic diversity within the Survey area is relatively low;
2. the habitat within the Survey area does provide habitat for native fauna, however it has been disturbed by historical mining and grazing and thus is no more significant than the surrounding vegetation within the pastoral leases;
3. there are no Threatened or Declared Rare Flora species in the Survey area and the available habitat is unlikely to support any;
4. there are no vegetation associations analogous to any described Threatened or Priority Ecological Community in the Survey area;
5. vegetation associations within the Survey area appear to well represented outside, however association 4 supports a Priority 4 species which indicates that it is of higher conservation value and possibly less well represented outside of the Survey area. However the main extent of this vegetation is not proposed to be cleared or impacted by the proposal;
6. there are several small ephemeral watercourses in the Survey area that are mapped as vegetation association 2. The proposed clearing footprint largely does not impinge on any of these watercourses and the orientation of the proposed landforms is unlikely to impact them to any significant level;
7. the Survey area has already been impacted by historical mining and grazing and the relatively small areas proposed for the Project are unlikely to cause further appreciable land degradation other than by the clearing itself;
8. the closest environmentally sensitive areas (DEC managed land) are 10 km to the south of the Survey area and are highly unlikely to be affected by the proposed clearing;
9. the areas selected for the proposed mining landforms are largely between flow lines and floodplains and thus are highly unlikely to cause any deterioration of surface water or groundwater quality; and
10. some small areas close to existing mining landforms are subject to localized flooding and pooling of water primarily as a result of historical interception of flow lines and other surface drainage. The proposed clearing, except for one small corner of the proposed Ore Pad avoids flow lines and floodplain areas. Minor adjustments to design and management will readily avoid any further disruption of surface water flows and potential flooding.

The proposed clearing of vegetation for the development of the Western Queen South Project is unlikely to cause any significant environmental impacts or loss of status of significant vegetation types or vascular flora species. Management of hydrocarbons, machinery hygiene for earthworks, clearing and vehicles access controls will minimise the likelihood of contamination of ground and surface water, introduction or increase in numbers of introduced plant species, excessive clearing or inadvertent vegetation damage through off-road activities.

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1. INTRODUCTION

1.1. Project Background and Location

Ramelius Resources Limited (Ramelius) is carrying out investigations to support a mining proposal for the Western Queen South Gold Project. The project is located approximately 90 km north-west of Mt Magnet (**Figure 1**). In order to submit a mining proposal to the DMP, Ramelius is required to evaluate areas proposed for the disturbance footprint including re-evaluating those previously surveyed for mining operations. It was considered that a Level 1 Flora and Vegetation survey with an assessment of the Ten Clearing Principles would provide adequate background information to apply for a Native Vegetation Clearing Permit. The survey area lies within tenements M59/208, M59/45 and L59/40. The area surveyed covers approximately 460 ha (**Figure 2**).

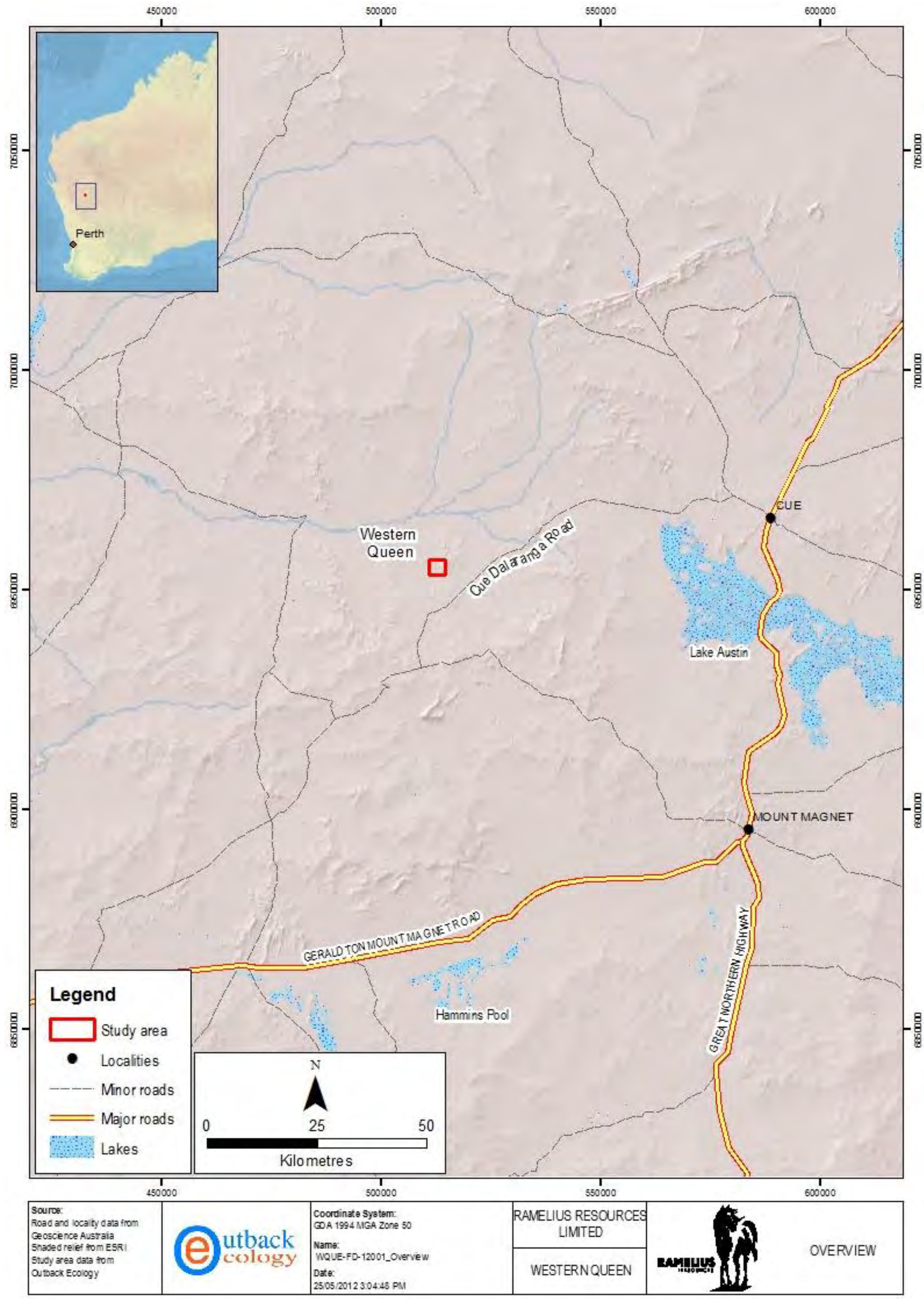


Figure 1: Western Queen South Gold Project location

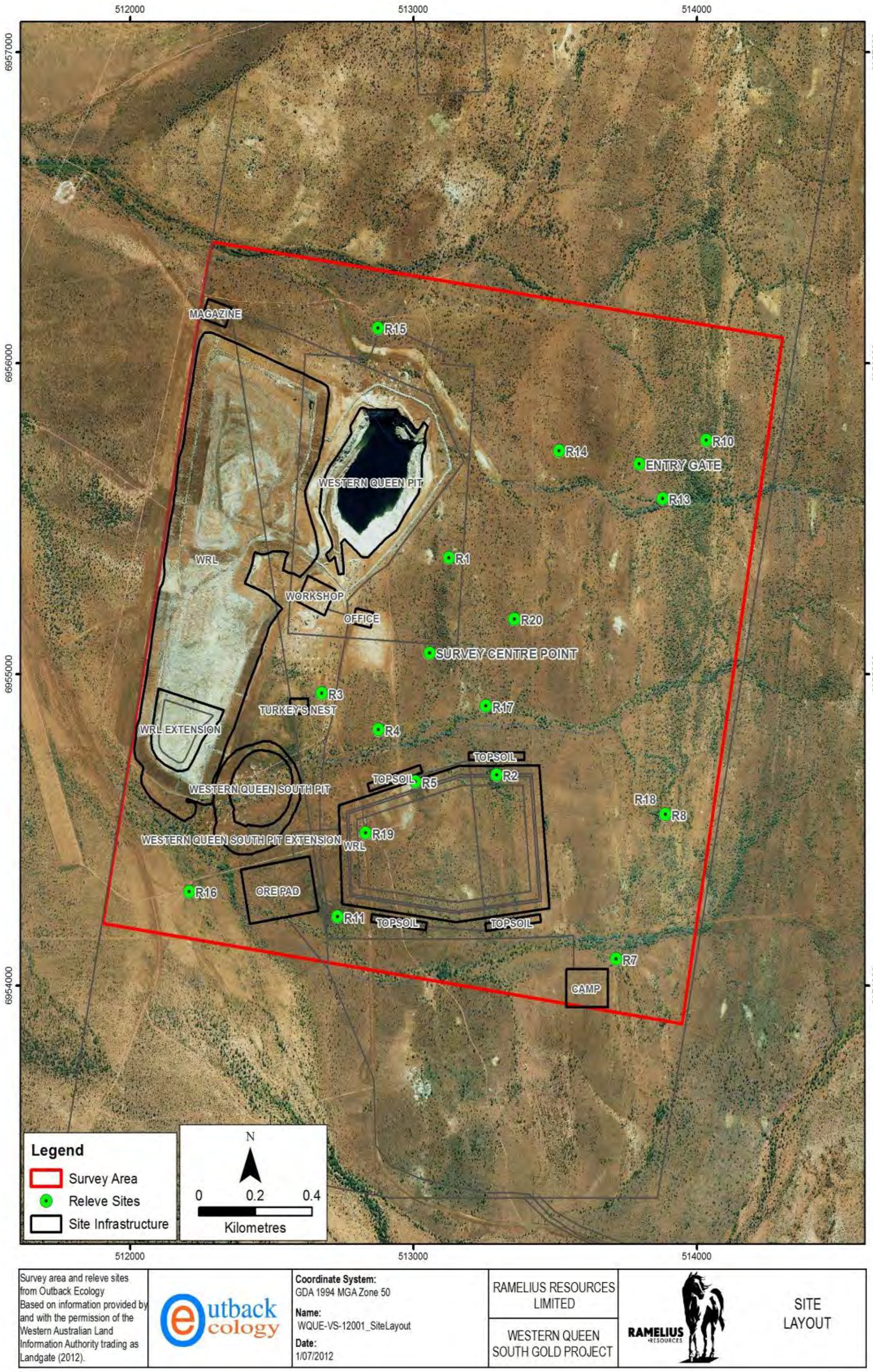


Figure 2: Western Queen South survey area showing centre point and way points sampled

1.2. Assessment Objectives

The specific objectives of this Level 1 flora and vegetation assessment were to:

- complete a desktop assessment to develop an inventory of flora species and vegetation communities previously identified within the Study area, or likely to be present within the Study area and its surrounds;
- assess the desktop findings in a regional context by comparison with available data from other localities within the bioregion;
- verify the results of the desktop study via a ground reconnaissance and undertake targeted searches for conservation significant flora, vegetation communities or habitat likely to support these, and groundwater dependent ecosystems;
- delineate and map vegetation communities and vegetation condition in the Study area;
- identify the potential impacts of the Project on the vascular flora and vegetation communities and their habitat within the Study area;
- provide management advice where any flora species of vegetation community of conservation significance is recorded within the Study area; and
- address whether it is likely that the proposed developments will be at variance with the ten clearing principles.

2. DESKTOP ASSESSMENT

Government databases were searched and reviewed for conservation significant flora, vegetation communities and weeds that are either known to occur or have the potential to occur in the Survey area. A search was made of the Department of Environment and Conservation's Threatened and Priority Ecological Communities (TECs and PECs) and Threatened and Priority Flora databases. Descriptions of the categories of TECs and PECs are provided in **Appendix A** and categories of Threatened and Priority Flora are described in **Appendix B**. The data from these sources and FloraBase were used to determine whether suitable habitat for significant flora and vegetation communities is likely to occur in the Survey area.

2.1. Database Searches

A comprehensive database search was undertaken for the Survey area, based on what was considered the centre point of the Survey area at 117^{o}07'56" E, 27^{o}31'41"S. Both Federal and State databases were searched (**Table 1**).

2.2. Literature Review

A literature review was undertaken of previous flora and vegetation survey work conducted over the Study area and surrounds (**Table 2**) including:

- BSD (1995) Hill 50 Gold Mine NL Western Queen Deposit. Notice of Intent. Prepared by BSD Consultants Pty Ltd for Hill 50 Gold Mine NL.
- Curry, P.J., Payne, A.L., Leighton, K.A., Hennig, P. & Blood, D.A. (1994) An inventory and condition survey of the Murchison River catchment and surrounds, Western Australia. Western Australian Department of Agriculture *Technical Bulletin* 8;
- Desmond et al. (2001) *Murchison 2 (MUR2 - Western Murchison subregion) – Biodiversity audit of the Western Murchison subregion*
- Outback Ecology (2007) Mt Magnet Gold, Harmony Gold Australia: Flora Survey of the Proposed Western Queen South Project M59/208; and
- Lindbeck, K. & Associates (1999) *Equigold NL as Project Manager for Dalgaranga Gold Mines Joint Venture – Addendum to Western Queen Notice of Intent (June 1998) Western Queen South Open Pit.* Report prepared for Dalgaranga Gold Mines Joint Venture by Keith Lindbeck & Associates, December 1999

Table 1: Database search details

Database	Date Searched	Information Provided	Search area	Search Reference
The Protected Matters Database search tool for Threatened species and Threatened ecological communities	30-3-12	World Heritage Properties National Heritage Places Threatened Ecological communities Threatened species Migratory species	50 km radius	IELWEP
Bureau of Meteorology (BOM) website	27-3-12	Climate statistics and recent rainfall records at the Mt Magnet weather station	N/A	N/A
Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) database (DEC)	Received 3-4-12	TECs and PECs that may occur in the survey area	50 km radius	07-0412EC
Threatened and Priority Flora Database (DEC)	Received 2-4-12	Threatened or Priority flora species that may occur in the survey area	50 km radius	07-0412FL
NatureMap Database	26-3-12	List of flora species that may occur in the survey area; includes priority flora and invasive species	40 km radius	N/A
Declared Weeds database (listed under the *Agriculture and Related Resources Protection Act 1976*.	30-3-12	List of declared weed species that may occur in the survey area	Shire of Yalgoo	N/A
Florabase – The Western Australian Flora	30-3-12	List of flora species that may occur in the survey area	Shire of Yalgoo	N/A

Table 2: Summary of previous flora surveys within the surrounding region

Survey/ Report	Assessment Type and Proximity to Study Area	Vegetation types identified and Floristic Diversity	Threatened Flora, Priority Flora and Floristic Diversity
BSD 1995	Desktop and Level 1 survey Includes the study area and surrounds	**Vegetation types:** Mulga shrubland and woodland over a range of landforms	Nine species that are still classified as conservation significant were recognised (desktop study) **Threatened Flora (DRF)** • *Eremophila rostrata* **Priority Flora (PF)** • *Angianthus microcephalus* • *Angianthus uniflorus* • *Drummondita miniata* • *Goodenia neogoodenia* • *Grevillea inconspicua* • *Hemigenia tysonii* • *Maireana prosthecochaeta* • *Verticordia jamiesonii* No PF or DRF were recorded during the field survey **Floristic Diversity:** 207 species (desktop study) 112 species (survey)
Curry *et al.*	Includes the study area encompassing 88,360 km^2 between Mt Magnet and Meekatharra	**Vegetation types:** Mulga dominated Shrubland and woodland	**Floristic Diversity:** 830 species 97% native 4.5% endemic or near-endemic
MUR 2	Western Murchison IBRA sub region 7,847,996 ha including the survey area	**Vegetation types:** • Mulga low woodlands • Hummock grasslands • Saltbush shrublands • Halosarcia (*Tecticornia*) low shrublands **Threatened Ecological Communites –** none recorded in MUR2	**Threatened Flora (DRF)** • *Eremophila rostrata* 15 Priority 1 species and 4 Priority 2 species
Outback Ecology 2007	Within site tenement M59/208	**Vegetation types:** • Low grass with occasional open scrub • Creekline Open Low Woodland over Open Low Scrub over Open Low Grass • Creekline Open Low Woodland over Open Scrub over Open Low Grass • Rehabilitation / Remnant Very Open Low Grass No TECs observed All degraded to highly degraded	**Threatened Flora (DRF)** • *Eremophila rostrata* (only subsp. *rostrata* and subsp. *trifida* considered DRF) **Desktop**: 15 PF were previously recorded within 50 km of the Study area and 6 considered potentially in Study area **Floristic Diversity:** 19 taxa 11 genera 10 families Mimosaceae Family (now Fabaceae) dominant (5 taxa, 1 genus) No introduced taxa.

Survey/ Report	**Assessment Type and Proximity to Study Area**	**Vegetation types identified and Floristic Diversity**	**Threatened Flora, Priority Flora and Floristic Diversity**
Harmony Gold 2007	Within site tenements M59/208, M59/45, L59/40 Meka Pastoral Station	**Vegetation types:** • Low grass with occasional open scrub • Creekline Open Low Woodland over Open Low Scrub over Open Low Grass • Creekline Open Low Woodland over Open Scrub over Open Low Grass • Rehabilitation / Remnant Very Open Low Grass Degraded to highly degraded	**DRF and PF** 13 taxa were recorded as having been sampled within the coordinates 27°52' – 28°12' S and 117° 58' E None were observed during the field survey **Floristic Diversity:** 19 taxa 11 genera 10 families No introduced taxa.

2.3. Climate

Long term weather data is available for Mt Magnet (90 km south-east of the Project). The area is on the border of two climatic regions – desert (summer and winter rainfall) and semi-desert Mediterranean (Harmony Gold, 2007). The mean daily maximum temperature ranges from 38 degrees in January to 18.7 degrees in July (**Figure 3**) (30 years of records) (BOM, 2012). Mean daily minimum temperatures recorded at Mount Magnet range from 6.7 degrees in July to 22.2 degrees in January (31 years of records) (BOM, 2012) (**Figure 3**). The highest recorded maximum was 47 degrees on 30 December 1972 and the lowest recorded minimum was -1.5 degrees on 12 July 1969 (BOM, 2012). Rainfall is highly variable and unreliable with an average rainfall of 238 mm (from 113 years of data) (BOM, 2012). The wettest months occur between January to August with October to December being the driest months (BOM, 2012) (**Figure 3**). On average there are 47 wet days a year (105 years of data), (BOM, 2012). Evaporation rates are high with the average mean daily evaporation ranging from 2.6 mm in June and July to 12.2 mm in January (Harmony Gold, 2007). The mean monthly relative humidity varies from 74% in June to 35% from December to January at 9am and 50% in June to 19% in December at 3pm (30 years of data) (BOM, 2012). The predominant wind direction recorded at 9am is north-east to easterly. This pattern is similar throughout the year (BOM, 2012). At 3pm the wind direction is variable but is generally easterly to south easterly for the majority of the year with a south westerly trend from August to October (BOM, 2012).

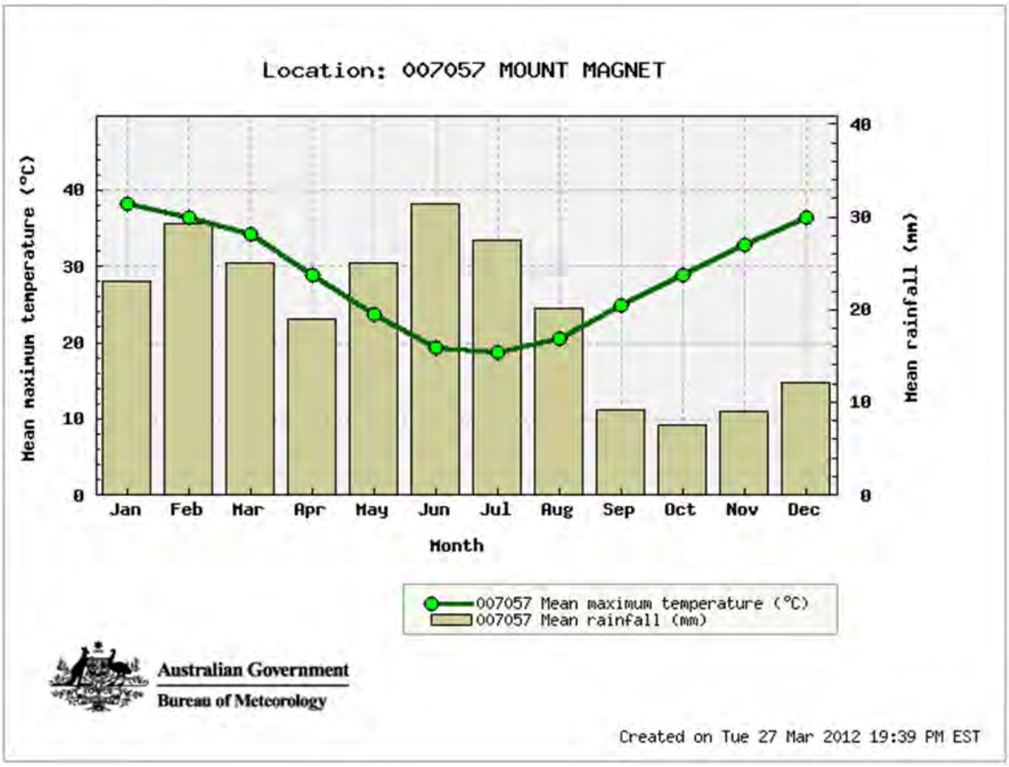


Figure 3: Mean rainfall and mean maximum temperature recorded at Mt Magnet (Rainfall 1894 – 2010 temperature 1957-1997) (BOM 27 March 2012)

2.4. Land Use and Tenure

Land tenure in the Murchison 2 region (Western Murchison subregion) includes pastoral leases, mining tenements and conservation reserves (Desmond et al., 2001). The primary land use in the region is pastoral grazing (96.2%). Although mining interests are also a considerable land use in the region, the majority of mining leases are still covered by the Pastoral Lands Act and are required to be stocked (Desmond et al., 2001). The Western Queen South site occurs within the Meka pastoral lease (Outback Ecology, 2007). The majority of the lease is used for sheep grazing (Outback Ecology, 2007). Low scale mining has occurred at the Western Queen project since the early 1930s with larger scale activity commenced in 1998 by Hill 50 Gold Mine operation, a subsidiary of Western Mining Corporation (now BHP Billiton) and by Dalgaranga Joint Venture between 2000-2001 (Outback Ecology, 2007). Rehabilitation was undertaken at the Western Queen site between 2001 and 2007 during a break in mining activities (Outback Ecology, 2007). In 2007 the site was purchased by Harmony Gold with pit mining carried out up to 40 m depth before the project ceased (Outback Ecology, 2012). Ramelius Resources Ltd purchased the site from Harmony Gold in July 2010.

2.5. Land Systems

The Western Australian Department of Agriculture completed a regional survey of land systems occurring within the Murchison region to develop a comprehensive description of biophysical resources and to provide an assessment of the condition of the soils and the vegetation of the north-eastern Goldfields (Pringle *et al.,* 1994). A component of the survey was the mapping of land types, land units and land systems of the Murchison, including the Study area. An assessment of land systems provides an indication of the occurrence and distribution of vegetation types present within and surrounding the Study area. The Study area is comprised of three land systems (**Table 3**) (**Figure 4**): Challenge, Gabanintha and Jundee land systems.

Table 3: Land systems occurring within the Western Queen South Study Area

Land system	Brief description	Total area (ha) within Study area	Proportion of Study area (%)
Challenge Land System	Gently sloping gritty and sandy-surfaced plains with granite outcrops and minor breakaways, supporting Mulga and some halophytic shrublands.	74	16
Gabanintha Land System	Ridges, hills and footslopes of various metamorphosed volcanic rocks (greenstones), supporting sparse *Acacia* and other mainly non-halophytic shrub lands.	326.4	70
Jundee Land System	Hardpan wash plains with variable dark gravely mantling and weakly groved vegetation; minor sandy banks; supports scattered Mulga shrublands.	67.5	14
Total		**467.9**	

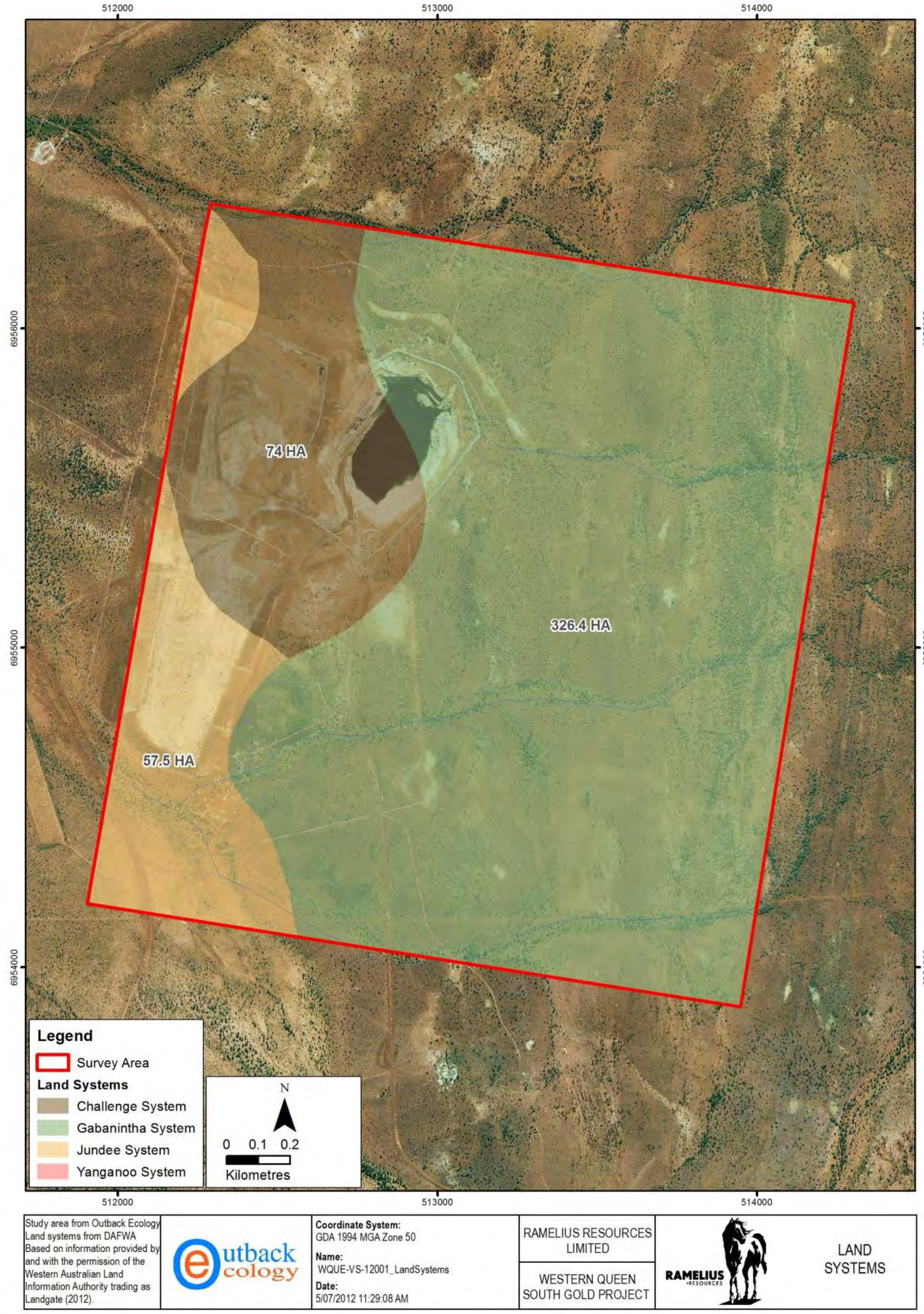


Figure 4: Land systems occurring within and surrounding the Study area

2.6. Beard's Vegetation Mapping

The Survey area is within the Eremaean Botanical Province in the Murchison Region, Austin Botanical District (Beard, 1976). Beard describes the vegetation of the district as “predominantly mulga woodland (*Acacia aneura*) on plains, reduced to scrub on hills” (Beard 1976). The mulga country was recognised by Beard and others as being particularly vulnerable to uncontrolled grazing.

The majority of the Survey area (416.3 ha or 91%) is mapped as Beard’s vegetation association 39 (a1Si) which is described as ‘Shrublands; mulga scrub’. The majority of the pre-European distribution of this vegetation association is still extant in the Murchison 2 subregion (Government of Western Australia, 2010).

The southwest corner of the Survey area is mapped as Beard’s vegetation association 18 (a1Li) described as ‘Low woodland; mulga (*Acacia aneura*)’ and represents 41.5 ha or 9% of the total area. The majority of the pre-European distribution of this vegetation association is still extant in the Murchison 2 subregion (Government of Western Australia, 2010).

Less than 5% of both of these vegetation associations are located within DEC managed lands in the Murchison 2 subregion (Government of Western Australia, 2010).

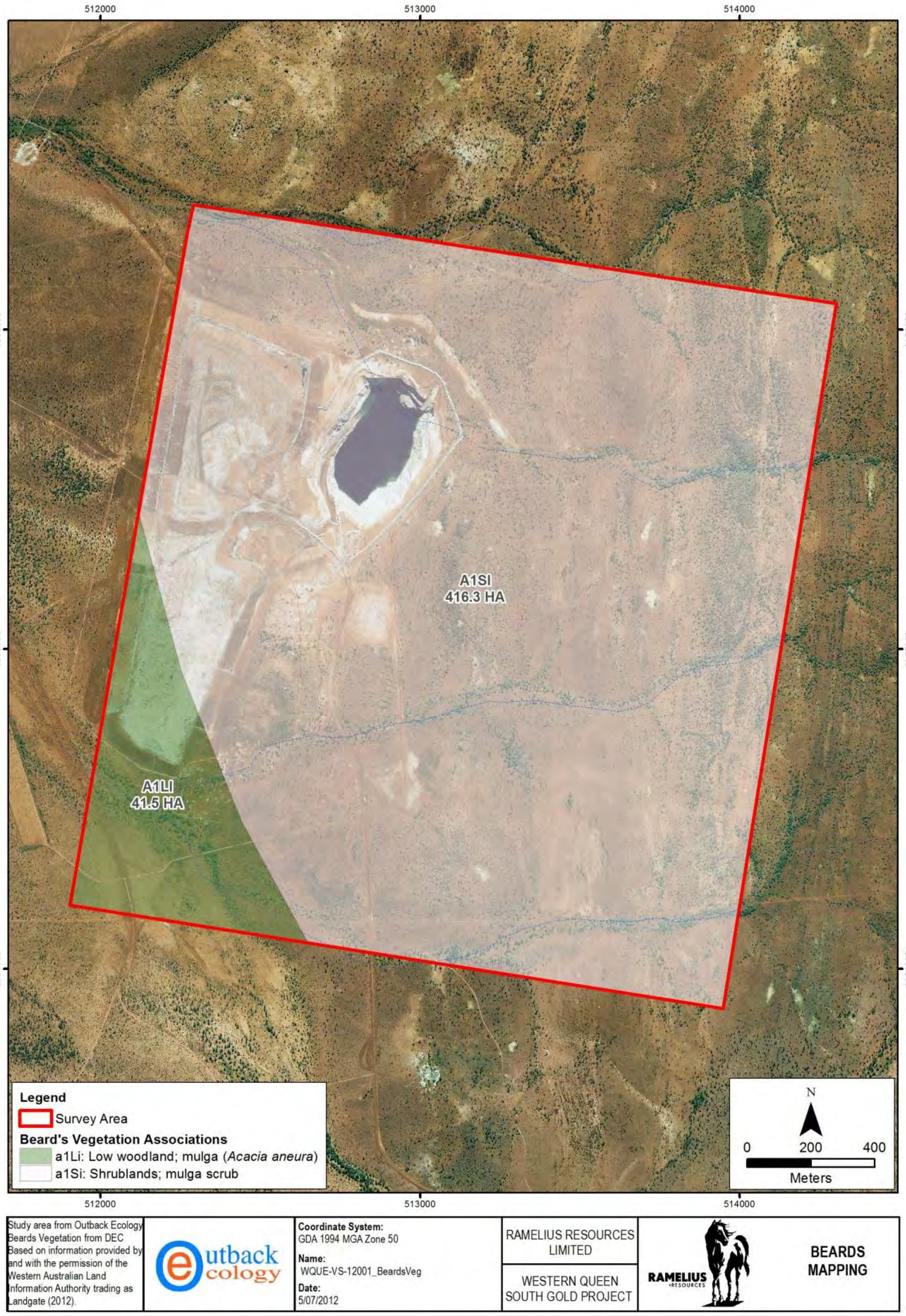


Figure 5: Beard's vegetation associations adjacent to the survey area

2.7. Biogeographic Region and Subregion

The Interim Biogeographic Regionalisation for Australia (IBRA) is a bioregional framework that divides Australia into 85 bioregions and 403 subregions on the basis of climate, geology, landforms, vegetation and fauna (Department of Sustainability, Environment, Water, Population and Communities 2010). The Western Queen South Gold Project is located within the 7,847,996 ha Murchison 2 (MUR2 – Western Murchison) subregion (Desmond *et al.,* 2001) (**Figure 6**). The area includes the northern part of the 'Murchison' Terrains of the Yilgarn Craton (Desmond *et al.,* 2001). MUR2 is an area characterised by "Mulga low woodlands, often rich in ephemerals, extensive hardpan washplains, surfaces associated with the occluded drainage occur throughout with hummock grasslands, saltbush shrublands and *Halosarcia* (now *Tecticornia*) shrublands". The headwaters of the Murchison and Wooramel Rivers occur in this subregion (Desmond *et al.,* 2001).

Grazing of native pastures comprise the dominant land use in the subregion (96.2%) (Desmond *et al.,* 2001). Historically there has been considerable mining interest in the area centred on nickel and gold deposits. Most mining tenements remain under pastoral lease and still require areas to be stocked. UCL and Crown Reserves compose 2.81% of the sub-region (Desmond *et al.,* 2001). The Project area lies within the Meka pastoral station with transport routes expected to traverse the Boogardie pastoral station. Gold has been mined in the area since the 1930s.

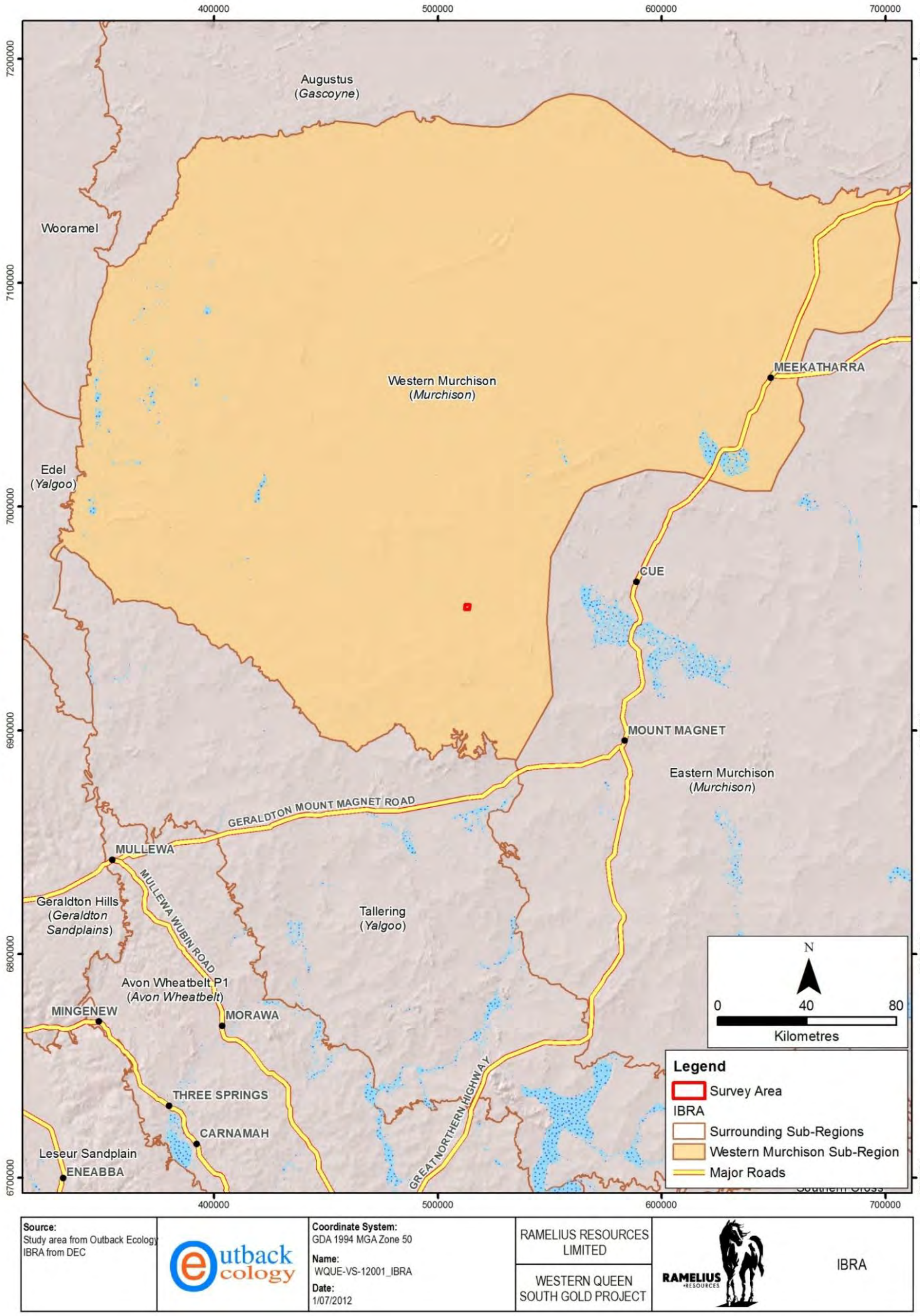


Figure 6: IBRA region and subregion

2.8. Matters of National Significance and Wetlands within 50 km of the Survey Area

The *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) specifies that “actions that have, or are likely to have, a significant impact on a matter of National Environmental Significance require approval from the Australian Government Minister for DSEWPaC (the minister)”. The eight matters of national environmental significance under the *EPBC Act* are:

- World heritage properties;
- National heritage places;
- Wetlands of international importance (listed under the Ramsar convention);
- Listed threatened species and ecological communities;
- Migratory species (protected under international agreements);
- Commonwealth marine areas;
- The Great Barrier Reef Marine Park; and
- Nuclear actions (including uranium mines).

The Protected Matters Database Search Tool allows geographic searches of a given area for the above eight matters of national significance. This database was accessed on Friday, 30 March, 2012, using a 50 km x 50 km square search centred on the Western Queen South site at 117^{o} 07’ 56” East and 27^{o} 31’ 41” South. There are no world heritage properties, wetlands of international importance, threatened ecological communities or threatened flora species within 50 km of the survey area. A single National Heritage Place Wilgie Mia Aboriginal Ochre Mine is located in the Weld Range 70 km north-west of Cue. This site is on the north-east edge of the search area.

2.9. Vegetation Communities and Ecosystems of Conservation Significance within 50 km of the Survey Area

Threatened Ecological Communities are protected under Commonwealth legislation and are recognised on a state and national level. Schedule 2 of the *Environmental Protection, Biodiversity and Conservation (EPBC) Act 1999* provides protection for threatened communities. Threatened ecological communities are allocated to one of four categories: ‘Presumed Totally Destroyed’, ‘Critically Endangered’, ‘Endangered’ or ‘Vulnerable’. Approval from the Minister for Sustainability, Environment, Water, Population and Communities must be sought to undertake any action that is likely to have a significant impact on a threatened ecological community.

Priority Ecological Communities are possible threatened ecological communities that do not meet survey criteria or that are not adequately defined. They are ranked in order of priority for survey and evaluation of their conservation status. DEC (2010) definitions of Threatened and Priority Ecological Communities are provided in **Appendix A.**

A search was undertaken of the DEC’s TEC and PEC databases. The search was conducted using a buffer of 50km from the survey area centre point (latitude 27°31'41.00"S, longitude 117° 7'56.00"E). Desktop studies did not identify any TECs or PECs within the Study area. However, two Priority 1 PECs, Gabyon calcrete groundwater assemblage type on Moore palaeodrainage on Gabyon Station and Meka calcrete groundwater assemblage on Murchison palaeodrainage on Meka Station, were found within 50 km of the Survey area (DEC, 2012) (**Figure 7**). Both of these PECs are made up of significant assemblages of invertebrates that are associated with groundwater in calcretes.

2.10. Conservation Reserves in the Vicinity

There are no conservation reserves adjacent to the Study area; however there is a DEC managed reserve less than 10 km to the south (**Figure 7**).

2.11. Flora of Conservation Significance within 50 km of the Survey Area

2.11.1. Threatened Flora

The DEC reviews the status of all flora species in Western Australia and identifies Threatened Flora (TF) that may be at risk of extinction without legislative protection. A list of Threatened (Declared Rare) Flora is published annually under the *Wildlife Conservation Act 1950* and the DEC reviews the status of these species to determine what resources are required to protect them.

A search of the DEC Threatened (Declared Rare) and Priority Flora database did not indentify any Threatened (Declared Rare) Flora species within 50 km of the Survey Area.

2.11.2. Priority Flora

Priority Flora (PF) are species listed by the DEC that have no legislative protections but may either be poorly known or their status and distributions are known but are considered at risk by threatening processes. The four categories of PF are described in **Appendix B.** A total of 67 species are listed on Florabase (DEC 2012) as occurring in the Shire of Yalgoo.

A search of the DEC flora databases identified 12 PF species that have been recorded within 50 km of the Survey area. The locations of these species in relation to the Survey area are shown in (**Figure 7**). The habit, flower colour, habitat, flowering times and likelihood of each species being present in the Study area are summarised (**Table 4**). A photograph of each species has also been included where available.

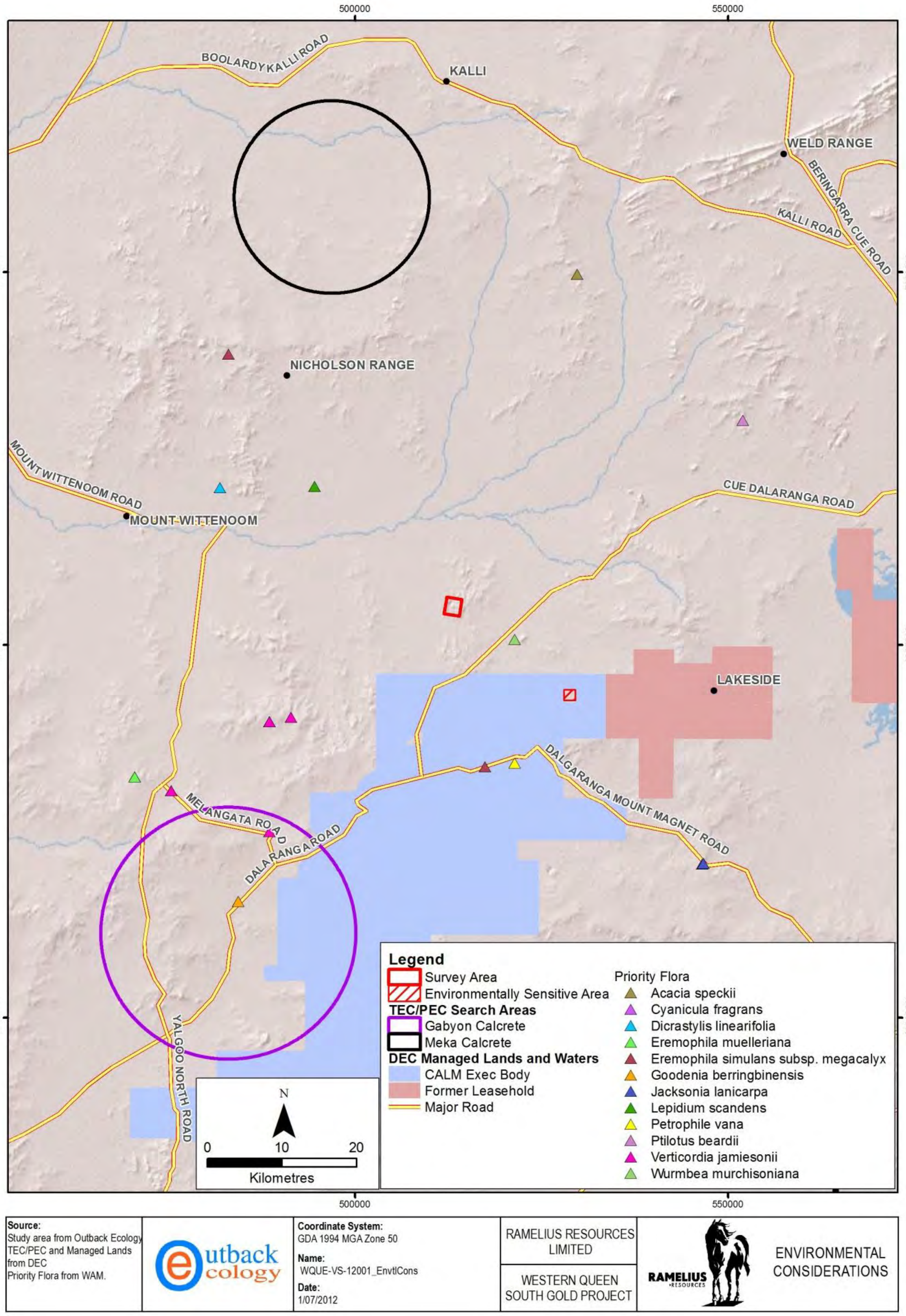
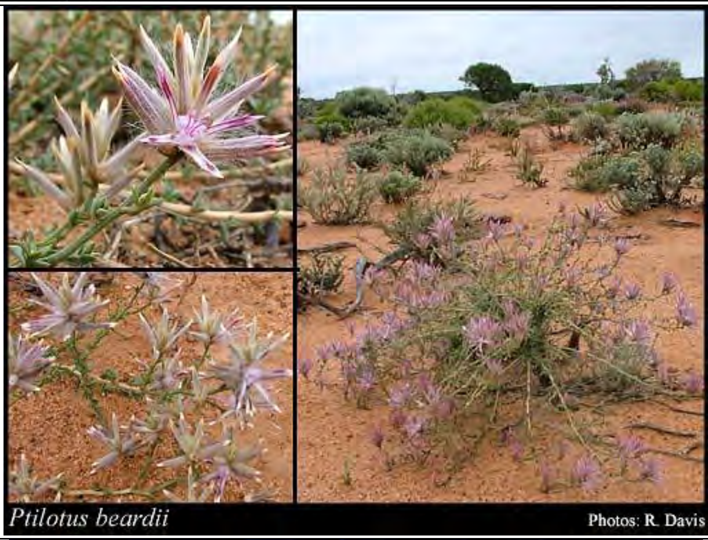


Figure 7: Matters of conservation significance within 50 km of the Survey area

Table 4: Priority Flora Species recorded within 50 km of the survey area

Taxa (Priority)	Image
Acacia speckii (P4) Bushy rounded shrub or tree 1.5 to 3 m. Rocky soils over granite, basalt or dolerite rocky hills or rises. Flowers in March. Possible	Not available
Cyanicula fragrans (P3) Tuberous, perennial herb from 0.06 to 0.12 m. Flowers blue between August and September. Red loam. Flat granite outcrops. Unlikely	
Dicrastylis linearifolia (P3) Much-branched shrub 1 to 3 m, inflorescence with scale-like indumentum; upper surface of leaves hairy; stamens usually 5. Flowers white between November and December. Red sand. Sandplain. Unlikely	

Taxa (Priority)	Image
Eremophila muelleriana (P3) Shrub or tree from 0.5 to 2.8 m. Flowers purple/purple-red/purple-black between August to October. Granitic soils. Unlikely	
Eremophila simulans subsp*. megacalyx* (P3) Shrub, 0.9 – 2 m high. Flower violet. Red, sandy gravel laterite, laterite banded ironstone with yellow brown shallow sandy loam soils, rocky slopes, laterite slopes and sandy plains. Flowers August to September. Possible	
Goodenia berringbinensis (P4) Ascending annual, herb, 0.1-0.3 m high. Flowers yellow in October. Red sandy loam. Along watercourses. Unlikely	Not available
Jacksonia lanicarpa (P1) Shrub to 2 m high. Flowers orange in November. Red Sand. Unlikely	Not available
Lepidium scandens (P3) Weak, ascending or twining shrub, 0.4 – 2 m high. Flowers white between August and September. Red sand and clay. Possible	Not available

Taxa (Priority)	Image
Petrophile vana (P1) Shrub to 1.5 m high. Perianth white-cream between May and September. Shallow, white, gritty clay-soil pockets and laterite breakaways. Possible.	
Ptilotus beardii (P3) Compact, perennial shrub, 0.R15-0.5 m high, leaves linear, 2-10 mm long, 0.5-3 mm wide; spike pink, hemispherical, R15-30 mm long, 20-40 mm wide, Fl. pink-red between August and October. Clayey soils. Saline flats, low breakaways. Possible.	
Verticordia jamiesonii (P3) Shrub, 0.2-0.6 m high. Fl. white/pink between September and October. Sandy clay soils. Lateritic breakaways. Possible	

Taxa (Priority)	Image
Wurmbea murchisoniana (P4) Cormous perennial herb, 0.1-0.26 m high, hermaphrodite. Fl. white between July and September. Clay, sandy clay, loam. Seasonally inundated clay hollows, rock pools. Unlikely.	

3. FIELD SURVEY METHODOLOGY

3.1. Vegetation Descriptions

The vegetation was described from 18 relevés within the Survey Area (**Figure 2**). Data sheets completed for each relevé recorded the coordinates, habitat, soils, rock type, evidence of disturbance, vegetation condition and the vegetative cover and height of each species present. Vegetation mapping notes were also recorded at several points throughout the study area. Several photographs were taken at each relevé and across the survey area, to accompany the data recorded. The vegetation structural classes were described according to Specht (1970) as modified by Aplin (1979) **(Appendix C**) and the vegetation condition was described using Keighery (1994) **(Appendix D).** The relevé data and photographs of each site is presented in **Appendix E.**

The survey area was traversed by vehicle and on foot. All flora species encountered were recorded opportunistically with specimens collected for confirmation of species identity as needed. In determining a species list for the survey area attention was also paid to searching for potential PF species identified in the desktop assessment.

3.2. Floristics

All vascular flora species in the area were recorded and if they could not be identified in the field, voucher specimens were collected and pressed for confirmation in the WA Herbarium.

3.3. Limitations and Constraints

The survey was carried out in good seasonal conditions, constraints and limitations are provided in **Table 5**.

Table 5: Summary of Potential Limitations and Constraints

Aspect	Constraint	Comment regarding the flora and vegetation survey
Competency/experience of consultants	No	The survey botanist is a flora specialist employed by Outback Ecology and has in excess of fifteen years experience undertaking flora surveys of this kind.
Scope	No	The scope was clearly defined and realistically achievable.
Proportion of flora identified	No	Of the 80 vascular flora species recorded during this survey, all except three were identified with confidence to species level. Three species were unconfirmed due to a lack of adequate flowering or fruiting material to verify their identifications.

Aspect	Constraint	Comment regarding the flora and vegetation survey
Information sources (e.g. historic or recent)	No	A number of local and regional studies have been carried out near the Survey area. Available data was reviewed prior to commencement of the survey.
Proportion of task achieved, and further work which might be needed	No	The distribution of relevés were targeted across the 460 ha Survey area in order to best ensure that all vegetation communities were captured and the majority of flora species recorded. Vegetation mapping notes were also recorded across the survey area in order to provide an overview of vegetation types.
Timing / weather / season / cycle	Yes	Although seasonal conditions were good, the survey did not take place during the peak flowering season due to timing constraints. This may mean that some annual species were not recorded and may also have had an effect on species identification due to the absence of flowers and fruiting bodies. The high percentage cover of annual grasses (*Aristida contorta)* provides supporting evidence for a good season with recent rain.
Disturbances	No	There was evidence of extensive grazing by sheep and feral goats throughout the survey area. Despite this much of the vegetation in the area was in good to excellent condition. The majority of the area planned for the proposed new waste dump had been previously cleared and were highly degraded.
Intensity	No	Survey intensity was adequate with 18 hours spent on the ground covering the survey area. Six vegetation communities were observed and highly degraded areas were mapped separately.
Completeness	No	The Survey area was mostly accessible by car and traversed on foot and thus it is considered that the ground was well covered to observe both vegetation and floristic richness. This survey is considered complete.
Resources	No	WAHERB specimens, taxonomic guides, DEC Database Searches and the FloraBase database were all used to prepare for the trip and used for the confirmation of any species where their identification was uncertain. Resources were adequate to carry out the survey satisfactorily.
Remoteness / access problems	No	The Survey area was mostly accessible by 4WD vehicle with some tracks overgrown. Those areas inaccessible by vehicle were traversed on foot.
Availability of contextual information	No	Information was derived from the Interim Biogeographic Regionalisation for Australia (IBRA) Murchison 2 (MUR2) Western Murchison subregion of the Murchison Bioregion, FloraBase, DEC lists and Bureau of Meteorology (BoM 2012).

4. RESULTS

4.1. Seasonal Conditions

Seasonal conditions were good during the field survey with six of the twelve months preceding the study having above average rainfall (**Figure 8** and **Figure 9**). Although rainfall was low in February 2012 it was well above average in December 2012 and close to the average in January 2012. March 2012 rainfall was well above average. This was reflected in the high percentage cover of annual grass species including *Aristida contorta*.

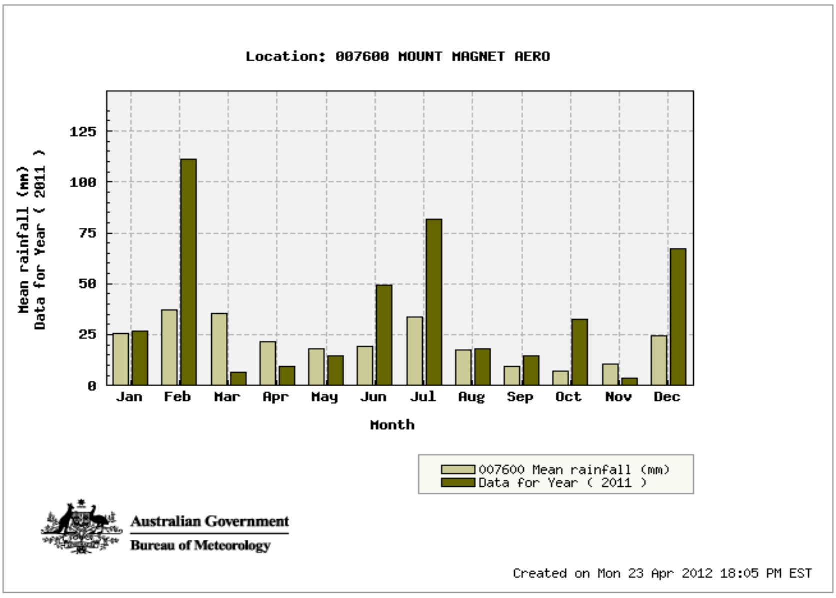


Figure 8: Monthly rainfall recorded at Mount Magnet in 2011 compared to average rainfall (BoM 2012)

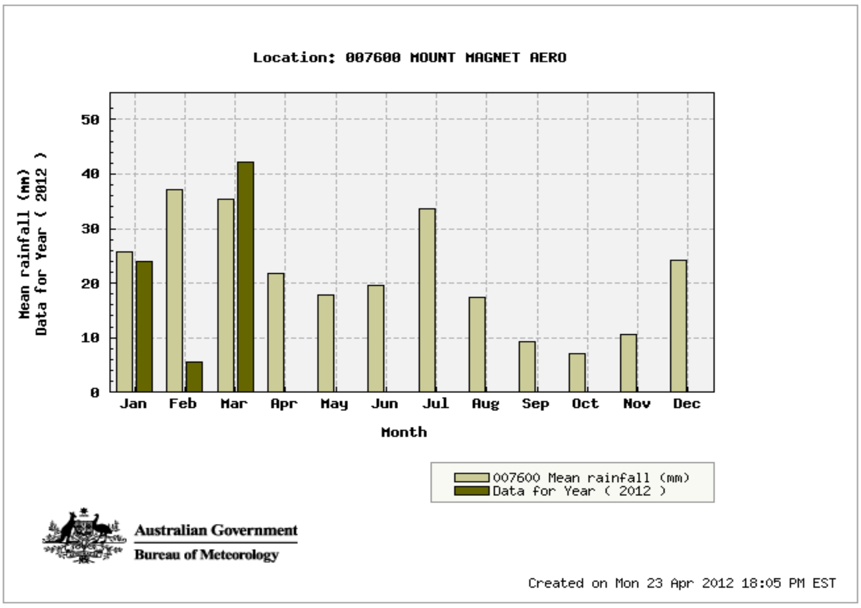


Figure 9: Monthly rainfall recorded at Mount Magnet in 2012 compared to average rainfall (BoM2012 accessed 23 Apr)

4.2. Survey Personnel, Completeness and Timing

The survey was completed over three days from 11 - 13 April, 2012, by Ms Jeni Alford, who holds a DEC Licence for Scientific or other Prescribed Purposed Number SL009526 (expiry 30-06-2012), and Ms Kelly Boxall. Approximately 18 hours were spent surveying the 460 ha which was considered adequate time to record all vascular flora in the Survey area and observe factors which may trigger the Ten Clearing Principles. A total of 18relevés were assessed during the field survey. The areas covered by vehicle and on foot are shown (**Figure 10**).

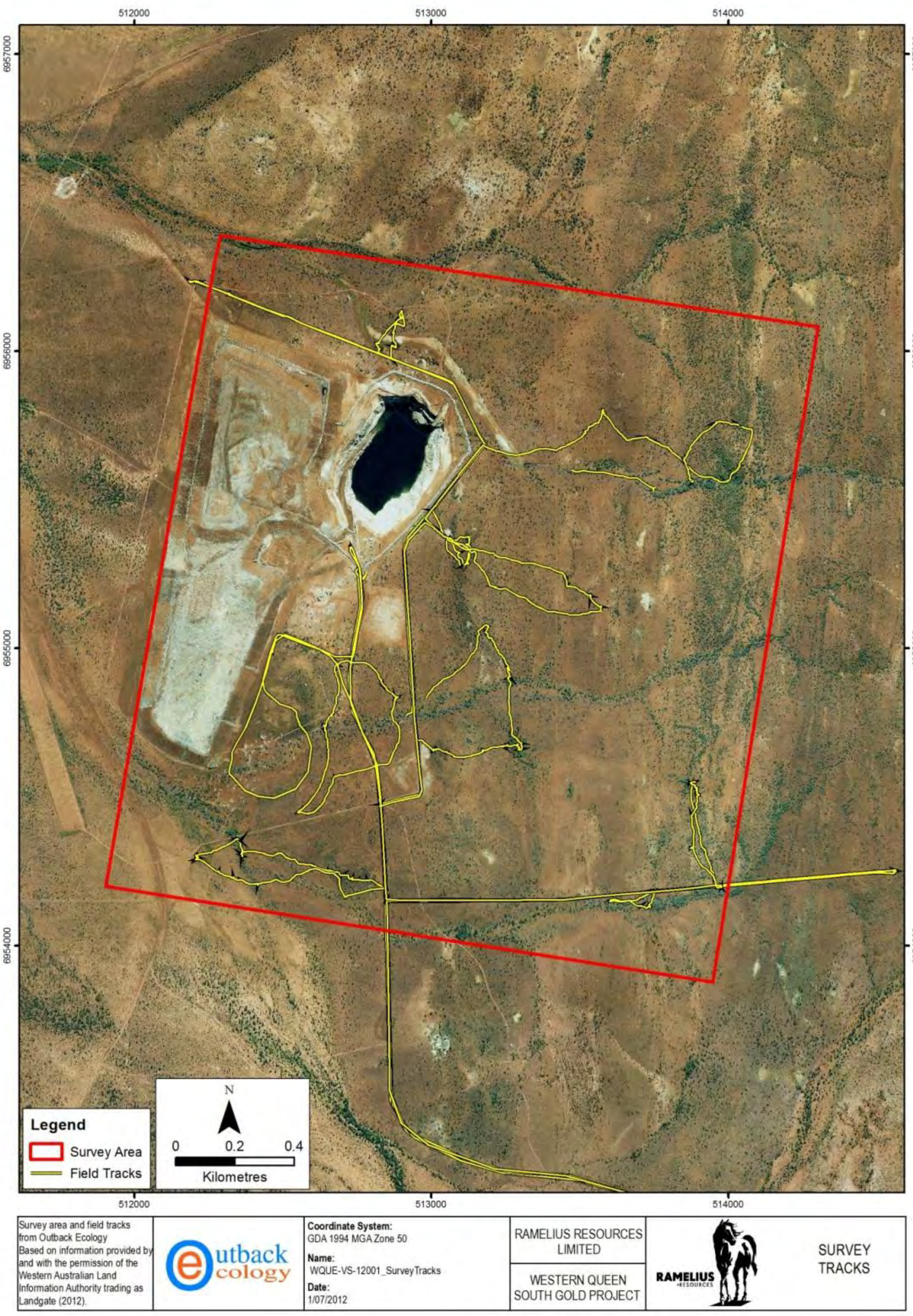


Figure 10: Survey area showing areas traversed during the field survey

4.3. Vegetation

Six vegetation associations were recorded and mapped within the Western Queen South Survey area. Areas that were considered to be in Degraded to Completely Degraded condition were also delineated in the field and reconciled on aerial photographs. No attempt was made to map or describe what these vegetation communities were prior to disturbance. The six vegetation associations and areas considered to be Completely Degraded are described and illustrated (**Plate 1, Plate 2, Plate 3, Plate 4, Plate 5, Plate 6**) in the following sections and are mapped (**Figure 11**).

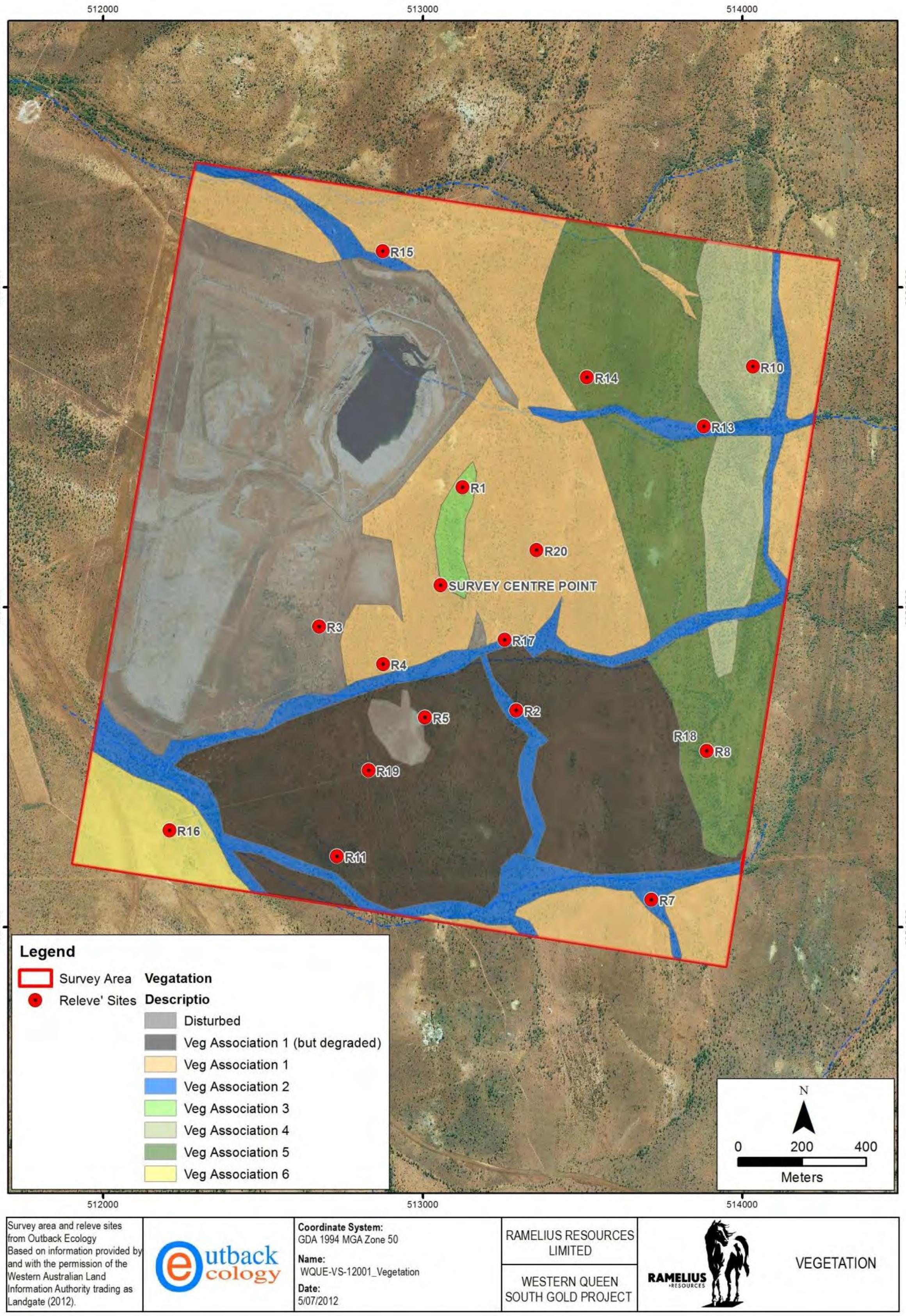


Figure 11: Vegetation associations in the Western Queen South Study area

1. *Acacia aneura* and *Acacia ramulosa* var. *linophylla* Low Open Woodland over *Eremophila fraseri* or *Eremophila exilifolia* Open Shrubland over *Aristida contorta* Tussock Grassland. This vegetation was recorded on the more rocky undulating hills and plains.

Vegetation association 1 was recorded in six relevés across the site. Relevés 11 and 19 were located in somewhat degraded vegetation whereas the vegetation recorded in relevés 4, 15, 17 and 20 was more intact.

Plate 1: Vegetation association 1 in Relevé 17

2. *Acacia aneura, Acacia grasbyi* and *Acacia tetragonophylla* Low Woodland to Low Open Woodland over *Eremophila fraseri* and *E. forrestii* subsp. *forrestii* Low Open Shrubland over *Aristida contorta* Tussock Grassland was recorded on the flow lines across the Survey area.

The vegetation varied to some degree within flow lines depending on the levels of disturbance and thus changes in surface water flow and sedimentation. One flow line to the north of the existing waste dump has been completely truncated by a man-made landform. The understorey of less well defined flow lines occasionally contained *Senna glutinosa* subsp. x *luerssenii*. Vegetation association 2 was recorded in relevés 2, 6, 7 and 13. The flow line at Relevé 13 was the largest and most well defined.

Plate 2: Vegetation association 2 in Relevé 6

3. *Acacia aneura* and *Acacia aneura* var. *fuliginea* Low Open Woodland over *Hakea preissii* and *Acacia synchronicia* over *Enneapogon caerulescens* and *Aristida contorta* Tussock Grassland over *Dissocarpus paradoxus* Open Herbland.

Vegetation association 3 was recorded in Relevé 1 on a small range of low rocky hills.

Plate 3: Vegetation association 3 in Relevé 1

4. The vegetation varied from *Acacia quadrimarginea* Tall Open Shrubland over *Dodonaea amplisemina* Low Shrubland over *Aristida contorta* Tussock Grassland.

Vegetation association was recorded in Relevé 10 on an undulating range of rocky hills on the northeast side of the Survey area.

Plate 4: Vegetation association 4 on the low undulating hills in the background

5. *Acacia aneura (A. quadrimarginea* and *A. aneura* var. *fuliginea)* Low Open Woodland over *Eremophila exilifolia* Open Shrubland over *Aristida contorta* Tussock Grassland.

Vegetation association 5 was recorded in Relevés 14 and 18. *Dodonaea amplisemina* was recorded in low numbers in relevé 14 but not in relevé 18. It may be scattered on the rockier hills within this association.

Plate 5: Vegetation association 5 in Relevé 14

6. *Acacia tetragonophylla* Scattered Tall Shrubs over *Senna* sp. Meekatharra (E. Bailey 1-26) and *Eremophila fraseri* Open Shrubland over *Ptilotus obovatus* and *Senna artemisioides* subsp. *helmsii* Scattered Low Shrubs over *Aristida contorta* Tussock Grassland (patchy).

Vegetation association 6 appears to be degraded possibly from grazing and drought and was recorded in Relevé 16 in the southwest corner of the Study area.

Plate 6: Vegetation association 6 in Relevé 16

4.4. Vegetation of Conservation Significance

The vegetation associations and habitats recorded within the Survey area were not analogous to any TECs under the *Wildlife Conservation Act* or *EPBC Act* or any PECs listed by DEC.

The flowline vegetation association 2 was in Good to Very Good condition in some parts, particularly the eastern side of the Survey area and may provide refugia for local fauna, thus is of somewhat higher value.

A Priority 4 species, *Dodonaea amplisemina,* was recorded on rocky hills within vegetation associations 4 and 5. A smaller occurrence was mapped at Relevé 5 on a low rocky rise on the northern edge of the proposed waste dump footprint with vegetation association 1 (disturbed). Only a few individuals were recorded at Relevé 14 in vegetation association 5 and the main population in terms of number of individuals is within vegetation association 4. *Dodonaea amplisemina* was estimated to provide 15% of the vegetative cover at Relevé 10. Not all of vegetation association 4 was checked for this species; however it is possibly distributed throughout most of this rocky upland habitat and thus these vegetation associations can be considered of somewhat higher conservation value than the other vegetation associations. The proposed disturbance footprint (**Figure 2**) does not impinge on this species other than in the one outlier population at Relevé 5.

4.5. Vegetation Condition

The entire Western Queen South Survey area has been impacted to varying degrees by mining and grazing activities, particularly in more recent times by large numbers of goats. Vegetation ranged in condition from Completely Degraded to Very Good. Vegetation within the eastern third of the Survey area was in much better condition than areas surrounding the existing waste dumps, pits and areas that had either been cleared for mining infrastructure or impacted by erosive processes such as fines leaching from the waste dump and other man made landforms. Some of the areas that were mapped as Very Poor to Completely Degraded are illustrated (**Plate 7, Plate 8, Plate 9, Plate 10**).

Plate 7: South pit bund

Plate 8: Proposed Waste Dump site

Plate 9: Pooled water inside south pit bund looking north-northwest

Plate 10: Rubbish inside south pit bund and on east side of existing Waste Dump

4.6. Flora

A total of 80 vascular flora species were recorded in the Western Queen South Study area, representing 26 families and 43 genera. Of these 8% were annuals or species that die off during the drier months, indicating that the survey timing was reasonably good. Several annuals had already dried out to the point were they could not be identified to genus level and three species were collected; a *Ptilotus, Lepidium* and a *Sclerolaena* for which no species name could be allocated due to insufficient flowering or fruiting material.

The most well represented families in the Survey area were Fabaceae (19%) with 15 species of which 11 were *Acacia*; Poaceae (14%) with 11 species, Malvaceae (11%) with nine taxa including four *Sida* species and Scrophulariaceae (9%) with seven *Eremophila* species. The proportions of Fabaceae and particularly Malvaceae were significantly higher than recorded across the Murchison 2 region, which are 12% and 4% respectively (based on FloraBase 2012 specimens) however the number of Scrophulariaceae (7%) and Poaceae (8%) recorded were as would be expected. The proportions of species are affected by levels of disturbance and diversity within any particular area.

A complete list of all species recorded within the Survey area is provided in **Appendix F.**

4.7. Flora of Conservation Significance

No TF have been recorded within 50 km of the Survey area and none were noted during the Survey. Twelve PF species were previously recorded within 50 km of the search area. Of these 12 were considered likely to be in the Survey area based on their habitat preferences (**Table 4**).

Only one Priority 4 Flora species were recorded during the survey. *Dodonaea amplisemina (***Plate 11***)* was recorded in Relevés 5, 10 and 14 on rocky hills in vegetation associations 1 and 4. The main population of this species was recorded in association 4 on a series of rocky hills on the eastern side of the Survey area. Only a few individuals of this PF species were recorded in Relevés 5 and 14.

Plate 11: *Dodonaea amplisemina* (from FloraBase 2012)

4.8. Introduced Species

Two introduced flora species, **Cucumis myriocarpus* (Prickly Paddy Melon) and **Solanum nigrum* (Black Berry Nightshade) were recorded in the Survey area. Both of these weed species were recorded in small, isolated populations within highly disturbed areas. Neither of these species is listed on the Department of Agriculture and Food Declared Plants list.

A description and photograph of each species is included below to provide information for site personnel to identify them should actions be taken to manage them or prevent their further spread.

4.8.1. *Cucumus myriocarpus* (Prickly Paddy Melon)

Two small populations of this species were recorded in the Survey area, one population of approximately six plants was located near a bund close to Relevé 15 and several individuals were recorded within the perimeter of the existing pit. The Paddy Melon is an annual herb originating in Southern Africa that prefers bare disturbed areas and is potentially toxic to sheep, cattle, horses and pigs (Florabase 2012 http://florabase.dec.wa.gov.au/browse/profile/7372) Yellow flowers appear between January to February or April to May with the melon like fruits developing between February to May. There are likely to be several other small populations of this species in the Study area, however it does not pose a significant threat to native vegetation or flora.

Figure 12: *Cucumis myriocarpus* (Prickly Paddy Melon)

4.8.2. *Solanum nigrum* (Black Berry Nightshade)

Few scattered individuals of this species were recorded within the flowlines in the Survey area. *Solanum nigrum* is an annual herb that can live from two to five years in favourable areas. It has a strong root system based around a central taproot and produces prolific seeds. Flowering is continuous throughout the plant's lifespan from five to nine weeks after germination. Fruiting can also occur continuously but is most likely in October and November. The green fruit and the leaves are variably toxic (Florabase 2012 http://florabase.dec.wa.gov.au/browse/profile/7022). Given the sparse distribution of this species within and likely, surrounding the Study area, it is unlikely to pose a significant threat to native vegetation or fauna.

Figure 13: *Solanum nigrum* (Black Berry Nightshade)

5. ASSESSMENT AGAINST THE TEN CLEARING PRINCIPLES

The proposal to clear land within the survey area to create a ROM pad, waste landform, workshop, offices, camp and haul roads is assessed against the Ten Clearing Principles as specified in Schedule 5 of the *EP Act* to determine whether a clearing permit would be acceptable in this area. Each of the ten clearing principles is addressed separately below in relation to the Project.

1. Native vegetation should not be cleared if it comprises a high level of biological diversity.

Eighty vascular plant species including two introduced species were recorded within the Study area which is relatively low however not unusual for this area particularly given the levels of historic disturbance (grazing and mining). Vegetation closest to the existing mining infrastructure, tracks and fence lines was generally in poorer condition than on the eastern side of the Study area. None of the flora species or vegetation associations recorded was listed as Threatened at a National or State level.

2. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

The majority of the native vegetation within the Study area has been impacted to varying degrees by pastoral and mining activities and also feral animals. The fauna habitats extended across much larger, similar habitats in the pastoral lands surrounding the Study area. Therefore, clearing of relatively (74.5 ha) small areas of vegetation that are already significantly degraded is highly unlikely to have any impact on the fauna of the Study area. The area proposed for the largest proportion of clearing (waste dump) has already been historically disturbed.

3. Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

None of the 80 vascular flora species recorded in the Study area during this and previous surveys is listed as Threatened or Declared Rare Flora at a National or State level. No DRF or Threatened species are listed to occur in the Murchison 2 bioregion and given the habitats present and levels of disturbance none are expected to occur in the Survey area.

4. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

No Threatened or Priority Ecological communities or communities analogous to these were recorded in the Survey area. The nearest conservation significant communities are both stygofauna/groundwater assemblages over 30 km from the Western Queen South Survey area and thus it is highly unlikely that would be impacted by the relatively limited clearing and modifications to surface landforms proposed.

5. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

The vegetation associations recorded within the Western Queen South Survey area extend into the surrounding pastoral stations and thus clearing of 74.5 ha is unlikely to have a significant impact on the status of these vegetation associations.

Priority 4 Flora species *Dodonaea amplisemina* was recorded in Relevé 10 in vegetation association 4 and thus this association can be considered of higher conservation value as an ecosystem supporting this poorly known species. Several individuals of this species were recorded on a small rocky rise on the northern edge of the proposed waste dump footprint. If at all possible this small population should be avoided, however the main population of *Dodonaea amplisemina* is some distance from the proposed disturbance and is thus highly unlikely to be impacted.

6. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

The flowline vegetation association 2 generally supported a denser tree cover and likely retains some pools of surface water providing refugia for fauna as the seasons dry out. The flowline vegetation in the eastern side of the survey area and a small, rocky gorge located near the eastern boundary are in much better condition than the flowlines close to the historical mining disturbance. A surface water control bund truncates the flowline which originally flowed east-west at the top of the existing waste dump landform. Only the proposed ore pad footprint (**Figure 2**) impinges on a section of vegetation association 2.

7. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

The vegetation within the Western Queen South Survey area has already been impacted by historic mining operations and grazing. Surface water flow within the Survey area has been modified as a consequence of intercepting flowlines with bunds, waste dumps and through clearing. Further land degradation could be avoided by minimizing further intercepts of the extant flowlines (vegetation association 2) where possible for example in the area proposed for the Ore Pad. The proposed clearing for the Western Queen South project is highly unlikely to cause appreciative land degradation over and above what has already occurred.

8. Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

There are no nature reserves or environmentally sensitive areas adjacent to the Survey area; however a DEC managed reserve is located approximately 10 km to the south. The proposed clearing and mining operations are highly unlikely to have any impact directly or indirectly on the environmental values of this reserve.

9. Native vegetation should not be cleared if the clearing of native vegetation is likely to cause deterioration in the quality of surface or underground water.

Historic mining operations and loss of vegetation cover as a consequence of grazing by domestic and feral animals has already likely impacted to some extent, the surface water movement and quality within the Western Queen South Survey area. However the relatively limited clearing proposed for the mining infrastructure and additional waste dump is unlikely to exacerbate changes to the quality of surface or groundwater, particularly if management procedures to minimize contaminant losses such as hydrocarbons are implemented. The proposed waste dump is situated between two east-west flowlines but does not intercept them and thus is unlikely to significantly affect surface water movement. The south-west corner of proposed Ore Pad footprint does intercept a flowline however will not impact surface flows if placement of ore material is managed to dump it to north-east of the existing flowline.

10. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate the incidence or intensity of flooding.

Several small areas of the Western Queen South Survey area close to existing mining landforms are currently subject to localised flooding and pooling of water as a consequence of modified surface water flows. However the proposed clearing footprints for the additional waste dump, ore pad and topsoil stockpiles are highly unlikely to cause or exacerbate further flooding or pooling as they have largely been located away from extant flow lines and do not intercept any significant floodplains.

6. CONCLUSIONS AND RECOMMENDATIONS

The proposed clearing for the Western Queen South project is unlikely to have any significant environmental impacts. The entire area has already been impacted by historic mining and grazing. Locations for proposed mining landforms have been strategically selected to avoid intercepts with major drainage lines and floodplains. The south-west corner of the proposed Ore Pad does intercept a minor drainage line however could be largely avoided with management procedures or a slight modification of its location.

The vegetation on the eastern side of the Survey area is in much better condition than that close to the existing mining landforms and vegetation associations within it supports a Priority 4 Flora species *Dodonaea amplisemina*. A small population of this species was recorded on the northern edge of the proposed waste dump and topsoil stockpile area; however this may be possibly avoided with a minor shift of the landform. Despite this the main population of this PF species is highly unlikely to be affected by the proposed developments.

No Threatened Flora or DRF was recorded in the Survey area and none are likely to be there, particularly as there as no such species listed within the West Murchison sub-bioregion. There are four Threatened species recorded in the Eastern Murchison sub-bioregion: *Atriplex* sp. Yeelirrie Station (L. Trotter and A. Douglas LCH 25025) in self-mulching red clay near Yeelirrie, *Ricinocarpos brevis* on rocky hill slopes near Kalgoorlie, *Eremophila rostrata* subsp. *rostrata* on a quartz hill near Cue and *Eremophila rostrata* subsp. *trifida* centred around Perenjori. None of these species are likely to occur in the Survey area based on their known distributions and habitat preferences.

None of the vegetation associations within the Survey area were analogous to any TECs or PECs and are widespread outside of the Survey area in the surrounding pastoral station.

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APPENDIX A

Definitions Of Threatened and Priority Vegetation Communities

Definitions of Threatened Ecological Communities (DEC 2010)

Category	Definition
Presumed totally destroyed (PD)	An ecological community which has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.
Critically endangered (CR)	An ecological community which has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
Endangered (EN)	An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.
Vulnerable (VU)	An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

Definitions of Priority Ecological Communities (DEC 2010)

Category	Definition
Priority 1	Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
Priority 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been

Category	Definition
	adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX B

Definitions Of Threatened and Priority Flora

Table 6: Definition of Declared Rare and Priority Flora Species Conservation Codes for Western Australian taxa

Conservation Code	Category Description
X	*Presumed Extinct Flora (Declared Rare Flora – Extinct)* "Taxa which have been adequately searched for and there is no reasonable doubt that the liast individual has died, and have been gazette as such.
T	*Threatened Flora (Declared Rare Flora – Extant)* "Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such."
P1	*Priority One – Poorly Known Species* "Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes."
P2	*Priority Two – Poorly Known Species* "Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes."
P3	*Priority Three – Poorly Known Species* "Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them."
P4	*Priority Four – Rare, near threatened and other species in need of monitoring* "(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy."
P5	*Priority Five – Conservation Dependent Species* "Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years."

APPENDIX C

Classification of Vegetation Structural Classes

Vegetation Structural Classes – Specht (1970) as modified by Aplin (1979).

Stratum	**Canopy Cover (%)**				
	70-100%	**30-70%**	**10-30%**	**2-10%**	**<2%**
Trees >30m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees <10m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Shrubs >2m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs <1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses Sedges, Herbs	Closed tussock grassland/bunch grassland /sedgeland /herbland	Tussock grassland/ bunch grassland/ sedgeland/ herbland	Open tussock grassland / bunch grassland/ sedgeland / herbland	Very open tussock grassland / bunch grassland / sedgeland / herbland	Scattered tussock grasses / bunch grasses / sedges / herbs

APPENDIX D

Vegetation Condition Scale

Table 7: Vegetation Condition Scale (Keighery, 1994)

Code	Description
Pristine	*Pristine or nearly so. No obvious signs of disturbance.*
Excellent	*Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.*
Very Good	*Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.*
Good	*Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.*
Degraded	*Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.*
Completely Degraded	*The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.*

APPENDIX E

Relevé Data

WESTERN QUEEN STUDY AREA **Site** Relevé 1

Date 11 and 12-04-2012 **Location** 50 J 513 125 m E, 659 5375 m S (start) to 513 110 m E and 6955280 m S

Habitat Escarpment **Soil**

Rock Type Granite some outcropping

Veg Condition Excellent **Seasonal Conditions** Excellent **Fire Age** No evidence

Notes Survey followed excellent seasonal conditions in this area. Lots of *Varanid* (lizard) burrows.

Vegetation: *Acacia aneura and Acacia aneura* var. *fuliginea* Low Open Woodland over *Hakea preissii* and *Acacia synchronicia* over *Enneapogon caerulescens* and *Aristida contorta* Tussock Grassland over *Dissocarpus paradoxus* Open Herbland.

Taxon	Voucher #	Cover %	Height (m)
Acacia aneura	R1-21	5	4-5
Acacia aneura var. *fuliginea* (Flora of Australia)	-	5	4-5
Acacia synchronicia	R1-19	1	4
Aristida contorta	-	70	0.3
Boerhavia coccinea	-	+	0.1
Cheilanthes sieberi subsp. *sieberi*	-	+	0.15
Cymbopogon ambiguus	-	+	0.6
Dissocarpus paradoxus	-	15	0.25-0.2
Enneapogon caerulescens	R1-7	70	0.1-0.3
Eremophila forrestii subsp. forrestii		+	0.5
Eremophila fraseri	-	+	1.5
Eremophila latrobei subsp. *latrobei*		1	0.8
Eriachne mucronata	-	+	0.25
Euphorbia drummondii subsp. *drummondii*	-	+	0.1
Hakea preissii	R1-17	2	3-4
Lepidium sp. (inadequate material to positively identify)	-	+	0.1
Maireana triptera	-	+	0.3
Ptilotus helipteroides	R1-22	+	0.01
Ptilotus obovatus	-	+	0.6
Ptilotus schwartzii	-	+	0.3
Senna glutinosa subsp. x *luerssenii*	-	+	0.04

Plate 12: Relevé 1

WESTERN QUEEN STUDY AREA **Site** Relevé 2

Date 12-04-2012 **Location** 50 J 513293 m E, 695 4677 m S (start) to 513271 m E and 6954721 m S
Habitat Drainage line/flood plain **Soil**
Veg Condition Excellent **Seasonal Conditions** Good **Fire Age** No evidence
Notes granite outcrop and open bare ground covered in stones and rocks

Vegetation: *Acacia aneura, Acacia grasbyi and Acacia tetragonophylla Low Woodland to Low Open Woodland over Eremophila fraseri and E. forrestii* subsp. *forrestii Low Open Shrubland* over *Aristida contorta* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Abutilon oxycarpum		+	0.6
Acacia aneura	R2-9	5	8
Acacia craspedocarpa	-	2	4
Acacia grasbyi		3	8-10
Acacia ramulosa var. *linophylla*	R2-7	5	4-8
Acacia tetragonophylla		1	4-6
Aristida contorta	-	50	0.2
Boerhavia coccinea	-	+	0.05
Cheilanthes sieberi subsp. *sieberi*	-	+	0.2
Eremophila forrestii subsp. *forrestii*		2	0.4-2.1
Eremophila fraseri	R2-10	2	0.6
Glycine canescens	R2-3	+	0.1-0.15
Hakea recurva	R2-2	+	1.2
Psydrax rigidula	R2-5	+	2.0
Ptilotus obovatus	-	+	0.6
Senna aff. sp. Meekatharra (E. Bailey 1-26)	-	+	0.3
Sida fibulifera	R2-4	+	0.07
Solanum ellipticum	R2-6	+	0.2
Solanum lasiophyllum		+	0.5
Wurmbea densiflora	R2-10	+	0.1

Plate 13: Relevé 2

WESTERN QUEEN STUDY AREA **Site** Relevé 3

Date 13-04-2012 **Location** 50 J 512 649 m E, 695 4979 m S (start) to 512 571 m E and 695 4467 m S

Habitat **Soil** Red gravel

Rock Type granite

Veg Condition Very Good **Seasonal Conditions** Good **Fire Age** No evidence

Notes degraded area around south pit

Vegetation: *Acacia aneura, A. ramulosa* var. *linophylla* and *A. aneura* var. *fuliginea* Low Open Woodland over *Eremophila exilifolia* Open Shrubland over *Aristida contorta* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Abutilon oxycarpum		+	0.2
Acacia aneura	R3-6	3	3
Acacia aneura var. *fuliginea* (Flora of Australia)	R3-5	2	4
Acacia craspedocarpa		+	2.5
Acacia ramulosa var. *linophylla*	R3-4	2	5
Acacia synchronicia		1	3
Acacia tetragonophylla		1	2.5
Acacia xiphophylla		2	3.5
Aristida contorta		1	0.2
Atriplex vesicaria		+	0.1
Centipeda ?thespidioides	R3-1	+	0.10
**Cucumis myriocarpus*		+	0.20
Dissocarpus paradoxus		+	0.15
Enneapogon caerulescens		+	0.15
Eragrostis falcata			0.01
Eremophila fraseri		+	0.5
Hakea preissii		+	2.5
Maireana triptera		+	0.3
Ptilotus aervoides		+	0.03
Ptilotus sp. (inadequate material to positively identify)		+	0.05
Sclerolaena sp. (inadequate material to positively identify)		1	0.2
Solanum lasiophyllum		+	0.3
Wahlenbergia tumidifructa	R3-2	+	0.1

Plate 14: Relevé 3 northern end

Plate 15: Relevé 3 centre point

WESTERN QUEEN STUDY AREA **Site** Relevé 4

Date 13-04-2012 **Location** 50 J 512876 m E, 695 4822 m S (start) to 512 787 m E and 695 4948 S

Habitat Sloping low rise and flat low foothill **Soil** Deep orange
Rock Type granite
Veg Condition Good **Seasonal Conditions** Very Good **Fire Age** No evidence
Notes granite large scattered rocks some outcropping

Vegetation: *Acacia craspedocarpa* and *A. aneura* Low Open Woodland over *Aristida contorta* Very Open Tussock Grassland.

Taxon	**Voucher #**	**Cover %**	**Height (m)**
Acacia aneura		1	4
Acacia craspedocarpa		5	2.5
Acacia aneura var. *major* (Flora of Australia)	R4-1	+	5
Aristida contorta		15	0.2
Dissocarpus paradoxus		+	0.15
Eremophila fraseri		+	1-1.5
Eremophila exilifolia		+	1.8
Maireana triptera		+	0.1
Ptilotus sp. (inadequate material to positively identify)		+	0.2
Ptilotus helipteroides		+	0.4
Ptilotus obovatus		+	0.3
Solanum lasiophyllum		+	0.15

Plate 16: Relevé 4

WESTERN QUEEN STUDY AREA **Site** Relevé 5

Date 12-04-2012 **Location** 50 J 513007 m E, 695 4655 m S (start) to 513 075 m E and 6954638m S

Habitat Rocky hill **Soil** Red gravel **Rock Type** granite

Veg Condition Very Good **Seasonal Conditions** Good **Fire Age** No evidence

Notes granite outcrop and open bare ground covered in stones and rocks

Vegetation: *Acacia aneura* and *Acacia ramulosa* var. *linophylla* Low Open Woodland over *Eremophila exilifolia* Open Shrubland over *Aristida contorta* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Acacia aneura	R5-6	5	3.5
Acacia craspedocarpa	R5-7	+	2.5
Acacia ramulosa var. *linophylla*	R5-5	2	2.5
Aristida contorta	-	40	0.2
Cheilanthes sieberi subsp. *sieberi*		+	0.08
Dodonaea amplisemina	R5-3	1	0.5
Eremophila exilifolia	R5-1	10	1.2
Eriachne pulchella	-	+	0.08
Hibiscus gardneri	R5-2	+	0.5 – 0.8
Maireana villosa	-	+	0.08
Ptilotus obovatus	-	+	0.5

Plate 17: Relevé 5

WESTERN QUEEN STUDY AREA **Site** Relevé 6

Date 12-04-2012 **Location** 50 J 512732 m E, 6954220 m S

Habitat Drainage line **Soil** Red-brown clay loam

Rock Type Ironstone

Veg Condition Good **Seasonal Conditions** Good **Fire Age** No evidence

Notes Some kangaroo scats.

Vegetation: *Acacia aneura* Low Woodland over *Acacia tetragonophylla* Scattered Tall Shrubs *over Eremophila fraseri* Scattered Shrubs

Taxon	Voucher #	Cover %	Height (m)
Abutilon oxycarpum	-	+	0.5
Acacia aneura var. *intermedia*	R6-1	30%	7m
Acacia tetragonophylla	-	2%	4m
Alternanthera nodiflora	R6-3	+	0.1
Boerhavia coccinea	R6-7	+	0.1
Eragrostis parviflora	R6-8	+	0.6
Eremophila exilifolia	-	+	2.5
Eremophila fraseri	-	2%	2
Eriachne flaccida	R6-4	+	0.3
Fimbristylis dichotoma	R6-2	+	0.2
Maireana villosa	-	+	0.04
Solanum lasiophyllum	-	+	0.5
Solanum nigrum	R6-6	+	0.1
Wurmbea densiflora	R6-5	+	0.1

Plate 18: Relevé 6

WESTERN QUEEN STUDY AREA **Site** Relevé 7

Date 12-04-2012 **Location** 50 J 513715.69 m E, 6954084 m S

Habitat Poorly defined, rocky flow line with sandy sections **Soil** Orange-red sandy-loam.

Veg Condition Excellent **Seasonal Conditions** Good **Fire Age** No evidence

Notes Some grazing was evident. Numerous indeterminate dead annuals present.

Vegetation: *Acacia aneura* and *A. aneura* var. *fuliginea* Low Open Forest over *Eremophila fraseri* and *Senna glutinosa* subsp. x *luerssenii* Scattered Shrubland over *Aristida contorta* Tussock Grassland.

Taxon	**Voucher #**	**Cover %**	**Height (m)**
Abutilon cryptopetalum		+	0.4
Acacia aneura	R7-6	5	3-4
Acacia aneura var. *fuliginea* (Flora of Australia)	R7-2	50% in flow line	5
Acacia quadrimarginea	R7-9	+	3
Androcalva luteiflora	R7-8	+	0.4
Aristida contorta	-	70	0.1-0.3
Cheilanthes sieberi subsp. *sieberi*	R7-5	1	0.1
Enneapogon caerulescens	-	+	
Eremophila exilifolia		+	0.6
Eremophila fraseri	-	1	1-1.5-3
Paspalidium clementii		+	0.10
Ptilotus obovatus	-	+	0.25
Senna glutinosa subsp. x *luerssenii*	R7-1	1	1.4-2.1
Solanum lasiophyllum	R7-7	+	0.30

Plate 19: Relevé 7

WESTERN QUEEN STUDY AREA **Site** Relevé 8

Date 13-04-2012 **Location** 50 J 513889 m E, 6954550 m S

Habitat Small upland flow line where vegetation is a little denser, but located within vegetation association 5.

Soil Red-orange **Rock Type** granite, ironstone and quartz

Veg Condition Excellent **Seasonal Conditions** Good **Fire Age** No evidence

Vegetation: *Acacia aneura* and *Acacia quadrimarginea* Low Open Forest over *Eremophila exilifolia* and *Ptilotus obovatus* Low Open Shrubland over *Aristida contorta* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Abutilon oxycarpum		+	0.4
Acacia aneura	R8-1	35	6
Acacia quadrimarginea	R8-2		3.5
Aristida contorta		40	0.3
Cheilanthes sieberi subsp. *sieberi*		+	0.08
Crassula colorata var. *acuminata*		+	0.05
Enneapogon caerulescens		+	0.1
Eremophila exilifolia		2	0.8
Eremophila longifolia	R8-3	+	0.70
Eriachne pulchella		+	0.07
Maireana triptera		+	0.06
Ptilotus obovatus		2	0.7
Ptilotus schwartzii		+	0.4
Senna glutinosa subsp. x *luerssenii*		+	0.4
Sida platycalyx		+	0.2
Solanum lasiophyllum		+	0.5

Plate 20: Small flowline within vegetation association 5 in relevé 8

WESTERN QUEEN STUDY AREA **Site** Relevé 10

Date 12-04-2012 **Location** 50 J 514033 m E, 6955752m S (start) to 513960m E and 695 5761 m S

Habitat Hill **Soil**

Rock Type Granite rocks and large boulders

Veg Condition Excellent **Seasonal Conditions** Good **Fire Age** No evidence

Vegetation: *Acacia quadrimarginea* Tall Open Shrubland over *Dodonaea amplisemina* Low Shrubland over *Aristida contorta* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Acacia quadrimarginea	-	15	2-3.5
Aristida contorta		30	.15
Dodonaea amplisemina	-	15	1
Eremophila exilifolia		1	0.5-2.5
Ptilotus schwartzii	-	+	0.5

Plate 21: Relevé 10

WESTERN QUEEN STUDY AREA **Site** Relevé 11

Date 12-04-2012 **Location** 50 J 512732 m E, 6954220 m S

Habitat Undulating plain **Soil** Red gravel

Rock Type Ironstone

Veg Condition Good **Seasonal Conditions** Good **Fire Age** No evidence

Notes Some animal scats.

Vegetation: *Acacia aneura* Low Open Woodland over *Eremophila fraseri* Scattered Shrubs over *Eremophila forrestii* subsp. *forrestii* and *Ptilotus obovatus* Scattered Low Shrubs over *Aristida contorta* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Acacia aneura	R11-12	+	3
Acacia aneura var. *fuliginea* (Flora of Australia)	R11-1	5%	3-5
Acacia craspedocarpa	R11-11	+	3
Acacia grasbyi	-		2
Acacia ramulosa var. *linophylla*	R11-10	+	3
Acacia tetragonophylla	-	+	1.7
Aristida contorta	-	40	0.2
Eremophila forrestii subsp. *forrestii*		1	0.6
Eremophila fraseri	-	1	1.5-2.5
Eremophila latrobei subsp. *latrobei*	R11-7	+	0.5
Maireana villosa	R11-6	+	0.3
Ptilotus obovatus	-	5%	0.5
Ptilotus schwartzii	R11-2	+	0.5
Sida calyxhymenia	R11-5	+	1.0
**Solanum nigrum*	-	+	0.5
Spartothamnella teucriiflora	R11-9	+	0.8
Thryptomene decussata	R11-4	+	1.5

Plate 22: Relevé 11

WESTERN QUEEN STUDY AREA **Site** Relevé 13

Date 12-04-2012 **Location** 50 J 513 879 m E, 695 5565 m S (start) to 513751 m E and 6955529 m S

Habitat Slightly incised, narrow drainage line R**ock Type** rocky bed

Veg Condition Excellent **Seasonal Conditions** Good **Fire Age** No evidence

Vegetation: *Acacia aneura* Low Open Forest over *Aristida contorta* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Abutilon oxycarpum	-	+	0.3
Acacia ramulosa var. linophylla	-	50	8
Aristida contorta		70	40
Cheilanthes sieberi subsp. *sieberi*	-	+	0.1
Eremophila fraseri		+	2.5
Eremophila exilifolia		+	3
Senna glutinosa subsp. x *luersenii*		+	0.8

Plate 23: Relevé 13

WESTERN QUEEN STUDY AREA **Site** Relevé 14

Date 12-04-2012 **Location** 50 J 513007 m E, 695 4655 m S (start) to 513 075 m E and 6954638m S

Habitat Hill **Soil** Red-orange clay loam.

Veg Condition Good **Seasonal Conditions** Good **Fire Age** No evidence

Notes this area appears to have been impacted by drought conditions in previous years.

Vegetation: *Acacia aneura (A. quadrimarginea* and *A. aneura* var. *fuliginea)* Low Open Woodland over *Eremophila exilifolia* Open Shrubland over *Aristida contorta* Tussock Grassland.

Taxon	**Voucher #**	**Cover %**	**Height (m)**
Acacia quadrimarginea	R14-4	+	2.5
Acacia aneura	R14-1	5	3.5-4
Acacia aneura var. *fuliginea* (Flora of Australia)	R14-3	+	2.5
Acacia tetragonophylla	-	-	0.4-1.7
Aristida contorta	-	30	0.1
Dodonaea amplisemina	R14-5	+	0.5
Eremophila fraseri	-	+	1.6
Eremophila exilifolia	-	+	1.6
Ptilotus schwartzii	R14-2	+	0.2
Maireana triptera	-	+	0.08
Ptilotus obovatus	-	+	0.4
Senna artemisioides subsp. *helmsii*	-	+	1.1
Senna glutinosa subsp. x *luerssenii*	-	+	0.8

Plate 24: Western end of Relevé 14

WESTERN QUEEN STUDY AREA **Site** Relevé 15

Date 11-04-2012 **Location** 50 J 512874 m E, 6956113 m S

Habitat Undulating plain **Soil** Orange-red clay-loam.

Rock Type Surface pebbles

Veg Condition Excellent **Seasonal Conditions** Good **Fire Age** No evidence

Notes Adjacent to a highly disturbed area - rabbit scats present, condition ranges from Poor-Partially degraded to Good

Vegetation: *Acacia aneura* and *A. grasbyi* Low Open Woodland over *Eremophila fraseri* Open Shrubland over *Aristida contorta* and *Enneapogon caerulescens* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Acacia aneura	R15-10	5-10 patchy	3-5
Acacia grasbyi	R15-11	2 patchy	3.5-4
Acacia tetragonophylla	-	1	3.5-5
Androcalva luteifolia	R15-12	+	0.8
Aristida contorta	-	50%	0.2-0.4
Crassula colorata var. *acuminata*	R15-14	+	0.05-0.1
Cymbopogon ambiguus	R15-4	+	0.5-0.8
Dissocarpus paradoxus	-	+	0.1
Enneapogon caerulescens	R15-7	50%	0.1-0.3
Eremophila fraseri	R15-2	2%	1-2.5
Eremophila platycalyx subsp. *platycalyx*	R15-18	+	1.5
Eriachne pulchella	R15-1	+	
Maireana pyramidata	R15-8	+	0.6-1.0
Maireana triptera	R15-6	+	0.6
Maireana villosa	R15-5	+	0.2-0.5
Ptilotus obovatus	R15-3	+	0.4
Scaevola spinescens	-	+	0.35
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	R15-9	+	0.4
Solanum lasiophyllum	-	+	0.5-0.6
Spartothamnella teucriiflora	R15-13	+	0.90

Plate 25: Relevé 15

WESTERN QUEEN STUDY AREA **Site** Relevé 16

Date 12-04-2012 **Location** 50 J 512208 m E, 6594302m S (start) to 512356 m E and 6954223 m S

Habitat Plain **Soil** Orange-red sandy loam

Rock Type Ironstone

Veg Condition Good **Seasonal Conditions** Good **Fire Age** No evidence

Notes Appears to have been heavily grazed.

Vegetation: *Acacia tetragonophylla* Scattered Tall Shrubs over *Senna* aff. sp. Meekatharra (E. Bailey 1-26) and *Eremophila fraseri* Open Shrubland over *Ptilotus obovatus* and *Senna artemisioides subsp. helmsii* Scattered Low Shrubs over *Aristida contorta* Tussock Grassland (patchy).

Taxon	Voucher #	Cover %	Height (m)
Acacia tetragonophylla	-	1	4
Aristida contorta	-	50%	0.2
Eremophila forrestii subsp. *forrestii*	R16-5	+	0.3
Eremophila fraseri	-	2	1-2
Eremophila sp	R16-6	+	0.7
Euphorbia australis	-	+	Ground cover
Hakea preissii (no flowers or fruits)	R16-7	+	0.5
Maireana villosa	R16-4	+	0.1
Ptilotus obovatus	-	1	0.3
Ptilotus sp. (inadequate material to positively identify)	R16-3	+	0.6
Senna aff. sp. Meekatharra (E. Bailey 1-26)	R16-1	5	1.3
Senna artemisioides subsp. helmsii	R16-2	1	0.7

Plate 26: Relevé 16

WESTERN QUEEN STUDY AREA **Site** Relevé 17

Date 12-04-2012 **Location** 50 J 513256 m E, 6954898 m S (start) to 513182 m E and 6955054m S

Habitat Slope and hilltop **Soil** Orange-red clay loam

Rock Type ironstone – some outcropping

Veg Condition Excellent **Seasonal Conditions** Good **Fire Age** No evidence

Notes granite outcrop and open bare ground covered in stones and rocks

Vegetation: *Acacia ramulosa* var. *linophylla* and *A. synchronicia* Low Open Woodland over *Eremophila exilifolia* Open Shrubland over *Aristida contorta* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Acacia aneura	R17-6	+	3-5
Acacia craspedocarpa		+	2.5
Acacia grasbyi	R17-1	1	2.5-4
Acacia ramulosa var. *linophylla*		2	4
Acacia synchronicia	R17-2	2	4
Androcalva luteiflora		+	0.8
Aristida contorta		40	0.2
Aristida holathera	R17-4	+	0.6
Dissocarpus paradoxus		5	0.1-0.2
Enneapogon caerulescens		+	0.3
Eremophila exilifolia		+	0.8
Eremophila fraseri		+	0.5
Grevillea berryana	R17-5	+	2.5
Maireana triptera		+	0.1-0.6
Ptilotus sp. (inadequate material to positively identify)		+	0.6
Ptilotus obovatus		3	0.6
Scaevola spinescens		+	0.6
Senna glutinosa subsp. x *luerssenii*		+	0.6
Solanum lasiophyllum		1	0.4

Plate 27: Relevé 17

WESTERN QUEEN STUDY AREA **Site** Relevé 18

Date 13-04-2012 **Location** 50 J 513 889 m E, 6954550m S (start) to 513 883 m E and 695 4329 m S

Habitat Crest of moderate hills, undulating **Soil** Orange-red

Rock Type granite, ironstone and quartz with some surface outcropping

Veg Condition Excellent **Seasonal Conditions** Good **Fire Age** No evidence

Notes this site is similar to Relevé 8 but has more skeletal surface soil.

Vegetation: *Acacia aneura* and *Acacia quadrimarginea Low Open Woodland* over *Eremophila exilifolia* and *Ptilotus obovatus* Low Open Shrubland over *Aristida contorta* Open Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Acacia aneura	R8-1	2	3-4
Acacia quadrimarginea	R8-2	2	2.5-3
Aristida contorta	-	30	0.2
Eremophila exilifolia	-	1	0.6
Eremophila forrestii subsp. *forrestii*	R18-2	+	0.4
Eremophila fraseri	-	+	1.2
Eriachne pulchella		+	0.1
Maireana triptera	-	+	0.1
Ptilotus obovatus	R18-3	1	0.6
Ptilotus schwartzii		+	0.5
Senna artemisioides subsp. *helmsii*	R18-1	+	0.7
Senna glutinosa subsp. x *luerssenii*	_	+	1.8

Plate 28: Relevé 18

WESTERN QUEEN STUDY AREA **Site** Relevé 19

Date 13-04-2012 **Location** 50 J 512 831 m E, 695 4490 m S

Habitat Plain **Soil** Deep red clay loam.

Rock Type ironstone

Veg Condition Poor **Seasonal Conditions** Good **Fire Age** No evidence

Notes some areas ripped and partially rehabilitated

Vegetation: *Acacia aneura* Low Open Woodland over *Eremophila fraseri* Open Shrubland over *Aristida contorta* Very Open Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Acacia aneura		1	4-5
Aristida contorta		2	0.2
Atriplex vesicaria		+	0.08
Cymbopogon ambiguus		+	0.6
Dissocarpus paradoxus		10	
Enneapogon caerulescens		+	0.2
Eragrostis dielsii		+	
Eremophila fraseri	=R5-1	+	1.1
Maireana villosa		+	0.5
Maireana triptera		+	0.5
Ptilotus sp. (inadequate material to positively identify)		+	0.05
Ptilotus obovatus		+	0.4
Sclerolaena sp. (material too poor to positively identify)		+	0.5

Plate 29: Relevé 19

WESTERN QUEEN STUDY AREA **Site** Relevé 20

Date 13-04-2012 **Location** 50 J 513 356 m E, 695 5178 m S (start) to 513 571 m E and 695 5124 m S

Habitat Gentle slope amongst moderate hills **Soil** rocky shale outcrop with granite quartz and ironstone on surface.

Veg Condition Very Good **Seasonal Conditions** Good **Fire Age** No evidence

Vegetation: *Acacia aneura* Scattered Low Trees over *Eremophila fraseri* Open Shrubland over *Aristida contorta* Tussock Grassland.

Taxon	Voucher #	Cover %	Height (m)
Acacia aneura	R20-1	2	3-3.5
Acacia tetragonophylla	-	+	1.0-3.0
Aristida contorta		35	0.2
Eremophila exilifolia	-	+	0.8
Eremophila fraseri		3	2
Eremophila longifolia	-	+	0.4
Eriachne pulchella	-	+	0.1
Ptilotus obovatus	-	+	0.4
Senna glutinosa subsp. x *luerssenii*		+	0.8
Solanum lasiophyllum		+	0.4

Plate 30: Relevé 20

APPENDIX F

Species List

FAMILY	TAXON
Amaranthaceae	*Alternanthera nodiflora*
	Ptilotus aervoides
	Ptilotus helipteroides
	Ptilotus obovatus
	Ptilotus schwartzii
	Ptilotus sp. (inadequate material to positively identify)
Asteraceae	*Centipeda? thespidioides*
Brassicaceae	*Lepidium* sp. (inadequate material available to positively identify)
Campanulaceae	*Wahlenbergia tumidifructa*
Chenopodiaceae	*Atriplex vesicaria*
	Dissocarpus paradoxus
	Maireana villosa
	Maireana pyramidata
	Sclerolaena sp. (inadequate material available to positively identify)
Colchicaceae	*Wurmbea densiflora*
Crassulaceae	*Crassula colorata* var. *acuminata*
Cucurbitaceae	**Cucumis myriocarpus*
Cyperaceae	*Fimbristylis dichotoma*
Euphorbiaceae	*Euphorbia australis*
	Euphorbia drummondii subsp. *drummondii*
Fabaceae	*Acacia aneura*
	Acacia aneura var. *fuliginea*
	Acacia aneura var. *intermedia*
	Acacia aneura var. *major*
	Acacia craspedocarpa
	Acacia grasbyi
	Acacia quadrimarginea
	Acacia ramulosa var. *linophylla*
	Acacia synchronicia
	Acacia tetragonophylla

FAMILY	TAXON
	Acacia xiphophylla
	Glycine canescens
	Senna aff. sp. Meekatharra (E. Bailey 1-26)
	Senna artemisioides subsp. *helmsii*
	Senna glutinosa subsp. x *luerssenii*
Goodeniaceae	*Scaevola spinescens*
Lamiaceae	*Spartothamnella teucriiflora*
Loranthaceae	*Lysiana murrayi*
Malvaceae	*Abutilon cryptopetalum*
	Abutilon oxycarpum
	Androcalva luteiflora
	Hibiscus gardneri
	Lawrencia sp.
	Sida calyxhymenia
	Sida fibulifera
	Sida platycalyx
	Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)
Myrtaceae	*Thryptomene decussata*
Nyctaginaceae	*Boerhavia coccinea*
Poaceae	*Aristida contorta*
	Aristida holathera
	Cymbopogon ambiguus
	Enneapogon caerulescens
	Eragrostis dielsii
	Eragrostis falcata
	Eragrostis parviflora
	Eriachne flaccida
	Eriachne mucronata
	Eriachne pulchella
	Paspalidium clementii
Proteaceae	*Grevillea berryana*
	Hakea recurva
	Hakea preissii

FAMILY	TAXON
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*
Rubiaceae	*Psydrax latifolia*
	Psydrax rigidula
Santalaceae	*Exocarpos aphyllus*
	Santalum spicatum
Sapindaceae	*Dodonaea amplisemina* **Priority 4**
Scrophulariaceae	*Eremophila exilifolia*
	Eremophila forrestii subsp. *forrestii*
	Eremophila fraseri
	Eremophila latrobei subsp. *latrobei*
	Eremophila longifolia
	Eremophila exilifolia
	Eremophila platycalyx subsp. *platycalyx*
Solanaceae	*Solanum ellipticum*
	Solanum lasiophyllum
	**Solanum nigrum*
Violaceae	*Hybanthus floribundus*

APPENDIX D
Terrestrial Fauna Desktop Study

RUMBLE
RESOURCES LTD

APPENDIX 2

FLORA AND VEGETATION ASSESSMENT REPORT (BOTANICA 2025)

WESTERN QUEEN PROJECT

Reconnaissance Flora-Vegetation and Basic Fauna Survey

Prepared for Mega Resources Ltd

February 2025

Prepared by

BOTANICA CONSULTING

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Document Information

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Cover Photo: Vegetation within the Western Queen project area (14/01/2025)

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EXECUTIVE SUMMARY

Botanica Consulting Pty Ltd (Botanica) was commissioned by Mega Resources Ltd to undertake a reconnaissance flora/ vegetation survey and basic fauna survey of their Western Queen project area (referred to as the 'survey area'). The survey area is approximately 2,898 ha in extent and is located approximately 86 km northwest of Mt. Magnet, Western Australia. This assessment is intended to support a Native Vegetation Clearing Permit (NVCP) application for the Western Queen project.

The study area lies within the Western Murchison (MUR2) subregion of the Murchison Bioregion, as defined by the Interim Biogeographic Regionalisation of Australia (IBRA).

Prior to the field assessment a literature review was undertaken of previous flora and fauna assessments conducted within the local region. Documents reviewed included:

- Maia Environmental Consultancy (2023). Cue Gold Project, Single – Phase Detailed Flora and Vegetation Assessment and Targeted Flora Survey. Prepared on behalf of Musgrave Minerals, September 2023
- 360 Environmental (2021). *Moyagee Gold Project Biological Survey*. Prepared on behalf of Musgrave Minerals, February 2021
- 360 Environmental (2018). *Moyagee Gold Project Detailed Flora and Vegetation Assessment*. Prepared on behalf of Musgrave Minerals, August 2018

In addition to the literature review, searches of the following databases were undertaken to aid in the compilation of a list of significant flora within the survey area:

- DBCA Threatened and Priority Flora databases (DBCA, 2024a);
- Atlas of Living Australia (ALA) database (ALA, 2024); and
- EPBC Protected Matters search tool (DCCEEW, 2024a).

The DBCA database searches, ALA spatial portal search and EPBC Protected Matters search were conducted with a 40 km buffer from the survey area.

The ALA desktop search identified 467 vascular flora species as occurring within 40 km of the survey area, representing 195 genera from 63 families. The most diverse families were Fabaceae (70 species), Asteraceae (60 species) and Scrophulariaceae (36 species). The most dominant genera were *Acacia* (44 species), *Eremophila* (35 species) and *Ptilotus* (15 species).

The desktop assessment identified 21 significant flora species recorded within a 40 km radius of the survey area. These consist of one Threatened, five Priority 1, two Priority 2, ten Priority 3 and three Priority 4 taxa. These taxa were assessed for distribution and known habitat to determine their

likelihood of occurrence within the survey area. The assessment did not identify any taxa as 'Previously Recorded' in the survey area, 17 were assessed as 'Unlikely', two were assessed as 'Possible' (one Priority 1 and one Priority 3) and one as 'Likely' (Priority 4).

The Protected Matters search (DCCEEW, 2024a) did not identify and Threatened Ecological Communities (TECs) as occurring within 40 km of the survey area.

Analysis of the Priority Ecological Communities within the Midwest region (DBCA, 2021) did not identify any significant vegetation assemblages as potentially occurring within the survey area.

The desktop review identified 13 terrestrial vertebrate fauna species of conservation significance that have previously been recorded in the regional area, some of which have the potential to occur in or utilise sections of the survey area at times. These species consisted of eight Threatened and seven migratory species (of which two are also listed as Threatened) under the EPBC Act. Habitat and distribution data was used to determine the likelihood of occurrence within the survey area. The assessment did not identify any taxa as 'Known to Occur' in the survey area, seven were assessed as 'Would Not Occur', three were assessed as 'Unlikely to Occur' and three were assessed as 'Possibly Occurs'; including the Migratory species *Merops ornatus* (Rainbow bee-eater), and two Vulnerable species *Leipoa ocellata* (Malleefowl) and *Aphelocephala leucopsis* (Southern Whiteface).

No Environmentally Sensitive Areas (ESAs) were identified within the survey area.

There are no wetlands of international importance (Ramsar Wetlands) or national importance (Australian Nature Conservation Agency Wetlands) within the survey area.

There are no proposed or gazetted conservation reserves within the survey area.

Botanica conducted a reconnaissance flora/ vegetation survey and basic fauna assessment on the 13-14th January 2025, with the area traversed on foot and by 4WD by Jim Williams (Director/Principal Botanist, Diploma of Horticulture).

The field survey identified 86 vascular flora taxa within the survey area. These taxa represented 42 genera across 27 families, with the most diverse families being Fabaceae (19 species), Chenopodiaceae (12 species) and Scrophulariaceae (11 species). Dominant genera include *Acacia* (14 species), *Eremophila* (11 species), and *Maireana* and *Ptilotus* (five species each).

No introduced (weed) species were recorded within the survey area.

No Threatened, Priority or otherwise significant flora species were recorded within the survey area.

A total of 11 broad-scale vegetation communities were identified within the survey area. Vegetation community descriptions and extents were determined from field survey results, aerial imagery interpretation and extrapolation of the communities. These communities, whilst locally variable, are relatively widespread throughout the Murchison bioregion.

No Threatened, Priority or otherwise significant ecological communities were identified within the survey area.

Based on vegetation and associated landforms identified during the flora and vegetation assessment, four broad scale terrestrial fauna habitats were identified as occurring within the survey area.

No evidence for the presence of Malleefowl, including nesting mounds, tracks or other signs, were recorded within the survey area. Available information suggests that a breeding population of this Malleefowl is unlikely to be present in the survey area. No other evidence of significant fauna species were observed during the survey. For the conservation significant fauna assessed as 'Possibly' occurring within the survey area, significant impact is deemed unlikely.

Native vegetation condition within the survey area was categorised as 'Very Good' to 'Degraded'. The majority of impacts within the survey area were from historical disturbance, predominately caused by exploration activities and feral animal grazing.

Based on the outcomes from the survey undertaken, Botanica assessed the results of the desktop and field survey with regards to the native vegetation clearing principles listed under Schedule 5 of the *Environmental Protection* (EP) *Act 1986*. The assessment found that the proposed vegetation clearing activities may be at variance with clearing principle (f).

1 INTRODUCTION

Botanica Consulting Pty Ltd (Botanica) was commissioned by Mega Resources Ltd to undertake a reconnaissance flora/ vegetation survey and basic fauna assessment of their Western Queen project area (referred to as the 'survey area'). The survey area is approximately 2,898 ha in extent and is located approximately 86 km northwest of Mt. Magnet, Western Australia in the Shire of Yalgoo (Figure 1-1). This assessment is intended to support a Native Vegetation Clearing Permit (NVCP) application for the Western Queen project.

1.1 Objectives

The flora assessment was conducted in accordance with the requirements of a reconnaissance flora and vegetation survey as defined in *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (Environmental Protection Authority [EPA], 2016a). The objectives of the assessment were to:

- gather background information on flora and vegetation in the target area (literature review, database and map-based searches);
- identify significant flora, vegetation and ecological communities and assess the potential sensitivity to impact;
- conduct a field survey to verify / ground truth the desktop assessment findings;
- undertake floristic community mapping to a scale appropriate for the bioregion and described according to the National Vegetation Information System (NVIS) structure and floristics;
- undertake vegetation condition mapping;
- assess the project area's plant species diversity, density, composition, structure and weed cover, using NVIS classification system for vegetation description;
- assess Matters of National Environmental Significance (MNES) and indicate whether potential impacts on MNES as protected under the *Environmental Protection, Biodiversity and Conservation Act 1999* (Cth) (EPBC Act) are likely to require referral of the project to the Commonwealth Department of Climate Change, Energy, the Environment, and Water (DCCEEW); and
- determine the State legislative context of environmental aspects required for the assessment.

The fauna assessment was conducted in accordance with the requirements of a basic terrestrial fauna survey as defined in *Technical Guidance - Terrestrial Fauna Surveys for Environmental Impact Assessment* (EPA, 2020). The objectives of the assessment were to:

- Undertake a literature review, including map-based information searches of all current and relevant literature sources and databases relating to the survey area;
- Undertake a desktop investigation to identify any previously recorded occurrences of or potentially occurring Threatened and Priority listed fauna within the survey area;
- Undertake searches on available databases for details relating to any Threatened and Priority listed fauna previously identified as occurring or potentially occurring within the survey area;
- Conduct fauna habitat mapping and identify habitat types which are suitable for each significant fauna considered likely or possible to occur, or fauna recorded in the survey area;
- Compile an inventory of fauna species occurrences within the survey area;
- Undertake opportunistic, low intensity sampling of fauna; and
- Report on the conservation status of species present using the Western Australian Museum and EPBC Act databases for presence of Threatened and Priority listed fauna species within the survey area.

Figure 1-1: Regional map of the desktop survey area

2 BIOPHYSICAL ENVIRONMENT

2.1 Regional Environment

The survey area lies within the Western Murchison (MUR2) subregion of the Murchison Bioregion, as defined by the Interim Biogeographic Regionalisation of Australia (IBRA) (DCCEEW, 2020). The Western Murchison comprises the northern parts of the Murchison Terrains of the Yilgarn Craton, and is characterised by extensive hardpan washplains of fine-textured Quaternary alluvial and eluvial soils, with surfaces associated with the occluded drainage occurring throughout and mantling granitic and greenstone strata of the northern part of the Yilgarn Craton. The subregion contains the headwaters of the Murchison and Wooramel Rivers, which drain the subregion westwards to the coast. Vegetation consists of mulga low woodlands, often rich in ephemerals (usually with bunch grasses), on outcrops, with hummock grasslands on Quaternary sandplains, saltbush shrublands on calcareous soils and *Tecticornia* low shrublands on saline alluvia. The climate is arid, with bimodal rainfall that usually falls in winter. (Cowan, 2001).

In accordance with Beard (1990), the Murchison region is located in the Austin Botanical District within the Eremaean Province of WA. It is defined by the vegetational expression of geological boundaries of the Yilgarn Block, described as Archaean granite with infolded volcanics and meta-sediments (greenstones) of a like age. The topography is undulating, with occasional ranges of low hills and extensive sandplains in the eastern half. The principal soil type is shallow earthy loam overlying red-brown hardpan, with shallow stony loams on hills and red earthy sands on sandplains. The western half of the region more or less coincides with the basin of the Murchison River, the eastern half embraces the drainage of former rivers, now dry, draining towards the Eucla Basin. Vegetation is predominantly mulga low woodland *(Acacia aneura)* on plains, reduced to scrub on hills, with a tree steppe of *Eucalyptus* spp. and *Triodia basedowii* on sandplains. The climate is arid, with summer and winter rains and an average annual precipitation of 200 mm.

2.2 Land Use

The dominant land uses of the Western Murchison subregion include grazing native pastures (96.2%), UCL and crown reserves (2.814%). Conservation areas consist of just 0.06%, while considerable areas of mining interests are located within pastoral areas (Cowan, 2001).

2.3 Soil Landscape Systems

The survey area lies within the Murchison Province, located in the inland Mid-west and northern Goldfields between Three Springs, the Gascoyne River, Wiluna, Cosmo Newberry and Menzies. The landscape consists of hardpan wash plains and sandplains (with some stony plains, hills, mesas and salt lakes) on the granitic rocks and greenstone of the Yilgarn Craton. Soils include red loamy earths, red sandy earths, red shallow loams, red deep sands and red-brown hardpan shallow loams (with some red shallow sands and red shallow sandy duplexes). Vegetation is typified by mulga shrublands with spinifex grasslands (and some bowgada shrublands, eucalypt woodlands and halophytic shrublands) (Tille, 2006).

The Murchison Province is further divided into soil-landscape zones, with the survey area located within the Yalgoo Plains Zone (273). The Yalgoo Plains Zone is comprised of hardpan wash plains (with some sandplains, stony plains, mesas and granite outcrops) on granitic rocks (with some greenstone) of the Yilgarn Craton (Murchison Domain). Soils consist of red loamy earths and red shallow loams (often with hardpans) with red deep sands and red shallow sands and some red shallow sandy duplexes. Vegetation is typified by mulga shrublands with bowgada shrublands, with some halophytic shrublands. This zone is located in the south-western Murchison from Paynes Find to Cue and Twin Peaks Station (Tille, 2006).

In accordance with soil landscape system mapping data (Government of Western Australia, 2019), the soil landscape zones are divided into soil landscape systems, with the survey areas located within five soil landscape systems, as described in Table 2-1 and shown in Figure 2-1.

Table 2-1: Soil landscape systems within the survey area

Soil Landscape System	Description	Extent within Survey Area
Challenge System	Gently undulating gritty and sandy surfaced plains, occasional granite hills, tors and low breakaways, supporting acacia shrublands and occasional halophytic shrublands.	424.2 ha (14.6%)
Gabanintha System	Greenstone ridges, hills and footslopes supporting sparse acacia and other mainly non-halophytic shrublands.	869.3 ha (30%)
Jundee System	Hardpan plains with variable gravelly mantles and minor sandy banks supporting weakly groved mulga shrublands.	1485.7 ha (51.3%)
Violet System	Gently undulating gravelly plains on greenstone, laterite and hardpan, with low stony rises and minor saline plains; supporting groved mulga and bowgada shrublands and occasionally chenopod shrublands.	0.2 ha (<0.1%)
Yanganoo System	Almost flat hardpan wash plains, with or without small wanderrie banks and weak groving; supporting mulga shrublands and wanderrie grasses on banks.	118.8 ha (4.1%)
TOTAL		**2898.2 ha (100%)**

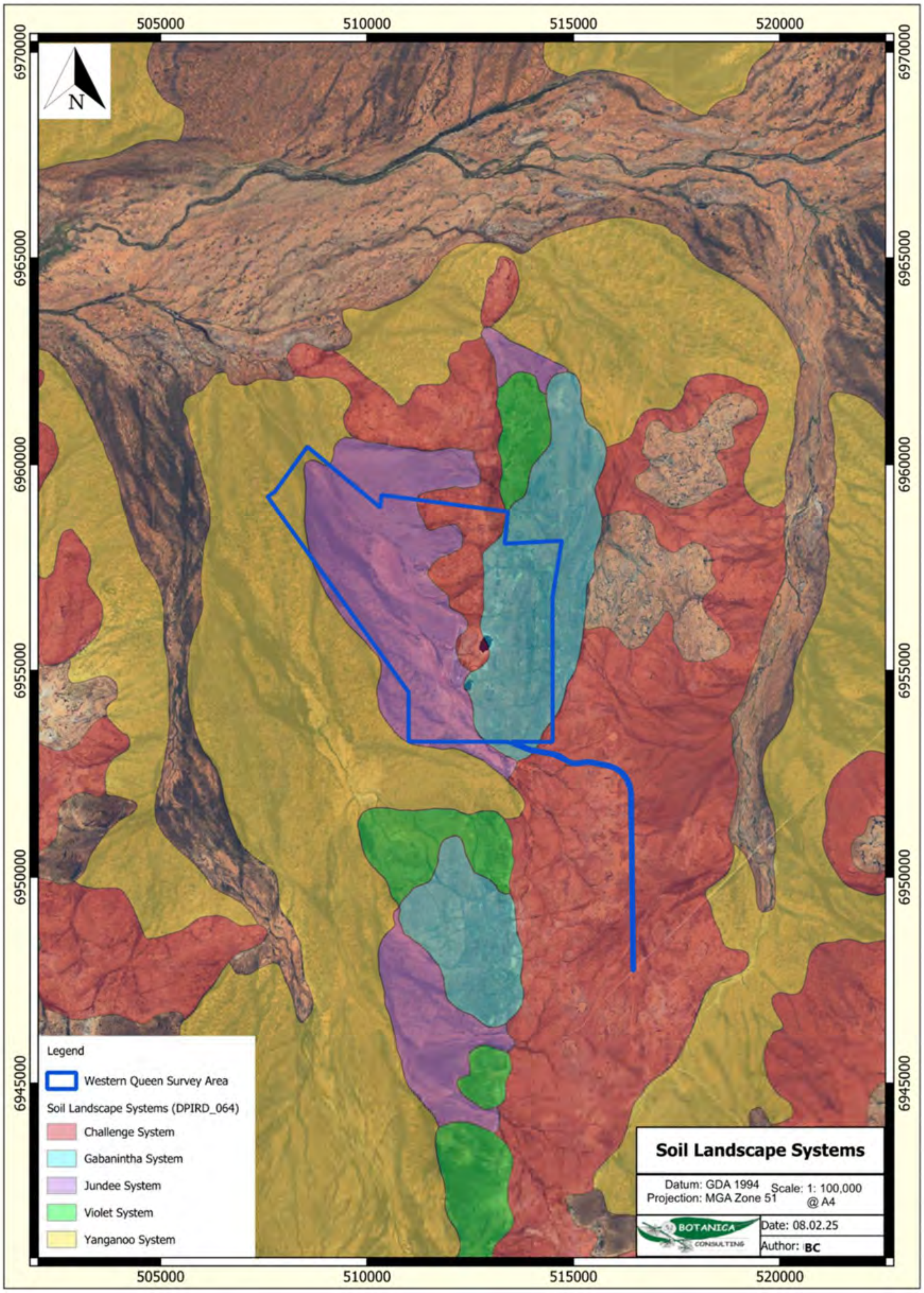

Figure 2-1: Map of soil landscape systems within the survey area

2.4 Regional Vegetation

In accordance with Tille (2006), the vegetation of the Yalgoo Plains Zone is typified by Acacia shrublands, sandplains and occasional dunes with grassy acacia shrublands and wash plains on hardpan with mulga shrublands.

More broadly, the vegetation of the Murchison Province is described by Tille (2006) as mulga (*Acacia aneura*) shrublands and woodlands with gidgee (*A. pruinocarpa*), curara (*A. tetragonophylla*), *A. linophylla*, bowgada (*A. ramulosa*), jam (*A. acuminata*), minniritchie (*A. grasbyi*), *Senna* spp. and *Eremophila* spp. dominate the hardpan wash plains. Denser, taller mulga woodlands are found on groves while the sandy banks support mulga, bowgada and curara shrublands with an understorey of wanderrie grasses (*Eragrostis* and *Eriachne* spp. and *Monachather paradoxa*). Snakewood (*A. xiphophylla*), bluebush (*Maireana* spp.) and saltbush (*Atriplex* spp.) grow on the saline drainage tracts. The sandplains in the east support grasslands of hard spinifex (*Triodia basedowii*). These grasslands occur with an open tree and shrub steppe of mulga, marble gum (*Eucalyptus* gongylocarpa), mallees (*E. kingsmillii*, *E. trichopoda*, *E. brachycorys* and *E. youngiana*), bowgada and spinifex wattle (*A. coolgardiensis*). In places denser woodlands of mulga, spinifex wattle or mallee are found over the spinifex. On western sandplains shrublands are dominated by bowgada with cypress pine (*Callitris columellaris*), mallees (e.g. *E. leptopoda* and *E. kingsmillii*), mulga and *Grevillea* spp. On the yellow sandplains in the south-west are closed mixed shrublands with *Melaleuca*, *Hakea*, *Calothamnus*, *Baeckea*, *Banksia prionotes*, *Allocasuarina*. and *Acacia* spp. The mesas have bowgada, mulga and *A. linophylla* shrublands above the breakaways, while the footslopes support shrublands with saltbush (*Atriplex* spp.), *Frankenia* spp., *Ptilotus* spp. and *Eremophila pterocarpa*. The hilly terrain has shrublands of mulga, minniritchie, *Eremophila* spp. and cotton bush (*Ptilotus obovatus*). Hills in the far west have woodlands of York gum (*Eucalyptus loxophleba*), salmon gum (*E. salmonophloia*) and jam. The stony plains support shrublands of mulga, gidgee, granite wattle (*Acacia quadrimarginea*), minniritchie, prickly wattle, snakewood, jam and *Eremophila* spp. On the valley floors there are shrublands of samphire (*Tecticornia* spp.), saltbush, sage (*Cratystylis subspinescens*) and *Frankenia* spp. surrounding salt lakes. Floodplains along the Murchison and its tributaries have shrublands of bluebush (*Maireana* spp.), saltbush and *Frankenia* spp., as well as mulga, prickly wattle and *Acacia distans*.

2.5 Conservation Values

The Western Murchison subregion contains 14 vegetation associations that have at least 85 per cent of their total extent in the Bioregion. The Bioregion is rich and diverse in flora and fauna but most species are wide ranging and usually occur in adjoining regions. A snake (*Pseudechis butleri*) is the only known regionally endemic vertebrate species.

There are three wetlands of national importance in the Bioregion: Lake Wooleen, Lake Breberle and Lake Anneen. There is one wetland of subregional importance, the Mungawolagudgi Claypan on Muggon Station. Riparian zone vegetation include the Murchison River and the Wooramel River.

No ecosystems are listed as Threatened under WA State legislation occur within the Western Murchison subregion, but 27 communities and vegetation associations are thought to be at risk for a variety of reasons. Grazing from livestock, goats and rabbits and changed fire regimes are the main threatening processes in the region, with clearing, impacts of mining, erosion and sedimentation also causing significant impacts.

2.6 Climate

The climate of the Western Murchison (MUR2) subregion is characterised as an arid climate with summer and winter rainfall of approximately 200 mm annually (Beard, 1990). Rainfall data for the Mount Magnet Aero weather station (#7600), located approximately 86 km southeast of the survey area, is shown in Figure 2-2. Mean monthly rainfall ranges from 35.6 mm in March to 7.2 mm in October, with a mean annual rainfall of 244.7 mm. The survey was conducted in January 2025, with the preceding months (November-December) characterised by above average rainfall – 43.6 mm and 26.2 mm respectively. Climate conditions are unlikely to represent a survey constraint.

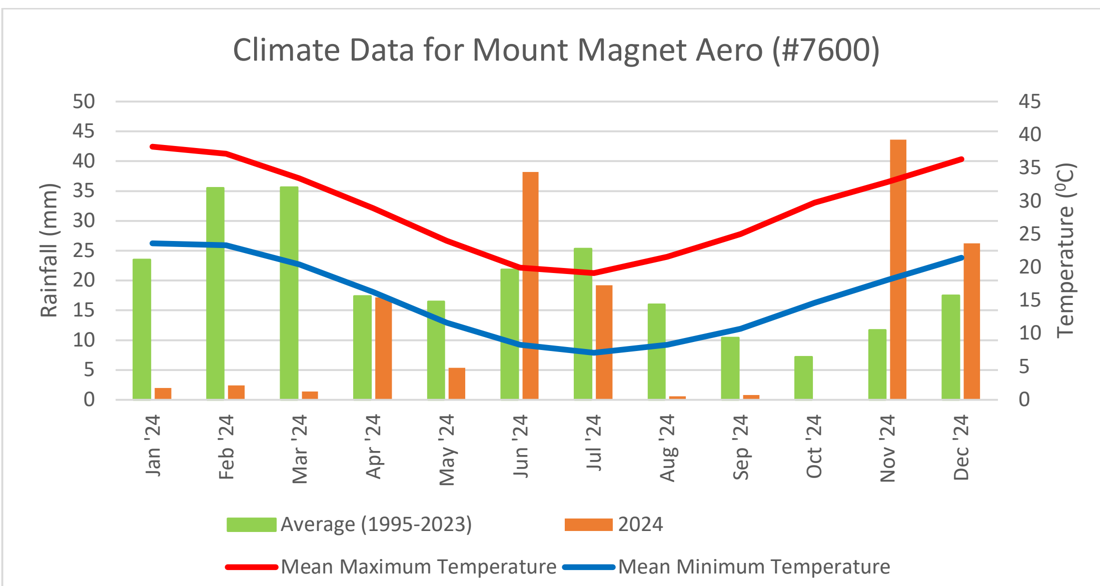

Figure 2-2: Climate data for Mount Magnet Aero (BoM, 2025a)

2.7 Hydrology

The survey area is located within the Murchison River surface water catchment area. According to the Geoscience Australia database (2015), there are no permanent or ephemeral water bodies within the survey area (Figure 2-3). There are several minor ephemeral drainage channels within the survey area (Figure 2-3), which drain northwest to the Sanford River a tributary of the Murchison River.

Groundwater Dependent Ecosystems (GDEs) includes biological assemblages of species such as wetlands or woodlands that use groundwater either opportunistically or as their primary water source. For the purposes of this report, a GDE is defined as any vegetation community that derives part of its water budget from groundwater and must be assumed to have some degree of groundwater dependency. In accordance with the BoM Atlas of Groundwater Dependent Ecosystems (BoM, 2024b) database, there are three potential terrestrial GDEs within the survey area, all of which are categorised as low potential. There are no potential aquatic GDEs within the survey area (Figure 2-3).

Table 2-2: Potential GDEs of the survey area

Geomorphology	Potential	Vegetation Description	Area
Sandplains and hardpan wash plains with outgoing drainage and salt lakes, broken by ridges of metamorphic rocks and granite.	Low	Low breakaways with saline gravelly lower plains supporting predominately halophytic low shrublands.	424.2 ha (14.7%)
		Salt lakes with extensively fringing saline plains, dunes and sandy banks, supporting low halophytic shrublands and scattered tall acacia shrublands.	1485.8 ha (51.4%)
		Distributary alluvial fans and wash plains supporting Mulga - chenopod shrublands.	118.8 ha (4.1%)
TOTAL			**2028.8 ha (70.1%)**

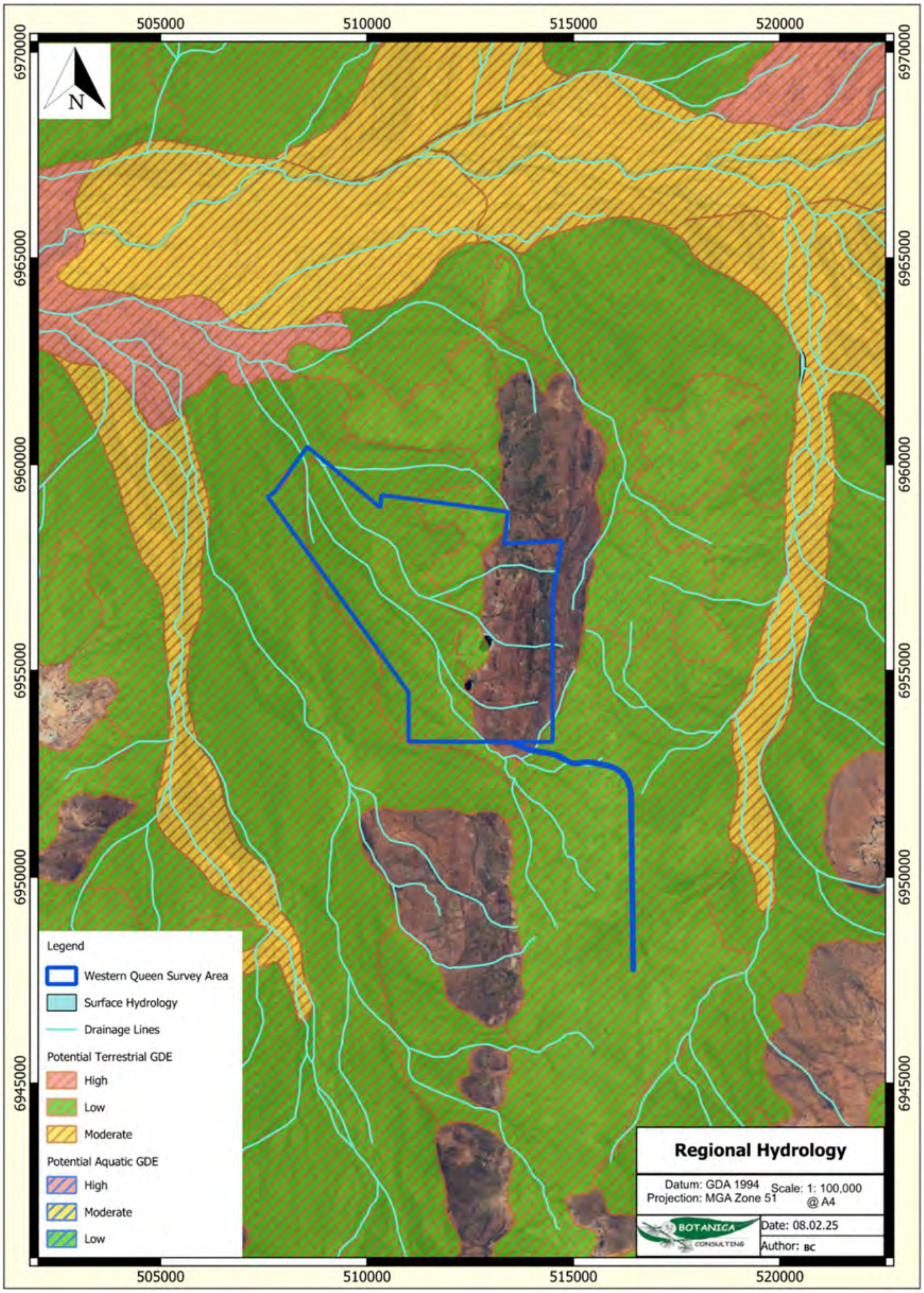

Figure 2-3: Regional hydrology of the survey area

3 SURVEY METHODOLOGY

3.1 Desktop Assessment

Prior to the field assessment a literature review was undertaken of previous flora and fauna assessments conducted within the local region. Documents reviewed included:

- Maia Environmental Consultancy (2023): *Cue Gold Project, Single – Phase Detailed Flora and Vegetation Assessment and Targeted Flora Survey*. Prepared on behalf of Musgrave Minerals, September 2023.
- 360 Environmental (2021). *Moyagee Gold Project Biological Survey*. Prepared on behalf of Musgrave Minerals, February 2021.
- 360 Environmental (2018). *Moyagee Gold Project Detailed Flora and Vegetation Assessment*. Prepared on behalf of Musgrave Minerals, August 2018.

In addition to the literature review, searches of the following databases were undertaken to aid in the compilation of a list of significant flora within the survey area:

- DBCA Threatened and Priority Flora databases (DBCA, 2024a);
- Atlas of Living Australia (ALA) database (ALA, 2024); and
- EPBC Protected Matters search tool (DCCEEW, 2024a).

The DBCA database searches, ALA spatial portal search and EPBC Protected Matters search were conducted with a 40 km buffer from the survey area.

Significant flora species identified by the desktop review were assessed with regards to their population extent and distribution and preferred habitat to determine their likelihood of occurrence within the survey area.

The assessment categorised flora species as follows:

- Unlikely - Suitable habitat is not expected to occur and/or the survey area is outside the known range of the species.
- Possible - Suitable habitat may be present, and the area is within the known range of the species. This option is also used when there is insufficient information to determine the preferred habitat of a species.
- Likely - Suitable habitat is expected to occur and there are records within 10 km of the survey area.

- Previously Recorded - A record for this species is located within the survey area. Field survey will ground-truth currently occurring individuals and populations.

It should be noted that these lists are based on observations from a broader area than the assessment area (40 km radius) and therefore may include taxa not present. The databases also often include very old records that may be incorrect or in some cases the taxa in question have become locally or regionally extinct. Information from these sources should therefore be taken as indicative only and local knowledge and information also needs to be taken into consideration when determining what actual species may be present within the specific area being investigated.

The conservation significance of flora taxa was assessed using data from the following sources:

- *Environment Protection and Biodiversity and Conservation* (EPBC) *Act 1999*. Administered by the Australian Government (DCCEEW);
- *Biodiversity Conservation* (BC) *Act 2016*. Administered by the WA Government (DBCA) - *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2024* (released November 2024);
- Red List produced by the Species Survival Commission (SSC) of the World Conservation Union (also known as the IUCN Red List – the acronym derived from its former name of the International Union for Conservation of Nature and Natural Resources). The Red List has no legislative power in Australia but is used as a framework for State and Commonwealth categories and criteria; and
- Priority Flora list. A non-legislative list maintained by DBCA for management purposes (released January 2025).

Descriptions of conservation significant species and communities are provided in Appendix A.

3.2 Flora and Vegetation Field Assessment

Botanica conducted a reconnaissance flora/ vegetation survey and basic fauna assessment on the 13-14th January 2025, with the area traversed on foot and by 4WD by Jim Williams (Director/Principal Botanist, Diploma of Horticulture). The GPS track log of the survey effort is shown in Figure 3-1.

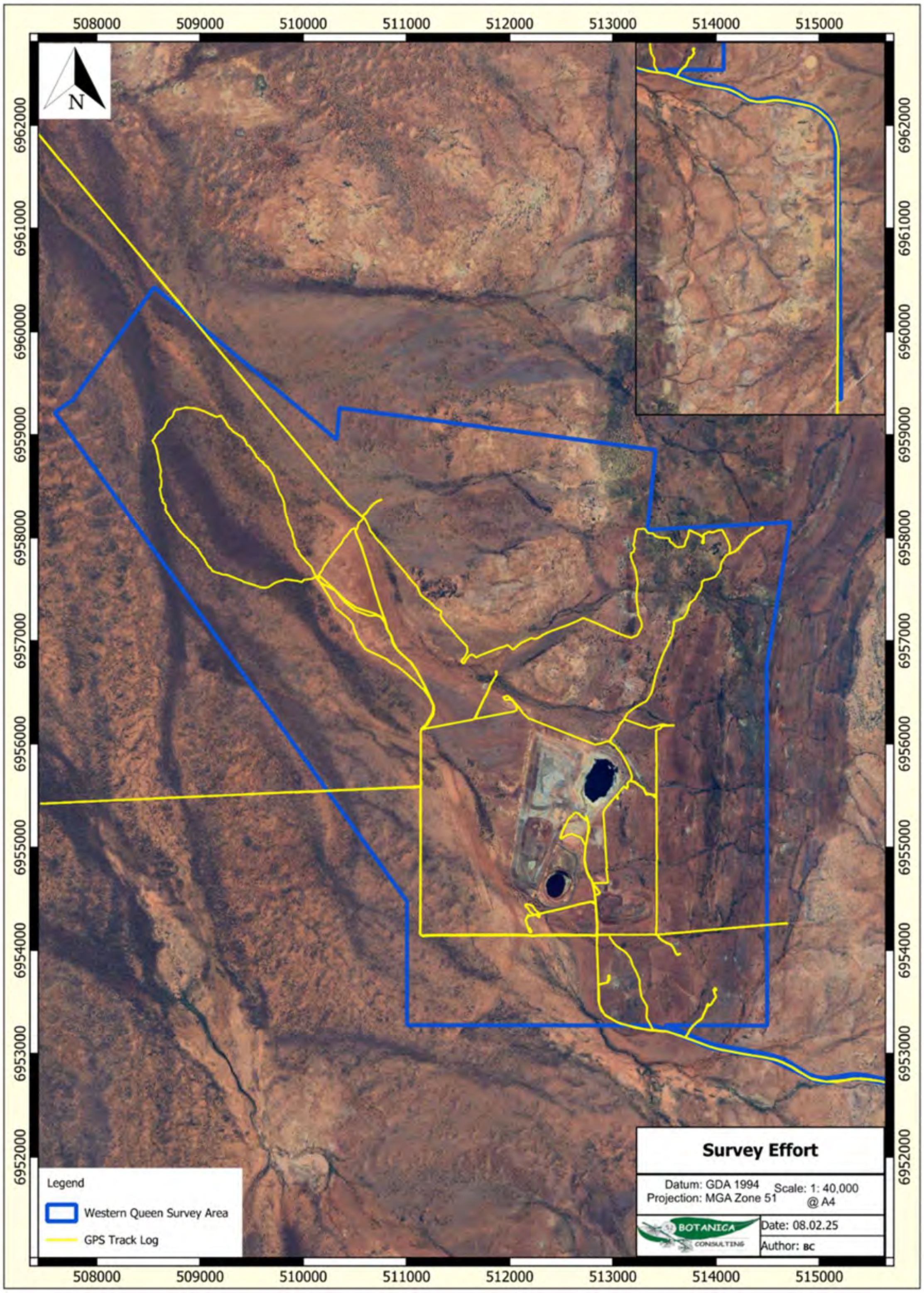

Figure 3-1: GPS track log of the survey effort

3.2.1 Flora Assessment

Prior to the commencement of field work, aerial photography was inspected and obvious differences in the vegetation assemblages were identified. The different vegetation communities identified were then inspected during the field survey to assess their validity. A handheld GPS unit was used to record the coordinates of the boundaries between existing vegetation communities. At each sample point, the following information was recorded:

- GPS location;
- Photograph of vegetation;
- Dominant taxa for each stratum;
- All vascular taxa (including annual taxa);
- Landform classification;
- Vegetation condition rating;
- Collection and documentation of unknown plant specimens; and
- GPS location, photograph and collection of flora of conservation significance if encountered.

Unknown specimens collected during the survey were identified with the aid of samples housed at the Botanica Herbarium and Western Australian Herbarium. Vegetation was classified in accordance with NVIS classifications.

3.3 Data Analysis Tools

Following field assessments, vegetation types and condition were mapped using the GIS program QGIS, and the hectare area/ percentage area of each vegetation type and condition within the survey area was calculated. Spatial maps illustrating the location of vegetation types and any significant flora/ vegetation and fauna were generated using QGIS.

3.4 Terrestrial Fauna Field Assessment

Fauna habitat types were identified across the survey area based on broad major vegetation groups and associated landform. A handheld GPS unit was used to record the coordinates of the boundaries between fauna habitats and each habitat was photographed.

The main aim of the fauna habitat assessment was to determine the likelihood of a species of conservation significance utilising habitat within the survey area. The habitat information obtained was also used to aid in finalising the overall potential fauna list.

Available information on the habitat requirements of the species of conservation significance listed as possibly occurring in the area (determined from the desktop assessment) was researched. During the field survey, the habitats within the survey area were assessed and specific elements identified, if present, to determine the likelihood of listed Threatened and Priority species utilising habitat within the survey area.

Opportunistic observations of fauna species were made during all field survey work.

Fauna of conservation significance identified during the literature review and database searches as previously being recorded in the general area were assessed and ranked for their likelihood of occurrence within the survey area. The rankings and criteria used were:

- Would Not Occur: There is no suitable habitat for the species in the survey area and/or there is no documented record of the species in the general area since records have been kept and/or the species is generally accepted as being locally/regionally extinct (supported by a lack of recent records).
- Locally Extinct: Populations no longer occur within a small part of the species natural range, in this case within 10 or 20 km of the survey area. Populations do however persist outside of this area.
- Regionally Extinct: Populations no longer occur in a large part of the species natural range, in this case within the Western Murchison subregion. Populations do however persist outside of this area.
- Unlikely to Occur: The survey area is outside of the currently documented distribution for the species in question, or no suitable habitat (type, quality and extent) was identified as being present during the field assessment. Individuals of some species may occur occasionally as vagrants/transients especially if suitable habitat is located nearby but the site itself would not support a population or part population of the species.
- Possibly Occurs: Survey area is within the known distribution of the species in question and habitat of at least marginal quality was identified as likely to be present during the field survey and literature review, supported in some cases by recent records being documented in literature from within or near the survey area. In some cases, while a species may be classified as possibly being present at times, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.
- Known to Occur: The species in question has been positively identified as being present (for sedentary species) or as using the survey area as habitat for some other purpose (for non-sedentary/mobile species) during field surveys within or near the survey area. This information may have been obtained by direct observation of individuals or by way of secondary evidence (e.g. tracks, foraging debris, scats). In some cases, while a species may be classified as known to occur, habitat may be marginal (e.g. poor quality, fragmented, limited in extent) and therefore the frequency of occurrence and/or population levels may be low.

3.5 Scientific Licences

Table 3-1: Scientific Licenses of Botanica Staff coordinating the survey

Licensed Staff	Permit Number	Date of Expiry
Jim Williams	FB62000457(licence to take flora for scientific purposes)	04/08/2025

3.6 Survey Limitations and Constraints

It is important to note that field surveys will entail limitations, notwithstanding careful planning and design. Potential limitations are listed in Table 3-2.

The conclusions presented in this report are based upon field data and environmental assessments and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of the field assessments. Also, it should be recognised that site conditions can change with time. Information not available at the time of this assessment which may subsequently become available may alter the conclusions presented.

Some species are reported as potentially occurring based on there being suitable habitat (quality and extent) within the survey area or immediately adjacent. The habitat requirements and ecology of many of the species known to occur in the wider area are however often not well understood or documented. It can therefore be difficult to exclude species from the potential list based on a lack of a specific habitats or microhabitats within the survey area. As a consequence of this limitation, the potential species list produced is most likely an overestimation of those species that actually utilise the survey area for some purpose.

In recognition of survey limitations, a precautionary approach has been adopted for this assessment. Any flora species that would possibly occur within the survey area (or immediately adjacent), as identified through ecological databases, publications, discussions with local experts/residents and the habitat knowledge of the author, has been listed as having the potential to occur.

Table 3-2: Limitations and constraints associated with the survey

Variable	Potential Impact on Survey	Details
Access problems	Not a constraint	The survey was conducted via 4WD and on foot. The survey area was easily accessible via existing tracks and roads.
Competency/ Experience	Not a constraint	The Botanica personnel that conducted the survey were regarded as suitably qualified and experienced. Coordinating Staff: Jim Williams (Principal Botanist) Data Interpretation: Jim Williams (Principal Botanist), and Kelby Jennings (Senior Environmental Consultant).
Timing of survey, weather & season	Minor constraint	Fieldwork was undertaken outside the EPA's recommended survey period (6-8 weeks post wet season (March-June)) for the Eremaean Province. However, the survey was able to describe the broad vegetation systems of the survey area, and potentially occurring

Variable	Potential Impact on Survey	Details
		significant flora are perennial and would have been detectable at time of the survey if present.
Area disturbance	Minor constraint	There is significant historical mining disturbance within the survey area, and evidence of feral animal grazing was present throughout the survey area.
Survey Effort/ Extent	Not a constraint	Survey intensity was appropriate for the size/significance of the area with a reconnaissance flora survey and basic fauna survey completed to identify vegetation types/ fauna habitats and significant flora, fauna and vegetation.
Availability of contextual information at a regional and local scale	Not a constraint	DBCA desktop searches for significant flora, fauna and ecological communities were used to inform the survey effort and identify the location of significant environmental values. BoM, DWER, DPIRD, DBCA and DCCEEW databases were reviewed to obtain appropriate regional desktop information on the biophysical environment of the local region. Botanica has conducted a number of surveys within the Murchison bioregion and was also able to obtain information about the area from previous research conducted within the area. Results of previous assessments in the local area were reviewed to provide context on the local environment.
Completeness	Not a constraint	In the opinion of Botanica, the survey area was covered sufficiently in order to fulfill the requirements of a reconnaissance level survey. Vegetation assemblages were described and mapped, and all observed flora individuals were able to be identified to species level. The vegetation associations for this study were based on visual descriptions of locations in the field. The distribution of these vegetation associations outside the survey area is not known, however vegetation associations identified were categorised via comparison to vegetation distributions throughout WA given on NVIS (DotEE, 2017).

4 RESULTS

4.1 Desktop Assessment

4.1.1 Flora

The ALA desktop search identified 467 vascular flora species as occurring within 40 km of the survey area, representing 195 genera from 63 families. The most diverse families were Fabaceae (70 species), Asteraceae (60 species) and Scrophulariaceae (36 species). The most dominant genera were *Acacia* (44 species), *Eremophila* (35 species) and *Ptilotus* (15 species).

4.1.1.1 Introduced Flora

Nineteen introduced (weed) flora species, representing 12 families, were identified in the desktop study area (Table 4-1). Of these, two species are listed as a Declared Pest on the Western Australian Organism List (WAOL) under the *Biosecurity and Agriculture Management (BAM) Act 2007* and as a Weed of National Significance (WONS).

Table 4-1: Introduced flora species of the desktop study area

Family	Taxon	DP	WONS
Aizoaceae	*Cleretum papulosum*		
Asteraceae	*Carthamus lanatus*		
Brassicaceae	*Carrichtera annua*		
Brassicaceae	*Sisymbrium erysimoides*		
Brassicaceae	*Sisymbrium orientale*		
Cactaceae	*Cylindropuntia fulgida*	Y	Y
Caryophyllaceae	*Silene gallica* var. *gallica*		
Caryophyllaceae	*Spergula pentandra*		
Chenopodiaceae	*Chenopodium murale*		
Fabaceae	*Medicago minima*		
Fabaceae	*Medicago polymorpha*		
Fabaceae	*Vachellia farnesiana* var. *farnesiana*		
Malvaceae	*Malva parviflora*		
Poaceae	*Cenchrus ciliaris*		
Poaceae	*Ehrharta longiflora*		
Polygonaceae	*Rumex hypogaeus*		
Polygonaceae	*Rumex vesicarius*		
Solanaceae	*Solanum nigrum*		
Tamaricaceae	*Tamarix aphylla*	Y	Y

4.1.1.2 Significant Flora

The assessment of the DBCA Threatened and Priority flora database searches (DBCA, 2024a), ALA (ALA, 2024) and Protected Matters search (DCCEEW, 2025a) and previous relevant literature identified 21 significant flora species recorded within a 40 km radius of the survey area. These consist of one Threatened, five Priority 1, two Priority 2, ten Priority 3 and three Priority 4 taxa (Appendix B).

The locations of the DBCA database records are illustrated spatially in Figure 4-1.

These taxa were assessed for distribution and known habitat to determine their likelihood of occurrence within the survey area (Appendix B). The assessment did not identify any taxa as 'Previously Recorded' in the survey area, 17 were assessed as 'Unlikely', two were assessed as 'Possible' (one Priority 1 and one Priority 3) and one as 'Likely' (Priority 4).

Table 4-2 provides a summary of the taxa assessed as Possible and Likely to occur in the survey area, whilst the full flora likelihood assessment is provided as Appendix B.

Table 4-2: Significant flora potentially occurring within the survey area

Taxon	DBCA Priority	Description	Comments	Likelihood
Acacia speckii	P4	Bushy, rounded shrub or tree, 1.5-3 m high. Rocky soils over granite, basalt or dolerite. Rocky hills or rises.	Within known range, habitat likely to be present.	Likely
Petrophile vana	P1	Shrub, to 1.5 m high. Shallow, white, gritty clay-soil pockets, laterite. Breakaways.	Within known range, habitat may be present.	Possible
Eremophila simulans subsp. *megacalyx*	P3	Shrub, 0.9-2 m high. Fl. violet, Aug to Sep.	Within known range.	Possible

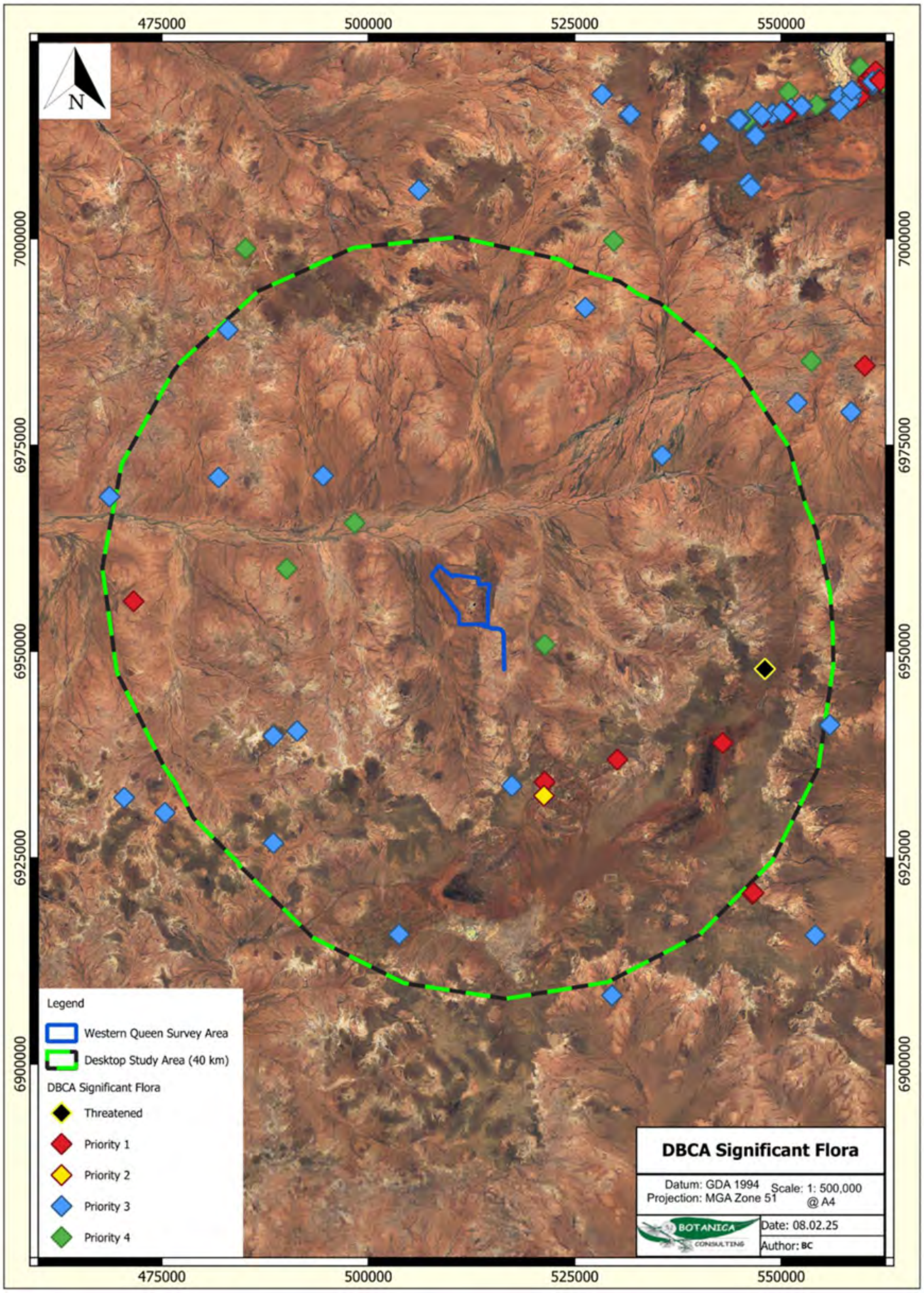

Figure 4-1: Significant flora within the desktop search area

4.1.2 Vegetation and Ecological Communities

4.1.2.1 Vegetation Associations

The pre-European vegetation association spatial mapping dataset (DPIRD, 2018) identified two vegetation associations as occurring within the survey area (Table 4-3). The association descriptions and their remaining extent, as specified in the 2018 Statewide Vegetation Statistics (DBCA, 2019b) are provided in Table 4-3. Areas retaining less than 30% of their pre-European vegetation extent generally experience exponentially accelerated species loss, while areas with less than 10% are considered "endangered" (EPA, 2000). Both vegetation associations retain >99% of their pre-European extent, and development within the survey area will not significantly reduce the current extent of these vegetation associations.

Table 4-3: Pre-European vegetation associations within the survey area

Vegetation Association	Current Extent	Protected for Conservation	Floristic Description	Extent within Survey Area
Upper Murchison 39	398,395.6 ha (99.76%)	-	Shrublands; mulga scrub	1164.2 ha (40.2%)
Upper Murchison 18	1,635,841.8 ha (99.73%)	-	Low woodland; mulga (*Acacia aneura*)	1734 ha (59.8%)
TOTAL				**2898.2 ha (100%)**

4.1.2.2 Significant Ecological Communities

The Protected Matters search (DCCEEW, 2024a) did not identify any Threatened Ecological Communities (TECs) as occurring within 40 km of the survey area.

The DBCA's *Threatened Ecological Community List* (State of Western Australia, 2023) does not list any TECs within the Shire of Yalgoo.

Analysis of the Priority Ecological Communities (PECs) within the Midwest region (DBCA, 2023) did not identify any significant vegetation assemblages as potentially occurring within the survey area.

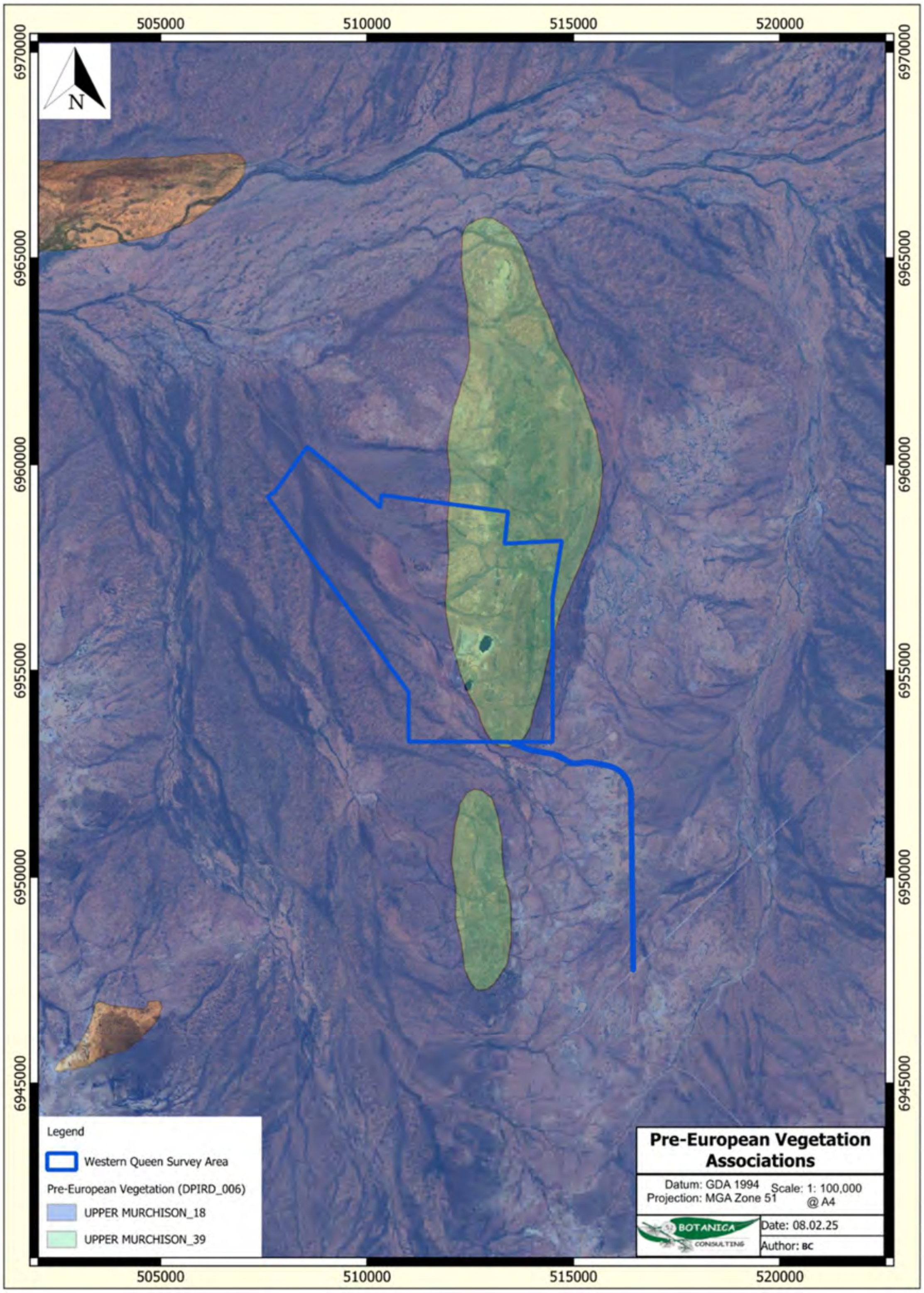

Figure 4-2: Pre-European vegetation associations of the survey area

4.1.3 Fauna

According to the results of the ALA database search (ALA, 2024), a total of 208 terrestrial vertebrate fauna taxa have been recorded within 40 km of the survey area, consisting of 156 birds, ten mammal, 33 reptile and nine amphibian taxa.

4.1.3.1 Significant Fauna

The desktop review identified 13 terrestrial vertebrate fauna species of conservation significance that have previously been recorded in the regional area[1], some of which have the potential to occur in or utilise sections of the survey area at times. These species consisted of eight Threatened and seven migratory species (of which two are also listed as Threatened) under the EPBC Act (Appendix C).

Habitat and distribution data was used to determine the likelihood of occurrence within the survey area (Appendix C). The assessment did not identify any taxa as ‘Known to Occur’ in the survey area, seven were assessed as ‘Would Not Occur’, three were assessed as ‘Unlikely to Occur’ and three were assessed as ‘Possibly Occurs’.

Table 4-4 provides a summary of the taxa assessed as Possibly Occurs in the survey area, whilst the full fauna likelihood assessment is provided in Appendix C.

[1] The desktop review also identified one terrestrial invertebrate (spider) fauna species of conservation significance which was not assessed.

Table 4-4: Potentially occurring significant fauna

Species	Conservation Status			Habitat Description	Assessment	Likelihood
	EPBC Act	BC Act	DBCA Priority			
Rainbow bee-eater *Merops ornatus*	MI	-	-	The Rainbow Bee-eater occurs in open woodlands and shrublands, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands and, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Department of the Environment, 2025).	Within known range. May occasionally visit but unlikely to significantly utilise the area.	Possibly Occurs
Malleefowl *Leipoa ocellata*	VU	VU	-	Scrublands and woodlands dominated by mallee and wattle species (Department of the Environment, 2025). Malleefowl are known to avoid open areas and instead select habitat where vegetation of two to four metres in height is prevalent (*i.e.* ~ 50% cover or greater) and provides adequate cover (Benshemesh *et al.* 2007).	Few regional records, suitable habitat may be present.	Possibly Occurs
Southern Whiteface *Aphelocephala leucopsis*	VU	VU	-	The Southern Whiteface occur across most of mainland Australia south of the tropics, from the north-eastern edge of the Western Australian wheatbelt, east to the Great Dividing Range. Habitat includes a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. These areas are usually in habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains. Critical habitat includes relatively undisturbed open woodlands and shrublands with an understorey of grasses and/or shrubs, habitat with low tree densities and an herbaceous understory litter cover which provides essential foraging habitat, and living and dead trees with hollows and crevices which are essential for roosting and nesting.	Within known range, but vegetation is unlikely to support breeding or optimal foraging habitat due to extensive impacts to vegetation. May occasionally visit but unlikely to significantly utilize the area.	Possibly Occurs

4.2 Field Assessment

4.2.1 Flora

The field survey identified 86 vascular flora taxa within the survey area. These taxa represented 42 genera across 27 families, with the most diverse families being Fabaceae (19 species) Chenopodiaceae (12 species) and Scrophulariaceae (11 species). Dominant genera include *Acacia* (14 species), *Eremophila* (11 species), and *Maireana* and *Ptilotus* (five species each). No introduced (weed) species were recorded within the survey area. The full field species inventory is listed in Appendix D.

4.2.2 Introduced Flora

No introduced (weed) species were recorded within the survey area.

4.2.3 Significant Flora

According to the EPA *Environmental Factor Guideline: Flora and Vegetation* (EPA, 2016b) significant flora includes:

- flora being identified as threatened or priority species;
- locally endemic flora or flora associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- new species or anomalous features that indicate a potential new species;
- flora representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids; and
- flora with relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

No Threatened, Priority or otherwise significant flora species were recorded within the survey area.

4.2.4 Vegetation Communities

A total of 11 broad-scale vegetation communities were identified within the survey area. Vegetation community descriptions and extent are listed below in Table 4-5 and illustrated spatially in Figure 4-3. Vegetation community descriptions and extents were determined from field survey results, aerial imagery interpretation and extrapolation of the communities.

Overall, the survey area was dominated by Acacia Forests and Woodlands (88.9%), the remaining vegetation was classified as Chenopod Shrublands (4.3%) and 6.8% had been previously cleared of vegetation (mining).

The survey found RP-AOW1 was the most commonly represented vegetation community in the survey area, occupying 543.7 ha (18.7%), while DD-CS1 was the least represented with 19.4 ha (0.7%). The most diverse vegetation types were CLP-AOW1, with 49 species (57.0%), while the least diverse was RH-AOW2 with seven species (8.1%).

These communities, whilst locally variable, are relatively widespread throughout the Murchison bioregion.

Table 4-5: Summary of vegetation types within the survey area

Vegetation Code	NVIS Vegetation Group	Vegetation Type	Landform	Image
CLP-AFW1 268.8 ha (9.3%)	Acacia Forests and Woodlands	*Acacia incurvaneura* low open forest over *Acacia ramulosa* var *ramulosa* mid open shrubland over *Eremophila punicea* and *E. compacta* sparse low shrubland	Clay-loam plain	
CLP-AOW1 197.6 ha (6.8%)	Acacia Forests and Woodlands	*Acacia aptaneura* and/or *Acacia incurvaneura* low open woodland over *Acacia acuminata* mid open shrubland over *Ptilotus obovatus* and *Eremophila compacta* low sparse shrubland	Clay-loam plain	

Vegetation Code	NVIS Vegetation Group	Vegetation Type	Landform	Image
DD-AFW1 532.3 ha (18.4%)	Acacia Forests and Woodlands	*Acacia incurvaneura*, *A. mulganeura*, *A. ramulosa* low open forest over *Acacia tetragonophylla*, *Eremophila punicea*, *Sida ectogama* mid open shrubland over *Atriplex bunburyana* and *Maireana pyramidata* low sparse chenopod shrubland	Drainage depression	
DD-AFW2 137.8 ha (4.8%)	Acacia Forests and Woodlands	*Acacia incurvaneura* low open forest over *Acacia tetragonophylla* and *Eremophila oppositifolia* mid open shrubland over *Atriplex bunburyana* and *Rhagodia eremaea* low sparse chenopod shrubland	Drainage depression	

Vegetation Code	NVIS Vegetation Group	Vegetation Type	Landform	Image
DD-AOW1 384.3 ha (13.3%)	Acacia Forests and Woodlands	*Acacia aptaneura* low open woodland over *Eremophila exilifolia* and *Acacia tetragonophylla* low open shrubland over *Maireana triptera* and *M. pyramidata* low sparse chenopod shrubland	Drainage depression	
DD-CS1 19.4 ha (0.7%)	Chenopod shrubland	*Maireana pyramidata, M. georgei* and *M. triptera* low sparse chenopod shrubland	Drainage depression	

Vegetation Code	NVIS Vegetation Group	Vegetation Type	Landform	Image
DD-CS2 105.2 ha (3.6%)	Chenopod shrubland	Low open shrubland of *Acacia tetragonophylla* over low sparse chenopod shrubland of *Maireana pyramidata*, *Enchylaena tomentosa* and *Maireana triptera*	Drainage depression	
RH-AFW1 79.6 ha (2.7%)	Acacia Forests and Woodlands	*Acacia aptaneura* and/or *Acacia incurvaneura* low open forest over *Eremophila latrobei* low sparse shrubland	Rocky hillslope	

Vegetation Code	NVIS Vegetation Group	Vegetation Type	Landform	Image
RH-AOW1 299.7 ha (10.3%)	Acacia Forests and Woodlands	*Acacia aptaneura*, *A. grasbyi* and *A. tetragonophylla* low open woodland over *Eremophila fraseri* and *E. forrestii* subsp. *forrestii* low open shrubland over *Aristida contorta* low sparse tussock grassland	Rocky hillslope	
RH-AOW2 132.9 ha (4.6%)	Acacia Forests and Woodlands	*Acacia aptaneura* and *Acacia ramulosa* var. *linophylla* low open woodland over *Eremophila fraseri* or *Eremophila exilifolia* open shrubland over *Aristida contorta* low tussock grassland	Rocky hillslope	

Vegetation Code	NVIS Vegetation Group	Vegetation Type	Landform	Image
RP-AOW1 543.7 ha (18.7%)	Acacia Forests and Woodlands	*Acacia pteraneura* and *Acacia grasbyi* low open woodland over *Senna artemisioides* subsp. *filifolia*, *Ptilotus rotundifolius* mid sparse shrubland over *Rhagodia drummondii*, *Maireana oppositifolia* low open chenopod shrubland	Rocky plain	
Cleared 196.9 ha (6.8%)	N/A	Cleared	N/A	N/A

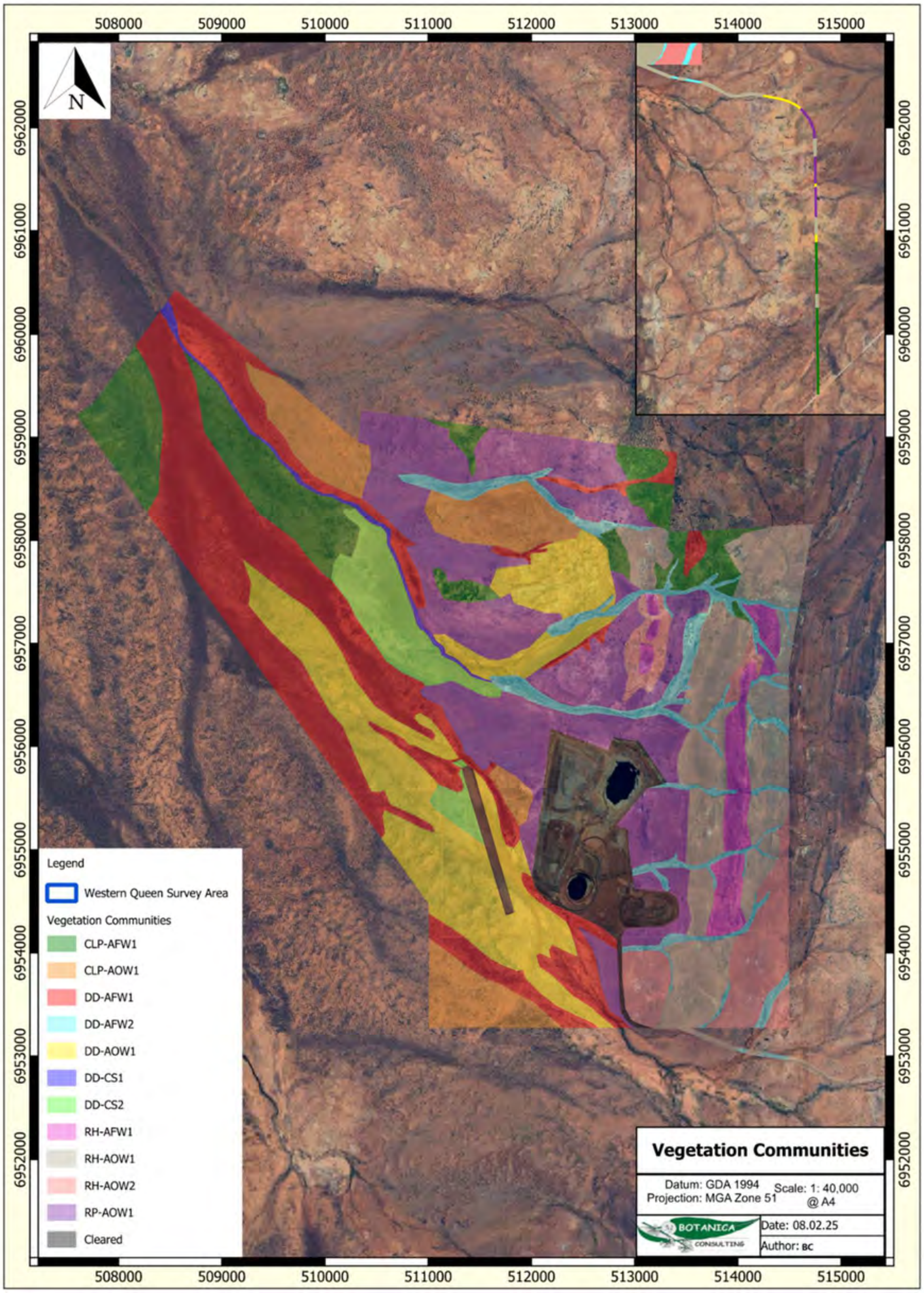

Figure 4-3: Vegetation communities within the survey area

4.2.5 Vegetation Condition

Based on the vegetation condition rating scale adapted from Keighery (1994) and Trudgen, (1988), native vegetation within the survey area was categorised as 'Very Good' to 'Degraded', with the majority (45.5%) being categorised as 'Good' (Table 4-6, Figure 4-4). Vegetation condition rating descriptions are listed in Appendix E.

The majority of impacts within the survey area were from historical disturbance, predominately caused by exploration activities and associated tracks, with significant feral animal grazing also observed.

Table 4-6: Vegetation condition rating within the survey area

Condition rating	Description	Area
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.	773.7 ha (26.7%)
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.	1,319.7 ha (45.5%)
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.	140.6 (4.9%)
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.	467.3 ha (16.1%)
Cleared	-	196.9 ha (6.8%)
TOTAL		**2,898.2 ha (100%)**

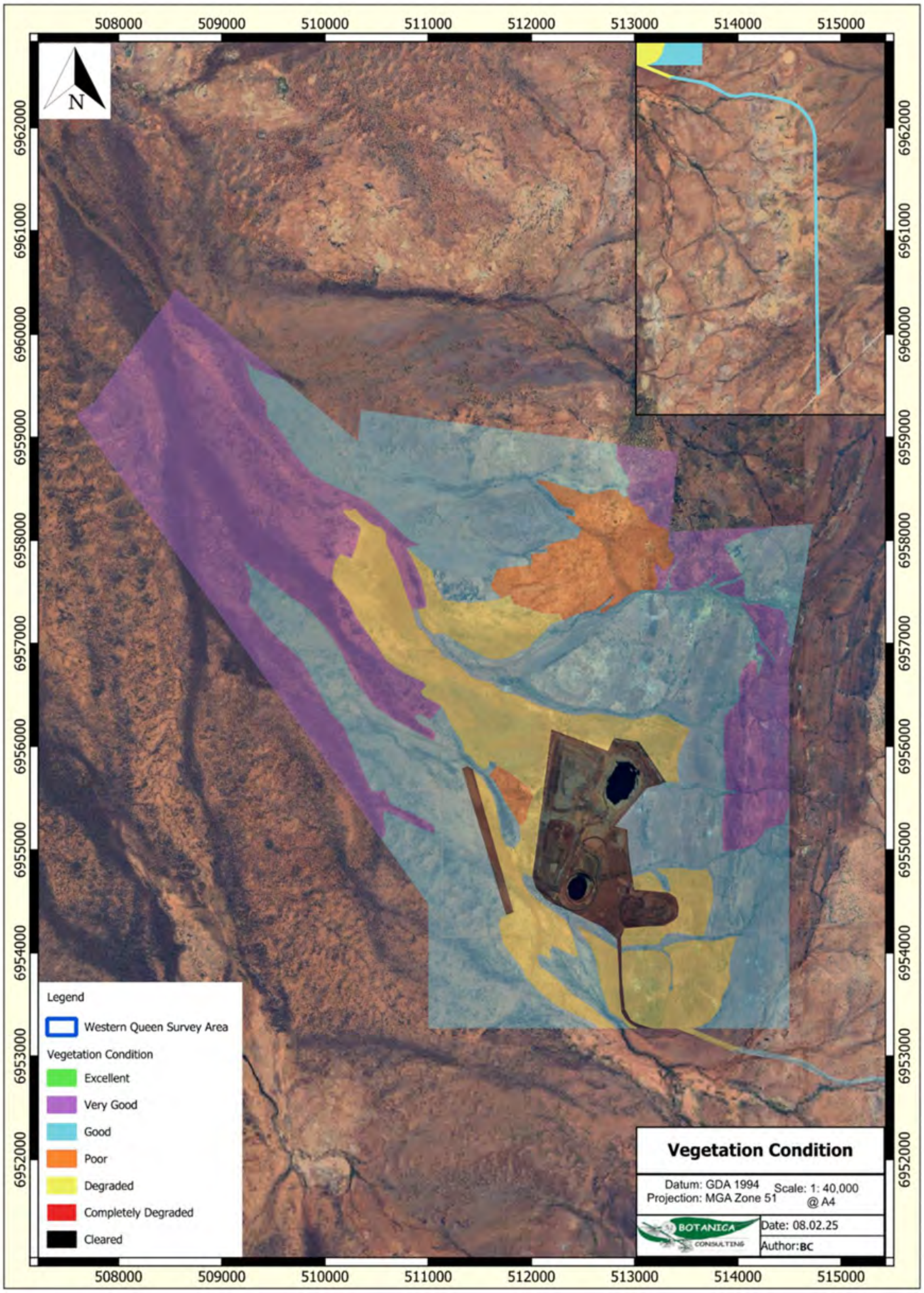

Figure 4-4: Vegetation condition within the survey area

4.2.6 Significant Vegetation

According to the EPA *Environmental Factor Guideline: Flora and Vegetation* (EPA, 2016b) significant vegetation includes:

- vegetation being identified as threatened or priority ecological communities;
- vegetation with restricted distribution;
- vegetation subject to a high degree of historical impact from threatening processes;
- vegetation which provides a role as a refuge; and
- vegetation providing an important function required to maintain ecological integrity of a significant ecosystem.

No Threatened, Priority or otherwise significant ecological communities were identified within the survey area.

4.2.7 Fauna Habitat

Based on vegetation and associated landforms identified during the flora and vegetation assessment, five broad scale terrestrial fauna habitats were identified as occurring within the survey area. Table 4-8provides the area and a visual representation of fauna habitat types, and the extent of fauna habitats is shown spatially in Figure 4-5.

Table 4-7 provides a list of opportunistic observations of fauna species that was made during the field survey with a total of 24 fauna species observed.

Table 4-7: Fauna observed during the survey

Taxon	Common Name	Comments
Avifauna		
Aquila audax	Wedge-tailed eagle	Observed
Barnardius zonarius	Ringneck parrot	Observed
Cinclosoma castanotum	Chestnut quail-thrush	Observed
Coracina novaehollandiae	Black-faced cuckoo-shrike	Observed
Corvus coronoides	Australian raven	Observed
Corvus orru	Torresian crow	Heard
Cracticus torquatus	Grey butcherbird	Observed
Dromaius novaehollandiae	Emu	Observed
Geopelia cuneata	Diamond dove	Observed
Grallina cyanoleuca	Magpie-lark	Observed
Gymnorhina tibicen	Australian magpie	Observed
Lichmera indistincta	Brown honey eater	Observed

Taxon	Common Name	Comments
Malurus splendens	Splendid fairy wren	Heard
Manorina flavigula	Yellow-throated Miner	Observed
Oreoica gutturalis	Crested bellbird	Heard
Phaps chalcoptera	Common bronzewing	Observed
Psephotellus varius	Mulga Parrot	Observed
Rhipidura leucophrys	Willie wagtail	Observed
Taeniopygia castanotis	Zebra finch	Observed
Mammals		
Canis lupus familiaris	Dog	Tracks observed
Capra aegagrus hircus	Goat	Observed
Felis catus	Cat	Tracks observed
Oryctolagus cuniculus	Rabbit	Scats Observed
Macropus sp.	Kangaroo and/or Euro	Tracks and Scats Observed

Table 4-8: Main terrestrial fauna habitats within the survey area

Fauna Habitat	Representative Fauna Attributes	Possibly Occurring Significant Species	Example Image
Acacia forest and woodland on clay-loam plain 466.4 ha (16.1%)	• Ground not especially suited to burrowing species. • Moderate diversity vegetation strata supporting avifauna assemblage. • Low vegetation density and low leaf litter.	Rainbow bee-eater *Merops ornatus*	
Acacia forest and woodland in drainage depression 1,054.4 ha (36.5%)	• Ground not suited to burrowing species. • Moderate diversity vegetation strata supporting avifauna assemblage. • Moderate vegetation density and moderate leaf litter.	Rainbow bee-eater *Merops ornatus* Malleefowl *Leipoa ocellata* Southern Whiteface *Aphelocephala leucopsis*	

Fauna Habitat	Representative Fauna Attributes	Possibly Occurring Significant Species	Example Image
Acacia forest and woodland on rocky hillslopes 512.2 ha (17.6%)	• Ground not suited to burrowing species. • Low diversity vegetation strata • Low vegetation density and low leaf litter	Rainbow bee-eater *Merops ornatus* Southern Whiteface *Aphelocephala leucopsis*	
Acacia forest and woodland on rocky plain 543.7 ha (18.7%)	• Ground suited to burrowing species. • Moderate diversity vegetation strata supporting avifauna assemblage • Moderate vegetation density and low to moderate leaf litter	Rainbow bee-eater *Merops ornatus* Malleefowl *Leipoa ocellata* Southern Whiteface *Aphelocephala leucopsis*	

Fauna Habitat	Representative Fauna Attributes	Possibly Occurring Significant Species	Example Image
Chenopod shrubland on clay-loam plain 124.6 ha (4.3%)	Ground not particularly suited to burrowing species. Low diversity vegetation strata Low vegetation density and low leaf litter	N/A	
Cleared 9.3 ha (2.6%)	N/A	N/A	N/A

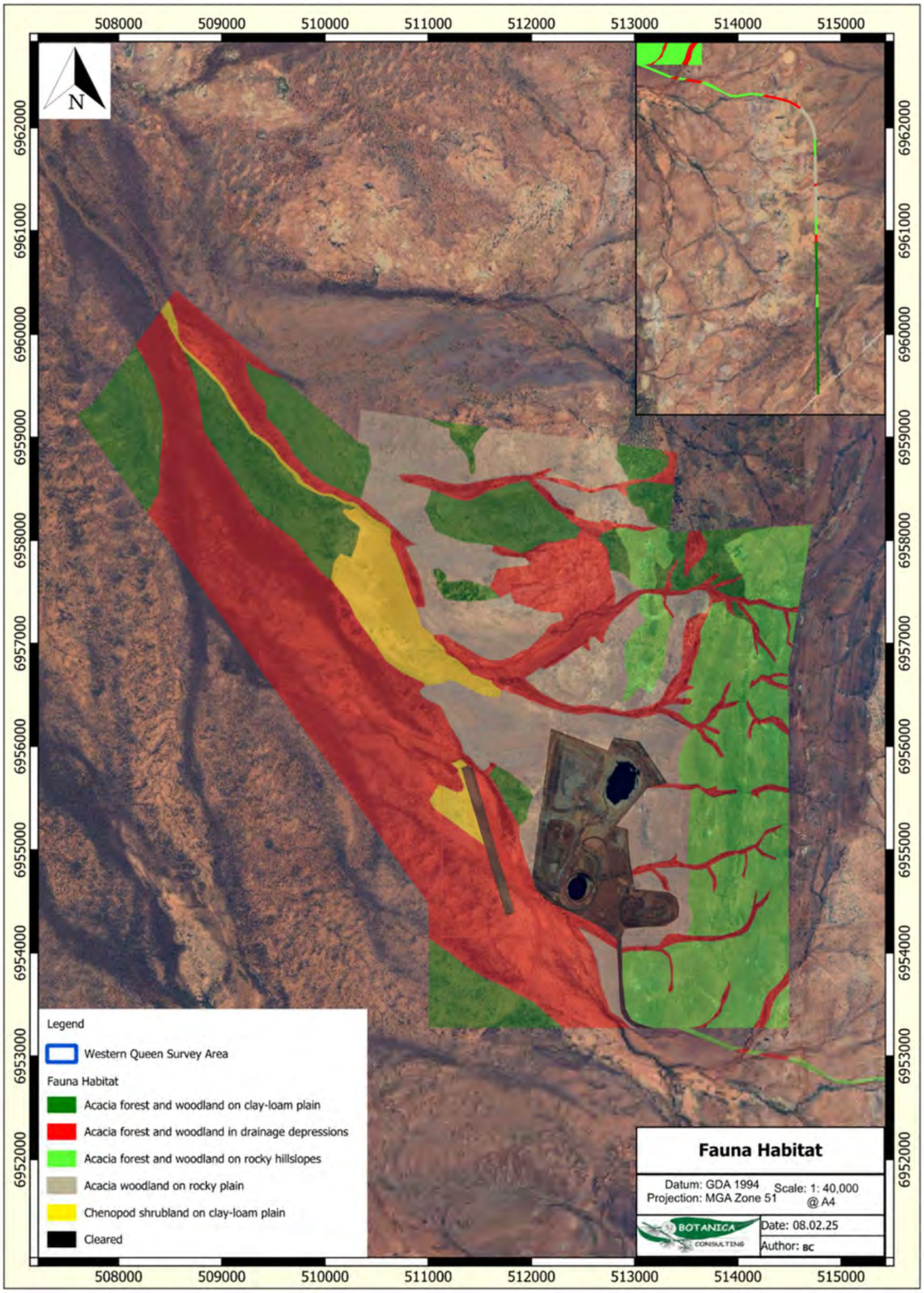

Figure 4-5: Fauna habitats within the survey area

4.2.8 Significant Fauna

According to the EPA *Environmental Factor Guideline: Terrestrial Fauna* (EPA, 2016c) significant fauna includes:

- Fauna being identified as a Threatened or Priority species;
- Fauna species with restricted distribution;
- Fauna subject to a high degree of historical impact from threatening processes; and
- Fauna providing an important function required to maintain the ecological integrity of a significant ecosystem.

No evidence for the presence of Malleefowl (*Leipoa ocellata*), including nesting mounds, tracks or other signs, were recorded within the survey area. No other evidence of significant fauna species were observed during the survey.

The current status of some species on site and/or in the general area is difficult to determine, however, based on the habitats present and, in some cases, direct observations or recent nearby records, the following species of conservation significance can be regarded as possibly utilising the survey area for some purpose at times, these being:

- **Rainbow Bee-eater (*Merops ornatus*) - Migratory (EPBC Act)**
  This species is distributed across much of mainland Australia, and occurs on several near-shore islands. It is not found in Tasmania, and is thinly distributed in the most arid regions of central and Western Australia. May occur as occasional vagrants but unlikely to significantly utilise habitat within the survey area. Significant impact unlikely.

- **Malleefowl (*Leipoa ocellata) -* Vulnerable (EPBC Act and BC Act)**
  This species is occasionally recorded in the Western Murchison (MUR2) subregion. The majority of habitat within the survey area appears unsuitable for breeding due to a relatively high level of disturbance. The 2025 field survey did not identify any evidence of Malleefowl utilising the survey area (no evidence of mounds or other activity such as diggings, tracks and feathers). Available information suggests that a breeding population of this species is unlikely to be present in the survey area, though transient non-breeding individuals may occasionally occur if present in the surrounding area. Significant impact unlikely.

- **Southern Whiteface (*Aphelocephala leucopsis) -* Vulnerable (EPBC Act and BC Act)**
  This species is recorded throughout inland Australia. This species prefers thick, undisturbed habitat, which is not present within the survey area due to historical clearing and grazing. May occur as occasional vagrants but unlikely to significantly utilise habitat within the survey area. Significant impact unlikely.

It should be noted that while habitats onsite for one or more of the species listed above are considered possibly suitable, some or all may be marginal in extent/quality and therefore the fauna species considered as possibly occurring may in fact only visit the area for short periods as infrequent vagrants.

4.3 Matters of National Environmental Significance

4.3.1 *Environment Protection and Biodiversity Conservation Act 1999* (Cth)

The EPBC Act protects Matters of National Environmental Significance (MNES) and is used by the Commonwealth DCCEEW to list threatened taxa and ecological communities into categories based on the criteria set out in the EPBC Act (www.environment.gov.au/epbc/index.html). The EPBC Act provides a national environmental assessment and approval system for proposed developments and enforces strict penalties for unauthorised actions that may affect MNES.

The EPBC Act covers 9 protected matters:

- world heritage areas
- national heritage places
- wetlands of international importance (listed under the Ramsar Convention)
- listed threatened species and ecological communities
- listed migratory species (protected under international agreements)
- Commonwealth marine areas
- Great Barrier Reef Marine Park
- nuclear actions (including uranium mines)
- water resources (that relate to unconventional gas development and large coal mining development).

No MNES as defined by the EPBC Act were identified within the survey area.

4.4 Matters of State Environmental Significance

4.4.1 *Environmental Protection Act 1986* (WA)

The EP Act provides for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment. The Act is administered by The Department of Water and Environment Regulation (DWER), which is the State Government's environmental regulatory agency.

Under Section 51C of the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (Clearing Regulations) any clearing of native vegetation in Western Australia that is not eligible for exemption under Schedule 6 of the EP Act or under the Clearing Regulations requires a clearing permit from the DWER or the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS). Under Section 51A of the EP Act native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native vegetation, but not vegetation planted in a plantation or planted with commercial intent. Section 51A of the EP Act defines clearing as “the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage to some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above”.

Environmentally sensitive areas (ESAs) are classes or areas of native vegetation as declared in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005* for the purposes of Part V Division 2 of the EP Act, where the exemptions for clearing vegetation under the Clearing Regulations do not apply.

The following areas are declared to be ESAs:

- a declared World Heritage property as defined in section 13 of the EPBC Act;
- an area that is included on the Register of the National Estate, because of its natural heritage value, under the Australian Heritage Council Act 2003 of the Commonwealth;
- a defined wetland and the area within 50 m of the wetland. Defined wetlands include Ramsar wetlands, conservation category wetlands and nationally important wetlands;
- the area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located;
- the area covered by a TEC;
- a Bush Forever site listed in “Bush Forever” Volumes 1 and 2 (2000), published by the Western Australia Planning Commission, except to the extent to which the site is approved to be developed by the Western Australia Planning Commission;
- the areas covered by the following policies –
    - *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*;
    - *Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002*;
- the areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* applies; and
- protected wetlands as defined in the *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*.

No ESAs declared under the EP Act were were identified within the survey area.

Additionally, in accordance with Schedule 1, Clause 4 of the Clearing Regulations, clearing of native vegetation in a 'Schedule One Area' for mining purposes is not permitted without a clearing permit.

No Schedule One Areas occur within the survey area.

4.4.2 *Biodiversity Conservation Act 2016* (WA)

The BC Act is administered by the DBCA to conserve and protect biodiversity and to promote the ecologically sustainable use of biodiversity components in the State of Western Australia,

Under the BC Act, native species are listed as Threatened when they face a high to very high risk of extinction in the wild, and ecological communities are listed as Threatened when they face a high to very high risk of collapse.

Whilst all native flora and fauna are protected throughout the State, special protection is afforded to threatened flora and ecological communities, with the authorisation of the Minister being required before such flora can be taken or communities modified.

Furthermore, The Minister may list vegetation as a 'critical habitat' if it is critical to the survival of a threatened species or ecological community. Under Section 54(1) of the BC Act, habitat is eligible for listing as critical habitat if:

a) it is critical to the survival of a threatened species or a threatened ecological community; and
b) its listing is otherwise in accordance with the ministerial guidelines.

No TECs, Threatened species or critical habitat listed under the BC Act were recorded within the survey area.

4.5 Other Areas of Conservation Significance

The DBCA lists 'Priority' species and ecological communities which are under consideration for declaration as 'Threatened' under the BC Act. These Priority species and PECs have no formal legal protection until they are endorsed by the Minister as being Threatened.

No Priority species or PECs were identified within the survey area.

There are no wetlands of international importance (Ramsar Wetlands) or national importance (Australian Nature Conservation Agency Wetlands) within the survey area.

There are no proposed nor gazetted conservation reserves within the survey area.

The closest lands of conservation significance is an ex-pastoral lease (LR3071/884), identified by DBCA as of interest for the conservation of flora and fauna. This area is located approximately 1.6 km south of the proposed access road and 7.1 km south of the main portion of the survey area, and activities within the survey area are unlikely to impact conservation values of this area.

Both proposed and gazetted conservation reserves are managed by DBCA, with gazetted conservation reserves vested with the Conservation and Parks Commission of Western Australia. The Conservation and Parks Commission is an independent statutory authority that was established under the *Conservation and Land Management* (CALM) *Act 1984* in November 2000 and is the controlling body in which the State's conservation estate, including national parks, conservation parks, nature reserves, state forests and timber reserves, are vested. The Conservation and Parks Commission develops policies and provides independent advice to the Minister for Environment with respect to conservation, the management of ecological biodiversity and the application of ecologically sustainable forest management. The DBCA manages land on behalf of the Conservation and Parks Commission.

A map showing areas of conservation significance in relation to the survey area is provided in Figure 4-6.

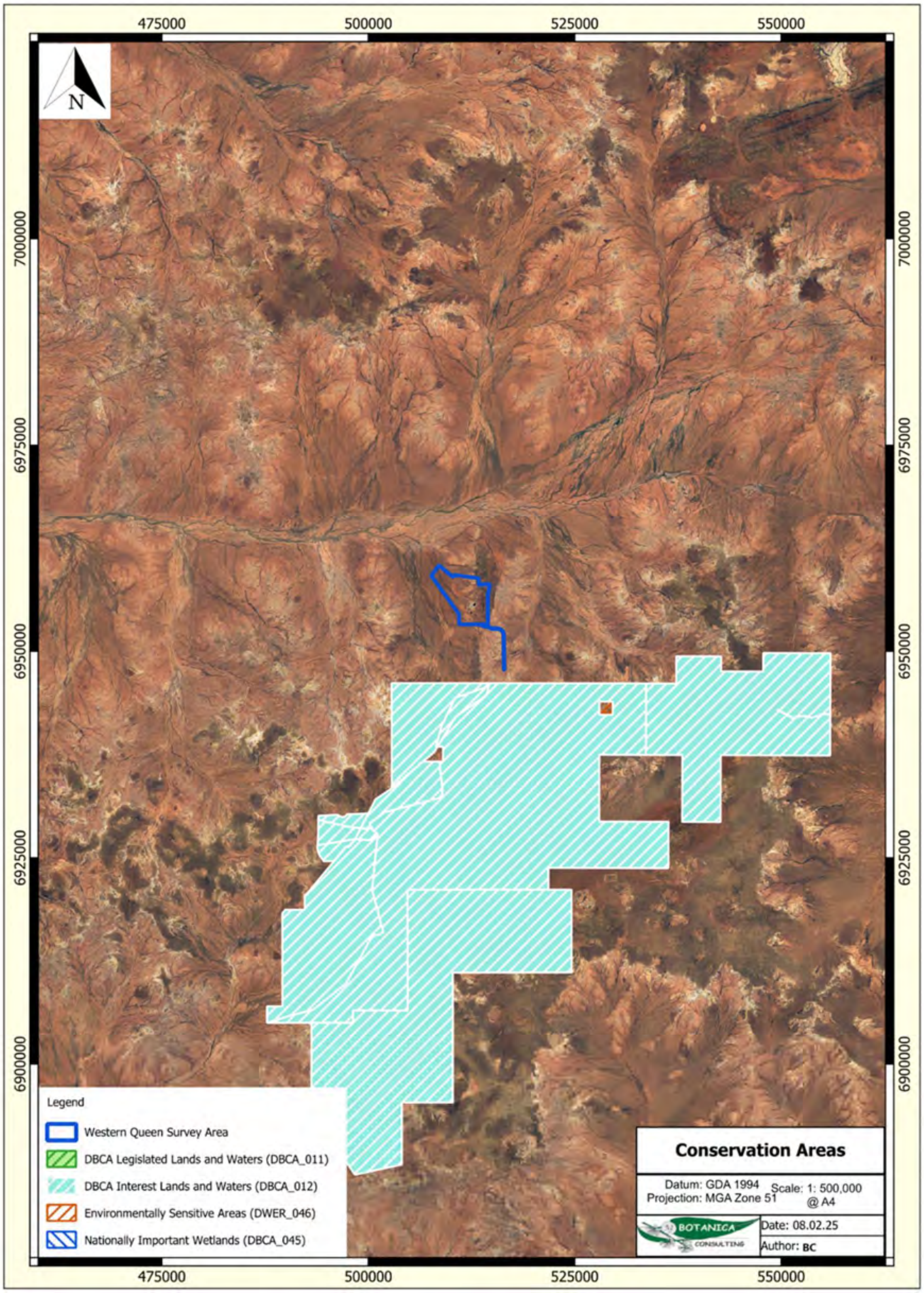

Figure 4-6: Areas of conservation significance

4.6 Native Vegetation Clearing Principles

Based on the outcomes from the survey undertaken, Botanica assessed the results of the desktop and field survey with regards to the native vegetation clearing principles listed under Schedule 5 of the EP Act (Table 4-9). The assessment found that the proposed vegetation clearing activities may be at variance with clearing principle (f).

Table 4-9: Assessment against native vegetation clearing principles

Letter	Principle Native vegetation should not be cleared if it:	Assessment	Outcome
(a)	comprises a high level of biological diversity.	Vegetation within the survey area is considered to be of moderate biological diversity and is well represented outside the survey area. No Threatened, Priority or otherwise significant flora or ecological communities were identified within the survey area.	Clearing is unlikely to be at variance with this principle
(b)	comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to WA.	The basic fauna search did not record any evidence for the presence of significant fauna or habitat within the survey area.	Clearing is unlikely to be at variance with this principle
(c)	includes, or is necessary for the continued existence of rare flora.	No Threatened Flora taxa, pursuant to the BC Act and the EPBC Act were identified within the survey area.	Clearing is unlikely to be at variance with this principle
(d)	comprises the whole or part of or is necessary for the maintenance of a threatened ecological community (TEC).	No Threatened Ecological Communities were identified as potentially occurring within the survey area.	Clearing is unlikely to be at variance with this principle
(e)	is significant as a remnant of native vegetation in an area that has been extensively cleared	All vegetation associations retain over 99% of their pre-European extent.	Clearing is unlikely to be at variance with this principle
(f)	is growing, in, or in association with, an environment associated with a watercourse or wetland	Several ephemeral drainage lines were identified within the survey area.	Clearing may be at variance with this principle
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The survey area and surrounding region has not been extensively cleared. Clearing within the survey area is not considered likely to lead to land degradation issues such as salinity, water logging or acidic soils.	Clearing is unlikely to be at variance with this principle
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Clearing within the survey area would not impact any conservation reserves.	Clearing is unlikely to be at variance with this principle
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Several ephemeral drainage lines were identified within the survey area. Clearing activities are unlikely to impact hydrological systems.	Clearing is unlikely to be at variance with this principle
(j)	Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding	Rainfall in the Western Murchison subregion has an average rainfall of 250mm. Rainfall events are unlikely to result in localised flooding. Clearing within the survey area is not likely to increase the incidence or intensity of flooding within the survey area or surrounds.	Clearing is unlikely to be at variance with this principle

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APPENDIX A: CONSERVATION CATEGORIES (BC ACT AND EPBC ACT)

Definitions of Conservation Significant Species

Code	Category
State categories of Threatened and Priority species	
Threatened Species (T) Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as Threatened species under section 26(2) of the BC Act.	
CR	**Critically Endangered** Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under Schedule 2 Division 1 of the *Biodiversity Conservation (Listing of Native Species) (Fauna) Order 2024* for critically endangered fauna or Schedule 1 Division 1 of the *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2024* for critically endangered flora.
EN	**Endangered** Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under Schedule 2 Division 2 of the *Biodiversity Conservation (Listing of Native Species) (Fauna) Order 2024* for endangered fauna or Schedule 1 Division 2 of the *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2024* for endangered flora.
VU	**Vulnerable** Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under Schedule 2 Division 3 of the *Biodiversity Conservation (Listing of Native Species) (Fauna) Order 2024* for vulnerable fauna or Schedule 1 Division 3 of the *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2024* for vulnerable flora.
Extinct species Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.	
EX	**Extinct** Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under Schedule 3 of the *Biodiversity Conservation (Listing of Native Species) (Fauna) Order 2024* for extinct fauna or Schedule 2 the *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2024* for extinct flora.
EW	**Extinct in the Wild** Species that *"is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act). Currently there are no Threatened fauna or Threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Specially protected species Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened species (critically endangered, endangered or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.	

<table>
<tr><th>Code</th><th>Category</th></tr>
<tr><td>CD</td><td>Species of special conservation interest
Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as Threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).
Published as conservation dependent fauna under Schedule 1 Division 1 of the Biodiversity Conservation (Listing of Native Species) (Fauna) Order 2024.</td></tr>
<tr><td>IA</td><td>International Agreement/ Migratory
Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).
Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
Published as migratory birds protected under an international agreement under Schedule 1 Division 2 of the Biodiversity Conservation (Listing of Native Species) (Fauna) Order 2024.</td></tr>
<tr><td>OS</td><td>Other specially protected species
Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).
Published as other specially protected fauna under Schedule 1 Division 3 of the Biodiversity Conservation (Listing of Native Species) (Fauna) Order 2024.</td></tr>
<tr><td colspan="2">Priority species
Possibly Threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of Priority for survey and evaluation of conservation status so that consideration can be given to their declaration as Threatened Fauna or Flora.
Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.
Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.</td></tr>
<tr><td>P1</td><td>Priority 1: Poorly-known species
Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.</td></tr>
<tr><td>P2</td><td>Priority 2: Poorly-known species
Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.</td></tr>
<tr><td>P3</td><td>Priority 3: Poorly-known species
Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.</td></tr>
<tr><td>P4</td><td>Priority 4: Rare, Near Threatened and other species in need of monitoring
(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent.</td></tr>
</table>

Code	Category
	(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
Commonwealth categories of Threatened species	
EX	**Extinct** Taxa where there is no reasonable doubt that the last member of the species has died.
EW	**Extinct in the Wild** Taxa where it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CR	**Critically Endangered** Taxa that are facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
EN	**Endangered** Taxa which are not critically endangered and is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
VU	**Vulnerable** Taxa which are not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which are the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Definitions of conservation significant communities

Category Code	Category
State categories of Threatened Ecological Communities (TEC)	
PD	**Presumed Totally Destroyed**
	An ecological community will be listed as Presumed Totally Destroyed if there are no recent records of the community being extant and either of the following applies:
	• records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or;
	• all occurrences recorded within the last 50 years have since been destroyed.
CR	**Critically Endangered**
	An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one of the following criteria:
	The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification;
	The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area;
	The ecological community is highly modified with potential of being rehabilitated in the immediate future.
EN	**Endangered**
	An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. The ecological community must meet any one of the following criteria:

Category Code	Category
	The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short-term future, or is unlikely to be substantially rehabilitated in the short-term future due to modification;
	The current distribution is limited i.e. highly restricted, having very few small or isolated occurrences, or covering a small area;
	The ecological community is highly modified with potential of being rehabilitated in the short-term future.
VU	**Vulnerable**
	An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one of the following criteria:
	The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated;
	The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution;
	The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.
Commonwealth categories of Threatened Ecological Communities (TEC)	
CE	**Critically Endangered** If, at that time, an ecological community is facing an extremely high risk of extinction in the wild in the immediate future (indicative timeframe being the next 10 years).
EN	**Endangered** If, at that time, an ecological community is not critically endangered but is facing a very high risk of extinction in the wild in the near future (indicative timeframe being the next 20 years).
VU	**Vulnerable** If, at that time, an ecological community is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium–term future (indicative timeframe being the next 50 years).
Priority Ecological Communities	
P1	**Poorly-known ecological communities**
	Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist.
P2	**Poorly-known ecological communities**
	Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, un-allocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.
P3	**Poorly known ecological communities**
	Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
	Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
	Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	**Ecological communities that are adequately known, rare but not threatened** or meet criteria for near threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.
P5	**Conservation Dependent ecological communities**
	Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX B:
SIGNIFICANT FLORA LIKELIHOOD ASSESSMENT

Taxon	Rank	Description and Habitat	Comments	Likelihood
Acacia lapidosa	Priority 1	-	Outside known range of species.	Unlikely
Acacia speckii	Priority 4	Bushy, rounded shrub or tree, 1.5-3 m high. Rocky soils over granite, basalt or dolerite. Rocky hills or rises.	Within known range, habitat likely to be present.	Likely
Acacia subsessilis	Priority 3	Rounded, straggly, pungent shrub, 1-2 m high. Fl. yellow, Jul to Aug. Red sand or stony gravel over ironstone. Rocky hills.	Outside known range of species, habitat unlikely to be present.	Unlikely
Acacia wilcoxii	Priority 1	Much-branched shrub, 2-4 m high. Fl. Aug to Sep. Granitic soils. Along creeks & adjacent stony plains & granite outcrops.	Outside known range of species (Gascoyne), habitat unlikely to be present.	Unlikely
Chamelaucium sp. Yalgoo (Y. Chadwick 1816)	Priority 1	Bushy, low shrub. Granite outcrops.	Outside known range of species.	Unlikely
Dicrastylis linearifolia	Priority 3	Much-branched shrub, 1-3 m high, inflorescence with scale-like indumentum; upper surface of leaves hairy; stamens usually 5. Fl. white, Nov to Dec. Red sand. Sandplain.	Within known range, habitat unlikely to be present.	Unlikely
Eremophila muelleriana	Priority 3	Shrub or tree, (0.3-)0.5-2.8(-4) m high. Fl. purple/purple-red/purple-black, Aug to Oct. Granitic soils.	At extreme of known range, habitat unlikely to be present.	Unlikely
Eremophila simulans subsp. *megacalyx*	Priority 3	Shrub, 0.9-2 m high. Fl. violet, Aug to Sep.	Within known range.	Possible
Frankenia confusa	Priority 4	Low, diffuse shrub, to 0.75 m high, to 0.75 wide. Fl. pink, Sep. Wet pale brown sand, brown clay, grey soil. Banks of rivers & waterholes, river floodplains.	At extreme of known range, habitat unlikely to be present.	Unlikely
Gnephosis cassiniana	Priority 3	Erect annual, herb, 0.01-0.06 m high. Fl. yellow, Sep to Oct. Sand, clay loam. Saline depressions, low wet areas.	Outside known range of species, habitat unlikely to be present.	Unlikely
Gunniopsis divisa	Priority 3	Annual, herb, 0.05-0.1 m high. Fl. white, Aug. Loam, quartz. Roadsides.	At extreme of known range, habitat unlikely to be present.	Unlikely
Jacksonia lanicarpa	Priority 1	Shrub, to 2 m high. Fl. orange, Nov. Red sand.	Within known range, habitat unlikely to be present.	Unlikely
Lepidium scandens	Priority 3	Weak, ascending or twining shrub, 0.4-2 m high. Fl. white, Aug to Sep. Red sand, clay.	Outside known range of species.	Unlikely
Petrophile pauciflora	Priority 3	Shrub, ca 1 m high. Fl. yellow, Sep. Decaying & dissected granite breakaways.	Within known range, habitat unlikely to be present.	Unlikely
Petrophile vana	Priority 1	Shrub, to 1.5 m high. Shallow, white, gritty clay-soil pockets, laterite. Breakaways.	Within known range, habitat may be present.	Possible

Taxon	Rank	Description and Habitat	Comments	Likelihood
Psammomoya grandiflora	Priority 2	Erect, spreading shrub, to 0.8 m high. Fl. white, Aug to Oct. Red loam, sand, jasperlite. Sandplains, rocky country.	Widespread, scattered records. Habitat unlikely to be present.	Unlikely
Sauropus sp. Woolgorong (M. Officer s.n. 10/8/94)	Priority 3	Shrub, 0.3-1 m high. Fl. yellow, Jun. Red sand. Plains.	Outside known range of species, habitat unlikely to be present.	Unlikely
Spirogardnera rubescens	VU	Spindly leafless shrub, to 1.6 m high. Fl. white, Aug to Dec. Laterite, sand over laterite, loam.	Outside known range of species (Geraldton Sandplains, Jarrah Forest, Swan Coastal Plain), habitat unlikely to be present.	Unlikely
Verticordia jamiesonii	Priority 3	Shrub, 0.2-0.6 m high. Fl. white/pink, Sep to Oct. Sandy clay soils. Lateritic breakaways.	Outside known range of species, habitat unlikely to be present.	Unlikely
Wurmbea murchisoniana	Priority 4	Cormous, perennial, herb, 0.1-0.26 m high, hermaphrodite. Fl. white, Jul to Sep. Clay, sandy clay, loam. Seasonally inundated clay hollows, rock pools.	Habitat unlikely to be present.	Unlikely

APPENDIX C:
SIGNIFICANT FAUNA LIKELIHOOD ASSESSMENT

Species	Conservation Status			Habitat Description	Assessment	Likelihood
	EPBC Act	BC Act	DBCA Priority			
BIRD						
Australian Painted Snipe *Rostratula australis*	EN	EN	-	The Australian Painted Snipe has been recorded at wetlands in all states of Australia. The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans.	No suitable habitat present.	Would Not Occur
Common Sandpiper *Actitis hypoleuco*	MI	MI	-	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Department of the Environment, 2025).	Migratory shorebird, no suitable habitat present.	Would Not Occur
Curlew Sandpiper *Calidris ferruginea*	CR / MI	CR	-	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Department of the Environment, 2025).	Migratory shorebird, no suitable habitat present.	Would Not Occur
Fork-tailed Swift *Apus pacificus*	MI	MI	-	Low to very high airspace over varied habitat from rainforest to semi desert (Birdlife Australia, 2019).	Very occasional transients only.	Unlikely to Occur
Grey Wagtail *Motacilla cinerea*	MI	MI	-	Running water in disused quarries, sandy, rocky streams in escarpments and rainforest, sewerage ponds, ploughed fields and airfields (Morecombe 2004).	No suitable habitat.	Would Not Occur

Species	Conservation Status			Habitat Description	Assessment	Likelihood
	EPBC Act	BC Act	DBCA Priority			
Malleefowl *Leipoa ocellata*	VU	VU	-	Scrublands and woodlands dominated by mallee and wattle species (Department of the Environment, 2025). Malleefowl are known to avoid open areas and instead select habitat where vegetation of two to four metres in height is prevalent (*i.e.* ~ 50% cover or greater) and provides adequate cover (Benshemesh *et al.* 2007).	Within known range, suitable habitat may be present.	Possibly Occurs
Night Parrot *Pezoporus occidentalis*	EN	CR	-	Most habitat records are of Triodia (Spinifex) grasslands and/or chenopod shrublands in the arid and semi-arid zones, or *Astrebla* spp. (Mitchell grass), shrubby samphire and chenopod associations, scattered trees and shrubs, *Acacia aneura* (Mulga) woodland, treeless areas and bare gibber are associated with sightings of the species. Roosting and nesting sites are consistently reported as within clumps of dense vegetation, primarily old and large Spinifex (*Triodia*) clumps, but sometimes other vegetation types (Department of the Environment, 2025).	At extreme of known range, no suitable habitat.	Unlikely to Occur
Pectoral Sandpiper Calidris melanotos	MI	MI	-	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. (Department of the Environment, 2025).	Migratory shorebird, no suitable habitat present.	Would Not Occur
Rainbow bee-eater *Merops ornatus*	MI	-	-	The Rainbow Bee-eater occurs in open woodlands and shrublands, including mallee, and in open forests that are usually dominated by eucalypts. It also occurs in grasslands and, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Department of the Environment, 2025).	Within known range. May occasionally visit but unlikely to significantly utilise the area.	Possibly Occurs
Sharp-tailed Sandpiper *Calidris acuminata*	VU /MI	MI	-	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry (Department of the Environment, 2025).	Migratory shorebird, no suitable habitat present.	Would Not Occur
Southern Whiteface *Aphelocephala leucopsis*	VU	VU	-	The Southern Whiteface occur across most of mainland Australia south of the tropics, from the north-eastern edge of the Western Australian wheatbelt, east to the Great Dividing Range. Habitat includes a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. These areas are usually in habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains. Critical habitat includes relatively undisturbed open woodlands and shrublands with an understorey of grasses and/or shrubs, habitat with low tree densities and an herbaceous understory litter cover which provides essential foraging habitat, and living and dead trees with hollows and crevices which are essential for roosting and nesting.	Within known range, but vegetation is unlikely to support breeding or optimal foraging habitat due to extensive impacts to vegetation. May occasionally visit but unlikely to significantly utilise the area.	Possibly Occurs

Species	Conservation Status			Habitat Description	Assessment	Likelihood
	EPBC Act	BC Act	DBCA Priority			
MAMMAL						
Greater Stick-nest Rat *Leporillus conditor*	VU	CD	-	The greater stick-nest rat was extinct on the Australian mainland by the 1930s, it remained only on the Franklin Islands, South Australia (Department of the Environment, 2025).	Very small number of records, species is considered regionally extinct.	Would Not Occur
REPTILE						
Western Spiny-tailed Skink *Egernia stokesii badia*	EN	VU	-	During surveys by Ecologia Environment (2006–09), all records of the black form of Western Spiny-tailed Skink were on small, isolated stands of granite containing suitable habitat to larger, more extensive clusters of rock. Flat granite domes, with no boulders or crevices, do not support Western Spiny-tailed Skink. This is distinct from the tree hollow habitat of the brown form (Department of the Environment, 2025).	Within known range, no suitable habitat present.	Unlikely to Occur
SPIDER						
Shield-backed Trapdoor Spider *Idiosoma nigrum*	VU	EN	-	Leaf litter and twigs are extremely important to the species as it provides material for the burrows, reduced soil moisture loss and increased prey availability. The species avoids areas of dense leaf litter as juveniles are unable to dig their initial hole in such areas (Department of the Environment, 2025).	NA	NA

NA – Not Assessed: species type outside of scope of basic terrestrial vertebrate fauna survey.

APPENDIX D:
LIST OF SPECIES IDENTIFIED WITHIN THE SURVEY AREA

(W) denotes introduced (weed) species; (A) denotes ephemeral (annual) species; (P) denotes Priority species

Family	Taxon	CLP-AFW1	CLP-AOW1	DD-AFW1	DD-AFW2	DD-AOW1	DD-CS1	DD-CS2	RH-AFW1	RH-AOW1	RH-AOW2	RP-AOW1
Amaranthaceae	*Ptilotus aervoides (A)*			*		*		*				
Amaranthaceae	*Ptilotus exaltatus (A)*		*	*					*			
Amaranthaceae	*Ptilotus obovatus*	*	*	*	*	*		*	*		*	*
Amaranthaceae	*Ptilotus schwartzii*	*	*									
Amaranthaceae	*Ptilotus rotundifolius*										*	*
Apocynaceae	*Leichhardtia australis*				*							*
Asteraceae	*Senecio magnificus (A)*		*						*			
Chenopodiaceae	*Atriplex bunburyana*		*	*								
Chenopodiaceae	*Atriplex codonocarpa (A)*			*			*		*			
Chenopodiaceae	*Enchylaena tomentosa*		*	*	*	*		*				
Chenopodiaceae	*Maireana georgei*	*			*		*		*	*		
Chenopodiaceae	*Maireana oppositifolia*		*									*
Chenopodiaceae	*Maireana pyramidata*		*	*		*	*	*	*			
Chenopodiaceae	*Maireana triptera*		*	*	*	*	*	*			*	*
Chenopodiaceae	*Rhagodia eremaea*				*							
Chenopodiaceae	*Rhagodia drummondii*		*	*	*			*				*
Chenopodiaceae	*Sclerolaena cuneata*		*				*					
Chenopodiaceae	*Sclerolaena densiflora*		*				*		*			
Chenopodiaceae	*Sclerolaena diacantha*		*	*	*	*		*	*			*
Chenopodiaceae	*Tecticornia disarticulata*		*	*	*	*		*				*
Colchicaceae	*Wurmbea tenella (A)*			*		*						
Euphorbiaceae	*Euphorbia drummondii (A)*		*	*	*	*	*	*				
Fabaceae	*Acacia acuminata*		*	*	*	*		*				
Fabaceae	*Acacia caesaneura*		*			*			*			

Family	Taxon	CLP-AFW1	CLP-AOW1	DD-AFW1	DD-AFW2	DD-AOW1	DD-CS1	DD-CS2	RH-AFW1	RH-AOW1	RH-AOW2	RP-AOW1
Fabaceae	*Acacia grasbyi*	*	*			*			*			*
Fabaceae	*Acacia incurvaneura*	*	*	*	*	*				*		*
Fabaceae	*Acacia pteraneura*		*						*			*
Fabaceae	*Acacia mulganeura*		*	*						*		
Fabaceae	*Acacia exocarpoides*	*							*	*		
Fabaceae	*Acacia quadrimarginea*								*			
Fabaceae	*Acacia ramulosa* var. *ramulosa*	*	*	*		*		*		*	*	*
Fabaceae	*Acacia burkittii*					*			*			
Fabaceae	*Acacia tetragonophylla*	*	*	*	*	*		*	*	*		*
Fabaceae	*Acacia aptaneura*	*	*			*				*		*
Fabaceae	*Acacia craspedocarpa*		*	*		*						*
Fabaceae	*Acacia fuscaneura*										*	
Fabaceae	*Senna artemisioides* subsp. × *artemisioides*											
Fabaceae	*Senna artemisioides* subsp. *filifolia*											*
Fabaceae	*Senna artemisioides* subsp. x *sturtii*											
Fabaceae	*Senna glutinosa* subsp. *chatelainiana*					*			*			
Fabaceae	*Senna* sp. Meekatharra		*	*								*
Geraniaceae	*Erodium cygnorum (A)*		*	*		*		*	*			*
Goodeniaceae	*Scaevola spinescens*		*	*	*	*						*
Haloragaceae	*Haloragis odontocarpa (A)*		*	*								
Hemerocallidaceae	*Dianella revoluta*		*			*						
Lamiaceae	*Teucrium teucriiflorum*	*				*						*
Loranthaceae	*Amyema fitzgeraldii*		*			*		*				
Malvaceae	*Abutilon cryptopetalum*		*	*	*	*		*				
Malvaceae	*Brachychiton gregorii*	*				*			*			*
Malvaceae	*Sida spodochroma*								*			
Malvaceae	*Sida calyxhymenia*		*	*	*	*		*		*		*
Malvaceae	*Sida ectogama*		*	*		*						
Montiaceae	*Calandrinia eremaea (A)*					*						
Myrtaceae	*Melaleuca hamata*											
Myrtaceae	*Melaleuca leiocarpa*				*				*			*
Nyctaginaceae	*Boerhavia coccinea*			*	*							
Pittosporaceae	*Pittosporum angustifolium*		*	*								
Poaceae	*Aristida contorta (A)*		*			*	*	*				

Family	Taxon	CLP-AFW1	CLP-AOW1	DD-AFW1	DD-AFW2	DD-AOW1	DD-CS1	DD-CS2	RH-AFW1	RH-AOW1	RH-AOW2	RP-AOW1
Poaceae	*Austrostipa elegantissima*											*
Poaceae	*Enneapogon caerulescens*			*		*	*	*				
Poaceae	*Eragrostis eriopoda*						*					*
Poaceae	*Eragrostis dielsii (A)*			*		*		*				
Poaceae	*Chloris truncata*			*								
Poaceae	*Cenchrus ciliaris (W)*		*						*			
Proteaceae	*Grevillea berryana*	*	*									
Proteaceae	*Hakea preissii*		*	*		*		*	*			
Proteaceae	*Hakea recurva* subsp. *arida*			*		*			*			
Pteridaceae	*Cheilanthes sieberi (A)*	*		*		*						*
Pteridaceae	*Cheilanthes lasiophylla (A)*								*			
Santalaceae	*Exocarpos aphyllus*			*	*				*			*
Sapindaceae	*Dodonaea rigida*	*										*
Scrophulariaceae	*Eremophila forrestii*	*				*	*					*
Scrophulariaceae	*Eremophila galeata*	*	*	*		*	*		*			
Scrophulariaceae	*Eremophila latrobei*	*	*			*				*		*
Scrophulariaceae	*Eremophila spectabilis*	*				*			*			
Scrophulariaceae	*Eremophila oldfieldii* subsp. *angustifolia*			*	*	*			*			
Scrophulariaceae	*Eremophila oppositifolia*				*							
Scrophulariaceae	*Eremophila pantonii*		*	*	*							*
Scrophulariaceae	*Eremophila compacta*	*	*	*								*
Scrophulariaceae	*Eremophila exilifolia*	*	*			*			*		*	
Scrophulariaceae	*Eremophila punicea*	*	*	*		*			*		*	
Scrophulariaceae	*Eremophila clarkei*	*	*	*		*				*		*
Solanaceae	*Lycium australe*	*	*		*							*
Solanaceae	*Nicotiana rosulata (A)*	*	*	*		*	*					
Solanaceae	*Solanum lasiophyllum*		*	*	*		*	*				*
Zygophyllaceae	*Tribulus astrocarpus*	*					*					

APPENDIX E:
VEGETATION CONDITION RATING

Vegetation Condition Rating	South West and Interzone Botanical Provinces	Eremaean and Northern Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor		Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e., areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX F: ATLAS OF LIVING AUSTRALIA DESKTOP SEARCH (40KM)

VASCULAR FLORA

Family	Taxon
Aizoaceae	*Cleretum papulosum*
Aizoaceae	*Gunniopsis divisa*
Aizoaceae	*Gunniopsis propinqua*
Aizoaceae	*Gunniopsis quadrifida*
Aizoaceae	*Gunniopsis rodwayi*
Aizoaceae	*Gunniopsis rubra*
Aizoaceae	*Gunniopsis septifraga*
Aizoaceae	*Tetragonia cristata*
Amaranthaceae	*Ptilotus aervoides*
Amaranthaceae	*Ptilotus chamaecladus*
Amaranthaceae	*Ptilotus divaricatus*
Amaranthaceae	*Ptilotus drummondii*
Amaranthaceae	*Ptilotus drummondii* var. *minor*
Amaranthaceae	*Ptilotus exaltatus*
Amaranthaceae	*Ptilotus gaudichaudii*
Amaranthaceae	*Ptilotus grandiflorus*
Amaranthaceae	*Ptilotus helichrysoides*
Amaranthaceae	*Ptilotus helipteroides*
Amaranthaceae	*Ptilotus obovatus*
Amaranthaceae	*Ptilotus polakii* subsp. *polakii*
Amaranthaceae	*Ptilotus polystachyus*
Amaranthaceae	*Ptilotus schwartzii*
Amaranthaceae	*Ptilotus xerophilus*
Apiaceae	*Apium annuum*

Family	Taxon
Apocynaceae	*Cynanchum floribundum*
Apocynaceae	*Gymnema graniticola*
Apocynaceae	*Vincetoxicum lineare*
Araliaceae	*Hydrocotyle intertexta*
Araliaceae	*Trachymene ceratocarpa*
Araliaceae	*Trachymene pilbarensis*
Asparagaceae	*Arthropodium dyeri*
Asparagaceae	*Thysanotus manglesianus*
Asparagaceae	*Thysanotus ramulosus*
Asteraceae	*Actinobole oldfieldianum*
Asteraceae	*Actinobole uliginosum*
Asteraceae	*Angianthus milnei*
Asteraceae	*Angianthus tomentosus*
Asteraceae	*Bellida graminea*
Asteraceae	*Brachyscome ciliaris*
Asteraceae	*Brachyscome iberidifolia*
Asteraceae	*Brachyscome perpusilla*
Asteraceae	*Brachyscome trachycarpa*
Asteraceae	*Calocephalus knappii*
Asteraceae	*Calocephalus multiflorus*
Asteraceae	*Calotis hispidula*
Asteraceae	*Calotis multicaulis*
Asteraceae	*Carthamus lanatus*
Asteraceae	*Centipeda thespidioides*
Asteraceae	*Cephalipterum drummondii*
Asteraceae	*Chrysocephalum puteale*
Asteraceae	*Chthonocephalus pseudevax*
Asteraceae	*Cratystylis subspinescens*
Asteraceae	*Erymophyllum compactum*
Asteraceae	*Erymophyllum tenellum*
Asteraceae	*Feldstonia nitens*
Asteraceae	*Gilberta tenuifolia*
Asteraceae	*Gnephosis arachnoidea*
Asteraceae	*Gnephosis brevifolia*
Asteraceae	*Gnephosis cassiniana*
Asteraceae	*Gnephosis tenuissima*

Family	Taxon
Asteraceae	*Helipterum craspedioides*
Asteraceae	*Hyalosperma zacchaeus*
Asteraceae	*Lemooria burkittii*
Asteraceae	*Minuria cunninghamii*
Asteraceae	*Myriocephalus gueriniae*
Asteraceae	*Myriocephalus pygmaeus*
Asteraceae	*Myriocephalus rudallii*
Asteraceae	*Olearia muelleri*
Asteraceae	*Olearia pimeleoides*
Asteraceae	*Olearia plucheacea*
Asteraceae	*Olearia stuartii*
Asteraceae	*Pluchea dentex*
Asteraceae	*Pluchea rubelliflora*
Asteraceae	*Podolepis capillaris*
Asteraceae	*Podotheca gnaphalioides*
Asteraceae	*Pogonolepis muelleriana*
Asteraceae	*Pogonolepis stricta*
Asteraceae	*Rhodanthe battii*
Asteraceae	*Rhodanthe charsleyae*
Asteraceae	*Rhodanthe chlorocephala*
Asteraceae	*Rhodanthe chlorocephala* subsp. *splendida*
Asteraceae	*Rhodanthe citrina*
Asteraceae	*Rhodanthe floribunda*
Asteraceae	*Rhodanthe humboldtiana*
Asteraceae	*Rhodanthe sterilescens*
Asteraceae	*Rhodanthe stricta*
Asteraceae	*Roebuckiella ciliocarpa*
Asteraceae	*Schoenia cassiniana*
Asteraceae	*Sondottia connata*
Asteraceae	*Streptoglossa cylindriceps*
Asteraceae	*Trichanthodium skirrophorum*
Asteraceae	*Vittadinia eremaea*
Asteraceae	*Waitzia acuminata* var. *acuminata*
Boraginaceae	*Heliotropium ammophilum*
Boraginaceae	*Heliotropium curassavicum*
Boraginaceae	*Trichodesma zeylanicum*

Family	Taxon
Boryaceae	*Borya sphaerocephala*
Brassicaceae	*Carrichtera annua*
Brassicaceae	*Lepidium oxytrichum*
Brassicaceae	*Lepidium platypetalum*
Brassicaceae	*Lepidium scandens*
Brassicaceae	*Menkea australis*
Brassicaceae	*Sisymbrium erysimoides*
Brassicaceae	*Sisymbrium orientale*
Brassicaceae	*Stenopetalum anfractum*
Cactaceae	*Cylindropuntia fulgida*
Campanulaceae	*Isotoma petraea*
Campanulaceae	*Lobelia winfridae*
Campanulaceae	*Wahlenbergia gracilenta*
Campanulaceae	*Wahlenbergia tumidifructa*
Caryophyllaceae	*Silene gallica* var. *gallica*
Caryophyllaceae	*Spergula pentandra*
Casuarinaceae	*Allocasuarina acutivalvis* subsp. *acutivalvis*
Casuarinaceae	*Casuarina pauper*
Celastraceae	*Psammomoya grandiflora*
Celastraceae	*Stackhousia monogyna*
Celastraceae	*Stackhousia* sp. Mt Keith (G.Cockerton & G.O'Keefe 11017)
Centrolepidaceae	*Centrolepis cephaloformis* subsp. *cephaloformis*
Chenopodiaceae	*Atriplex bunburyana*
Chenopodiaceae	*Atriplex semilunaris*
Chenopodiaceae	*Atriplex stipitata* subsp. *stipitata*
Chenopodiaceae	*Atriplex vesicaria*
Chenopodiaceae	*Chenopodium curvispicatum*
Chenopodiaceae	*Chenopodium gaudichaudianum*
Chenopodiaceae	*Chenopodium murale*
Chenopodiaceae	*Didymanthus roei*
Chenopodiaceae	*Dissocarpus paradoxus*
Chenopodiaceae	*Dysphania kalpari*
Chenopodiaceae	*Dysphania rhadinostachya* subsp. *inflata*
Chenopodiaceae	*Enchylaena lanata*
Chenopodiaceae	*Enchylaena tomentosa*
Chenopodiaceae	*Eriochiton sclerolaenoides*

Family	Taxon
Chenopodiaceae	*Maireana atkinsiana*
Chenopodiaceae	*Maireana carnosa*
Chenopodiaceae	*Maireana convexa*
Chenopodiaceae	*Maireana suaedifolia*
Chenopodiaceae	*Maireana thesioides*
Chenopodiaceae	*Maireana trichoptera*
Chenopodiaceae	*Maireana triptera*
Chenopodiaceae	*Rhagodia eremaea*
Chenopodiaceae	*Rhagodia preissii* subsp. *preissii*
Chenopodiaceae	*Salsola australis*
Chenopodiaceae	*Sclerolaena burbidgeae*
Chenopodiaceae	*Sclerolaena densiflora*
Chenopodiaceae	*Sclerolaena eriacantha*
Chenopodiaceae	*Sclerolaena eurotioides*
Chenopodiaceae	*Sclerolaena fusiformis*
Chenopodiaceae	*Sclerolaena gardneri*
Chenopodiaceae	*Sclerolaena recurvicuspis*
Colchicaceae	*Wurmbea inframediana*
Colchicaceae	*Wurmbea murchisoniana*
Colchicaceae	*Wurmbea tenella*
Convolvulaceae	*Duperreya commixta*
Convolvulaceae	*Duperreya sericea*
Crassulaceae	*Crassula colorata*
Crassulaceae	*Crassula colorata* var. *acuminata*
Cyperaceae	*Lepidosperma* sp. Wolga Rock (S.D.Hopper 6513)
Cyperaceae	*Schoenus variicellae*
Droseraceae	*Drosera finlaysoniana*
Droseraceae	*Drosera glanduligera*
Droseraceae	*Drosera macrantha* subsp. *eremaea*
Elatinaceae	*Bergia perennis* subsp. *exigua*
Euphorbiaceae	*Calycopeplus paucifolius*
Euphorbiaceae	*Euphorbia drummondii*
Euphorbiaceae	*Euphorbia porcata*
Euphorbiaceae	*Ricinocarpos muricatus*
Fabaceae	*Acacia anthochaera*
Fabaceae	*Acacia aptaneura*

Family	Taxon
Fabaceae	*Acacia aulacophylla*
Fabaceae	*Acacia burkittii*
Fabaceae	*Acacia caesaneura*
Fabaceae	*Acacia cockertoniana*
Fabaceae	*Acacia craspedocarpa*
Fabaceae	*Acacia cyperophylla*
Fabaceae	*Acacia daviesioides*
Fabaceae	*Acacia exocarpoides*
Fabaceae	*Acacia grasbyi*
Fabaceae	*Acacia incurvaneura*
Fabaceae	*Acacia kalgoorliensis*
Fabaceae	*Acacia lapidosa*
Fabaceae	*Acacia ligulata*
Fabaceae	*Acacia macraneura*
Fabaceae	*Acacia masliniana*
Fabaceae	*Acacia murrayana*
Fabaceae	*Acacia palustris*
Fabaceae	*Acacia prainii*
Fabaceae	*Acacia pruinocarpa*
Fabaceae	*Acacia pteraneura*
Fabaceae	*Acacia ramulosa*
Fabaceae	*Acacia ramulosa* var. *linophylla*
Fabaceae	*Acacia ramulosa* var. *ramulosa*
Fabaceae	*Acacia rhodophloia*
Fabaceae	*Acacia saligna* subsp. Wheatbelt (B.R.Maslin 8602)
Fabaceae	*Acacia scleroclada*
Fabaceae	*Acacia sclerosperma*
Fabaceae	*Acacia sclerosperma* subsp. *sclerosperma*
Fabaceae	*Acacia sibina*
Fabaceae	*Acacia sibirica*
Fabaceae	*Acacia* sp. (Townsville)
Fabaceae	*Acacia* sp. Weld Range (A.Markey & S.Dillon 2994)
Fabaceae	*Acacia speckii*
Fabaceae	*Acacia subsessilis*
Fabaceae	*Acacia synchronicia*
Fabaceae	*Acacia tetragonophylla*

Family	Taxon
Fabaceae	*Acacia tysonii*
Fabaceae	*Acacia umbraculiformis*
Fabaceae	*Acacia victoriae*
Fabaceae	*Acacia victoriae* subsp. *victoriae*
Fabaceae	*Acacia wilcoxii*
Fabaceae	*Acacia wiseana*
Fabaceae	*Cullen cinereum*
Fabaceae	*Gastrolobium laytonii*
Fabaceae	*Glycine canescens*
Fabaceae	*Jacksonia lanicarpa*
Fabaceae	*Medicago minima*
Fabaceae	*Medicago polymorpha*
Fabaceae	*Mirbelia microphylla*
Fabaceae	*Mirbelia rhagodioides*
Fabaceae	*Muelleranthus trifoliolatus*
Fabaceae	*Senna artemisioides*
Fabaceae	*Senna artemisioides* subsp. *filifolia*
Fabaceae	*Senna artemisioides* subsp. *helmsii*
Fabaceae	*Senna artemisioides* subsp. *x petiolaris*
Fabaceae	*Senna artemisioides* subsp. *x sturtii*
Fabaceae	*Senna charlesiana*
Fabaceae	*Senna glutinosa* subsp. *chatelainiana*
Fabaceae	*Senna* sp. Austin (A.Strid 20210)
Fabaceae	*Senna* sp. Meekatharra (E.Bailey 1-26)
Fabaceae	*Senna symonii*
Fabaceae	*Swainsona affinis*
Fabaceae	*Swainsona elegans*
Fabaceae	*Swainsona gracilis*
Fabaceae	*Swainsona rostellata*
Fabaceae	*Swainsona tenuis*
Fabaceae	*Trigonella suavissima*
Fabaceae	*Vachellia farnesiana* var. *farnesiana*
Frankeniaceae	*Frankenia cinerea*
Frankeniaceae	*Frankenia confusa*
Frankeniaceae	*Frankenia cordata*
Frankeniaceae	*Frankenia irregularis*

Family	Taxon
Frankeniaceae	*Frankenia laxiflora*
Frankeniaceae	*Frankenia sessilis*
Frankeniaceae	*Frankenia setosa*
Geraniaceae	*Erodium crinitum*
Geraniaceae	*Erodium cygnorum*
Goodeniaceae	*Brunonia australis*
Goodeniaceae	*Dampiera eriocephala*
Goodeniaceae	*Dampiera roycei*
Goodeniaceae	*Goodenia berardiana*
Goodeniaceae	*Goodenia havilandii*
Goodeniaceae	*Goodenia kingiana*
Goodeniaceae	*Goodenia mimuloides*
Goodeniaceae	*Goodenia occidentalis*
Goodeniaceae	*Goodenia pusilliflora*
Goodeniaceae	*Goodenia* sp. Midwest (K.A.Shepherd & C.F.Wilkins KS 1609)
Goodeniaceae	*Scaevola spinescens*
Goodeniaceae	*Velleia cycnopotamica*
Goodeniaceae	*Velleia rosea*
Gyrostemonaceae	*Codonocarpus cotinifolius*
Haloragaceae	*Haloragis odontocarpa f. rugosa*
Haloragaceae	*Haloragis trigonocarpa*
Hemerocallidaceae	*Dianella revoluta*
Hypericaceae	*Hypericum gramineum*
Juncaceae	*Juncus aridicola*
Juncaginaceae	*Triglochin* sp. A Flora of Australia (G.J.Keighery 2477)
Lamiaceae	*Dicrastylis linearifolia*
Lamiaceae	*Hemigenia benthamii*
Lamiaceae	*Hemigenia* sp. Yalgoo (A.M.Ashby 2624)
Lamiaceae	*Hemigenia yalgensis*
Lamiaceae	*Prostanthera albiflora*
Lamiaceae	*Prostanthera althoferi* subsp. *althoferi*
Lamiaceae	*Prostanthera campbellii*
Lamiaceae	*Prostanthera grylloana*
Lamiaceae	*Prostanthera patens*
Lamiaceae	*Salvia verbenaca*
Lamiaceae	*Teucrium teucriiflorum*

Family	Taxon
Loranthaceae	*Amyema miraculosa* subsp. *boormanii*
Loranthaceae	*Amyema nestor*
Loranthaceae	*Lysiana casuarinae*
Loranthaceae	*Lysiana murrayi*
Malvaceae	*Abutilon cryptopetalum*
Malvaceae	*Abutilon leucopetalum*
Malvaceae	*Abutilon otocarpum*
Malvaceae	*Abutilon oxycarpum* subsp. Prostrate (A.A.Mitchell PRP 1266)
Malvaceae	*Androcalva luteiflora*
Malvaceae	*Hibiscus coatesii*
Malvaceae	*Hibiscus* sp. Gardneri (A.L.Payne PRP 1435)
Malvaceae	*Lawrencia glomerata*
Malvaceae	*Lawrencia helmsii*
Malvaceae	*Malva parviflora*
Malvaceae	*Seringia exastia*
Malvaceae	*Seringia integrifolia*
Malvaceae	*Seringia velutina*
Malvaceae	*Sida calyxhymenia*
Malvaceae	*Sida petrophila*
Malvaceae	*Sida phaeotricha*
Malvaceae	*Sida rohlenae*
Malvaceae	*Sida* sp. dark green fruits (S.van Leeuwen 2260)
Malvaceae	*Sida* sp. Golden calyces pubescent (G.J.Leach 1966)
Malvaceae	*Sida* sp. spiciform panicles (E.Leyland s.n. 14/8/1990)
Marsileaceae	*Marsilea hirsuta*
Myrtaceae	*Aluta aspera* subsp. *hesperia*
Myrtaceae	*Callistemon phoeniceus*
Myrtaceae	*Calytrix desolata*
Myrtaceae	*Calytrix divergens*
Myrtaceae	*Calytrix erosipetala*
Myrtaceae	*Chamelaucium* sp. Yalgoo (Y.Chadwick 1816)
Myrtaceae	*Eucalyptus eremicola* subsp. *peeneri*
Myrtaceae	*Eucalyptus gypsophila*
Myrtaceae	*Eucalyptus kochii* subsp. *borealis*
Myrtaceae	*Eucalyptus leptopoda* subsp. *elevata*
Myrtaceae	*Eucalyptus petraea*

Family	Taxon
Myrtaceae	*Eucalyptus striaticalyx*
Myrtaceae	*Eucalyptus victrix*
Myrtaceae	*Homalocalyx thryptomenoides*
Myrtaceae	*Melaleuca eleuterostachya*
Myrtaceae	*Melaleuca stereophloia*
Myrtaceae	*Melaleuca strobophylla*
Myrtaceae	*Micromyrtus flaviflora*
Myrtaceae	*Micromyrtus sulphurea*
Myrtaceae	*Thryptomene costata*
Myrtaceae	*Thryptomene decussata*
Myrtaceae	*Thryptomene johnsonii*
Myrtaceae	*Verticordia jamiesonii*
Nyctaginaceae	*Commicarpus australis*
Orchidaceae	*Microtis eremaea*
Orchidaceae	*Prasophyllum gracile*
Orchidaceae	*Pterostylis setulosa*
Phrymaceae	*Elacholoma hornii*
Phrymaceae	*Peplidium muelleri*
Phyllanthaceae	*Phyllanthus erwinii*
Phyllanthaceae	*Poranthera microphylla*
Phyllanthaceae	*Sauropus* sp. Woolgorong (M.Officer s.n. 10/8/94)
Picrodendraceae	*Stachystemon intricatus*
Pittosporaceae	*Bursaria occidentalis*
Pittosporaceae	*Cheiranthera simplicifolia*
Pittosporaceae	*Pittosporum angustifolium*
Plantaginaceae	*Plantago debilis*
Plantaginaceae	*Plantago drummondii*
Plantaginaceae	*Stemodia viscosa*
Plumbaginaceae	*Muellerolimon salicorniaceum*
Poaceae	*Alopecurus geniculatus*
Poaceae	*Aristida contorta*
Poaceae	*Austrostipa nitida*
Poaceae	*Cenchrus ciliaris*
Poaceae	*Cymbopogon ambiguus*
Poaceae	*Ehrharta longiflora*
Poaceae	*Enneapogon caerulescens*

Family	Taxon
Poaceae	*Eragrostis dielsii*
Poaceae	*Eragrostis eriopoda*
Poaceae	*Eragrostis falcata*
Poaceae	*Eragrostis lanipes*
Poaceae	*Eragrostis setifolia*
Poaceae	*Eriachne mucronata*
Poaceae	*Eriachne ovata*
Poaceae	*Eriachne pulchella*
Poaceae	*Eriachne pulchella* subsp. *pulchella*
Poaceae	*Iseilema dolichotrichum*
Poaceae	*Monachather paradoxus*
Poaceae	*Paspalidium clementii*
Poaceae	*Pentameris airoides*
Poaceae	*Themeda triandra*
Poaceae	*Thyridolepis mitchelliana*
Poaceae	*Thyridolepis multiculmis*
Poaceae	*Triodia tomentosa*
Polygalaceae	*Comesperma volubile*
Polygonaceae	*Muehlenbeckia adpressa*
Polygonaceae	*Rumex hypogaeus*
Polygonaceae	*Rumex vesicarius*
Portulacaceae	*Calandrinia creethae*
Portulacaceae	*Calandrinia eremaea*
Portulacaceae	*Calandrinia papillata*
Portulacaceae	*Calandrinia ptychosperma*
Portulacaceae	*Calandrinia pumila*
Portulacaceae	*Calandrinia remota*
Portulacaceae	*Calandrinia* sp. Bungalbin (G.J.Keighery & N.Gibson 1656)
Portulacaceae	*Portulaca oleracea*
Proteaceae	*Grevillea deflexa*
Proteaceae	*Grevillea eriostachya*
Proteaceae	*Grevillea hakeoides* subsp. *stenophylla*
Proteaceae	*Grevillea juncifolia* subsp. *juncifolia*
Proteaceae	*Grevillea levis*
Proteaceae	*Grevillea nematophylla* subsp. *supraplana*
Proteaceae	*Grevillea obliquistigma*

Family	Taxon
Proteaceae	*Grevillea obliquistigma* subsp. *obliquistigma*
Proteaceae	*Grevillea sarissa* subsp. *sarissa*
Proteaceae	*Hakea lorea*
Proteaceae	*Hakea preissii*
Proteaceae	*Hakea recurva* subsp. *arida*
Proteaceae	*Hakea recurva* subsp. *recurva*
Proteaceae	*Persoonia stricta*
Proteaceae	*Petrophile pauciflora*
Proteaceae	*Petrophile vana*
Pteridaceae	*Cheilanthes sieberi*
Pteridaceae	*Cheilanthes sp.* (Prince Regent NT)
Rubiaceae	*Psydrax latifolia*
Rubiaceae	*Psydrax suaveolens*
Rutaceae	*Philotheca brucei* subsp. *brucei*
Rutaceae	*Philotheca sericea*
Santalaceae	*Exocarpos aphyllus*
Santalaceae	*Santalum acuminatum*
Santalaceae	*Santalum lanceolatum*
Santalaceae	*Spirogardnera rubescens*
Sapindaceae	*Dodonaea adenophora*
Sapindaceae	*Dodonaea inaequifolia*
Sapindaceae	*Dodonaea microzyga* var. *acrolobata*
Sapindaceae	*Dodonaea pachyneura*
Sapindaceae	*Dodonaea petiolaris*
Sapindaceae	*Dodonaea pinifolia*
Sapindaceae	*Dodonaea viscosa* subsp. *angustissima*
Scrophulariaceae	*Eremophila alternifolia*
Scrophulariaceae	*Eremophila clarkei*
Scrophulariaceae	*Eremophila compacta* subsp. *compacta*
Scrophulariaceae	*Eremophila eriocalyx*
Scrophulariaceae	*Eremophila exilifolia*
Scrophulariaceae	*Eremophila foliosissima*
Scrophulariaceae	*Eremophila forrestii*
Scrophulariaceae	*Eremophila forrestii* subsp. *forrestii*
Scrophulariaceae	*Eremophila galeata*
Scrophulariaceae	*Eremophila georgei*

Family	Taxon
Scrophulariaceae	*Eremophila gilesii* subsp. *variabilis*
Scrophulariaceae	*Eremophila glabra* subsp. *tomentosa*
Scrophulariaceae	*Eremophila glutinosa*
Scrophulariaceae	*Eremophila hughesii*
Scrophulariaceae	*Eremophila latrobei*
Scrophulariaceae	*Eremophila latrobei* subsp. *latrobei*
Scrophulariaceae	*Eremophila longifolia*
Scrophulariaceae	*Eremophila mackinlayi* subsp. *spathulata*
Scrophulariaceae	*Eremophila miniata*
Scrophulariaceae	*Eremophila muelleriana*
Scrophulariaceae	*Eremophila oldfieldii* subsp. *angustifolia*
Scrophulariaceae	*Eremophila oppositifolia* subsp. *angustifolia*
Scrophulariaceae	*Eremophila pantonii*
Scrophulariaceae	*Eremophila platycalyx* subsp. Granites (D.J.Edinger & G.Marsh DJE 4782)
Scrophulariaceae	*Eremophila platycalyx* subsp. *platycalyx*
Scrophulariaceae	*Eremophila platycalyx* subsp. Yalgoo (A.Markey & S.Dillon 3337)
Scrophulariaceae	*Eremophila pterocarpa*
Scrophulariaceae	*Eremophila punicea*
Scrophulariaceae	*Eremophila serrulata*
Scrophulariaceae	*Eremophila shonae* subsp. *shonae*
Scrophulariaceae	*Eremophila simulans* subsp. *lapidensis*
Scrophulariaceae	*Eremophila simulans* subsp. *megacalyx*
Scrophulariaceae	*Eremophila simulans* subsp. *simulans*
Scrophulariaceae	*Eremophila youngii*
Scrophulariaceae	*Eremophila youngii* subsp. *youngii*
Scrophulariaceae	*Myoporum montanum*
Solanaceae	*Lycium australe*
Solanaceae	*Nicotiana cavicola*
Solanaceae	*Nicotiana occidentalis* subsp. *obliqua*
Solanaceae	*Nicotiana rosulata*
Solanaceae	*Solanum cleistogamum*
Solanaceae	*Solanum ferocissimum*
Solanaceae	*Solanum lasiophyllum*
Solanaceae	*Solanum nigrum*
Solanaceae	*Solanum orbiculatum* subsp. *orbiculatum*

Family	Taxon
Stylidiaceae	*Levenhookia leptantha*
Stylidiaceae	*Stylidium longibracteatum*
Stylidiaceae	*Stylidium warriedarense*
Tamaricaceae	*Tamarix aphylla*
Thymelaeaceae	*Pimelea microcephala* subsp. *microcephala*
Zygophyllaceae	*Roepera aurantiaca*
Zygophyllaceae	*Roepera aurantiaca* subsp. *aurantiaca*
Zygophyllaceae	*Roepera eichleri*
Zygophyllaceae	*Roepera eremaea*
Zygophyllaceae	*Roepera ovata*
Zygophyllaceae	*Tribulus astrocarpus*
Zygophyllaceae	*Tribulus forrestii*

TERRESTRIAL VERTEBRATE FAUNA FLORA

Class	Family	Taxon	Vernacular Name
Amphibia	Limnodynastidae	*Neobatrachus kunapalari*	Wheatbelt Frog
Amphibia	Limnodynastidae	*Neobatrachus sutor*	Shoemaker Frog
Amphibia	Limnodynastidae	*Neobatrachus wilsmorei*	Goldfields Bullfrog
Amphibia	Limnodynastidae	*Platyplectrum spenceri*	Spencer's Burrowing Frog
Amphibia	Myobatrachidae	*Pseudophryne*	
Amphibia	Myobatrachidae	*Pseudophryne occidentalis*	Orange-crowned Toadlet
Amphibia	Pelodryadidae	*Cyclorana occidentalis*	
Amphibia	Pelodryadidae	*Cyclorana platycephala*	Water-holding Frog
Amphibia	Pelodryadidae	*Litoria rubella*	Little Red Tree Frog
Aves	Acanthizidae	*Acanthiza (Acanthiza) apicalis*	Red-rumped Tit
Aves	Acanthizidae	*Acanthiza (Geobasileus) chrysorrhoa*	Yellow-rumped Thornbill
Aves	Acanthizidae	*Acanthiza (Geobasileus) iredalei*	Slender-billed Thornbill
Aves	Acanthizidae	*Acanthiza (Geobasileus) uropygialis*	Chestnut-rumped Thornbill
Aves	Acanthizidae	*Acanthiza (Milligania) robustirostris*	Slaty-backed Thornbill
Aves	Acanthizidae	*Aphelocephala leucopsis*	Southern Whiteface
Aves	Acanthizidae	*Aphelocephala nigricincta*	Banded Whiteface
Aves	Acanthizidae	*Gerygone fusca*	Western Gerygone
Aves	Acanthizidae	*Gerygone olivacea olivacea*	Eastern White-throated Gerygone

Class	Family	Taxon	Vernacular Name
Aves	Acanthizidae	*Pyrrholaemus brunneus*	Redthroat
Aves	Acanthizidae	*Smicrornis brevirostris*	Weebill
Aves	Accipitridae	*Accipiter (Leucospiza) fasciatus*	Brown Goshawk
Aves	Accipitridae	*Accipiter (Paraspizias) cirrocephalus*	Collared Sparrowhawk
Aves	Accipitridae	*Aquila (Uroaetus) audax*	Wedge-tailed Eagle
Aves	Accipitridae	*Circus approximans*	Swamp Harrier
Aves	Accipitridae	*Circus assimilis*	Spotted Harrier
Aves	Accipitridae	*Elanus axillaris*	Black-shouldered Kite
Aves	Accipitridae	*Haliastur sphenurus*	Whistling Kite
Aves	Accipitridae	*Hamirostra melanosternon*	Black-breasted Buzzard
Aves	Accipitridae	*Hieraaetus (Hieraaetus) morphnoides*	Little Eagle
Aves	Accipitridae	*Lophoictinia isura*	Square-tailed Kite
Aves	Accipitridae	*Milvus migrans*	Black Kite
Aves	Aegothelidae	*Aegotheles (Aegotheles) cristatus*	Australian Owlet-nightjar
Aves	Alcedinidae	*Todiramphus (Cyanalcyon) pyrrhopygius*	Red-backed Kingfisher
Aves	Alcedinidae	*Todiramphus (Todiramphus) sanctus*	Sacred Kingfisher
Aves	Anatidae	*Anas (Anas) superciliosa*	Pacific Black Duck
Aves	Anatidae	*Anas (Nettion) castanea*	Chestnut Teal
Aves	Anatidae	*Anas gracilis*	Grey Teal
Aves	Anatidae	*Aythya (Nyroca) australis*	Hardhead
Aves	Anatidae	*Chenonetta jubata*	Australian Wood Duck
Aves	Anatidae	*Cygnus atratus*	Black Swan
Aves	Anatidae	*Malacorhynchus membranaceus*	Pink-eared Duck
Aves	Anatidae	*Spatula rhynchotis*	Australasian Shoveler
Aves	Anatidae	*Tadorna (Casarca) tadornoides*	Australian Shelduck
Aves	Apodidae	*Apus (Apus) pacificus*	Fork-tailed Swift
Aves	Ardeidae	*Ardea alba modesta*	Great Egret
Aves	Ardeidae	*Ardea pacifica*	White-necked Heron
Aves	Ardeidae	*Egretta novaehollandiae*	White-faced Heron
Aves	Artamidae	*Artamus (Angroyan) cinereus*	Black-faced Woodswallow
Aves	Artamidae	*Artamus (Angroyan) cyanopterus*	Dusky Woodswallow

Class	Family	Taxon	Vernacular Name
Aves	Artamidae	*Artamus (Angroyan) minor*	Little Woodswallow
Aves	Artamidae	*Artamus (Campbellornis) personatus*	Masked Woodswallow
Aves	Artamidae	*Artamus (Campbellornis) superciliosus*	White-browed Woodswallow
Aves	Artamidae	*Cracticus nigrogularis*	Pied Butcherbird
Aves	Artamidae	*Cracticus torquatus*	Grey Butcherbird
Aves	Artamidae	*Gymnorhina tibicen*	Australian Magpie
Aves	Artamidae	*Strepera (Neostrepera) versicolor*	Grey Currawong
Aves	Burhinidae	*Burhinus (Burhinus) grallarius*	Bush Stone-curlew
Aves	Cacatuidae	*Cacatua (Licmetis) sanguinea*	Little Corella
Aves	Cacatuidae	*Calyptorhynchus (Calyptorhynchus) banksii*	Red-tailed Black Cockatoo
Aves	Cacatuidae	*Eolophus roseicapilla*	Galah
Aves	Cacatuidae	*Nymphicus hollandicus*	Cockatiel
Aves	Campephagidae	*Coracina (Coracina) novaehollandiae*	Black-faced Cuckoo-shrike
Aves	Campephagidae	*Coracina (Coracina) novaehollandiae novaehollandiae*	Tasmanian Black-faced Cuckoo-shrike
Aves	Campephagidae	*Coracina (Pteropodocys) maxima*	Ground Cuckoo-shrike
Aves	Campephagidae	*Lalage (Lalage) tricolor*	White-winged Triller
Aves	Caprimulgidae	*Eurostopodus (Eurostopodus) argus*	Spotted Nightjar
Aves	Casuariidae	*Dromaius novaehollandiae*	Emu
Aves	Charadriidae	*Charadrius (Charadrius) ruficapillus*	Red-capped Plover
Aves	Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel
Aves	Charadriidae	*Erythrogonys cinctus*	Red-kneed Dotterel
Aves	Charadriidae	*Vanellus (Lobivanellus) tricolor*	Banded Lapwing
Aves	Cinclosomatidae	*Cinclosoma (Samuela) castaneothorax*	Chestnut-breasted Quail-thrush
Aves	Cinclosomatidae	*Cinclosoma (Samuela) marginatum*	Western Quail-thrush
Aves	Climacteridae	*Climacteris (Climacterobates) affinis*	White-browed Treecreeper
Aves	Columbidae	*Geopelia cuneata*	Diamond Dove
Aves	Columbidae	*Geophaps (Lophophaps) plumifera*	Spinifex Pigeon
Aves	Columbidae	*Ocyphaps lophotes*	Crested Pigeon

Class	Family	Taxon	Vernacular Name
Aves	Columbidae	*Phaps (Phaps) chalcoptera*	Common Bronzewing
Aves	Corvidae	*Corvus bennetti*	Little Crow
Aves	Corvidae	*Corvus coronoides*	Australian Raven
Aves	Corvidae	*Corvus orru*	Torresian Crow
Aves	Corvidae	*Corvus orru cecilae*	Australian Torresian Crow
Aves	Cuculidae	*Chalcites basalis*	Horsfield's Bronze-cuckoo
Aves	Cuculidae	*Chalcites osculans*	Black-eared Cuckoo
Aves	Cuculidae	*Heteroscenes pallidus*	Pallid Cuckoo
Aves	Dicaeidae	*Dicaeum (Dicaeum) hirundinaceum*	Mistletoebird
Aves	Estrildidae	*Taeniopygia guttata*	Zebra Finch
Aves	Falconidae	*Falco (Falco) longipennis*	Australian Hobby
Aves	Falconidae	*Falco (Hierofalco) peregrinus*	Peregrine Falcon
Aves	Falconidae	*Falco (Ieracidea) berigora*	Brown Falcon
Aves	Falconidae	*Falco (Tinnunculus) cenchroides*	Nankeen Kestrel
Aves	Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow
Aves	Hirundinidae	*Hirundo (Hirundo) neoxena*	Welcome Swallow
Aves	Hirundinidae	*Petrochelidon (Hylochelidon) nigricans*	Tree Martin
Aves	Hirundinidae	*Petrochelidon (Petrochelidon) ariel*	Fairy Martin
Aves	Laridae	*Chlidonias (Pelodes) hybrida*	Whiskered Tern
Aves	Laridae	*Gelochelidon nilotica*	Gull-billed Tern
Aves	Locustellidae	*Cincloramphus (Cincloramphus) cruralis*	Brown Songlark
Aves	Locustellidae	*Cincloramphus (Maclennania) mathewsi*	Rufous Songlark
Aves	Maluridae	*Malurus (Leggeornis) assimilis*	Purple-backed Fairy-wren
Aves	Maluridae	*Malurus (Leggeornis) lamberti*	Variegated Fairy-wren
Aves	Maluridae	*Malurus (Malurus) splendens*	Splendid Fairy-wren
Aves	Maluridae	*Malurus (Musciparus) leucopterus*	White-winged Fairy-wren
Aves	Megapodiidae	*Leipoa ocellata*	Malleefowl
Aves	Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater
Aves	Meliphagidae	*Anthochaera (Anthochaera) carunculata*	Red Wattlebird
Aves	Meliphagidae	*Certhionyx (Certhionyx) variegatus*	Pied Honeyeater
Aves	Meliphagidae	*Conopophila (Lacustroica) whitei*	Grey Honeyeater
Aves	Meliphagidae	*Epthianura (Aurepthianura) aurifrons*	Orange Chat
Aves	Meliphagidae	*Epthianura (Epthianura) albifrons*	White-fronted Chat
Aves	Meliphagidae	*Epthianura (Parepthianura) tricolor*	Crimson Chat
Aves	Meliphagidae	*Gavicalis virescens*	Singing Honeyeater
Aves	Meliphagidae	*Lichmera (Lichmera) indistincta*	Brown Honeyeater
Aves	Meliphagidae	*Manorina (Myzantha) flavigula*	Yellow-throated Miner
Aves	Meliphagidae	*Ptilotula penicillata*	White-plumed Honeyeater
Aves	Meliphagidae	*Ptilotula plumula*	Grey-fronted Honeyeater
Aves	Meliphagidae	*Purnella albifrons*	White-fronted Honeyeater
Aves	Meliphagidae	*Sugomel niger*	Black Honeyeater
Aves	Meropidae	*Merops (Merops) ornatus*	Rainbow Bee-eater
Aves	Monarchidae	*Grallina cyanoleuca*	Magpie-lark
Aves	Motacillidae	*Anthus (Anthus) novaeseelandiae*	Australian Pipit
Aves	Motacillidae	*Anthus (Anthus) novaeseelandiae novaeseelandiae*	
Aves	Neosittidae	*Daphoenositta (Neositta) chrysoptera*	Varied Sittella
Aves	Oreoicidae	*Oreoica gutturalis*	Crested Bellbird
Aves	Otididae	*Ardeotis australis*	Australian Bustard
Aves	Pachycephalidae	*Colluricincla (Colluricincla) harmonica*	Grey Shrike-thrush
Aves	Pachycephalidae	*Pachycephala (Alisterornis) rufiventris*	Rufous Whistler
Aves	Pardalotidae	*Pardalotus (Pardalotinus) striatus*	Striated Pardalote
Aves	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican
Aves	Petroicidae	*Melanodryas (Melanodryas) cucullata*	Hooded Robin
Aves	Petroicidae	*Melanodryas (Melanodryas) cucullata westralensis*	Western Hooded Robin
Aves	Petroicidae	*Microeca (Microeca) fascinans*	Jacky Winter

Class	Family	Taxon	Vernacular Name
Aves	Petroicidae	*Petroica (Petroica) boodang*	Scarlet Robin
Aves	Petroicidae	*Petroica (Petroica) goodenovii*	Red-capped Robin
Aves	Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant
Aves	Phasianidae	*Coturnix (Coturnix) pectoralis*	Stubble Quail
Aves	Podargidae	*Podargus strigoides*	Tawny Frogmouth
Aves	Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe
Aves	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe
Aves	Pomatostomidae	*Pomatostomus (Morganornis) superciliosus*	White-browed Babbler
Aves	Pomatostomidae	*Pomatostomus (Pomatostomus) temporalis*	Grey-crowned Babbler
Aves	Psittacidae	*Barnardius zonarius*	Australian Ringneck
Aves	Psittacidae	*Melopsittacus undulatus*	Budgerigar
Aves	Psittacidae	*Neophema (Neophema) splendida*	Scarlet-chested Parrot
Aves	Psittacidae	*Neopsephotus bourkii*	Bourke's Parrot
Aves	Psittacidae	*Pezoporus occidentalis*	Night Parrot
Aves	Psittacidae	*Psephotellus varius*	Mulga Parrot
Aves	Psophodidae	*Psophodes (Sphenostoma) occidentalis*	Chiming Wedgebill
Aves	Ptilonorhynchidae	*Chlamydera guttata*	Western Bowerbird
Aves	Ptilonorhynchidae	*Chlamydera nuchalis nuchalis*	Western Great Bowerbird
Aves	Rallidae	*Fulica atra*	Eurasian Coot
Aves	Rallidae	*Tribonyx ventralis*	Black-tailed Native-hen
Aves	Recurvirostridae	*Cladorhynchus leucocephalus*	Banded Stilt
Aves	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt
Aves	Recurvirostridae	*Himantopus himantopus leucocephalus*	Pied Stilt
Aves	Recurvirostridae	*Recurvirostra novaehollandiae*	Red-necked Avocet
Aves	Rhipiduridae	*Rhipidura (Rhipidura) albiscapa*	Grey Fantail
Aves	Rhipiduridae	*Rhipidura (Sauloprocta) leucophrys*	Willie Wagtail
Aves	Scolopacidae	*Tringa (Glottis) nebularia*	Common Greenshank

Class	Family	Taxon	Vernacular Name
Aves	Strigidae	*Ninox (Ninox) novaeseelandiae*	Southern Boobook
Aves	Threskiornithidae	*Platalea (Platibis) flavipes*	Yellow-billed Spoonbill
Aves	Threskiornithidae	*Threskiornis moluccus*	Australian White Ibis
Aves	Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis
Aves	Turnicidae	*Turnix (Alphaturnia) velox*	Little Button-quail
Aves	Tytonidae	*Tyto javanica*	Eastern Barn Owl
Mammalia	Bovidae	*Capra hircus*	Goat
Mammalia	Dasyuridae	*Sminthopsis crassicaudata*	Fat-tailed Dunnart
Mammalia	Equidae	*Equus (Equus) caballus*	Horse
Mammalia	Felidae	*Felis catus*	Cat
Mammalia	Leporidae	*Oryctolagus cuniculus*	Rabbit
Mammalia	Macropodidae	*Osphranter rufus*	Red Kangaroo
Mammalia	Molossidae	*Austronomus australis*	White-striped Freetail-bat
Mammalia	Muridae	*Mus musculus*	House Mouse
Mammalia	Muridae	*Notomys alexis*	Spinifex Hopping-mouse
Mammalia	Muridae	*Notomys mitchellii*	Mitchell's Hopping-mouse
Reptilia	Agamidae	*Ctenophorus caudicinctus*	Ring-tailed Dragon
Reptilia	Agamidae	*Ctenophorus nuchalis*	Central Netted Dragon
Reptilia	Agamidae	*Ctenophorus ornatus*	Ornate Dragon
Reptilia	Agamidae	*Ctenophorus reticulatus*	Western Netted Dragon
Reptilia	Agamidae	*Ctenophorus scutulatus*	Lozenge-marked Dragon
Reptilia	Diplodactylidae	*Crenadactylus ocellatus*	South-western Clawless Gecko
Reptilia	Diplodactylidae	*Oedura fimbria*	
Reptilia	Diplodactylidae	*Rhynchoedura ornata*	Western Beaked Gecko
Reptilia	Diplodactylidae	*Strophurus strophurus*	Western Spiny-tailed Gecko
Reptilia	Elapidae	*Pseudonaja modesta*	Ringed Brown Snake
Reptilia	Elapidae	*Simoselaps bertholdi*	Jan's Banded Snake
Reptilia	Elapidae	*Suta fasciata*	Rosen's Snake
Reptilia	Gekkonidae	*Gehyra polka*	
Reptilia	Gekkonidae	*Gehyra punctata*	Spotted Dtella
Reptilia	Gekkonidae	*Gehyra variegata*	Tree Dtella
Reptilia	Gekkonidae	*Heteronotia binoei*	Bynoe's Gecko
Reptilia	Pygopodidae	*Delma tincta*	Excitable Delma
Reptilia	Pythonidae	*Antaresia perthensis*	Pygmy Python

Class	Family	Taxon	Vernacular Name
Reptilia	Scincidae	*Ctenotus leonhardii*	Leonhardi's Ctenotus
Reptilia	Scincidae	*Ctenotus mimetes*	Checker-sided Ctenotus
Reptilia	Scincidae	*Ctenotus schomburgkii*	Schomburgk's Ctenotus
Reptilia	Scincidae	*Ctenotus severus*	Stern Ctenotus
Reptilia	Scincidae	*Egernia depressa*	Pygmy Spiny-tailed Skink
Reptilia	Scincidae	*Egernia stokesii*	Stokes' Skink
Reptilia	Scincidae	*Lerista gerrardii*	Bold-striped Robust Slider
Reptilia	Scincidae	*Lerista lineata*	Perth Slider
Reptilia	Scincidae	*Lerista macropisthopus fusciceps*	
Reptilia	Scincidae	*Lerista nichollsi*	Inland Broad-blazed Slider
Reptilia	Scincidae	*Lerista timida*	Timid Slider
Reptilia	Scincidae	*Liopholis striata*	Nocturnal Desert-skink
Reptilia	Scincidae	*Menetia greyii*	Grey's Menetia
Reptilia	Varanidae	*Varanus caudolineatus*	Stripe-tailed Monitor
Reptilia	Varanidae	*Varanus panoptes rubidus*	

APPENDIX G:
EPBC PROTECTED MATTERS SEARCH (40KM BUFFER)

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 05-Feb-2025

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	9
Listed Migratory Species:	6

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	9
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	3
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	2
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
MAMMAL		
Leporillus conditor Wopilkara, Greater Stick-nest Rat [137]	Vulnerable	Species or species habitat may occur within area
REPTILE		
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat known to occur within area
SPIDER		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State
Dalgaranga and Noongal Pastoral Leases	NRS Addition - Gazettal in Progress	WA
Lakeside	National Park	WA
Lakeside Pastoral Lease	NRS Addition - Gazettal in Progress	WA

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Oakajee Rail Development	2010/5500	Controlled Action	Post-Approval
Not controlled action			
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data is available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on the contents of this report.

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions when time permits.

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded breeding sites; and
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

APPENDIX 3

SURFACE WATER ASSESSMENT REPORT (AECOM 2025)

Prepared for
Rumble Resources Ltd
ABN: 74 1482 142 60

Western Queen Surface Water Assessment

12-Jun-2025
Western Queen Dewatering
Doc No. 60745106_ENV_RPT_RevA

aecom.com

Delivering a better world

Western Queen Surface Water Assessment

Client: Rumble Resources Ltd

ABN: 74 1482 142 60

Prepared by

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			Name/Position	Signature
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Executive Summary

Rumble Resources Ltd (Rumble), along with co-operation agreement partners, Bain, and MEGA Resources (MEGA), are proposing to commence mining operations within the Western Queen Mine, located approximately 90km northwest of Mount Magnet in Western Australia.

This surface water flood assessment, inclusive of an excess water discharge wetting front assessment, was completed to support ongoing approvals and water management for the proposed project.

The Western Queen Mine is located at the top of the local catchment just west of a major catchment divide running generally north-south. The area west of the major catchment divide drains to the northwest away from the Project site. The area east of the divide, drains eastward.

Within the local catchment, drainage across the proposed mine site follows a series of poorly defined flow paths that coalesce to the south of Western South (WQS) into a northwest-draining creekline. Catchment areas upstream of the proposed infrastructure are relatively small meaning surface water management infrastructure will have to manage flows from mainly within the Project area.

Key surface water aspects and findings associated with the proposed project include:

Surface Water Management Infrastructure - Operations

Proposed surface water management measures during mining operations include:

- drainage channels to capture runoff and prevent standing water.
- sediment basins to temporarily intercept runoff to minimise the turbidity and release of suspended sediment.
- Flood protection bunds around both Western Queen North (WQN) and WQS pit edges will be required to limit the inflow of additional surface water runoff into the pit.
- In-pit drainage (direct rainfall) will be required to divert surface water runoff into dedicated sumps with pumps to dispose the runoff, potentially to alternative storage facility depending on water quality.
- Storage of abstracted water in a dedicated mine water storage pond suitable of storing two days capacity should be constructed to minimise sediment load (from in-pit sump pumping).
- Given the key risks to surface water are erosion, sedimentation of creeklines and impacts to riverine vegetation downstream, a surface water monitoring programme will be implemented.

Surface Water Management Infrastructure - Closure

At closure, all temporary mine site infrastructure will be removed, and the disturbed development footprints rehabilitated. The only permanent changes in landform are the waste rock dump and the open pit.

Proposed surface water management measures that will remain post-closure include:

- The surface water drainage channels around the southern open pit areas should remain and continue to drain into the sediment ponds. This is recommended to minimise the release of sediment from the newly rehabilitated open pit area and WRDs.
- Key sediment ponds should remain for up to 2 years following closure or until negligible material loss from rehabilitated and revegetated WRD and mine laydown areas is expected. They should then be removed and rehabilitated.
- At closure, the pit will need to be surrounded by an abandonment bund in line with DMIRS requirements. The bund will serve two purposes: maintain flows past the pit to minimise changes to flows and hydroperiods downstream, and the other being to maintain geotechnical integrity by preventing surface water from flowing over the pit crest.
- During the closure phase (typically five to ten years after the end of operations), opportunistic surface water quality testing should continue to support closure-related assessments of rehabilitation compliance.

Discharge to Local Creekline

With a predicted range of WQS groundwater inflows of between 2,300 to 3,200 kL/day, a mine water usage (dust suppression etc) up to about 800 kL/day, a total mine water excess may be up to about 2,400 kL/day over the duration of mining. The equates to a total dewatering volume is predicted to be between about 1,500 kL/day to 2,400 kL/day (up to 1.0 GL/annum) over the anticipated 608 days of mining. Should unforeseen high yielding structural features be encountered during mining, a worst-case dewatering requirement of 5,800 kL/annum has been predicted.

Groundwater salinity in the WQS area has previously been report to average about 2,100 mg/L TDS (maximum 3,700 mg/L TDS) and of high quality (lower salinity) than that measured in other areas within the Western Queen area. With this in mind, excess groundwater is proposed to be discharged to the environment over a duration of up to about 1.7 years.

Surface water modelling was undertaken to assess sensitivity of the predicted wetting front extent with discharge rates. The model was based on a 1:20 year rainfall event and relevant findings from this assessment include:

- Under all simulated discharge rates (1,500 kL/day, 2,400 and 5,800 kL/day), a wetted front generally remains within the low flow channels.
- Under an estimated average discharge rate of 1,500 kL/day (total 0.9 GL), a wetted front extent of about 1.75km is predicted.
- Under an estimated average discharge rate of 2,400 kL/day (total 1.5 GL), a wetted front extent of 2.0km is predicted.
- Under the extreme discharge rate of 5,800 kL/day (total 3.5 GL), should unforeseen higher dewatering rates occur, a maximum wetted front extent of up to about 3.9km is predicted.

The wet weather assessment found that mine water releases do not affect baseline (non-mine-related) flooding conditions. This is because the mine's contribution—0.03 m^3/s (2,400 kL/day)—is negligible compared to the natural baseline flow of 1.75 m^3/s at the release point. Therefore, mine discharges during wet weather are not expected to adversely impact the receiving environment.

The above results are consistent with predictions made for the adjacent Dalgaranga Gold Project by Spartan Resourced Limited, whereby wetting front modelling predicted a broader extent of about 2.5 km and up to about 500m wide for a 2.5 GL/annum (6,800 kL/day) approved discharge rate.

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was engaged by Rumble Resources Ltd (Rumble) to undertake a mine dewatering assessment of the Western Queen Mine, located approximately 90km northwest of Mount Magnet in Western Australia (Figure 1).

Historical mining at the Western Queen was conducted in two pits:

- Western Queen North (WQN) pit was initially undertaken by Western Mining from 1998 until 2002. Mining included open pit and underground workings.
- Western Queen South (WQS) pit was initially undertaken by Harmony Gold Pty Ltd (Harmony) between June and November 2007. During this time, the pit was developed to a depth of approximately 41m below ground level (mbgl). Pit wall instability and water ingress resulted in early closure of WQS which was subsequently placed on care and maintenance. Mining re-commenced between 2011 and 2013 by Ramelius Resources Ltd (Ramelius).

In late-2019, Rumble purchased the historical Western Queen Mine. The site layout is presented on Figure 1. Rumble recently completed several exploration drilling campaigns to develop an updated resource model. To allow Rumble, along with co-operation agreement partners, Bain, and MEGA Resources (MEGA), to commence mining operations within WQS and WQN, a number of technical studies are required to support mining approvals.

This report presents the findings of surface water flood assessment, inclusive of an excess water discharge wetting front assessment, to support ongoing approvals and water management for the proposed project.

1.1 Study Objectives

Based on the recent Department of Mine, Industry Regulation and Safety (DMIRS) mining proposal guidelines (March 2020a), the key requirements for the surface water assessment include:

- A description of the catchment area(s), including a map identifying the project area in relation to the catchment(s).
- A description of the surface hydrology of the project area and potentially affected downstream environment (e.g. ephemeral creeks, permanent creeks/rivers, playa lakes, wetlands, water holes).
- A description of the environmental values and beneficial uses of surface water.
- Details of any surface water management areas that the project intersects or may impact.
- The water quality characteristics of the surface hydrology of the area including salinity and pH.
- A description of the flooding characteristics of the area. Where flooding presents a risk to the environmental management of the proposal (including post-closure), appropriate flood modelling and mapping will be required.

The key objectives of the surface water flood modelling study include:

- Desktop surface water assessment - to establish the hydrology and drainage characteristics of the site.
- Flood modelling - high-level TUFLOW flood modelling to assess changes to surface water drainage and environmental values (if any) as a result of the proposed infrastructure during the baseline, operational and closure phases.
- Drainage infrastructure conceptual designs – identify water management infrastructure that will be required for the project.
- Flood modelling for direct creekline discharge options assessment - undertake high-level flood modelling of identified down-gradient drainage areas to assess implication of proposed creekline discharge options.

A desktop surface water assessment has been undertaken to establish the hydrology and drainage characteristics of the site.

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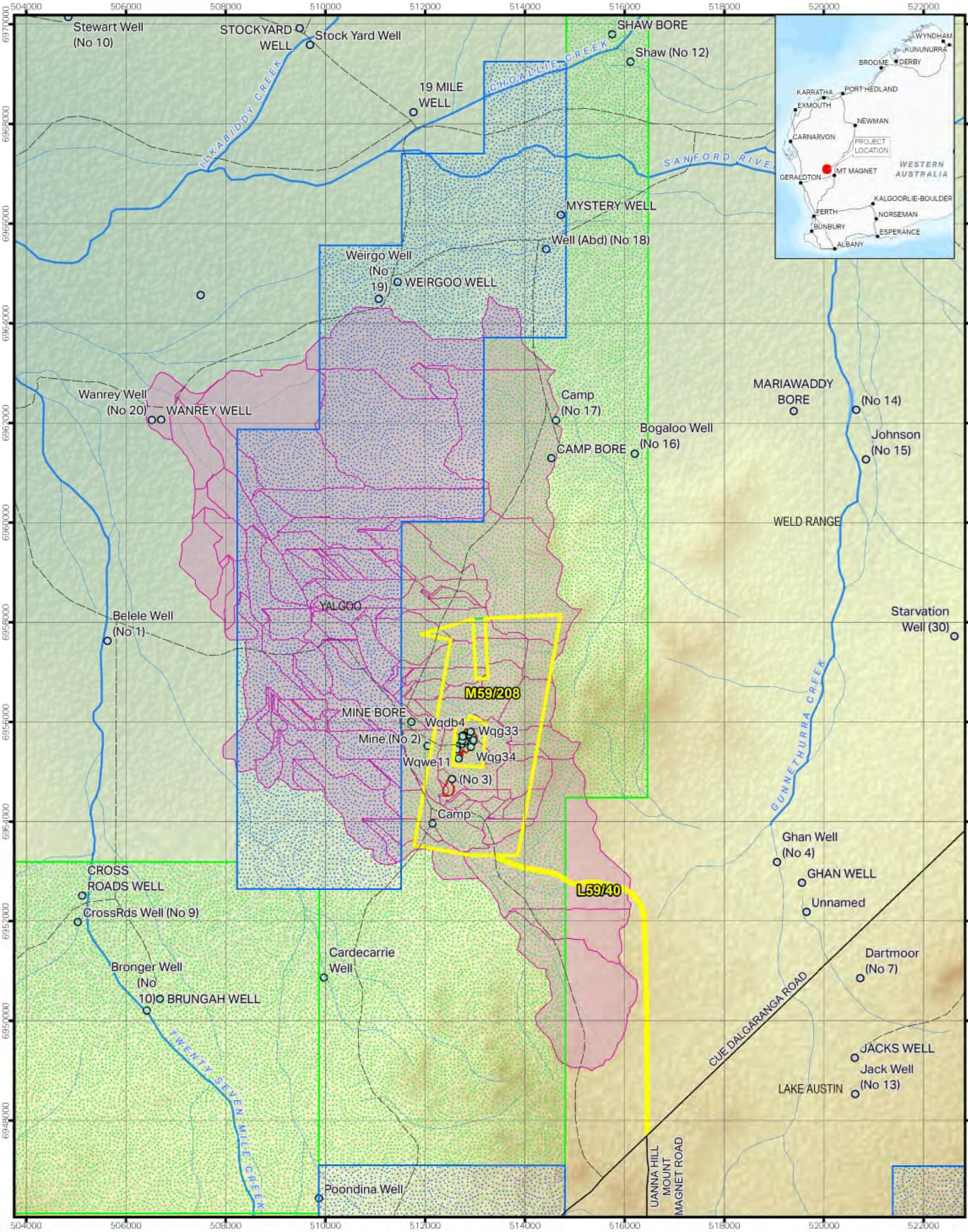

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GDA 1994 MGA ZONE 50

LEGEND

- Existing Pit Outlines
- Western Queen Tenements
- Rumble Resources Tenements
  - Live
  - Pending
- Catchment - Modelled
- Sub-catchment Modelled
- Lakes
- Major Watercourses
- Minor Road
- Track
- Regional Station Bores / Wells
- Elevation (m AHD)
  - 500
  - 300

Locality Plan

WESTERN QUEEN

WESTERN QUEEN SURFACE WATER ASSESSMENT

Figure

1

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2.0 Surface Water Characteristics

The site topography has been based on a LIDAR survey completed in April 2025. This survey data has been used to prepare a drainage map, identifying catchments and drainage lines and identify key surface water environmental values. These include rainfall records of nearest rainfall stations and determine the design rainfall depths for the site.

2.1 Rainfall

The region has a semi-arid climate characterised by low rainfall and a large temperature range. The winter months of May to August typically have the highest and most reliable average rainfall, but intense rainfall can occur periodically in the summer months (Johnson et. al., 1999).

Local climate data is available from the Bureau of Meteorology (BoM) station at nearby Yoweragabbie (Station No. 7095 – BoM, 2025). The average annual rainfall over the past 10 years is 217.5mm (Table 1). The data set indicate the highest rainfalls occur in February and March, while the monthly average is commonly exceeded in January and March. Above-average rainfall years e.g. 2014 to 2018 incorporate more winter months that exceed the averages.

The 50th percentile annual rainfall for the project area taken from the last 10 years of data is about 237mm (Table 2). For context, the annual rainfall for 2022 and 2023 was only 206mm and 152mm, representing extremely (below and just above the 25th percentile) dry years. Rainfall in 2015 and 2021 is the only recent year to have exceeded the 75th percentile.

Table 1 Rainfall Data: Station No. 7095 (BoM, 2025)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	mm												
2014	25	72.6	7	10.8	88.6	3.7	1.3	1.4	16.8	4.2	9	10.3	250.7
2015	29.3	21	149.6	12.6	2.1	12.8	24.4	22.1	0.2	0	21.3	3.4	298.8
2016	29.4	12.3	46.1	11.6	21.1	40.5	38.9	17.7	6.4	5.8	5	15.8	250.6
2017	24.8	117.7	2.9	5.2	1.2	8.3	10.4	27.9	30.6	0	7.5	5.2	241.7
2018	43.4	19.3	15.6	3.1	0	32.4	26.4	16.7	1.8	37.6	44.1	0	240.4
2019	0	0.9	12.2	34.7	0	48.6	10.9	8.3	0	0	0	12	127.6
2020	25.8	44.8	21	0	2.2	12.5	12.5	16.5	0	0	4.2	3.8	143.3
2021	0	61.9	29	5.8	92	14.5	35.5	0	0	16.2	9	0	263.9
2022	0	6	45	18.5	7.5	21.5	9	49	49.5	0	0	0	206
2023	40	0	54	9	3	25	0	17	3	0	1	0	152
Avg.*	**21.77**	**35.65**	**38.24**	**11.13**	**21.77**	**21.98**	**16.93**	**17.66**	**10.83**	**6.38**	**10.11**	**5.05**	**217.5**

Table 2 Monthly Rainfall Data from 1998 – 2023: Yoweragabbie Station No. 7095 (BoM, 2025)

Rainfall Stat	Monthly Rainfall (mm) (BoM, 1998-2023)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
max	160.7	161.2	185.5	194.6	186	122.8	103.2	105.3	100.8	60.2	54.1	112.4	534.6
mean	21.6	23.7	24	18.1	25.8	30.8	27.8	20	10.2	7.1	8.6	13.4	229.2
min	0	0	0	0	0	0	0	0	0	0	0	0	61.1
90^{th} percentile	56	80	79	33	68	48	53	38	29	26	30	46	295
75^{th} percentile	40	43	45	18	25	32	37	22	22	6	14	22	254
50^{th} percentile	25	16	22	8	11	17	14	17	8	3	6	12	237
25^{th} percentile	9	0	6	5	2	10	10	8	3	0	1	3	189
10^{th} percentile	0	0	0	0	1	4	6	3	0	0	0	0	146

2.2 Evaporation

The long-term average monthly evaporation for the Western Queen mine is shown in Table 3. The annual pan evaporation for 2021 was recorded as 2,688mm at Mt Magnet (BoM, 2021). To estimate the evaporation from an open water body (storage / evaporation pond) the pan evaporation is adjusted by a regional pan factor and further adjusted for the salinity of the water. The resulting mean monthly open water evaporation is estimated at 2,121 mm per annum.

Table 3 Long-Term Average Monthly Evaporation (BoM, 2025)

	Monthly Evaporation (mm) (BoM, 2021)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	353	293	8.05	250	180	134	100	103	122	200	275	304	2,688

2.3 Design Rainfall and IFD

For designing water management infrastructure for the site, the BoM recommends the use of the following rainfall Intensity-Frequency-Duration (IFD) relationship (BoM, 2024). The IFD data for the site is shown in Table 4.

Table 4 Intensity-Frequency-Duration of Rainfall at the Western Queen site. (BoM, 2024)

Duration	Depth (mm)						
	63.2% AEP	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
1 hour	13.0	15.6	24.4	31.1	38.4	49.3	58.6
1.5 hour	14.8	17.7	27.8	35.5	43.8	56.3	67.0
2 hour	16.2	19.4	30.4	38.9	48.0	61.8	73.6
3 hour	18.4	22.0	34.5	44.2	54.7	70.5	84.0
4.5 hour	20.9	24.9	39.2	50.4	62.4	80.4	95.9
6 hour	22.8	27.2	43.0	55.2	68.6	88.3	105
9 hour	25.7	30.8	48.7	62.8	78.2	101	120

Duration	Depth (mm)						
	63.2% AEP	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
12 hour	27.9	33.4	53.0	68.5	85.5	110	130
18 hour	31.0	37.2	59.3	76.8	96.1	123	145
24 hour	33.2	39.9	63.7	82.6	103	132	155
30 hour	34.8	41.8	66.9	86.8	109	138	162
36 hour	36.0	43.4	69.4	90.1	113	143	167
48 hour	37.8	45.6	73.0	94.7	119	149	174
72 hour	40.0	48.3	77.3	100.0	125	156	180
96 hour	41.4	50.0	80.0	103	128	159	184
120 hour	42.6	51.5	82.1	105	131	162	186
144 hour	43.7	52.8	84.0	108	133	164	189
168 hour	44.9	54.2	86.0	110	135	167	192

2.4 Surface Water Drainage

The Western Queen Mine is located at the top of the local catchment just west of a major catchment divide running generally north-south. The area west of the major catchment divide drains to the northwest away from the Project site. The area east of the divide, drains eastward. The surface water catchments and drainage lines are shown on Figure 1.

Within the local catchment, drainage across the proposed mine site follows a series of poorly defined flow paths that coalesce to the south of WQS into a northwest-draining creekline. Catchment areas upstream of the proposed infrastructure are relatively small meaning surface water management infrastructure will have to manage flows from mainly within the Project area.

2.5 Potential Surface Water Issues

2.5.1 Potential environmental receptors

Given the Project is located near the uppermost catchment divide, potential surface water receptors are more likely to be located downstream of the proposed project. These receptors may include riverine vegetation that is present in the creekline to the north (WQN) and south (WQS) of the Project. The source of the impact could be the presence of infrastructure that impedes runoff or re-directs it to other parts of the catchment that could change the availability of, or duration that surface water is present downstream. Disturbance of soils within the project footprint could initiate mobilisation of sediment from areas such as the waste rock dump (WRD).

2.5.2 Change in surface water environmental characteristics downstream (flow volumes)

Impact risks associated with changes to downstream flow volumes are considered minimal for the following reasons:

- The disturbed footprint area is small compared to the much larger drainage catchment that drains past the site to the west.
- The only part of the proposed project that will not contribute to surface water runoff are the open pits. The small reduction in runoff is expected to be compensated by the increased runoff from existing and proposed hardstand areas.

- The highly variable rainfall in the area results in a highly variable stream flow (seasonally and annually). The downstream receptors would therefore naturally be exposed to highly variable stream flows. The minimal change in stream flow volumes potentially caused by the proposed project would be indistinguishable downstream.

Over and above, the operational life of the project is only about 2-years. This very short duration means operational impacts are likely to occur within a short 2-seasonal cycle.

2.5.3 Change in surface water quality downstream (sediment load, chemical)

Potential impact sources within the project footprint that could alter the quality of surface water include:

- Disturbed areas where the soil is exposed to channelled runoff due to high local flow velocities. To mitigate this risk, runoff from the mine site will need to be directed to shallow sediment basins, which will be designed following IECA Best Practice Erosion and Sediment Control guidelines. These basins should be shallow enough to optimise sediment settling and facilitate maintenance, while also incorporating adequate storage for both runoff and sediment. Outlets should be designed to safely disperse treated runoff to downstream watercourses in a non-erosive manner.
- Water transferred between WQS and WQN contain salt at concentrations above natural surface water runoff. Similarly, surface water runoff from heavy vehicle refuelling areas may contain hydrocarbons. To minimise the risk to downstream surface water quality these water sources should not be released directly into the environment.
- Groundwater abstracted from WQS contains salt at concentrations similar to regional groundwater and natural surface water runoff. To minimise the risk to downstream surface water quality, groundwater released directly into the environment should be like for like and have minimal sediment loads. Given the short duration of the project, salt accumulated is not expected to be significant.

3.0 Surface Water Flood Modelling

A two-dimensional hydraulic (TUFLOW) model was developed of the site to assess its drainage characteristics. The hydraulic and supporting hydrologic modelling approach is described by the section below.

3.1 Modelling Approach

An outline of the hydrologic (XP-RAFTS) modelling approach used by this project is provided by Table 5.

Table 5 Hydrologic Modelling Approach

Item	Description
Hydrologic Modelling Package	• Catchment SIM (3.61) • XP-RAFTS (2018.3) • Storm Injector (v1.4.0.0)
Catchment Delineation	Shuttle Radar Topography Mission (SRTM) Digital Elevation model (DEM) data and Catchment SIM was used to automatically delineate the XP-RAFTS catchments.
Design Rainfall Depths	BoM 2016 Intensity Frequency Duration (IFD) depths provided in Table 4 adjusted to present day (2025) rainfall conditions using Australian Rainfall and Runoff (ARR) Version 4.2 Shared Socioeconomic Pathways (SSP) 4.5 climate change adjustment factors.
Temporal Pattern Approach	ARR Version 4.2 ensemble temporal pattern approach with filtering to removed embedded bursts.
Temporal Pattern Selection	• Critical duration: the critical duration of each AEP design event is the duration that results in the highest peak flood condition level of the associated temporal pattern ensembles. • Critical temporal pattern: the temporal pattern that results in a peak flood condition level closest to the median flood condition level at the project area.
Areal Reduction Factor (ARF)	ARF = 1
Pre-burst Rainfall	Median pre-burst depths.
Losses	• Initial Loss (IL): 40 mm • Continuous Loss (CL): 3 mm/hour
Design Events	1% AEP (1 in 100-year event)

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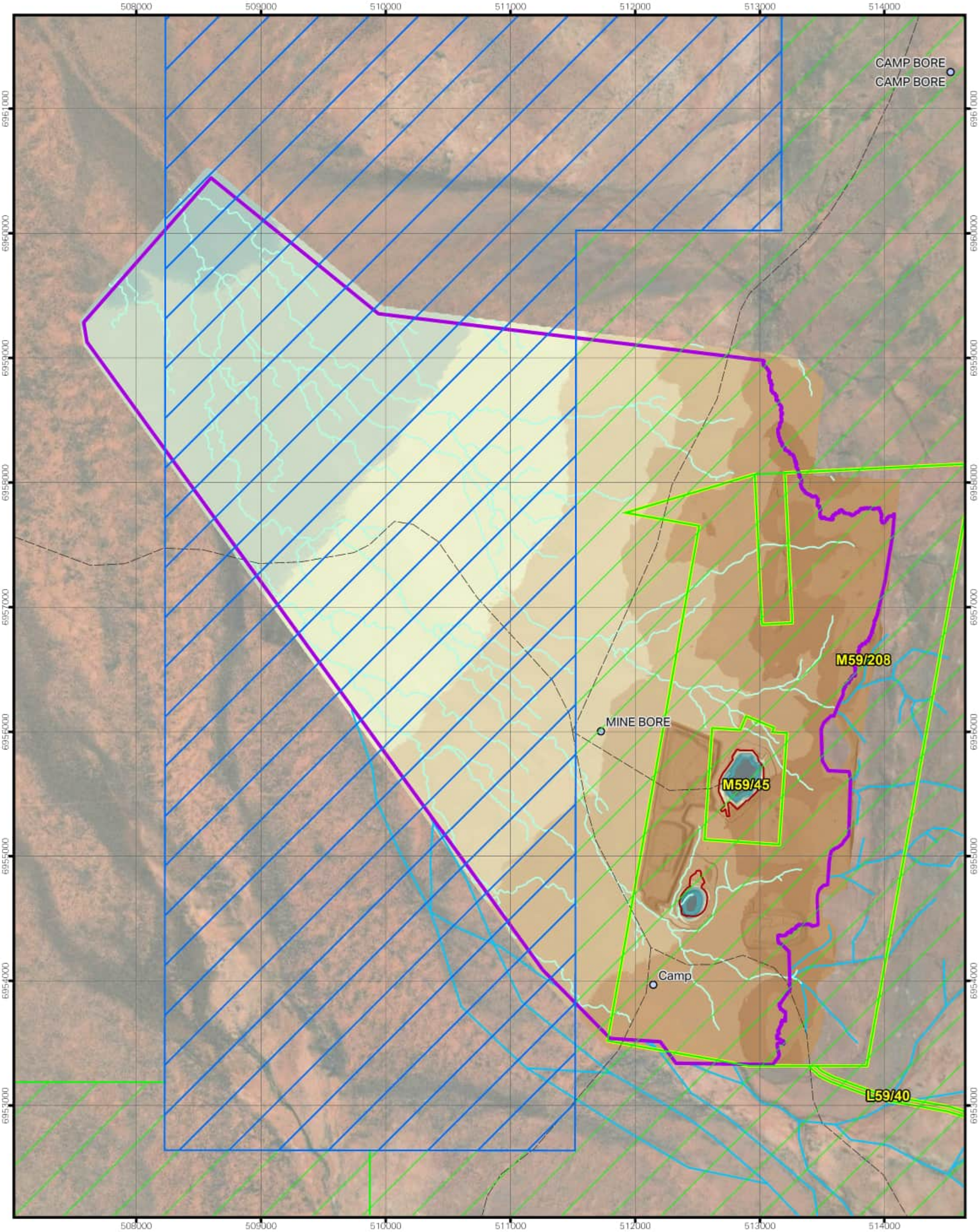

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GDA 1994 MGA ZONE 50

LEGEND
Existing Pit Outlines
Western Queen Tenements
Rumble Resources Tenements
Live
Pending
TUFLOW Model Area
Regional Station Bores / Wells
Drainage Lines
Modelled Drainage Lines
Track
Elevation (m AHD)
352 - 360
360.1 - 365
365.1 - 370
370.1 - 375
375.1 - 380
380.1 - 385
385.1 - 390
390.1 - 395
395.1 - 400
> 400

TUFLOW Model Domain

WESTERN QUEEN

WESTERN QUEEN SURFACE WATER ASSESSMENT

Figure 2

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An outline of the hydraulic (TUFLOW) modelling approach used by this project is provided by Table 6.

Table 6 TUFLOW Modelling Approach

Item	Description
Hydraulic analysis Approach	• TUFLOW HPC (2025-0-0) • 3 metre cell resolution
Model Extent	The model domain covers the area shown by Figure 2.
Terrain Models	Client supplied LASer (LAS) drone survey data processed into a 0.5 metre DEM using Global Mapper Geographical Information System (GIS) software.
Manning's n	**Manning's n Coefficients:** • Savannah (woodland): 0.068 • Savannah (grassland): 0.065
Boundary Conditions	**Inflow Boundaries** • A Rain-On-Grid (ROG) approach was adopted for all catchment areas within the TUFLOW model. • External model inflows from Storm Injector were applied using a single TUFLOW flow versus time (QT) type boundary at the upstream (northwestern) end of the TUFLOW model. **Outflow Boundaries** • TUFLOW automatically calculated Head versus Flow (HQ) boundary conditions were applied for all model inflows.
Design Event Simulation	All ARR 2019 ensemble point temporal patterns for all storm durations from 1 hour to 12 hours.
Design Event Simulation	1% AEP

3.2 Modelling Results

Peak 1% AEP depths and velocities at the Site are presented on Figure 3 and Figure 4.

Key observations show:

Western Queen North Pit (combined Duke, existing WQN and Princess):

- There is a drainage line running west towards the pit from the east, through the proposed Duke deposit area.
- An existing flow diversion bund directs water in the drainage line around the north of the existing pit in a north-westerly direction before the diverted flow rejoins the original drainage line further east.
- Depths within the diverted section of the drainage line range from 0.1 m to 1.0 m, with an average depth of 0.4 m.
- Velocities within the diverted extent of the drainage line range from 0.3 m/s to 1.1 m/s, with an average velocity of 0.7 m/s.

Western Queen South Pit:

- The pit is located near the confluence of three drainage lines.

- Flow in the northeastern drainage line is diverted southwest around the pit by an existing diversion bund, where it intersects the other two drainage lines. Depths within the diverted section of the drainage line range from 0.1 m to 0.9 m, with an average depth of 0.6 m. Velocities within the diverted extent of the drainage line range from 0.2 m/s to 1.2 m/s, with an average velocity of 0.6 m/s.
- Flow in the drainage line directly south of the pit is not contained within well-defined channels. Instead, water discharges northward toward the pit as broad (~550 m wide), shallow sheet flow, with an average depth of 0.1 m and velocity of 0.2 m/s.
- Runoff trapped within the diversion bund flows to a low point located between the waste dump and the southwestern boundary of the pit.

Cranes Pit:

- The pit is located in the top of the catchment with no apparent local drainage features.
- A drainage line located about 220 m south reports shallow sheet flow, with an average depth of 0.2 m and velocity of about 0.7 m/s.

Haul Road Access:

- There is a drainage line running west towards the existing WQN pit from the east, cutting across the proposed haul road, nearby the northwest corner of the proposed eastern waste dump.
- Predicted flood depths range up to about 0.7 m with a predicted velocity up to about 1.1 m/sec.
- To the south of WQS, the haul road crosses a mine drainage line with predicted flood depths of up to 0.4 m and a predicted velocity of up to 0.6 m/sec.

Proposed Magazine Area:

- The small drainage line running west towards the existing WQN pit from the east, runs just north of the proposed Magazine area.
- Predicted flood depths along the proposed access track range up to about 0.6 m with a predicted velocity up to about 1.3 m/sec.
- An area in the north-eastern corner of the proposed area reports a predicted flood depths up to about 0.2 m with a predicted velocity of about of <0.5 m/sec.

Proposed ROM Area:

- A main westerly flowing broad drainage line, located south of the existing WQS pit, cuts across the proposed ROM area.
- Predicted flood depths range up to about 0.5 m with a predicted velocity up to about 0.6 m/sec.

Proposed Office area:

- No drainage lines are apparent in the proposed office area.

A comparison between the proposed extensions of Western Queen North and South pit layouts and the baseline hydraulic modelling results highlights the need to extend the existing flow diversion bunds. Conceptual surface water management infrastructure that should be considered during operations and post-closure are presented in the following sections.

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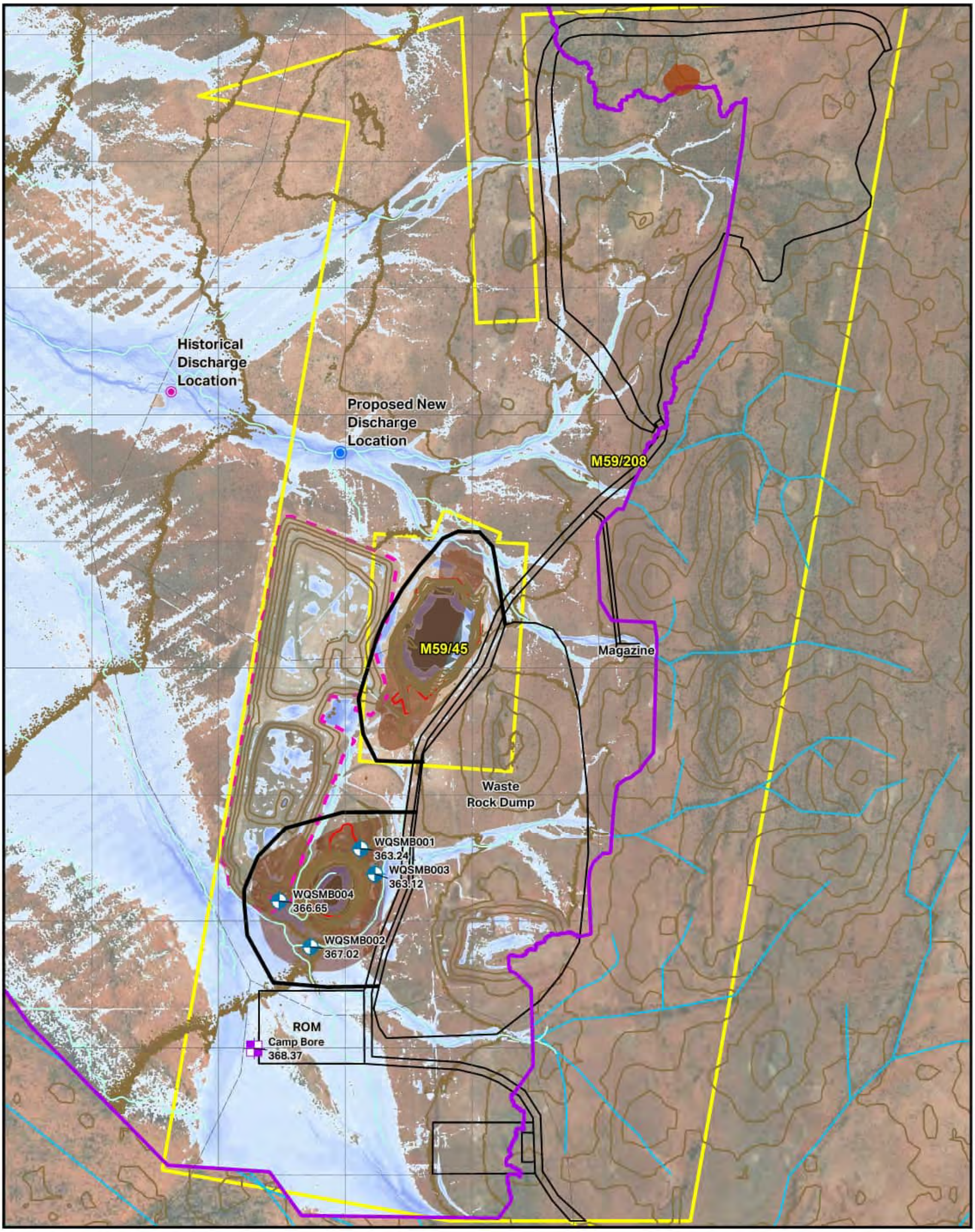

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0 100 200 300 400 metres

GDA 1994 MGA ZONE 50

LEGEND

- Western Queen Tenements
- Existing Pit Outline
- Proposed Pit
- TUFLOW Model Area
- Proposed Site Layout
- Existing Waste Dump
- Drainage Lines
- Modelled Drainage Lines
- Contours

Depth (m)

- < 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- > 2.0

- Monitoring Bore
- Production Bore
- Historical Discharge Location
- Proposed New Discharge Location

Peak 1 Percent Annual Exceedance Probability (AEP) Depth

WESTERN QUEEN

WESTERN QUEEN SURFACE WATER ASSESSMENT

Figure 3

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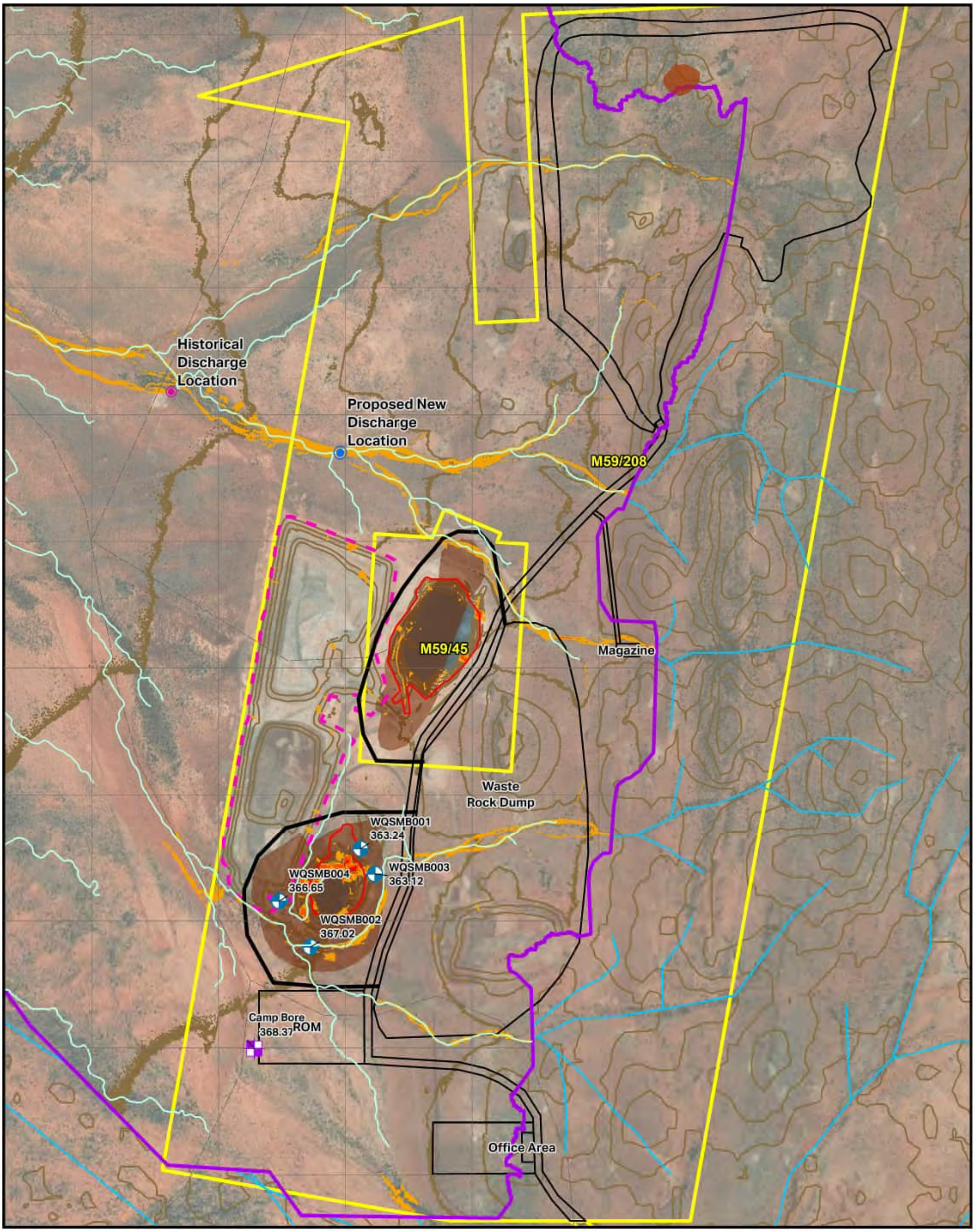

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LEGEND

- Western Queen Tenements
- Existing Pit Outline
- Proposed Pit
- TUFLOW Model Area
- Proposed Site Layout
- Existing Waste Dump
- Drainage Lines
- Modelled Drainage Lines
- Contours

Surface Water Flood Model: Velocities (m/s)

- < 1
- 1 - 2
- > 2

- Monitoring Bore
- Production Bore
- Historical Discharge Location
- Proposed New Discharge Location

Peak 1 Percent Annual Exceedance Probability (AEP) Velocity

WESTERN QUEEN

WESTERN QUEEN SURFACE WATER ASSESSMENT

Figure 4

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4.0 Surface Water Management – Operations

4.1 Surface water management infrastructure

Proposed surface water management measures during mining operations are shown on Figure 5. These measures include:

- drainage channels to capture runoff and safely disperse it downstream.
- sediment basins to temporarily intercept runoff to minimise the turbidity and release of suspended sediment.
- diversion bunds to redirect runoff around infrastructure such as the open pit and WRD.
- capture and removal of rainfall within the open pit.

4.2 Diversion bund

A diversion bund is proposed around both the WQN and WQS open pits using the existing western WRD and the eastern WRD as shown on Figure 5 his bund should be constructed to minimise the risk of overtopping the pit crest for the safety of mine workers and geotechnical stability of the pit walls. The designs of these structures should consider closure requirements as detailed in Section 5.0.

4.3 Drainage channels

To minimise runoff-related changes to the catchment hydrology, a network of drainage channels is recommended to capture runoff from hard stand areas.

Toe drains around the waste rock dumps and mine laydown and workshop areas are recommended to collect and divert runoff that may carry high sediment loads. These toe drains should redirect this runoff to sediment basins (Figure 5).

The open pit intersects a natural drainage line and will block the flow of this natural channel. To divert the flow in the natural creek a surface water runoff diversion bund and drain is required around the southern corner of the open pit. This diversion bund and channel would need to be designed to carry the natural flow of the creek for at least a 20yr or higher rainfall event. The location and natural ground profile along the diversion channel are shown on Figure 5.

The flood modelling for the 100yr AEP, 1-hour event simulated the maximum water depths and maximum flow velocities at the natural drainage channels intersecting with the surface water diversion drain around the south-eastern corner of the WRD.

The results show that even for a 100yr AEP, 1-hour event the maximum water depth is a maximum of 0.43 m. This means that a relatively shallow by wide diversion channel would be the appropriate design. The simulated stream flow velocities at these locations are less than 1m/s. which means that anticipated stream flow velocities in the diversion channel are likely to be the same. Streamflow velocities of less than 1m/s do not have enough stream power to be erosive, therefore the channel does not require to be lined to prevent erosion.

4.4 Sediment ponds

Recommended locations of the sediment ponds are shown on Figure 5 These are located immediately downstream of disturbed areas and are intended to temporarily contain runoff that may contain elevated sediment.

Typically, the sediment ponds are sized to contain the first flush component of a rainfall event with a retention time of about 3 days. This retention time will allow any sediment to settle in the pond before water can be released into the downstream environment.

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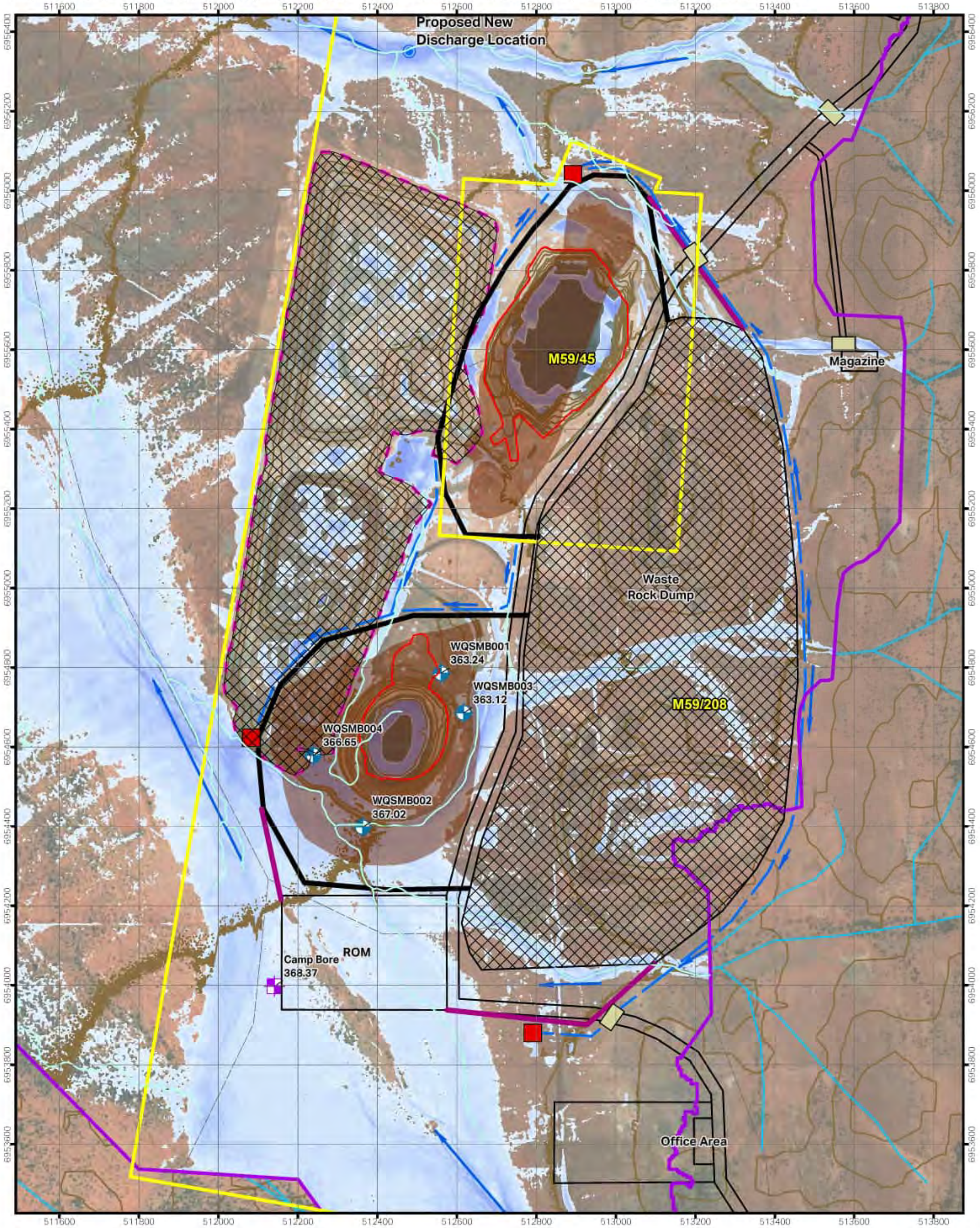

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LEGEND

- Western Queen Tenements
- Existing Pit Outline
- TUFLOW Model Area
- Proposed Site Layout
- Existing Waste Dump
- Waste Roack Dump
- Drainage Lines
- Modelled Drainage Lines
- Monitoring Bore
- Production Bore
- Proposed New Discharge Location
- Contours
- Surface Water Drainage Culvert
- Surface Water Runoff Detention and Sediment Pond
- SW Drainage Channel
- SW Drainage Flow Direction
- Flood Protection Bund

Flood Depth (m)

- < 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- > 2.0

Conceptual Drainage Design: Operations

WESTERN QUEEN

WESTERN QUEEN SURFACE WATER ASSESSMENT

Figure 5

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The runoff from small runoff events would be retained in the sediment ponds and evaporate. Under these conditions, all surface flows will be retained in disturbed areas.

4.5 Direct rainfall on the Pit

Direct rainfall in the pit will runoff from the pit walls, ramps and floor and collected in a pit sump. The pit sump should be designed to be able to contain runoff to minimise delays to the mining schedule. The location of the sump should be carefully planned to allow access of a sump pump and discharge pipeline to proposed tanks or turkey's nest. As the sump will be a temporary structure during the operational phase, temporary in-pit drains may be required to direct runoff across the pit floor.

4.6 Surface water quality

Rainfall and surface water runoff are infrequent and, depending on the season, highly variable. The primary mechanism to manage surface water quality is to temporarily intercept runoff with sediment basins. The intent of these basins is to minimise the transportation of sediment from disturbed areas.

To minimise risks associated with leaks and spills of hydrocarbons, areas such as vehicle refuelling tanks, transfer areas and workshops should be bunded in line with current DMIRS regulations.

Leaks and spills of fuels or any other potentially contaminating substances should be minimised by implementing a hazardous materials management plan, which should be developed to comply with DMIRS and the Department of Water and Environmental Regulation (DWER) regulations.

4.7 Surface water monitoring

Given the key risks to surface water are erosion, sedimentation of creeklines and impacts to riverine vegetation downstream, the following monitoring programme is recommended:

- Undertake monthly visual observations of all drainage channels, diversion bunds and sediment basins to ensure they remain clear and are functioning as designed.
- Undertake monthly visual inspections of vegetation downstream to identify if it is being affected by runoff from the project site. If this occurs, undertake an assessment of the affected vegetation to determine if the change is significant and whether the surface water infrastructure needs to be modified to minimise further impact.
- Undertake monitoring, sampling and analyses as specified in Table 7. This programme should commence before construction starts to obtain data on the ambient quality of surface water in the area.

Table 7 Recommended Surface Water Monitoring Programme

Sites	Parameter Type	Parameters to be Measured	Frequency
Surface Water Quality Monitoring Points	Quality (field)	pH, EC, TDS, temperature	Opportunistic
	Surface Water Quality (laboratory)	**Physicochemical:** pH, EC, TSS, TDS, total acidity, total alkalinity, hardness **Major ions:** Na, K, Ca, Mg, HCO_3, CO_3, Cl, SO_4, NO_3, total nitrogen **Total & dissolved trace metals/ metalloids:** Al, As, Cd, Cr, Cu, Fe, Hg, Pb, Mn, Ni, Se and Zn	Opportunistic

Because of the short duration of the proposed Project, the results of the above monitoring programme should be reviewed as the results become available. The results should be incorporated into the annual environmental report in line with DMIRS requirements.

4.1 Recommendations

Further design development is recommended to refine the high-level conceptual design, with particular focus on:

- Geotechnical assessment of the bund to confirm stability and reduce the risk of settlement or structural failure.
- Provision of adequate freeboard to ensure the bund maintains a safe height margin above the design flood level.
- Incorporation of a new sediment basin within the bunded area to treat potentially sediment-laden runoff prior to discharge to the receiving environment.
- Design of internal drainage within the bund to direct surface runoff away from the pit and toward the sediment basin.
- Refinement of the alignment and geometry of the diversion drain to maintain discharge flow conditions similar to baseline levels.
- Application of appropriate surface treatments along the diversion drain to prevent erosion and minimise sediment transport to the receiving environment.

5.0 Surface Water Management – Closure

5.1 Surface water management infrastructure

At closure, all temporary mine site infrastructure will be removed, and the disturbed development footprints rehabilitated. The only permanent changes in landform are the waste rock dump and the open pit.

5.2 Drainage channels

The surface water drainage channels around the southern open pit areas should remain and continue to drain into the sediment ponds. This is recommended to minimise the release of sediment from the newly rehabilitated open pit area and WRDs. The designs of these channels should direct the first-flush runoff to the sediment basins. These drains may need to be cleared after the first few years during which the rehabilitated surface is undergoing revegetation.

The surface water diversion drain around the operational mine laydown areas may need to remain a permanent diversion of the reinstated upstream catchment area. The closure design of the diversion channels may well differ from the operational design as the operational stage of the project is less than three-years and the closure design will need to be sustainable for much longer into the future.

5.3 Sediment ponds

The location of the sediment ponds is shown Figure 6. Recommendations in relation to sediment basins after closure include:

- A basin next to the eastern WRD that should remain for up to 2 years following closure or until negligible material loss from WRD is expected. They may need to be cleaned out after the first few years as they will capture more sediment-laden runoff during and immediately after the WRD is capped. Following this period, they can be removed and rehabilitated.
- The sediment basin down-stream of the open pit area should remain for up to 2 years following closure or until negligible material loss from rehabilitated and revegetated area is expected.
- One basin downstream (north) of the infrastructure area. This basin should remain active for up to 2 years during the closure phase to intercept most of the sediment from the newly rehabilitated surface. Minor changes may be required to allow this basin to function effectively once the drainage channels have been rehabilitated. The basins may need to be cleaned-out a few years into closure to ensure they continue to operate as designed. At the end of the closure phase, this basin could also be rehabilitated if required to meet closure criteria linked to the post closure hydrology.

5.4 Abandonment bund

At closure, the pit will need to be surrounded by an abandonment bund in line with DMIRS requirements. The bund will serve two purposes: maintain flows past the pit to minimise changes to flows and hydroperiods downstream, and the other being to maintain geotechnical integrity by preventing surface water from flowing over the pit crest. The bund design should incorporate erosion-resistant characteristics to ensure they remain in place and functional during the post-closure phase. This will mainly apply to the bund around the southern side of the pit where velocities are likely to remain higher than baseline. Typically, erosion is minimised by selecting durable waste rock to armour the bund, possibly in conjunction with widening the diversion channel to lower the channel velocity.

5.5 Surface water quality

After closure all potentially contaminating materials must be removed from the site or relocated to an approved repository. This may include soils that contain residues from former hydrocarbon storage and transfer areas, chemical storage sites and former ore stockpile areas. Due to the short duration of the proposed Project, this should be largely avoidable if comprehensive preventative measures are implemented, and monitored, and unplanned leaks and spills are carefully managed.

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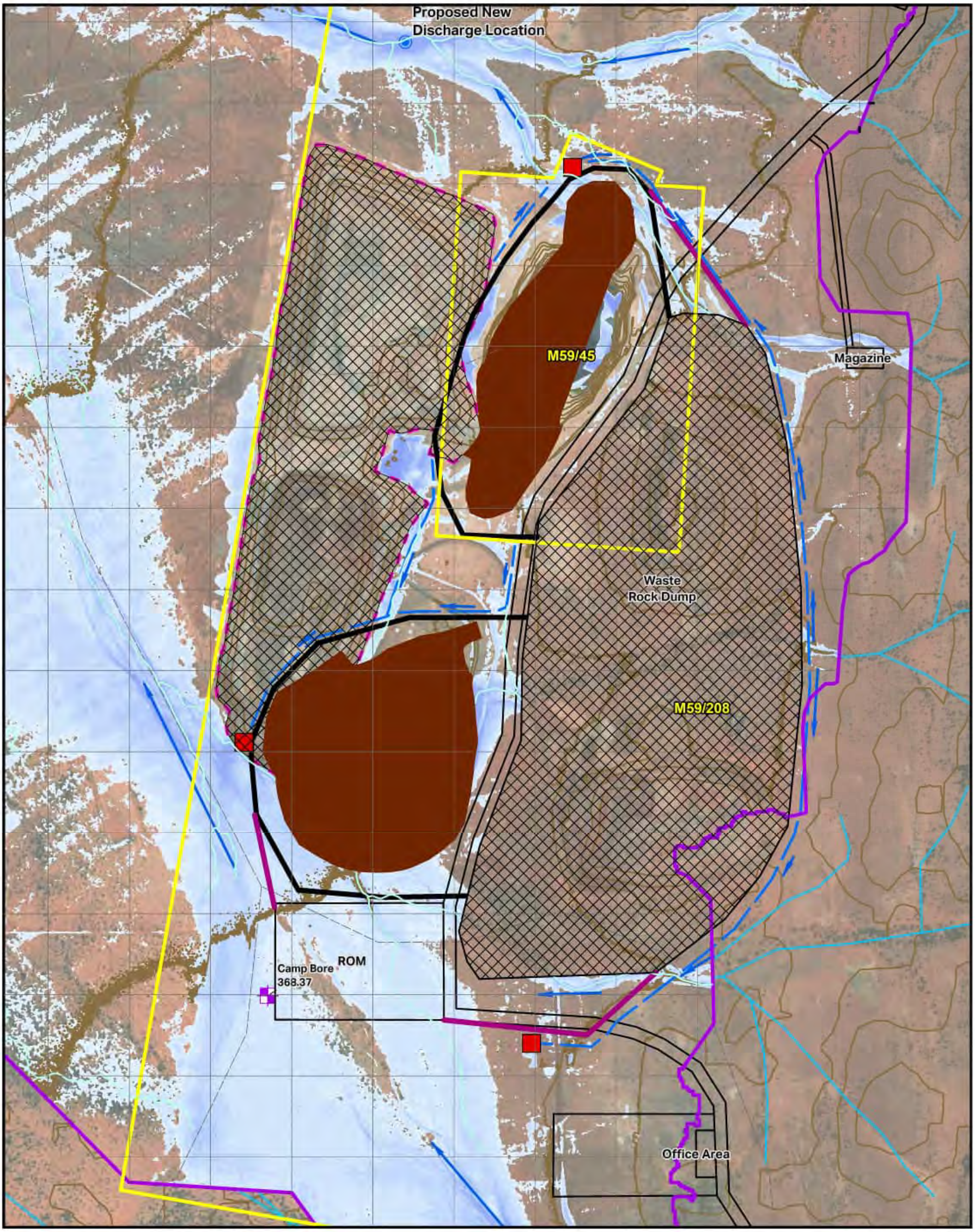

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metres
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LEGEND
- Western Queen Tenements
- TUFLOW Model Area
- Proposed Site Layout
- Existing Waste Dump
- Waste Roack Dump
- Drainage Lines
- Modelled Drainage Lines
- Production Bore
- Proposed New Discharge Location
- Contours
- Surface Water Runoff Detention and Sediment Pond
- SW Drainage Channel
- SW Drainage Flow Direction
- Flood Protection Bund

Flood Depth (m)
- < 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- > 2.0

Conceptual Drainage Design: Closure

WESTERN QUEEN

WESTERN QUEEN SURFACE WATER ASSESSMENT

Figure
6

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With the inclusion of the WRD toe drains and sediment traps around the WRD and north of the former infrastructure area, surface water quality downstream is unlikely to be adversely affected after closure. However, this will need to be demonstrated by monitoring before, during and after the operational phase and adapting closure designs to meet agreed closure outcomes.

5.6 Surface water monitoring

During the closure phase (typically five to ten years after the end of operations) the observations outlined in the monitoring programme in Section 4.7 should continue but at six-monthly frequency. Opportunistic surface water quality testing should continue to support closure-related assessments of rehabilitation compliance.

6.0 Discharge to Local Creekline

6.1 Excess Mine Water Rates and Water Quality

Mining below the water table requires a mine dewatering plan or strategy that supports the capture and removal of groundwater (and surface water) inflows to facilitate dry mining conditions in active areas. With a predicted range of WQS groundwater inflows of between 2,300 to 3,200 kL/day, a mine water usage (dust suppression etc) up to about 800 kL/day, a total mine water excess may be up to about 2,400 kL/day over the duration of mining. The equates to a total dewatering volume is predicted to be between about 1,500 kL/day to 2,400 kL/day (up to 1 GL/annum) over the anticipated 608 days of mining.

Groundwater salinity in the WQS area has previously been report to average about 2,100 mg/L TDS (maximum 3,700 mg/L TDS) and of high quality (lower salinity) than that measured in other areas within the Western Queen areas. With this in mind, excess groundwater is proposed to be discharged to the environment over a duration of up to about 1.7 years.

As a result of mine dewatering, predicted drawdown may propagate up to 2 km from the WQS open pit. To assist mitigation of the drawdown impacts, and allow for management of mine water, it is proposed to discharge excess water to a local creekline (indicative location 511,813mE, 6,956,590mN) within the drawdown capture zone.

Importantly, prior to discharge, all abstracted water will require retention within a suitably designed transfer pond to minimise sediment loads. Minimising sediment where possible can also be achieved through abstraction from production bores rather than pit floor sump pumping. Minimising erosion at the outfall location will also be a requirement.

6.2 Flora and Vegetation Survey

A recent vegetation and fauna survey (Botanica, 2025) reported the proposed discharge area is comprised of the Jundee landscape system that is described as hardpan plains with variable mantles and minor sandy banks supporting weakly banded mulga scrublands. The survey did not identify any significant vegetation assemblages and concluded there was a low risk of potential terrestrial groundwater dependent ecosystems (GDE). Vegetation condition was reported as good (*low levels of grazing or slightly aggressive weeds*) within narrow creek channels to degraded (*severely impacted by grazing, and very frequent fires*) within the floodplain areas. Further down-gradient of the historical discharge location (about 2km distance), the vegetation condition was reported as very good (*some relatively slight signs of damage caused by human activities*). The closest station well, Wanrey Well, is about 7 km northwest of the proposed outfall location.

6.3 Wetting Front Modelling

To assess the footprint length and surface water expression (wetting front) arising from discharge of water to a local creek with discharging up to 1.5 GL/annum over the duration of the project, the projects developed steady state TuFlow surface water flood model was used. This modelling approach uses Manning's equation to estimate wetted perimeter, top width, velocity, and water depth and is considered a standard technique to estimate change in water level and water surface area associated with changes in discharge.

Importantly, this model down not consider groundwater and surface water interactions, and subsequent recharge to deeper aquifers, and loss through evapo-transpiration. The model results therefore like provide a worst-case scenario in terms of predicted wetting front extent.

With the above in mind, the change on the receiving environment associated with the proposed environmental discharge was evaluated for a dry weather case, where there is no rainfall, and a wet weather case, where there is runoff in the drainage lines.

Key assessment parameters are presented in Table 8.

Table 8 Creek Discharge Assessment Parameters

Parameter	TUFLOW Modelling Approach	Values	
		Dry Weather	Wet Weather
Discharge Location	Located northwest of Western Queen North at an ephemeral stream (512,480mE, 6,956,350mN).		
Discharge Rates	TUFLOW QT Boundary	1,500 kL/day (lower-case) 2,400 kL/day (likely-case) 5,800 kL/day (peak dewatering discharge)	
Design Storm Event	As per section 3.1.	N/A	20% AEP (~1 in 5 year)
Infiltration	TUFLOW initial and continuing infiltration soil loss	0.1 m/day (±0.05 to 0.20 m/day)	Evaporation effects assumed negligible due to saturated soil conditions.
Wetting front cutoff depth	Filtered in GIS.	0.05 m	0.05 m (default for rain-on-grid filtering)
Evaporation	Result adjustment applied in GIS.	Summer (Jan): 23.2 mm/day Winter (Jul): 7.8 mm/day	Evaporation effects assumed negligible.
Groundwater Level	Not modelled.	Estimated groundwater table ~15 m below natural ground level; considered deep enough to not influence surface water dynamics.	

6.4 Model Results

The downstream extent of surface water exposure from the creek discharge assessment under various wet and dry weather conditions in context with vegetation condition reported from the 2025 survey is presented on Figure 7. The recent vegetation and fauna survey (Botanica, 2025) at the Western Queen project area did not identify any significant vegetation assemblages and there is a low risk of potential terrestrial groundwater dependent ecosystems (GDE) in the adjacent floodplain areas. The closest station well, Wanrey Well, is about 7 km northwest and down-gradient of the proposed outfall location.

Modelling results show the formation of disconnected ponded areas within the ephemeral stream, with increasing separation from the release point. This discontinuous ponding pattern reflects a limitation of the TUFLOW modelling approach, whereby evaporation and wetting front conditions are assessed post-simulation rather than dynamically.

Accordingly, the delineation of visible discharge extent downstream of the release point has been based on the observed maximum spacing between discrete ponded areas. A separation distance greater than 150 metres, with a continued divergence, has been adopted as the threshold beyond which surface discharge is considered no longer evident.

Surface water modelling was undertaken to assess sensitivity of the predicted wetting front extent with discharge rates. The model was based on a 1:20 year rainfall event and relevant findings from this assessment include:

- Under all simulated discharge rates (1,500 kL/day, 2,400 and 5,800 kL/day), a wetted front generally remains within the low flow channels.
- Under an estimated average discharge rate of 1,500 kL/day (total 0.9 GL), a wetted front extent of about 1.75km is predicted.
- Under an estimated average discharge rate of 2,400 kL/day (total 1.5 GL), a wetted front extent of 2.0km is predicted.

- Under the extreme discharge rate of 5,800 kL/day (total 3.5 GL), should unforeseen higher dewatering rates occur, a maximum wetted front extent of up to about 3.9km is predicted.

The wet weather assessment found that mine water releases do not affect baseline (non-mine-related) flooding conditions. This is because the mine's contribution—0.03 m^3/s (2,400 kL/day)—is negligible compared to the natural baseline flow of 1.75 m^3/s at the release point. Therefore, mine discharges during wet weather are not expected to adversely impact the receiving environment.

The above results are consistent with predictions made for the adjacent Dalgaranga Gold Project by Spartan Resourced Limited, whereby wetting front modelling predicted a broader extent of about 2.5 km and up to about 500m wide for a 2.5 GL/annum (6,800 kL/day) approved discharge rate.

6.5 Risk Assessment

Risks of discharging excess water to the environment from the Western Queen mine to allow mining ore was reviewed in accordance with the potential source, pathway, and impact to receptors guideline (DWER 2020b).

Groundwater salinity in the WQS area has previously been reported to average about 2,100 mg/L TDS (between 1,050 mg/L TDS and 3,700 mg/L TDS) and is of higher quality (lower salinity) than that measured in other areas within the Western Queen areas. With this in mind, excess groundwater is proposed to be discharged to the environment over a duration of up to about 1.7 years.

Proposed operational control are provided in Table 10.

Table 9 Proposed Surface Water Related Controls

Emission	Source	Potential Pathway	Proposed Controls
Excess mine water	Discharge of excess mine water dewatered from the Western Queen pits to allow mining of ore	Direct discharge to land – overland run-off	Undertaken monitoring of vegetation health within the discharge wetting front.
			Transfer pond use to mitigate sediment loads prior to discharge.
		Discharge to land via pipeline – unforeseen pipeline ruptures	Use of high-density polyethylene (HPDE) pipeline. Flow meters installed at these start of the pipeline and at the outfall location to allow reconciliation of flow rates and leak detection.
		Erosion at the discharge point	Outfall designed to reduce velocity of flows and prevent erosion.

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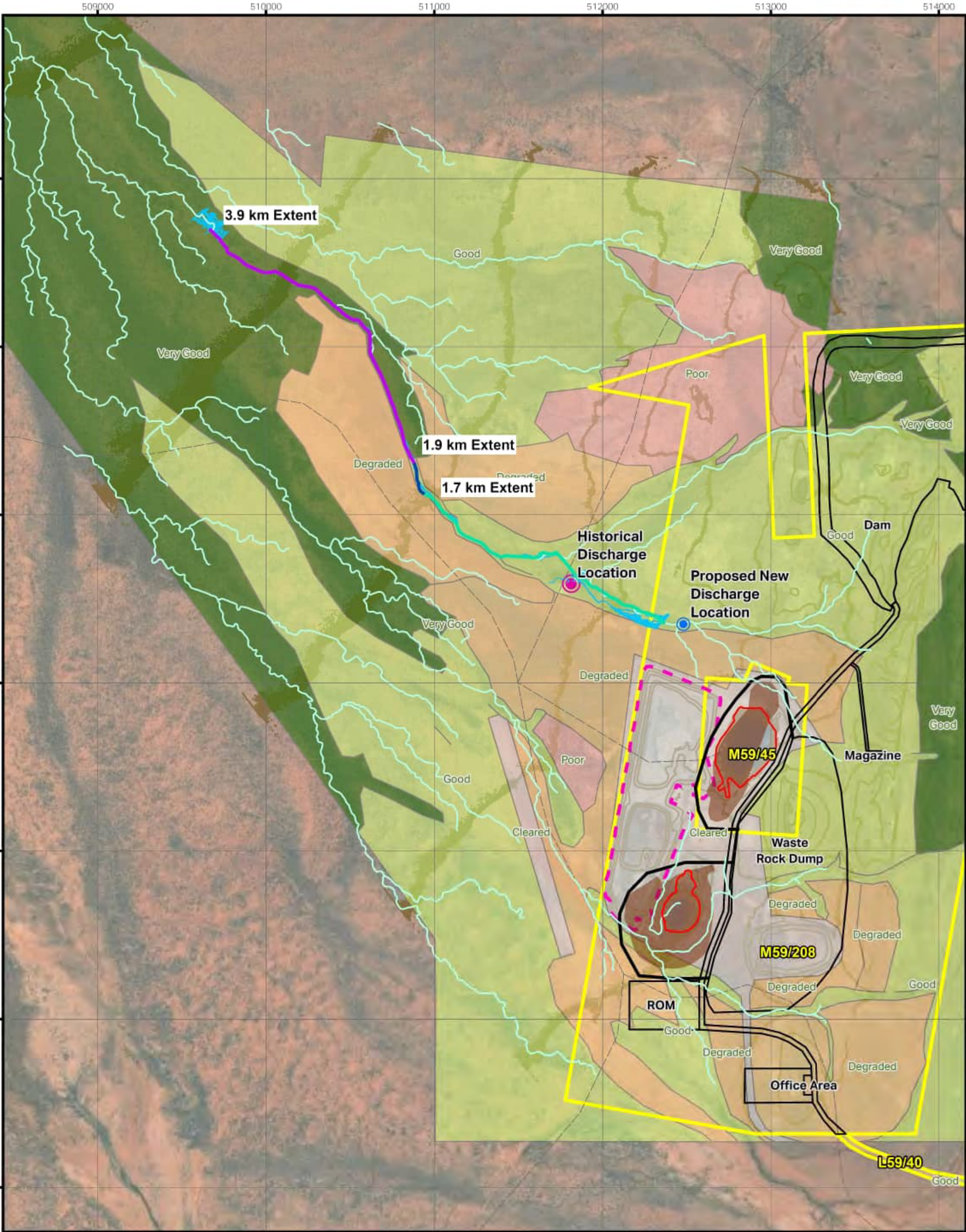

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metres
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LEGEND

- Western Queen Tenements
- Existing Pit Outline
- Proposed Pit
- Proposed Site Layout
- Existing Waste Dump
- Contours
- Modelled Flow Areas
- Winter 5800 kl/day Extent
- Winter 2400 kl/day Extent
- Winter 1500 kl/day Extent

Vegetation Condition
- Very Good
- Good
- Degraded
- Poor
- Cleared

Conceptual Creek Discharge

WESTERN QUEEN

WESTERN QUEEN SURFACE WATER ASSESSMENT

Figure 7

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6.6 Outfall Conceptual Design Options

A key consideration for the proposed excess mine water discharge is to minimise erosion at the discharge point. With the proposed discharge flow rates up to 2,400 kL/day or about 30 L/sec in mind, a number of initial conceptual erosion prevention options include (but not limited too):

- **Gravel lined (riprap) channel** - Riprap is used to stabilise areas with high erosive power by increasing surface roughness and slowing the velocity of runoff. Riprap is a permanent layer of large, angular stone, or boulders typically used to stabilise, and protect the soil surface against erosion and scour in areas of concentrated flow.

Plate 1 Gravel Lined Outfall/ Channel

- **Soak Wells** – gravel filled soak wells can provide an alternative option for minimising erosion at the discharge locations.

Plate 2 Soak Well Installation

- **Engineered outfall tank** – designed to reduce the flow velocity from a single pipeline and an allowance for the water to spread across over conveyor belt or similar material to prevent local erosion.

Plate 3 Engineering Outfall Tank

6.7 Operational Monitoring

No hydrologic model formulation can be entirely validated without comparison with field observations. After discharges have commenced, where possible, it is recommended that surface infiltration rates can be confirmed through calibration of the model to observed data. Monitoring of the wetting front extent will help with this model calibration. Proposed surface water related water monitoring is summarised in Table 10.

Table 10 Recommended Surface Water Monitoring Programme

Sites	Parameter Type	Parameters to be Measured	Frequency
Discharge Water Monitoring Points	Vegetation Health	Vegetation health survey	Quarterly
	Quality (field)	pH, EC, TDS, temperature	Daily
	Wetting Front Extent (field)	Visual estimate of wetting front distance from discharge location.	Weekly
	Quality (laboratory)	**Physicochemical:** pH, EC, TSS, TDS, total acidity, total alkalinity, hardness **Major ions:** Na, K, Ca, Mg, HCO_3, CO_3, Cl, SO_4, NO_3, total nitrogen **Total & dissolved trace metals/ metalloids:** Al, As, Cd, Cr, Cu, Fe, Hg, Pb, Mn, Ni, Se and Zn	Quarterly

6.8 Model Assumptions and Exclusions

The model was developed assuming the following:

- There are no point source discharges along the reach of the river other than the discharge from mine operations.

- Given the open landscape without dense vegetation, point potential evaporation data was used in this model.
- Surface infiltration rates are likely to vary considerably in the field between reaches and from published values, however, are considered appropriate prior to the commencement of discharges.

7.0 Conclusions

Rumble Resources Ltd (Rumble), along with co-operation agreement partners, Bain, and MEGA Resources (MEGA), are proposing to commence mining operations within the Western Queen Mine, located approximately 90km northwest of Mount Magnet in Western Australia.

This surface water flood assessment, inclusive of an excess water discharge wetting front assessment, was completed to support ongoing approvals and water management for the proposed project.

The Western Queen Mine is located at the top of the local catchment just west of a major catchment divide running generally north-south. The area west of the major catchment divide drains to the northwest away from the Project site. The area east of the divide, drains eastward.

Within the local catchment, drainage across the proposed mine site follows a series of poorly defined flow paths that coalesce to the south of Western Queen South (WQS) into a northwest-draining creekline. Catchment areas upstream of the proposed infrastructure are relatively small meaning surface water management infrastructure will have to manage flows from mainly within the Project area.

Key surface water aspects and findings associated with the proposed project include:

Surface Water Management Infrastructure - Operations

Proposed surface water management measures during mining operations include:

- drainage channels to capture runoff and prevent standing water.
- sediment basins to temporarily intercept runoff to minimise the turbidity and release of suspended sediment.
- Flood protection bunds around both Western Queen North (WQN) and WQS pit edges will be required to limit the inflow of additional surface water runoff into the pit.
- In-pit drainage (direct rainfall) will be required to divert surface water runoff into dedicated sumps with pumps to dispose the runoff, potentially to alternative storage facility depending on water quality.
- Storage of abstracted water in a dedicated mine water storage pond suitable of storing two days capacity should be constructed to minimise sediment load (from in-pit sump pumping).
- Given the key risks to surface water are erosion, sedimentation of creeklines and impacts to riverine vegetation downstream, a surface water monitoring programme will be implemented.

Surface Water Management Infrastructure - Closure

At closure, all temporary mine site infrastructure will be removed, and the disturbed development footprints rehabilitated. The only permanent changes in landform are the waste rock dump and the open pit.

Proposed surface water management measures that will remain post-closure include:

- The surface water drainage channels around the southern open pit areas should remain and continue to drain into the sediment ponds. This is recommended to minimise the release of sediment from the newly rehabilitated open pit area and WRDs.
- Key sediment ponds should remain for up to 2 years following closure or until negligible material loss from rehabilitated and revegetated WRD and mine laydown areas is expected. They should then be removed and rehabilitated.
- At closure, the pit will need to be surrounded by an abandonment bund in line with DMIRS requirements. The bund will serve two purposes: maintain flows past the pit to minimise changes to flows and hydroperiods downstream, and the other being to maintain geotechnical integrity by preventing surface water from flowing over the pit crest.
- During the closure phase (typically five to ten years after the end of operations), opportunistic surface water quality testing should continue to support closure-related assessments of rehabilitation compliance.

Discharge to Local Creekline

With a predicted range of WQS groundwater inflows of between 2,300 to 3,200 kL/day, a mine water usage (dust suppression etc) up to about 800 kL/day, a total mine water excess may be up to about 2,400 kL/day over the duration of mining. The equates to a total dewatering volume is predicted to be between about 1,500 kL/day to 2,400 kL/day (up to 1.0 GL/annum) over the anticipated 608 days of mining. Should unforeseen high yielding structural features be encountered during mining, a worst-case dewatering requirement of 5,800 kL/annum has been predicted.

Groundwater salinity in the WQS area has previously been report to average about 2,100 mg/L TDS (maximum 3,700 mg/L TDS) and of high quality (lower salinity) than that measured in other areas within the Western Queen area. With this in mind, excess groundwater is proposed to be discharged to the environment over a duration of up to about 1.7 years.

Surface water modelling was undertaken to assess sensitivity of the predicted wetting front extent with discharge rates. The model was based on a 1:20 year rainfall event and relevant findings from this assessment include:

- Under all simulated discharge rates (1,500 kL/day, 2,400 and 5,800 kL/day), a wetted front generally remains within the low flow channels.
- Under an estimated average discharge rate of 1,500 kL/day (total 0.9 GL), a wetted front extent of about 1.75km is predicted.
- Under an estimated average discharge rate of 2,400 kL/day (total 1.5 GL), a wetted front extent of 2.0km is predicted.
- Under the extreme discharge rate of 5,800 kL/day (total 3.5 GL), should unforeseen higher dewatering rates occur, a maximum wetted front extent of up to about 3.9km is predicted.

The wet weather assessment found that mine water releases do not affect baseline (non-mine-related) flooding conditions. This is because the mine's contribution—0.03 m^3/s (2,400 kL/day)—is negligible compared to the natural baseline flow of 1.75 m^3/s at the release point. Therefore, mine discharges during wet weather are not expected to adversely impact the receiving environment.

The above results are consistent with predictions made for the adjacent Dalgaranga Gold Project by Spartan Resourced Limited, whereby wetting front modelling predicted a broader extent of about 2.5 km and up to about 500m wide for a 2.5 GL/annum (6,800 kL/day) approved discharge rate.

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RUMBLE
RESOURCES LTD

APPENDIX 4

GROUNDWATER ASSESSMENT REPORT (AECOM 2025)

Prepared for
Rumble Resources Ltd
ABN: 74 1482 142 60

AECOM

Western Queen Groundwater Assessment

Western Queen Dewatering

12-Jun-2025
Western Queen Dewatering

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Western Queen Groundwater Assessment

Western Queen Dewatering

Client: Rumble Resources Ltd

ABN: 74 1482 142 60

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Quality Information

Document Western Queen Groundwater Assessment

Ref 60745106

Date 12-Jun-2025

Originator Julian Fowler

Checker/s Gary Brophy

Verifier/s Gary Brophy

Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
0	12-Jun-2025	Final	Gary Brophy Technical Director	

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Executive Summary

The proposed Western Queen Development, a co-operation arrangement between Rumble Resources Ltd (Rumble) , Bain Global Resources and MEGA Resources (MEGA), is currently assessing the feasibility of the proposed re-development of Western Queen South (WQS) and pits within and adjacent to Western Queen North (WQN). This proposed project includes the development of up to four open pits (WQS, Princess, Duke, and Cranes deposits).

Historical mining at the Western Queen Mine was conducted in two pits:

- Western Queen North (WQN) pit was initially undertaken by Western Mining from 1998 until 2002. Mining included open pit and underground workings.
- Western Queen South (WQS) pit was initially undertaken by Harmony Gold Pty Ltd (Harmony) between June and November 2007. During this time, the pit was developed to a depth of approximately 41m below ground level (mbgl). Pit wall instability and water ingress resulted in early closure of WQS which was subsequently placed on care and maintenance. Mining re-commenced between 2011 and 2013 by Ramelius Resources Ltd (Ramelius).

A shallow depth to groundwater of between 25m and 30mbgl will necessitate dewatering to allow for below groundwater mining. This report presents a summary of hydrogeological findings and site investigation results to support project feasibility input and environmental approvals.

Similar to historical dewatering requirements, to enable re-mining of the WQS deposit, several groundwater related activities will be required including:

- pit lake dewatering
- advanced open pit dewatering
- management of excess abstracted mine water.

Conceptual Groundwater Model

Based on the knowledgebase review, the conceptual hydrogeology of the project includes:

- The local ground elevation around 390 m Australian Height Datum (m AHD).
- The pre-mining water level was reported at about 355m reduced level (RL) (35mbgl) to the north of WQN and about 367m RL (23mbgl) in WQS.
- Regional groundwater flow generally follows topography and flows to regional low-lying areas in the west associated with present day drainages and ultimately discharges towards the north-western Sandford River.
- The average annual rainfall is about 217 mm, with annual evaporation up to 2,600 mm.
- Stratigraphic units in order of increasing depth:
  - Alluvial and aeolian superficial sediments (Aquifer where saturated) - Local ferricrete formations may be preferential pathways that transmit rainfall recharge to low lying areas.
  - Saprolite clay (Aquitard) - Extremely weathered saprolitic clay that is normally of low to very low hydraulic conductivity and forms an aquitard when below the water table.
  - Saprock (Aquifer where saturated) - moderately weathered bedrock, varying between being an aquitard to aquifer of low to moderate hydraulic conductivity. Locally, the saprock interval may be transmissive along contact zones and/or fault or shear zones.
  - Fresh bedrock (Aquitard) - generally massive and non-fractured and is regarded as a regional aquitard that is expected to yield little groundwater.

- The alluvial sediments occur to a depth of about 5mbgl (385m AHD) on the northern side of WQS and about 27mbgl (363m AHD) on the southern side. Surface water infiltration into these shallow deposits is probably an important mechanism for local groundwater recharge.
- The fracturing intensity and saprock thicknesses were found to be greater at contact zones between rock types and the mineralised zones.
- The high transmissivity value determined for WQN of 84 m^2/day was not considered appropriate for WQS. An aquifer transmissivity of 30 m^2/day and hydraulic conductivity of 0.5 m/day were estimated by Morgan (2000).
- Based on in situ water quality sampling, pit lake salinity is approximately 18,400mg/L – Total Dissolved Solids (TDS) for WQS and 18,800mg/L TDS for WQN.
- Historical dewatering abstraction of up to 54 L/sec or 4,650 kL/day were reported from WQN (Morgan, 1999) and 30 L/sec or 2,500 kL/day during mining of WQS (Morgan, 2000).
- Historical groundwater is reportedly fresh to slightly brackish, sodium chloride type with TDS concentrations at WQN ranging up between 2,000 mg/L and 10,660 mg/L (average 4,500 mg/L TDS) and between 1,200 mg/L and 3,700mg/L (average 2,100mg/L TDS) at WQS. Groundwater is generally neutral to slightly alkaline pH (pH 7.9 to 8.1).

Pit Lake Water Transfer

WQN currently holds approximately 3.2 Gigalitres (GL) of water and an additional water storage capacity of about 2.4 GL to a point 1.5m below the pit crest. With the proposed Princess and Duke pit developments, this may increase total WQN capacity up to 3.8 GL.

The WQS pit currently holds approximately 672,000 kL or 0.7 Gigalitres (GL) of water (based on a pit lake elevation estimate of 362m AHD). To allow future deepening of the WQS open pit, the water stored within the existing pit will be transferred to WQN.

The water quality characteristics in both pits have been measured and are very similar. However, at lower pit lake elevations, suspended sediments will likely increase, though no environmental impact is foreseen with this water transfer strategy.

To minimise pit wall stability issues and allow groundwater to drain and pore pressures to be lowered, it is proposed the pit lake be emptied over a period at least 90 days. Over the 90-day period an expected additional 0.2GL of dewatered water from groundwater inflows is estimated, based on the assumed 2,200 kL/day inflows, and an additional estimated 500 kL/day form interconnection between WQN and WQS. This equates to a total of up to 1.0GL (about 130 L/sec), that may require abstraction to allow access to the WQS pit floor.

The maximum WQN pit lake elevation has been defined by potential mounding-related impacts on local vegetation and the groundwater resource, along with having enough remaining capacity to limit over-topping from high rainfall events. A high-level assessment of the propagation of predicted mounding from WQN reported groundwater levels are predicted to remain below about 20m bgl in the northern areas at distances of about 200m.

Pit Water Transfer over a proposed 90-day period up to 130 L/sec or 11,000 kL/day

Groundwater Dewatering

Simplified analytical groundwater models have been completed to determine indicative dewatering rates and maximum drawdown extents for WQS. Dewatering for WQN will require the pit lake to be partially lowered, and the proposed Cranes development is above the water table. Findings from the predictive WQS groundwater modelling are summarised in Table ES1.

Table ES1 Summary of Predicted Dewatering Estimates

Deposit	Estimated Dewatering Duration[1]	Predicted Steady-State Abstraction Range		Predicted Total Project Abstraction Volume	Predicted Drawdown Distance - 1 m contour	Comments
		(kL/day)	L/sec	(GL)	(m)	
WQS	608 days	2,400 to 5,800	27 to 67	1.4 to 2.7	1,700 to 2,000	Drawdown will propagate to the adjacent WQN and proposed discharge location
Note [1] – MEGA, 2025						

Based on the modelling, an indicative reasonable case (lower-case) maximum abstraction is predicted to be up to about 1.0 GL/annum.

WQS Dewatering over the proposed 608-day period up to 1.0 GL/annum (Total 1.5 GL)

Dewatering Strategy

The recommended dewatering strategy should seek to dewater ahead of mining to avoid difficult mining conditions, i.e. boggy pit floor, lower pore pressures in the pit walls through targeted horizontal drains, and control pit wall seepage and horizontal drain inflows through a closed collect system to minimise uncontrolled drainage to the pit floor and flows across benches.

Dewatering options considered include:

- Option 1: Dewatering Bores – to abstract groundwater from deeper flow paths in-pit or ex-pit, depending on their depth, interconnectedness, and permeability. Their effectiveness can be limited in deep fractured rock settings due to the low hydraulic conductivity and often compartmentalised nature of these aquifers. In-pit bores are often sacrificial and only effective for short periods. Opportunities to dewater in advance of mining from bores exist as per details in Section 6.1.1.
- Option 2: Shallow Sumps – to intercept gravity drainage from seeps and drain holes on the pit floor.
- Option 3: Preferentially Sloped Pit Floor – to allow for gravity drainage across a sloped pit floor to strategically placed sumps, potentially on deep permeable structures to intercept groundwater inflows.
- Option 4: Horizontal Drain Holes – using a system of closely spaced interconnected drain holes to gravity drain and depressurise rock contacts and fault zones behind pit walls to improve geotechnical stability.

Mine Water Management Strategy

Several alternative excess water management options have been identified and, in order of priority, include:

- Mine water use – road watering, dust suppression, etc.
- Environmental discharge to local creekline – reserved for fresh to brackish groundwater (<2,100 mg/L TDS).
- Additional storage within WQN – reserved for water salinity above 15,000 mg/L TDS.
- Use of mechanical evaporators on WQN to allow more storage capacity (if required).
- Dedicated evaporation pond (if required).
- Future discharge to the Sandford River.

Having multiple water discharge options allows the project to manage water quality constraints (salinity) outside the option to discharge local groundwater to the environment via a local creekline.

Following disposal of higher salinity (18,000 mg/L TDS) WQS pit lake stored water (totalling about 1.0GL) to WQN, it is estimated WQN will have a remaining void capacity of about 1.5GL (without Duke and Princess extensions). With a predicted range of WQS groundwater inflows of between 2,300 to 4,500 kL/day, a total dewatering volume is predicted to be between about 1.4 and 2.7 GL over the anticipated 608 days of mining.

Previously up to about 800 kL/day (10 L/sec) was used during mining for dust suppression on site (Morgan, 1999). Using these estimates for water usage, the total mine excess may be up to about 1.5 GL over the duration of mining. Although not likely a uniform volume per day, this equates to an excess of up to about 2,400 kL/day or 28 L/sec.

Figure ES1 presents a schematic diagram of the proposed water transfer strategy.

Mine Water Usage estimate of 800 kL/day (0.3 GL/annum)

Mine Water Management – Environmental Discharge

Groundwater salinity in the WQS area has previously been reported to average about 2,100 mg/L TDS (maximum 3,700 mg/L TDS) and is of higher quality (lower salinity) than that measured in other areas within the Western Queen areas. With this in mind, excess groundwater is proposed to be discharged to the environment over a duration of up to about 1.7 years.

A recent vegetation and fauna survey (Botanica, 2025) at the Western Queen project area did not identify any significant vegetation assemblages and there is a low risk of potential terrestrial groundwater dependent ecosystems (GDE) in the adjacent floodplain areas. The closest station well, Wanrey Well, is about 7 km northwest and down-gradient of the proposed outfall location.

Surface water modelling was undertaken to assess sensitivity of the predicted wetting front extent with discharge rates. The model was based on a 1:20 year rainfall event and relevant findings from this assessment include:

- Under the lower discharge rate of 1,500 kL/day (total 1.0 GL), a wetted front extent of 1.75km is predicted and generally remains within the low flow channel.
- Under an estimated average discharge rate of 2,400 kL/day (total 1.5 GL), a wetted front extent of 2.0km is predicted.
- Under the extreme discharge rate of 5,800 kL/day (total 3.5 GL), should unforeseen higher dewatering rate occur, a wetted front extent of up to about 3.9km is predicted.

The wet weather assessment found that mine water releases do not affect baseline (non-mine-related) flooding conditions. This is because the mine’s contribution—0.03 m^3/s (2,400 kL/day)—is negligible compared to the natural baseline flow of 1.75 m^3/s at the release point. Therefore, mine discharges during wet weather are not expected to adversely impact the receiving environment.

Proposed Environmental Discharge of excess mine water with a salinity average of 2,100 mg/L TDS over the proposed 608-day period up to 2,400 kL/day (1.5 GL)

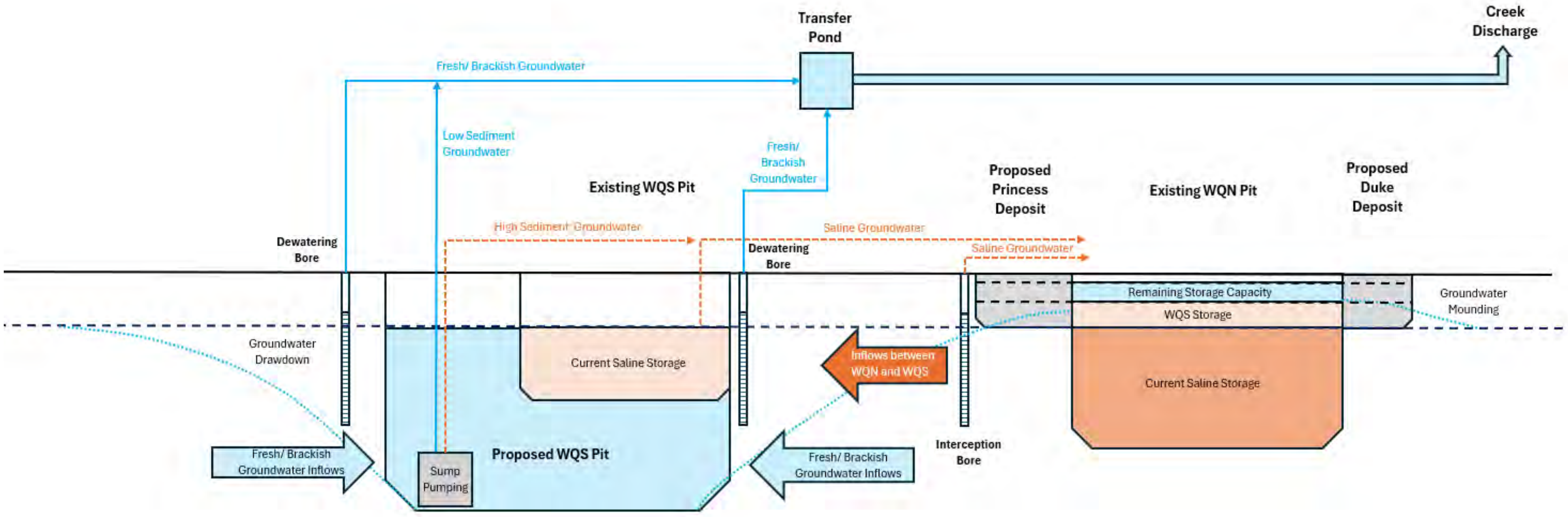

Figure ES1 Conceptual Water Management Strategy Schematic

Post Closure - Residual Drawdown

Results of the post closure water balance identified that the residual post-closure drawdown footprint associated with WQS will create a hydraulic sink (Table ES2).

Table ES2 Summary of Residual WQS Pit Lake Drawdown

Description	WQS Pit
Max Pit Lake Fill Level (m AHD)	343
Years to Reach Steady State	55
Estimated Residual Pit Freeboard - Overtopping (low pit crest to maximum fill level)(m)	55
Residual Difference from Baseline (m)	18
Final Pit Surface Area (m^2)	224,688
Residual Evaporation Loss (kL/annum)	8,429
Post-Closure Groundwater Flow	Groundwater Sink
External Factors	None
Potential for poor water quality to develop due to evapo-concentration	Potential
Potential to contaminate groundwater if quality is poor and level is too high	None
Potential for unstable materials to release; Solutes through oxidation, weathering, and erosion	Unknown
Potential for geotechnical pit wall instability	Potential on NE face, where historical failures have occurred.
Potential for human and birdlife interaction	Unknown
Post-Closure Volume of Freeboard – Overtopping (m^3)	5,393,724
Pit Lake Over-Topping during extreme climatic events	Unlikely
Potential for post-closure environmental impacts	Unlikely

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was engaged by Rumble Resources Ltd (Rumble) to undertake a mine dewatering assessment of the Western Queen Mine, located approximately 90km northwest of Mount Magnet in Western Australia (Figure 2).

Historical mining at the Western Queen was conducted in two pits:

- Western Queen North (WQN) pit was initially undertaken by Western Mining from 1998 until 2002. Mining included open pit and underground workings.
- Western Queen South (WQS) pit was initially undertaken by Harmony Gold Pty Ltd (Harmony) between June and November 2007. During this time, the pit was developed to a depth of approximately 41m below ground level (mbgl). Pit wall instability and water ingress resulted in early closure of WQS which was subsequently placed on care and maintenance. Mining re-commenced between 2011 and 2013 by Ramelius Resources Ltd (Ramelius).

In late-2019, Rumble purchased the historical Western Queen Mine. The site layout is presented on Figure 3.

Rumble recently completed several exploration drilling campaigns to develop an updated resource model. To allow Rumble, along with co-operation agreement partners, Bain and MEGA Resources (MEGA), to commence mining operations within Western Queen South Mine (WQS) and in the vicinity of the Western Queen North Mine (WQN), a number of technical studies are required to support mining approvals.

1.1 Study Objectives

The project objective was to provide supporting documents for environmental approvals, works approvals, and groundwater related licencing requirements. To meet this objective, the scope of work included:

1. Groundwater Assessment – desktop hydrogeological assessment, including site collection of groundwater levels and water quality samples and to assess local catchment conditions. Analytical groundwater models were used to predict dewatering rates and volumes and pit lake post-closure residual changes.
2. Assess opportunities for managing Excess Mine Water through transfer between open pits, creek discharge and potential mechanical evaporator implementation.

This report presents a summary of hydrogeological findings and data gaps following site work for feasibility input and environmental approvals. This report has been prepared in accordance with the requirements of:

1. *Operational policy no. 5.12 – Hydrogeological reporting associated with a groundwater well licence* (Department of Water (DoW), 2007).
2. *Mining Proposal Guidance – How to prepare in accordance with Part 1 of the Statutory Guidelines for Mining Proposals* (Department of Water and Environmental Regulation (DWER), 2020; Section 8.5.2).

This report summarises the groundwater characteristics of Western Queen mining area, including estimated dewatering rates and volumes, high level site water balance, opportunities to manage excess mine water through exiting open pit water transfer and creek discharge, and post-closure pit lake residual groundwater related impacts.

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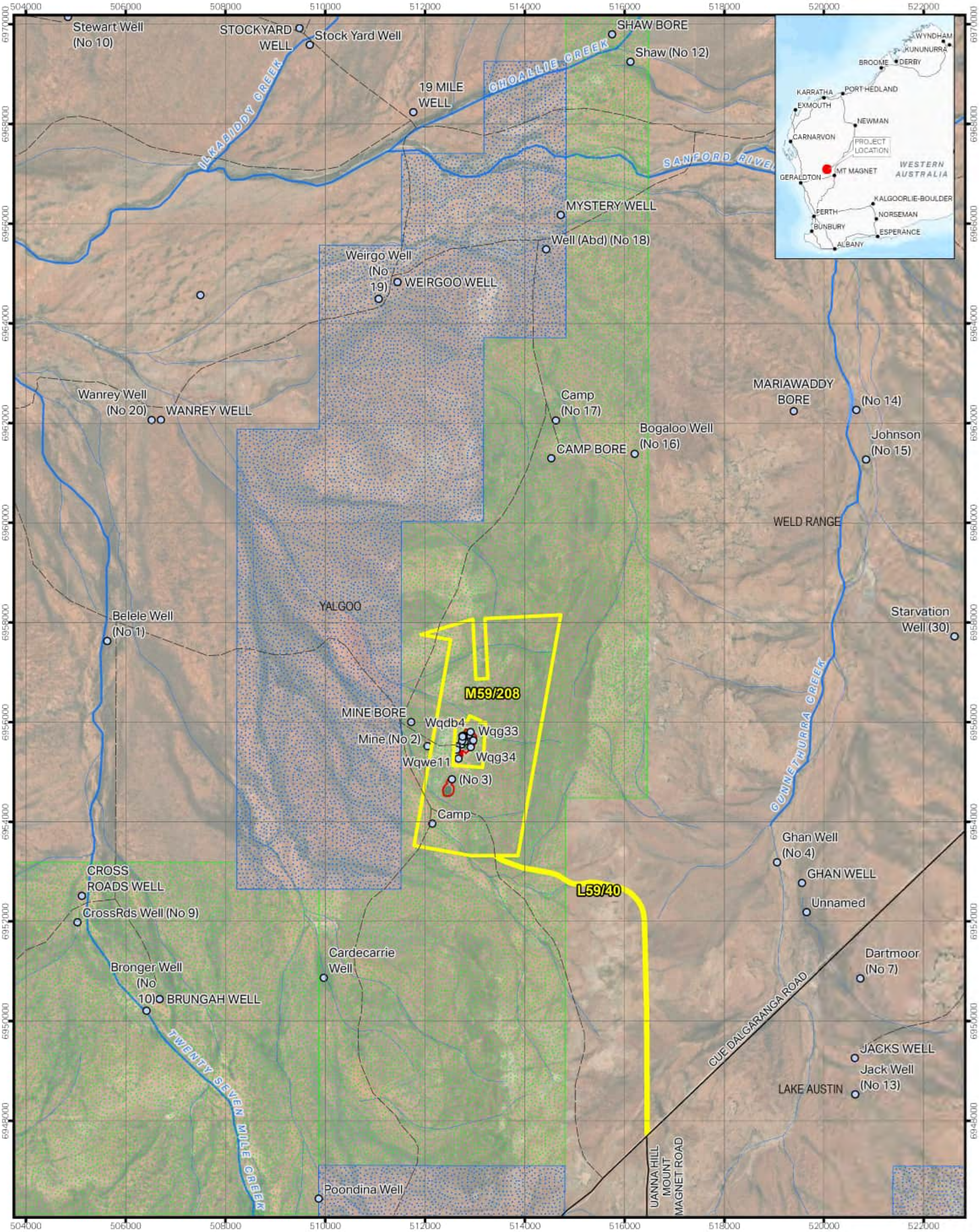

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LEGEND
- Existing Pit Outlines
- Western Queen Tenements
- Rumble Resources Tenements
  - Live
  - Pending
- Lakes
- Major Watercourses
- Minor Road
- Track
- Regional Station Bores / Wells

Locality Plan

WESTERN QUEEN

WESTERN QUEEN DEWATERING ASSESSMENT

Figure 2

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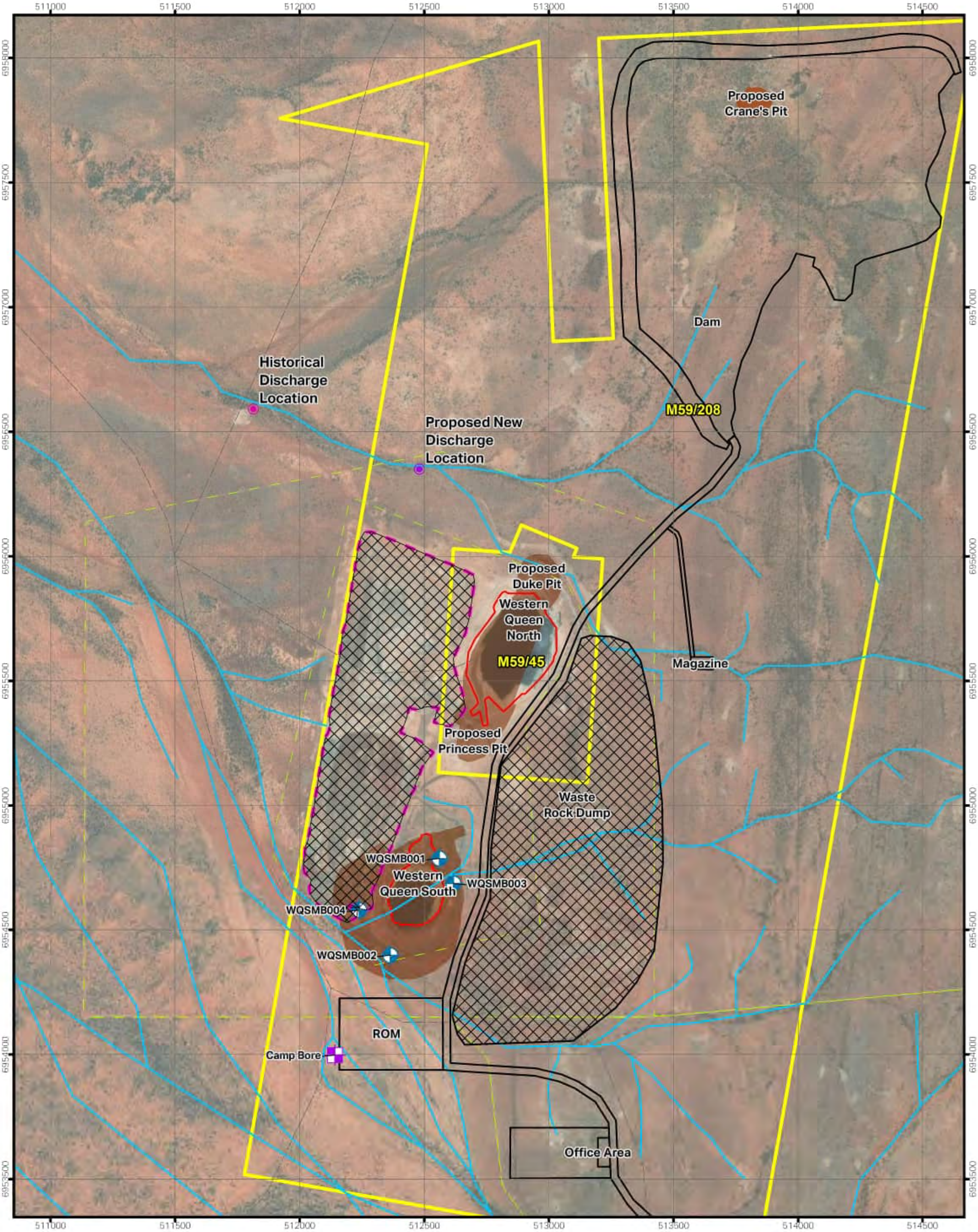

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LEGEND
- Western Queen Tenements
- Existing Pit Outline
- Proposed Pit
- Proposed Site Layout
- Existing Waste Dump
- Waste Roack Dump
- Drainage Lines
- Existing Monitoring Bore
- Existing Production Bore
- Historical Discharge Location
- Proposed New Discharge Location

Site Layout

WESTERN QUEEN

WESTERN QUEEN DEWATERING ASSESSMENT

Figure 3

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1.2 Proposed Mine Development

Rumble, along with co-operation agreement partner, Bain Global Resources and MEGA Resources (MEGA), propose to commence mining operations within Western Queen South Mine (WQSM) and Western Queen North Mine (WQNM). As part of the operation WQNM will be further developed into two additional adjacent open pits, Duke Mine (DM) and Princess Mine (PM). Figure 4 presents an indicative cross section of the proposed Western Queen development.

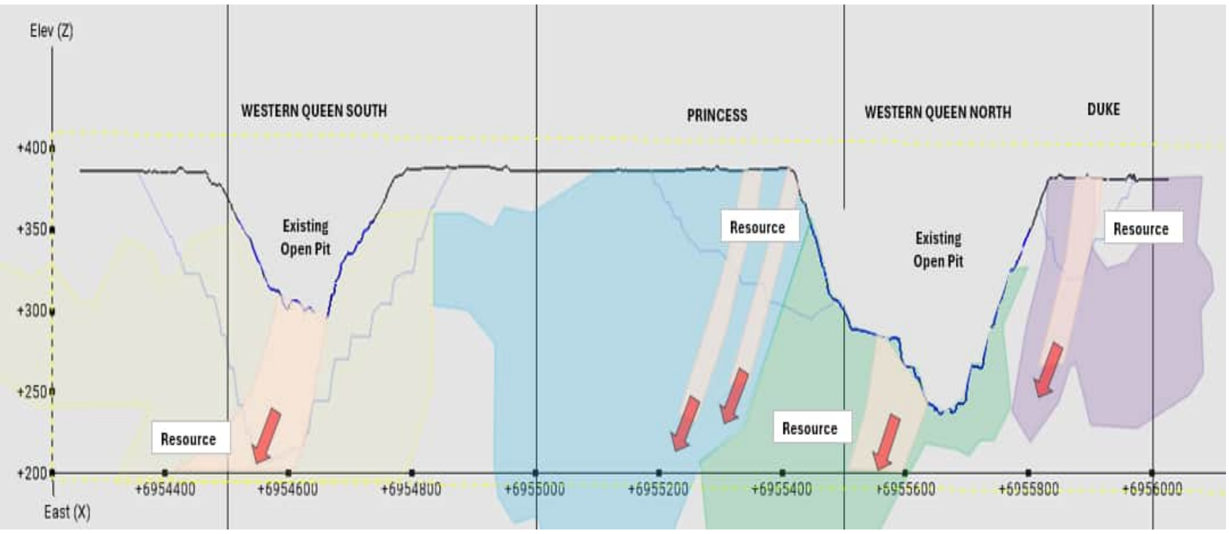

Figure 4 Western Queen Gold Deposit Longitudinal Section (modified Rumble, 2024)

The proposed project includes:

- Partially filled existing open pits with a pit lake elevation of about 362 metres Australian Height Datum (m Australian Height Datum (m AHD)).
- Maximum pit floor elevations of 200m AHD for WQS.
- Mining duration up to 1.6 years (577 days). Dewatering duration allowance of 608 days.

1.3 Previous Studies

Several water related studies have been completed and provided information on the local hydrogeological characteristics and historical challenges related to mine dewatering. In date order, documents reviewed include:

- Morgan, 1999, Western Queen Pit Dewatering Investigation, for Dalgaranga Gold Mines Joint Venture, 14th May 1999.
- Morgan, 2000, Hydrogeological Report Western Queen South Project, for Dalgaranga Gold Mines Joint Venture, 18th January 2000.
- MWES, 2012a. Western Queen South: Groundwater and Surface Water Assessment for Mining & Environmental Applications, for Mt Magnet Gold Pty Ltd, 10th May 2012.
- MWES, 2012b. Western Queen South: Monitoring Bore Drilling Results and Hydrogeological Review, for Mt Magnet Gold Pty Ltd, 17th April 2012.
- Peter O'Bryan and Associates, 2012. Western Queen South Open Pit – preliminary Geotechnical Assessment, for Mt Magnet Gold Pty Ltd, 23rd November 2012.
- Ramelius Resources Ltd, 2014. Western Queen South – Pit Closure Report, June 2014.
- AECOM Pty Ltd, 2021. Western Queen South – Dewatering Review, June 2021.

In addition to the above reports, several datasets were provided and used in the assessment. Datasets provided include:

- WQS monitoring bore data (130807 pit_monitoring_bores.xlsx).
- Leapfrog Works file (Western Queen Water Volumes 20200824.lfview).
- 2013 Ramelius geotechnical photographs.
- WQ PITS - WESTERN QUEEN PITS_02 PIT DESIGN_QUEEN241028_DTM.dxf
- WQ PITS - WESTERN QUEEN PITS_02 PIT DESIGN_FULL DTM FOR DP_DUKEANDPRINCESS_DTM.dxf

1.4 Historical Mining

The region has a long history of mining and exploration, evident by the numerous historical shafts, and costeans scattered across the site's tenements. Mining occurred between 1998 and 2002 with mining of the WQN open pit and underground.

In mid-2007, Harmony Gold Australia commenced open pit mining on the WQS deposit that extended from about 390m AHD to 350m AHD and approximately 260m long by 220m wide. However, development of the open pit was terminated 7m below the water table due to the floor becoming boggy and unsafe for mining activities. Geotechnical wall instability eventually resulted in the early closure of the WQS pit, with the eastern wall deemed too unstable for mining to continue. The wall instability was reported (Peter O'Bryan and Associates, 2012) to be related to a pegmatite dyke dipping 65º west into the eastern pit wall and strong shearing against the surrounding mafic rock.

To re-establish safe mining conditions, a cut-back of the WQS open pit was completed, with the access ramp entering on the western side in more competent rock. Mining extended to 290m reduced level (RL) (60mbgl) but again terminated in late-2007 due to further pit wall instability, combined with the cessation of the Mt Magnet mill where the ore was processed.

Ramelius restarted the Mt Magnet processing facility in 2011 to target a mining local gold reserves through to 2014 (Ramelius Resources, 2014). Two wall failures were noted during the operational phase of WQS (Ramelius, 2014):

- On 31 August 2013 a portion of the oxide zone of the northeastern wall failed.
- On 4 August 2013 a large section of the western wall failed between the ramp and the pit floor (325m RL).

Following the cessation of mining and dewatering, groundwater levels recovered, and pit lakes formed in both the WQS and WQN voids.

Table 3 summarises current pit volumes in context with proposal. Based on the estimated pit lake elevations in both pits of 362 m AHD, there is up to approximately 2.5 Gigalitres (GL) of remaining capacity in WQN (to 1.5m below the low pit crest) for future excess water storage.

1.5 WQS Historical Pit Wall Instability

The Western Queen Dewatering Report (AECOM, 2021) outlines the history of wall instability within the WQS pit, and the links to past dewatering and depressurisation activities. A summary of this historical instability is presented below:

- Geotechnical issues and pit wall instability resulted in the early closure of WQS pit in late 2007, with the north-eastern wall deemed too unstable to continue with mining activity. A geotechnical assessment by AMC Consultants (AMC, 2007) concluded that high pore water pressures had destabilised clay material on either side of a pegmatite dyke.
- Following a period of care and maintenance, a further geotechnical assessment of the WQS pit was completed in 2012 (Peter O'Bryan and Associates, 2012) indicated that during the care and maintained period, groundwater had formed a pit lake with a level of about 366m RL. The geotechnical assessment concluded that the stability of the upper wall at WQS would be governed

Table 3 Summary of Estimated Pit Volumes and Potential Water Storage Capacities

Void	Water Stored	Total Pit Volume	Total Pit Lake Volume	1.5m Below Pit Crest		2m Below Pit Crest		3m Below Pit Crest	
				Total Pit Volume to	Remaining Water Storage Capacity	Total Pit Volume to	Remaining Water Storage Capacity	Total Pit Volume to	Remaining Water Storage Capacity
	(kL)	(m^3)							
WQN	3,177,000	5,754,000	3,177,000	5,586,000	2,409,000	5,531,000	2,353,000	5,422,000	2,244,000
WQN - with Princess and Duke	*3,177,000*	*8,350,000*	*3,177,000*	*8,069,000*	*4,892,000*	*7,977,000*	*4,799,000*	*7,794,000*	*4,616,000*
WQS	672,000	2,122,000	671,000	2,015,000	1,344,000	1,981,000	1,309,000	1,913,000	1,241,000
WQS Planned	-	*8,817,000*	*0*	*8,565,000*	*8,565,000*	*8,482,000*	*8,482,000*	*8,319,000*	*8,319,000*

by weak rock strength associated with deep weathering as well as the possible influence of geological structures and groundwater pressures.

- Mining resumed in July 2013 and in August 2013 Ramelius Resources (2014) reported a portion of the oxide zone of the northwestern wall failed along a slip plane in ultramafic saprolite, characterised by wet, talc textured clay.
- In December 2013, another pit wall failure occurred between the ramp at 355m AHD and the pit floor (325m AHD) on the opposite western pit wall. Ramelius described the failure as being caused by toppling of clayey materials along steep, smooth, westerly dipping geological structures and contact zones. These zones spanned the saprolite and transitional saprock zone. This occurrence resulted in suspended mining activities whilst remediation works were underway.
- Hydrostatic pressure from groundwater was also considered (Peter O'Bryan and Associates, 2012) to be a factor, despite the presence of horizontal drainholes intercepting high groundwater yields behind the pit wall. The pit design was then modified to include an extra-large berm at the 325m AHD to strengthen the wall and prevent further failure. This design change had a knock-on effect of limiting the maximum pit depth from 290 to 300m AHD.
- Although the majority of groundwater inflow was reported by Ramelius Resources (2014) as being from the transitional/fresh rock interface, small amounts of seepage in the pit wall above the pit floor suggested there was poor connectivity between aquifer zones and vertical drainage behind the pit wall. In our opinion, this has likely been a significant contributor to the historical pit wall failures.
- A present-day east to west surface water drainage features now diverted around the WQS pit, may contribute to local recharge during higher rainfall events. It is apparent that this surface drainage line is aligned with some of the pit wall failure areas. It is unknown if the drainage line is formed along a sub-surface geological fault or shear. However, such features often underlie such topographically low areas. As a result of the flood bund, this may result in surface water sheetflow typically accumulating in this area allowing longer retention times for infiltration to the groundwater table through the upper alluvial sediments, upgradient of the open pit.

1.6 Historical Dewatering

A review of historical dewatering of the Western Queen area was completed by AECOM (2021) and included a compilation of several groundwater studies (Morgan, 1999; Morgan, 2000; and MWES, 2012a and 2021b). In context with the proposed mine development, key findings included:

WQN

- Morgan (1999) identified the WQN pre-mining groundwater table of about 35mbgl (355m RL)
- The main aquifer at WQN is linked to bedrock with varying degrees of oxidation (weathering) and fracturing.

- Alluvial sediments overlie the weathered bedrock. They consist of a layered succession and were reported to be of low permeability.
- Native groundwater was reported as slightly brackish in quality (1,000mg/L TDS – Total Dissolved Solids). This lower salinity indicates local groundwater recharge may be occurring through the upper alluvial sentiments.
- A final WQN pit depth of 145m (245m AHD) required 110m of dewatering to maintain dry in-pit conditions.
- Groundwater levels at WQN were monitored in 11 monitoring bores and recorded an average drawdown of 18m over a 7-month period.
- Rates of drawdown were reported to be highly sensitive to the pumping rates.
- Bore WQDB2, installed in the WQN pit, was capable of maintaining groundwater levels approximately 8 m below the final pit floor depth.
- Morgan concluded that the dewatering bore was sufficient to successfully deplete aquifer storage at WQN and to retard water inflow from the surrounding aquifer.

WQS

- During reverse-circulation mineral exploration drilling, water intersects were reported in all holes with 25 of the 57 holes reported as intersecting significant aquifer zones, based on continuous airlift flows during drilling (Morgan, 2000).
- No specific initial groundwater test drilling was completed for WQS, with the groundwater assessment based on analogies with groundwater findings from WQN.
- The local hydro-stratigraphy was identified (from top-down) as:
  - transported alluvial sediments (**aquifer where saturated**) – interlayers pisolitic colluvium and ferruginous clay and some strongly silicified horizons (silcrete)
  - saprolite (**aquitard where saturated**) – a soft moist clay unit devoid of primary structure up to 40m thick
  - saprock (**aquifer where saturated**) – at the transition between the saprolite and fresh rock, but was reported to be generally a thin interval
  - fresh bedrock (**aquitard**) – including competent amphibolite with small zones of ultramafic.
- Structurally, there is a sheared zone of amphibolite along part of the Western Queen Shear zone.
- Pre-mining groundwater levels at WQS ranged between 19 and 23 meters below ground level (mbgl) with a flat gradient from northeast to southwest.
- Dewatering from 25 to 80mbgl was achieved over a period of 8-months.

Estimates of groundwater inflows were based on hydraulic properties derived from WQN and concluded pumping rates between 1,000 and 2,550 kilolitres/ day (kL/day) over the 250-day period would be required to maintain dry mining conditions to a depth of 80mbgl (MWES (2012a).

In addition to the initial groundwater characterisation, MWES (2012a) installed four monitoring bores around the WQS open pit cutback and concluded that ex-pit dewatering via bores would likely have limited success due to the low hydraulic conductivity of alluvial clay and weathered rock between the surface and about 90m depth.

MWES concluded that all identified aquifers were from fractures within the saprock interval between the saprolite and fresh bedrock. However, the fractured rock aquifer was considered to have a low hydraulic conductivity and yield low to moderate flow rates (up to 250kL/day) based on airlift yields during drilling. To provide a buffer, flows of up to 1,300kL/day were planned for by Ramelius.

However, during mining, it was reported by Ramelius (2014) that groundwater inflows were significantly greater than expected, with rates up to 2,800kL/day. This was in line with the initial upper end of the range of estimated inflow rates predicted by Morgan (2000). Figure 5 presents historical abstraction rates in context with mining rate (pit floor elevation).

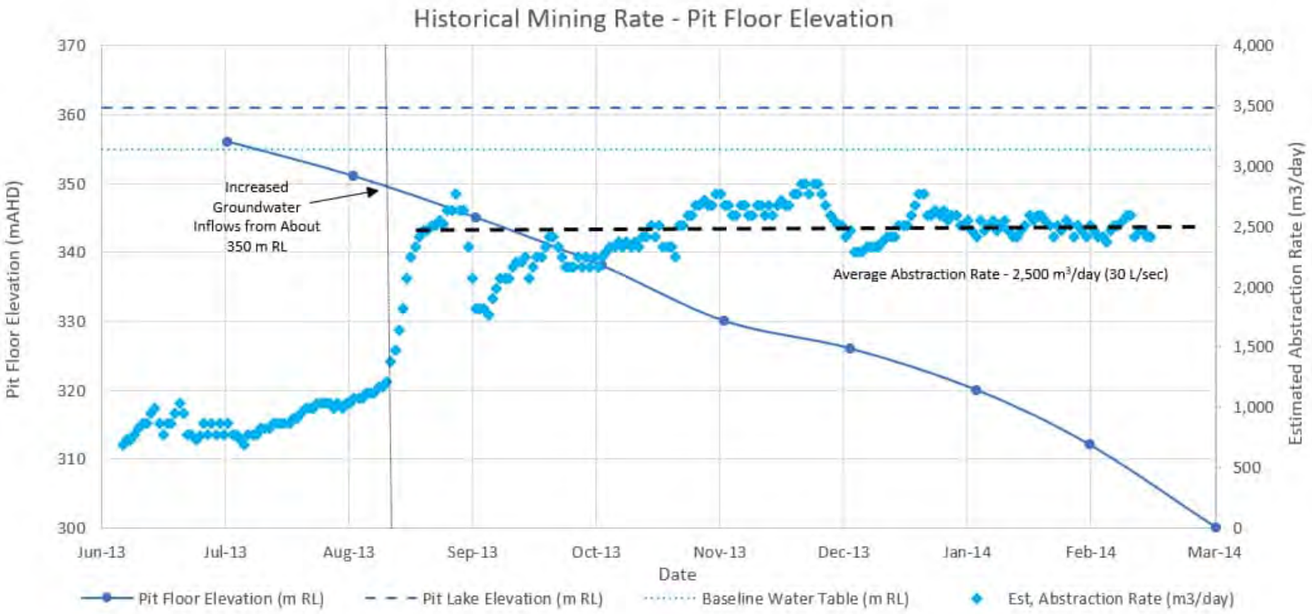

Figure 5 WQS - Historical Abstraction Rate in Context to Pit Floor Elevation

Based on the information available, it is apparent that that a constant recharge source at elevation between 340m AHD and 350 m AHD resulted in a consistent average groundwater inflow rate of about 2,500 kL/day as the pit floor was progressed. It is therefore likely this rate may form the expected minimum for future mining at WQS.

It has been reported (Ramelius (2014) that maintaining dewatered conditions against such high (unexpected) groundwater inflows ultimately resulted in part, in the cessation of mining. Several groundwater related issues reported during cut-back mining include:

- Water flows into the pit started between 864 and 1,300kL/day, and in late-2013 were relatively steady at between 2,100 to 2,600kL/day. This coincided with the exposure of less oxidised (clayey) and more competent bedrock in the northern end of the pit.
- Groundwater levels generally reached a steady-state by late-2013, likely a result of the steady rates of abstraction.
- Higher groundwater inflows were encountered when the pit floor reached fractured saprock beneath the saprolite.
- No reduction in groundwater inflows was reported as mining continued into the fresh bedrock.
- Dewatering was managed by in pit sumps as mining progressed. Interruption to pumping during blasting resulted in partial flooding of the pit floor.
- Excess abstracted groundwater above mine requirements was diverted to WQN for storage.
- Sub-horizontal drain holes were installed in the cutback walls (elevation 355m AHD) to promote drainage within the eastern side. These were reported (Ramelius, 2014) to be successful in draining the pit walls and lowering pore pressures in oxide and transitional zones. However, groundwater inflows from these holes were uncontrolled and drained into the pit floor sump.
- Groundwater levels in ex-pit monitoring bores fell in response to blasting from elevation 350m RL and the installation of horizontal drainholes.

- High and continuous inflow rates at an elevation of about 345m RL were encountered from locally transmissive zones in one area on the north-eastern wall.
- The local structural corridor (shear zone) between WQN and WQS open pits, located approximately 700m apart, may promote some groundwater connectivity.
- Groundwater levels were monitored in five ex-pit monitoring bores (WQSMB01, WQSMB02, WQSMB03, WQSMB04 and Bore 41045) (Figure 2). Bore details are provided in Table 4. All the bores showed a steady decrease in the groundwater level around the pit during the first five months of mining (Figure 6).

Table 4 WQS - Monitoring Bore Details

Bore ID	Easting	Northing	Ground RL	Stick-up	Completion Date	Casing Diameter	Total Depth	Cased Depth
	(MGA)	(MGA)	(m AHD)	(m)		(mm)	(mbgl)	(mbgl)
WQSMB001	512,560	6,954,795	394.04	0.2	14-Mar-12	80	78	77.5
WQSMB002	512,363	6,954,398	389.80	0.2	13-Mar-12	80	90	89.5
WQSMB003	512,617	6,954,686	391.55	0.2	13-Mar-12	80	72	71.5
WQSMB004	512,239	6,954,579	389.29	0.2	14-Mar-12	80	90	89.5

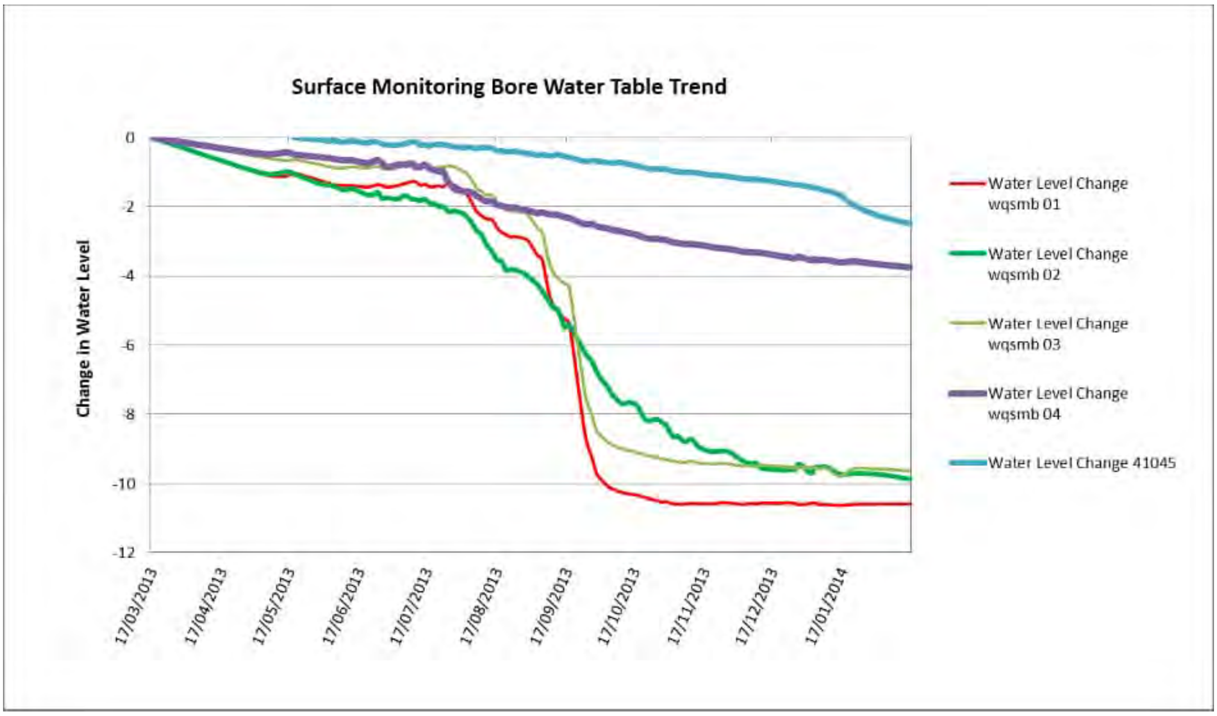

Figure 6 WQS Hydrograph - Historical Groundwater Levels (Source: Ramelius, 2014)

- It was apparent that some groundwater levels (WQSMB04 and Bore 41045) remained at elevated levels behind the pit walls (Figure 6) and were reported to have likely contributed to pit wall instability.

In conclusion, groundwater flow is controlled by regional geological structural features that are fractured and permeable, and local higher transmissive zones linked to moderate degrees of weathering, higher fracture frequency, and connectivity between local and regional geological structures.

2.0 Site Characteristics

2.1 Climate

The region has a semi-arid climate characterised by low rainfall and a large temperature range. The winter months of May to August typically have the highest and most reliable average rainfall, but intense rainfall can occur periodically in the summer months (Johnson et. al., 1999).

2.1.1 Rainfall

Local climate data is available from the Bureau of Meteorology (BoM) station at nearby Yoweragabbie (Station No. 7095 – BoM, 2025). The average annual rainfall over the past 10 years is 217.5mm (Table 5). The data set indicate the highest rainfalls occur in February and March, while the monthly average is commonly exceeded in January and March. Above-average rainfall years e.g. 2014 to 2018 incorporate more winter months that exceed the averages.

Table 5 Rainfall Data: Station No. 7095 (BoM, 2025)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	mm												
2014	25	72.6	7	10.8	88.6	3.7	1.3	1.4	16.8	4.2	9	10.3	250.7
2015	29.3	21	149.6	12.6	2.1	12.8	24.4	22.1	0.2	0	21.3	3.4	298.8
2016	29.4	12.3	46.1	11.6	21.1	40.5	38.9	17.7	6.4	5.8	5	15.8	250.6
2017	24.8	117.7	2.9	5.2	1.2	8.3	10.4	27.9	30.6	0	7.5	5.2	241.7
2018	43.4	19.3	15.6	3.1	0	32.4	26.4	16.7	1.8	37.6	44.1	0	240.4
2019	0	0.9	12.2	34.7	0	48.6	10.9	8.3	0	0	0	12	127.6
2020	25.8	44.8	21	0	2.2	12.5	12.5	16.5	0	0	4.2	3.8	143.3
2021	0	61.9	29	5.8	92	14.5	35.5	0	0	16.2	9	0	263.9
2022	0	6	45	18.5	7.5	21.5	9	49	49.5	0	0	0	206
2023	40	0	54	9	3	25	0	17	3	0	1	0	152
Avg.*	**21.77**	**35.65**	**38.24**	**11.13**	**21.77**	**21.98**	**16.93**	**17.66**	**10.83**	**6.38**	**10.11**	**5.05**	**217.5**
Note: Blue = above monthly average													

2.1.2 Evaporation

The long-term average monthly evaporation for the Western Queen mine is shown in Table 6. The annual pan evaporation for 2020 was recorded as 2,688mm at Mt Magnet (BoM, 2021).

Table 6 Long-Term Average Monthly Evaporation (BoM, 2025)

	Monthly Evaporation (mm) (BoM, 2021)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	353	293	8.05	250	180	134	100	103	122	200	275	304	2,688

2.2 Regional Vegetation

The vegetation of the region has been mapped and described by several previous studies (Beard, 1974 and 1994; Pringle et al., 1994; Mattiske, 2020). The project lies in the Austin Botanical District of the Eremaean Botanical Province and the East Murchison (MUR1) subregion of the Murchison Region of the Interim Biogeographic Regionalisation for Australia (IBRA) (DAWE 2020). Grazing has strongly influenced the structure and composition of much of the vegetation throughout the area. Vegetation associations of the areas surrounding the project area are generally defined as Mulga Woodland. These woodlands include Acacia and Casuarina species, both of which have a laterally spreading, relatively shallow root system. Mulga represents the most deeply rooted species in these ecosystems. Regional flora studies indicate mulga root depths have been recorded between 0.1 and 1.0 m. It is therefore likely that local vegetation is not and has never been dependent on groundwater.

A recent reconnaissance flora/ vegetation survey and basic fauna survey was undertaken by Botanica Consulting Pty Ltd (Botanica) at the Western Queen Project area. The survey was completed in January 2025. Key vegetation related observations include:

- Analysis of the Priority Ecological Communities within the Midwest region (DBCA, 2021) did not identify any significant vegetation assemblages as potentially occurring within the survey area.
- No Environmentally Sensitive Areas (ESAs) were identified within the survey area.
- There are no wetlands of international importance (Ramsar Wetlands) or national importance (Australian Nature Conservation Agency Wetlands) within the survey area.
- There are no proposed or gazetted conservation reserves within the survey area.
- No Threatened, Priority or otherwise significant flora species were recorded within the survey area.
- No Threatened, Priority or otherwise significant ecological communities were identified within the survey area.

Furthermore, a low risk of potential terrestrial groundwater dependent ecosystems (GDE) was reported in the adjacent floodplain areas.

2.3 Regional Hydrology

There are no natural permanent surface water bodies in the Western Queen Mine area. Ephemeral drainage channels flow only after heavy rainfall. Recharge occurs after large rainfall events when the surface water is present in low-lying areas for extended periods of time.

Several small surface water catchments drain from southeast to northwest across the Western Queen mine area. A main drainage runs west of the mining areas. A small natural drainage channel, with a catchment area of about 150ha, historically ran from east to west, through the WQS open pit area. As part of the mine development surface water flows are now diverted around the pit (MWES, 2012a). It is unknown if this drainage line is linked to sub-surface geological features (faults and/or shear zone) that may have been a contributing factor with pit wall instability.

Figure 2 presents local infrastructure in context to the current drainage lines.

2.4 Geology

2.4.1 Regional Geology

The Western Queen mine area lies within the Archaean Warda Warra Greenstone Belt, a north trending enclave within the Murchison Province of the Yilgarn Craton. The Warda Warra greenstone is surrounded by granitic rocks and consist of a mafic hanging wall contracting an ultramafic footwall. The contact dips steeply to the west and strikes north-northeast (Water Management Consultants, 1996). The belt is about 35km in length, and at the southern end near the Western Queen deposit it is 2km wide. To the north, it is up to 7km wide. The north-striking and west-dipping layered sequence has been metamorphosed to amphibolite grade and is enveloped by recrystallised granitoids (Ramelius Resources, 2014).

2.4.2 Local Geology

The local geology and geological structures that impact groundwater occurrence and flow in the Western Queen area is presented on Figure 7. In 2014, Ramelius Resources described the local stratigraphy as a steeply west-dipping greenstone sequence comprised of inter-bedded schistose amphibolites of mafic to ultramafic composition with thin iron formation horizons, spinifex textured komatiitic basalt, dolerite sills, talc chlorite schist and other assorted ultramafics. Later dolerite dykes and pegmatoid felsic intrusives cut the amphibolites.

The mafic lithologies are overlain by an overburden comprising of transported pisolitic colluvium and ferruginous clays, capped with a laterite formation of Tertiary age. The depth of the transported cover material is reported to be approximately 3m on the northern side of WQS, increasing significantly up to about 41m on the southern side (MWES, 2012).

The mineralised system that hosts the WQS deposit is a continuation of the deposit in the WQN mine to the north. Located within sheared mafic amphibolite host material, the layering in this zone dips steeply to the west, with the hanging wall being a continuation of the mafic amphibolite and the footwall a more ultramafic composition amphibolite. The amphibolite sequence is intruded by pegmatite and dolerite dykes.

Both the east and west sides of the mineralised zone are intruded by pegmatite dykes, stringers of which cut the mineralised zone. A prominent pegmatite dyke dipping at 65^{o} west, intrudes the western pit wall at WQS. Because the contact zones are fractured, they are a preferential groundwater flow path.

Oxidation of the bedrock at WQS varies considerably and extends to greater depths on the southern side of the deposit. This increased depth of weathering corresponds with increase depth of transported overburden because a shallow palaeovalley formed where these weathered materials were exposed.

The depth of the base of complete oxidation (BOCO) is interpreted to be located at about 41m depth on the northern side of the deposit and about 70m on the southern side. This influences the depth and distribution of fractured bedrock aquifers.

Across the proposed WQS mining area the *transitional* weathering (saprock) zone is limited to a sharp gradation between BOCO and the top of fresh rock (TOFR). TOFR is interpreted to lie at ~ 50m depth in the north and ~ 81m in the south of the deposit (Peter O'Bryan and Associates, 2012).

2.1 Hydrogeology Overview

The most prevalent aquifer at the Western Queen Mine site is associated with weathered and fractured Archaean bedrock. Previous reviews have established that fracturing results in high permeabilities in a variety of rock types above 50 to 60 meters depth, with fracturing being less common to 100 meters and difficult to find below 100m depth (Water Management Consultants, 1996). Fracturing was also noted to occur in or near pegmatite units at a number of locations.

The saprock aquifer is typically characterised by secondary porosity and permeability, often in association with geological structures. The storativity and hydraulic conductivity of this aquifer is largely related to the degree of weathering (clay content) and fracture intensity. Based on photographic evidence within the Western Queen Dewatering report (AECOM, 2021) the saprock aquifer is, outside of deep geological structures, only a thin layer at the transition between oxidised (clayey) weathered and fresh bedrock.

The saprock aquifer is overlain by a thick layer of saprolitic clay and superficial alluvial and laterite deposits. The saprolite zone varies in depth between 40m in the northern end of the deposit to 90m to the south. This deepening of the oxidation boundary roughly coincides with the deepening of the overlying transported alluvial sediments.

The Western Queen Shear is the dominant feature controlling the occurrence of deep permeable fractured aquifers. The WQS deposit is in a sheared amphibolite forming part of the Western Queen Shear. The fresh rock is comprised of competent (non-fractured) amphibolite in a steeply west dipping configuration.

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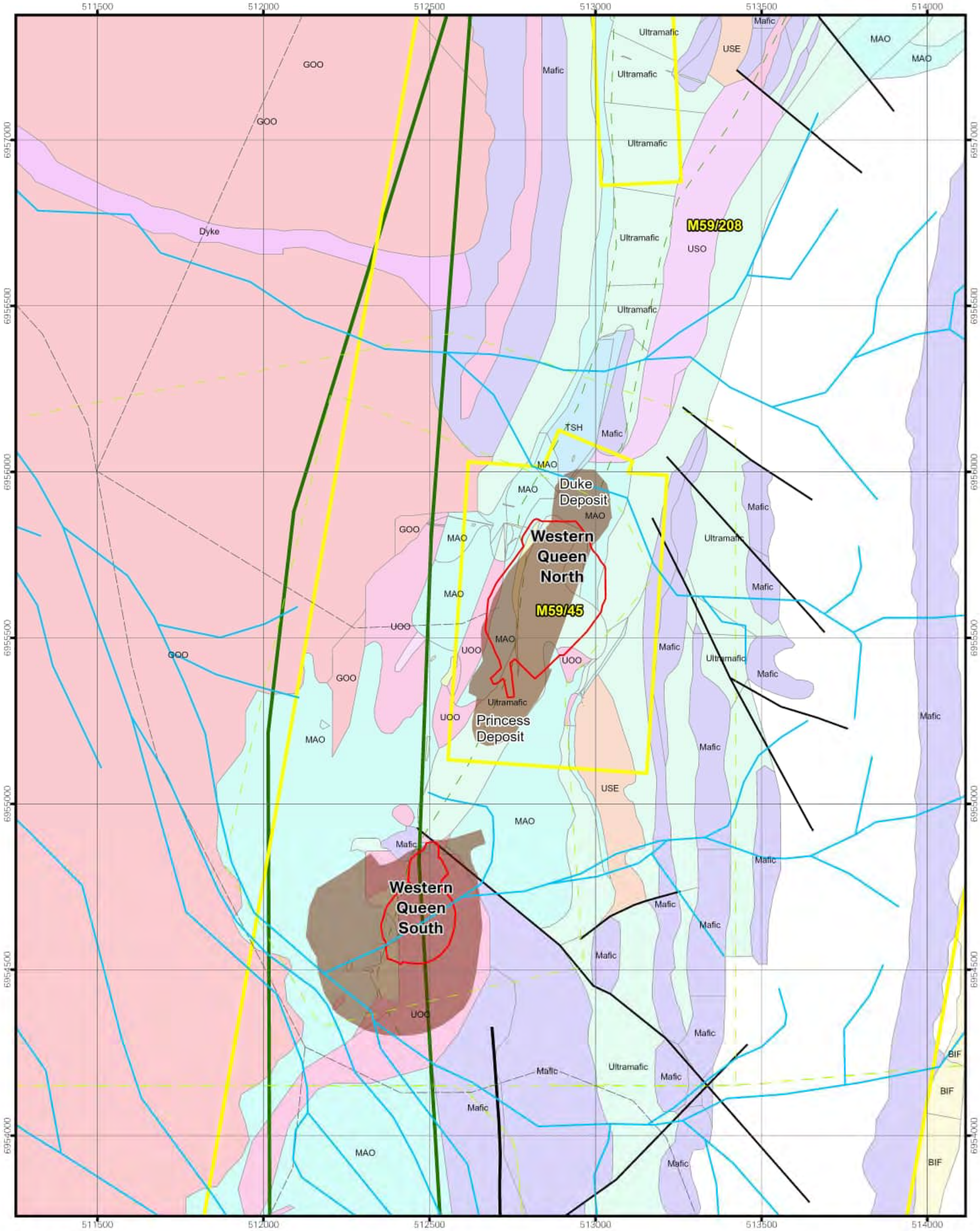

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1:15,000 (when printed at A4)

0 50 100 150 200 metres

GDA 1994 MGA ZONE 50

LEGEND

- Western Queen Tenements
- Existing Pit Outline
- Proposed Pit
- Haul Road
- Drainage Lines
- Fences
- Regional Structures (500k)
- Inferred fault
- Shear

Geology

- BIF
- Dyke
- GOO
- GPO
- MAO
- MDO
- Mafic
- Pegmatite
- Pegmatitie
- TSH
- UOO
- USE
- USH
- USO
- Ultramafic

Geology and Structures

WESTERN QUEEN

WESTERN QUEEN DEWATERING ASSESSMENT

Figure 7

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A4 size

Recharge to the aquifers hosted by the superficial alluvial and laterite deposits occurs via rainfall infiltration, typically after short duration sheet flooding events that flow along local surface drainages. This recharge would likely be migrating down to the saprolite clay then flow laterally towards the pit where it discharges as seepage high in the pit wall. The rate of recharge is typically linked to how long surface water remains in low-lying areas. The former creek line that crossed the WQS footprint has been bunded to divert surface water around the pit. Ponding and enhanced recharge behind this bund may be exacerbating high water levels behind the north-eastern wall of the WQS pit.

A long-term pumping test was carried out in the old main shaft of WQN in 1995. This test was undertaken over a period of 27 days at a pumping rate between 1,598 kL/day and 1,117 kL/day. Aquifer parameters were calculated from this test, with adopted values of Transmissivity of 75 m^2/day and a Storage Coefficient of 0.013 (Hydrosearch, 1996). In addition, Morgan (2000) reported these initial predictions from WQN were not considered valid for WQS because these high values were derived from unique highly transmissive fractured rocks deep in the section that were not detected during exploration at WQS. Therefore, with transmissivity of 30 m^2/day and a saturated thickness estimate of 60m, a hydraulic conductivity of 0.5 m/day is derived. A specific yield (Sy) of 0.02 (dimensionless) was used for estimating groundwater in storage for WQS.

The pre-mining water table was relatively flat, generally ranging between 19 and 23mbgl, forming a saturated zone of approximately 60m thick. Morgan (2000) estimated dewatering requirements to be up to about 2,500kL/day based on the estimated specific yield and transmissivity values. Although, these high yields were not intersected in more recent groundwater monitoring bores, this initial estimate was close to the final measured abstraction prior to cessation of mining.

Generally, groundwater within the main transmission zone which occurs between 40 and 80 m depth reported electrical conductivity (EC) in the range 3,000 µS/cm to 4,000 µS/cm (Water Management Consultants, 1996). An increase in conductivity with depth was also identified and where permeable fractures occur below 80- m depth, the groundwater quality deteriorated up to 15,000 µS/cm or 9,800 mg/L Total Dissolved Solids (TDS).

Historical groundwater salinity at WQS was reported by Morgan (2000) as being of better-quality ranging between 1,800 – 1,900µS/cm, equivalent to about 1,000 to 1,050mg/L TDS and neutral pH of about 7.6. Ground was collected from three exploration holes (Table 7) and samples sent for laboratory analysis. Native groundwater quality (baseline) for WQS is presented in Table 8.

Table 7 Groundwater Chemistry of Western Queen South (Morgan, 2000)

Hole No.	Easting	Northing	GL (m AHD)	Depth (m)
QNC 38900-4	20,739	38,899	390.12	121
QNC 38875-1	20,759	38,878	389.94	90
QNC 38950-3	20,709	38,949	390.31	160

Table 8 Groundwater Chemistry of Western Queen South (Morgan, 2000)

Component	Units	Detection Limit	M001	M002	M003
			QNC 38900-4	QNC 38875-1	QNC 38950-3
			WQS (Morgan, 2000)		
Electrical Conductivity (EC)	mS/cm	1	1,900	1,800	1,800
Total Dissolved Solids (TDS)	mg/L	1	1,050	1,050	1,000
Sodium	mg/L	1	340	345	335
Potassium	mg/L	1	9	9	9
Calcium	mg/L	1	22	20	20
Magnesium	mg/L	1	20	20	19
Harness ($CaCO_3$)	mg/L	1	135	130	130
Iron	mg/L	0.01	<0.01	<0.01	<0.01
Silicon	mg/L	1	40	33	34
Cadmium	mg/L	1	<1	<1	<1
Lead	mg/L	1	<1	<1	<1

Component	Units	Detection Limit	M001	M002	M003
			QNC 38900-4	QNC 38875-1	QNC 38950-3
			WQS (Morgan, 2000)		
Copper	mg/L	0.01	<0.01	<0.01	<0.01
Manganese	mg/L	0.01	<0.01	0.06	<0.01
Zinc	mg/L	0.01	0.02	0.13	0.02
Selenium	mg/L	1	<1	<1	<1
Arsenic	mg/L	1	<1	<1	<1
Chromium	mg/L	0.01	<0.01	<0.01	<0.01
Mercury	mg/L	0.1	<0.1	<0.1	<0.1
pH	-	1	7.55	7.3	7.45
Carbonate	mg/L	1	<1	<1	<1
Bicarbonate	mg/L	1	134	131	122
Hydroxide	mg/L	1	<1	122	<1
Ion Balance	mg/L	1	0.3	3.7	3.3
Chloride	mg/L	1	450	415	415
Sulphate	mg/L	1	98	92	91
Fluoride	mg/L	0.1	0.9	1	1
Nitrate (as NO_3)	mg/L	0.01	51	51	44
Nitrite (asNO_2)	mg/L	0.01	<0.01	<0.01	<0.01

MWES Consulting sampled groundwater from four groundwater monitoring bores at WQS in 2012. In context with measured groundwater inflows, local groundwater quality is summarised in Table 9. Results highlight lower salinity concentrations in WQS compared to WQN.

Table 9 Historical Western Queen Groundwater Quality Analysis

Bore ID	Maximum Flow Rate During Drilling	EC @ 25º C	TDS	pH
	L/sec	µS/cm	mg/L	
WQS (MWES, 2012)				
WQSMB01	0.76	4,700	3,700	7.9
WQSMB02	0.44	2,100	1,300	8.1
WQSMB03	2.90	3,900	2,400	8.1
WQSMB04	0.31	1,900	1,200	8.2
		Minimum	*1,200*	-
		Maximum	*3,700*	-
		Average	*2,150*	-
WQN (Morgan, 2000)				
WQG31-SW	30.1	3,500	2,275	-
WQG32-NW	2.0	4,000	2,600	-
WQG33-NE	4.6	16,400	10,660	-
WQG34-SE	2.5	3,800	2,470	-
		Minimum	*2.275*	-
		Maximum	*10.660*	-
		Average	*4.500*	-

Morgan (2000) reported heavy metals have historically been reported mostly below detection limits set by the laboratory indicating that heavy metals are not of environmental concern. Nitrate was reported high (44 to 51 mg/L), however is typical of natural groundwaters in the arid to semi-arid regions of Western Australia.

3.0 Hydrogeological Site Work 2025

3.1 Overview

To complement the historical hydrogeological information available and collect more recent groundwater related data, a 5-day site reconnaissance was undertaken. Site works were conducted by AECOM between 17 and 21 February 2025, with support from Rumble and Mega personnel.

The objective was to visually assess current pit lakes, open pit extent in context of existing pits and historical dewatering challenges, and mine water discharge options, such as the proposed evaporation pond area and local creeklines for potential direct discharge. Pit lake sampling locations are presented in Table 10 and on Figure 8**.** The following tasks were completed during this site visit:

- Use of a small boat on both WQS and WQN pit lakes to allow pit lake water quality information to be collected.
- Water quality profiling at two locations within each pit (WQN and WQS) using a multi-parameter YSI ProDDS water quality meter capable of 100m depth, to allow measurements of pH, Oxidation Reduction Potential (ORP), Dissolved Oxygen (DO), Electrical Conductivity (EC), Salinity, Temperature, Total Dissolved Solids (TDS) and Turbidity for the entire vertical column (116m max Western Queen North; 60m max Western Queen South).
- To complement the profiling, water samples were collected from nominal depths of 30m and 60m. Samples were dispatched to ALS Environmental, a NATA certified laboratory, for analysis of major ions and metals.
- Ad hoc groundwater levels from existing monitoring bores and opportunistic open exploration holes were measured using an electric dipmeter and where possible, groundwater samples were bailed and dispatched for laboratory analysis.

Table 10 2025 Pit Lake Sampling Locations

Western Queen Pit	Easting (MGA)	Northing (MGA)	Pit Lake Elevation	Floor Elevation (m AHD)	Water Depth (m)
			(m AHD)		
South 1	512,465	6,954,650	362	301	61
South 2	512,442	6,954,594	362	318	44
North 1	512,807	6,955,568	361	276	85
North 2	512,881	6,955,655	361	268	93

Details of field results are provided below.

3.2 WQN and WQS Pit Lakes

3.2.1 Water Quality Profiling

Field water quality measurements were derived using an Aqua TROLL 600 Multiparameter Sonde. Measured parameters included pH, conductivity, salinity (TDS), turbidity, dissolved oxygen, redox potential, resistivity, density, temperature and pressure. Upon review of the results the instrument was found to be faulty, due to abnormally low and high in parts of the profiles. However, the data does provide the following:

- The water column is stratified.
- The water column reports a neutral pH (a general pH between 7 and 8).
- A thermal barrier appears to exist in both pit lakes at around 20m depth.
- Water quality spatial patterns appear to be the result of rainfall runoff down pit ramp areas.

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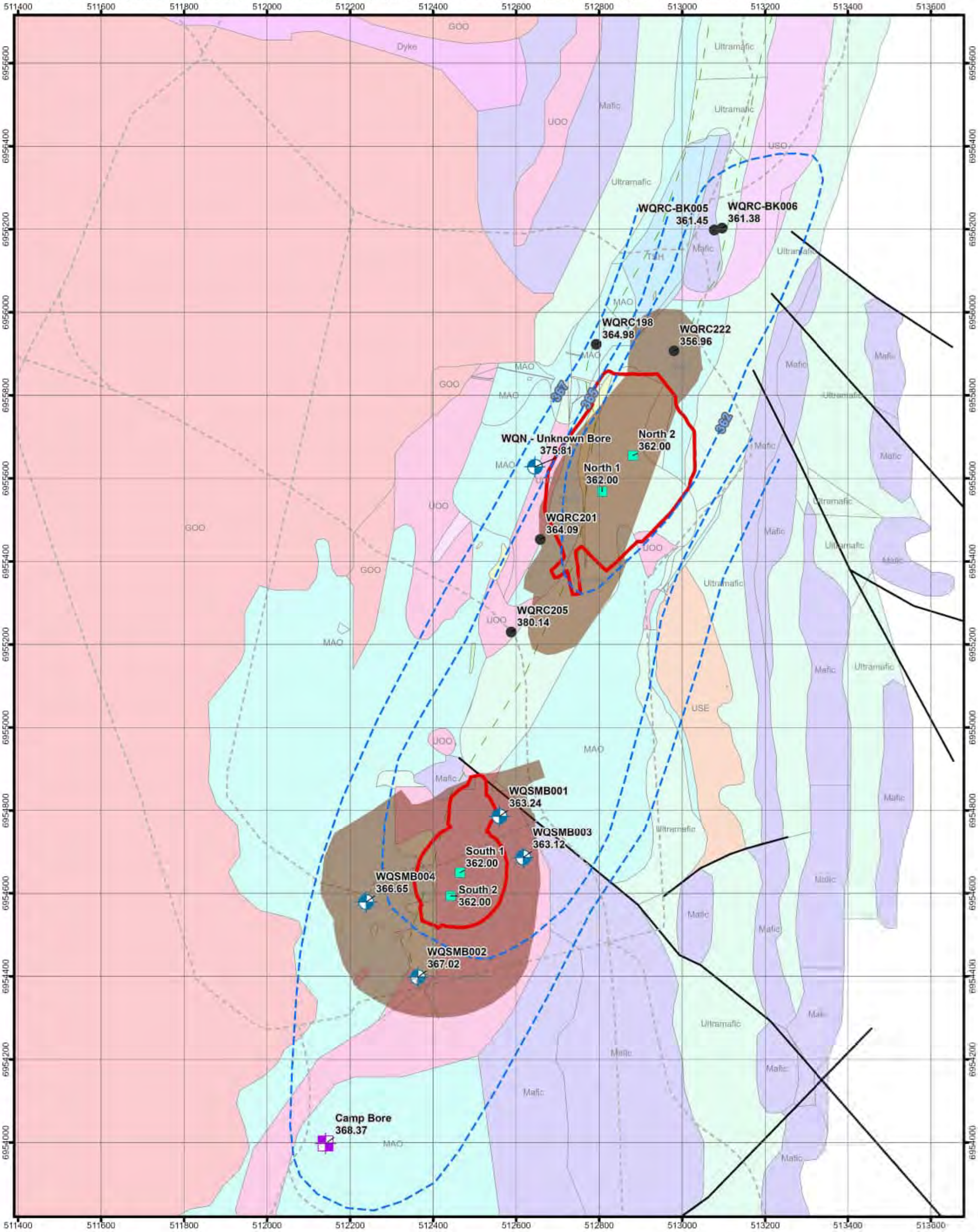

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DATE MODIFIED 27 MAY 2025 APPROVED BY G.BROPHY

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0 50 100 150 200 metres

GDA 1994 MGA ZONE 50

LEGEND

- Existing Pit Outlines
- Proposed Pit
- Track, Unsealed
- Exploration hole
- Monitoring Bore
- Production Bore
- Pit Lake
- Groundwater Level Contours (mAHD)
- Inferred fault
- Shear

Geology

- Dyke
- GOO
- GPO
- MAO
- MDO
- Mafic
- Pegmatite
- Pegmatitie
- TSH
- UOO
- USE
- USH
- USO
- Ultramafic

Western Queen Groundwater Contours (Feb, 2025)

WESTERN QUEEN

WESTERN QUEEN DEWATERING ASSESSMENT

Figure 8

A4 size

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- Dissolved oxygen concentrations in both ends of WQS and the southern end of WQN report increasing concentrations to 20 to 30m depths. This may indicate a rainfall recharge event occurred given this aligns with elevated turbidity in the water column.

Pit lake water quality profile results for WQS are presented on Table 11 and for WQN on Figure 8.

3.2.2 Laboratory Sampling

During the 2025 site work, pit lake water sampled were collected from the water column and dispatched for laboratory analysis. Laboratory results are summarised in Table 11. Laboratory certificates are provided in Appendix A.

Key pit lake water quality observations:

- Generally, a uniform salinity throughout the water column for both open pits and ranges between 18,400mg/L TDS at the surface (<10m depth) and 31,100 mg/L TDS at a depth of 75m.
- pH values reporting neutral (pH 7.6) to slightly alkaline (pH 8.3) water
- Sodium Chloride water type
- Elevated metals concentrations (iron, Manganese, Chromium) below 75m in WQN.
- Slight reduction in Nitrate, Nitrite below 75m depth in WQN.

In context to the above pit lake water quality, laboratory groundwater quality for the WQS area (Table 9) reported an average salinity of about 2,150 mg/L TDS, neutral pH (pH 7.5) and an elevated bicarbonate compared with the pit lake water.

In conclusion, pit lake water quality in both open pits has likely undergone evapo-concentration over the estimated 10-year period as pit lake levels recovered. The water quality is however observed to have similar chemical composition and therefore mixing between the two pits would pose little additional risk.

To help inform other excess water management options, pit lake laboratory results were screened against water standards for likely at-risk water resource users, including freshwater fish within the local creeks and Sanford River and local livestock. The two categories include:

- Criteria 1 - ANZG (2018) Freshwater Unknown Light organic solvent preservative (LOSP) Toxicant default guideline value (DGV)
- Criteria 2 - ANZECC 2000 Livestock DW Low Risk Trigger Values

The results indicated exceedances mostly within WQN for metals and sulphate (Table 12). A single exceedance in WQS was noted due to cobalt.

Table 11 Summary of Pit Lake Laboratory Sample Results (February 2025)

Component	Units	WESTERN QUEEN NORTH					WESTERN QUEEN SOUTH			
		WQN1	WQN2	WQN3	WQN4	WQN5	WQS1	WQS2	WQS3	WQS4
		Sample Depth (m)								
		20	92	75	20	10	30	50	6	18
Electrical Conductivity (EC)	mS/cm	25,900	24,900	43,700	24,700	25,000	24,600	25,000	25,700	25,100
Total Dissolved Solids (TDS)	mg/L	19,200	18,500	31,100	18,200	18,700	18,400	18,900	18,800	18,800
Sodium	mg/L	4,090	3,850	8,240	3,850	3,870	3,650	3,750	3,770	3,790
Potassium	mg/L	94	116	287	116	117	101	103	103	104
Calcium	mg/L	583	580	582	577	589	619	629	640	644
Magnesium	mg/L	580	571	789	565	576	602	613	622	626
Harness ($CaCO_3$)	mg/L	90	93	152	91	89	82	99	62	81
Iron	mg/L	<0.05	<0.05	3.41	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	<0.0002	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0015
Lead	mg/L	<0.002	<0.002	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	0.006
Copper	mg/L	<0.002	<0.002	0.112	<0.002	<0.002	0.005	0.004	<0.002	0.006
Manganese	mg/L	0.023	0.008	0.668	0.006	0.003	0.002	0.058	0.004	0.008
Zinc	mg/L	0.06	0.023	0.071	0.011	<0.010	<0.010	<0.010	0.016	0.011
Selenium	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Arsenic	mg/L	<0.002	<0.002	0.005	<0.002	<0.002	<0.002	<0.002	<0.002	0.008
Chromium	mg/L	0.002	0.003	0.901	0.008	0.003	<0.002	<0.002	<0.002	0.006
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
pH	-	8.14	8.31	8.18	8.34	8.23	7.86	7.78	7.63	8.22
Carbonate	mg/L	<1	<1	<1	2	<1	<1	<1	<1	<1
Bicarbonate	mg/L	90	92	152	88	89	82	99	62	81
Hydroxide	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ion Balance	mg/L	2.12	0.09	2.95	0.3	1.5	3.81	0.26	0.7	1.24
Chloride	mg/L	8,720	7,990	14,000	8,010	8,310	8,580	8,140	8,310	8,440
Sulphate	mg/L	984	940	1,700	934	935	830	830	846	855
Fluoride	mg/L	1.6	1.6	1.5	1.6	1.6	1	1	1	1
Nitrate (as NO_3)	mg/L	8.19	8.35	6.54	8.27	8.29	1.28	0.98	1.17	1.17
Nitrite (asNO_2)	mg/L	0.24	0.25	0.19	0.22	0.28	0.02	0.01	0.05	0.05

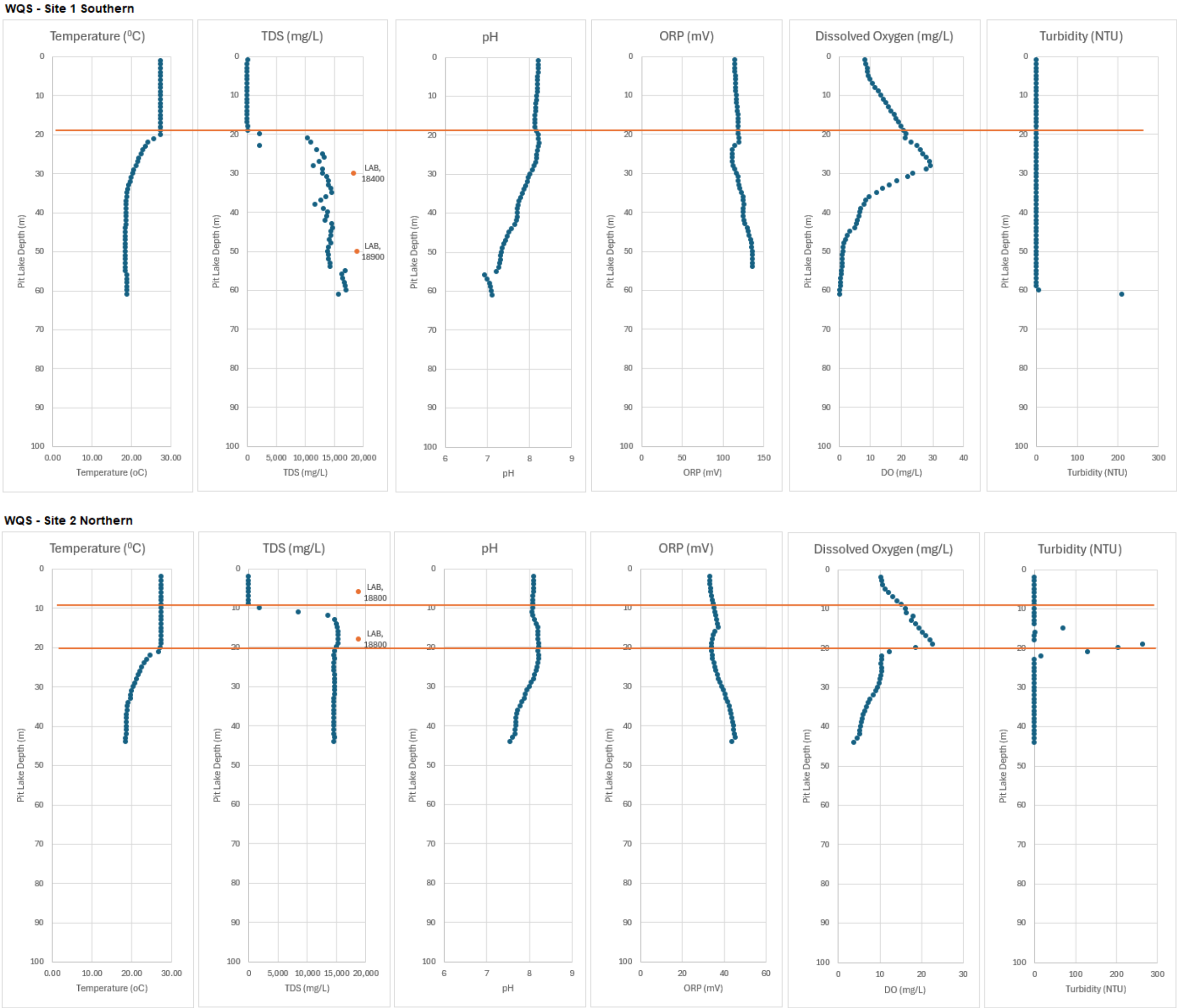


Figure 9 Western Queen South – Pit Lake Profile Plots

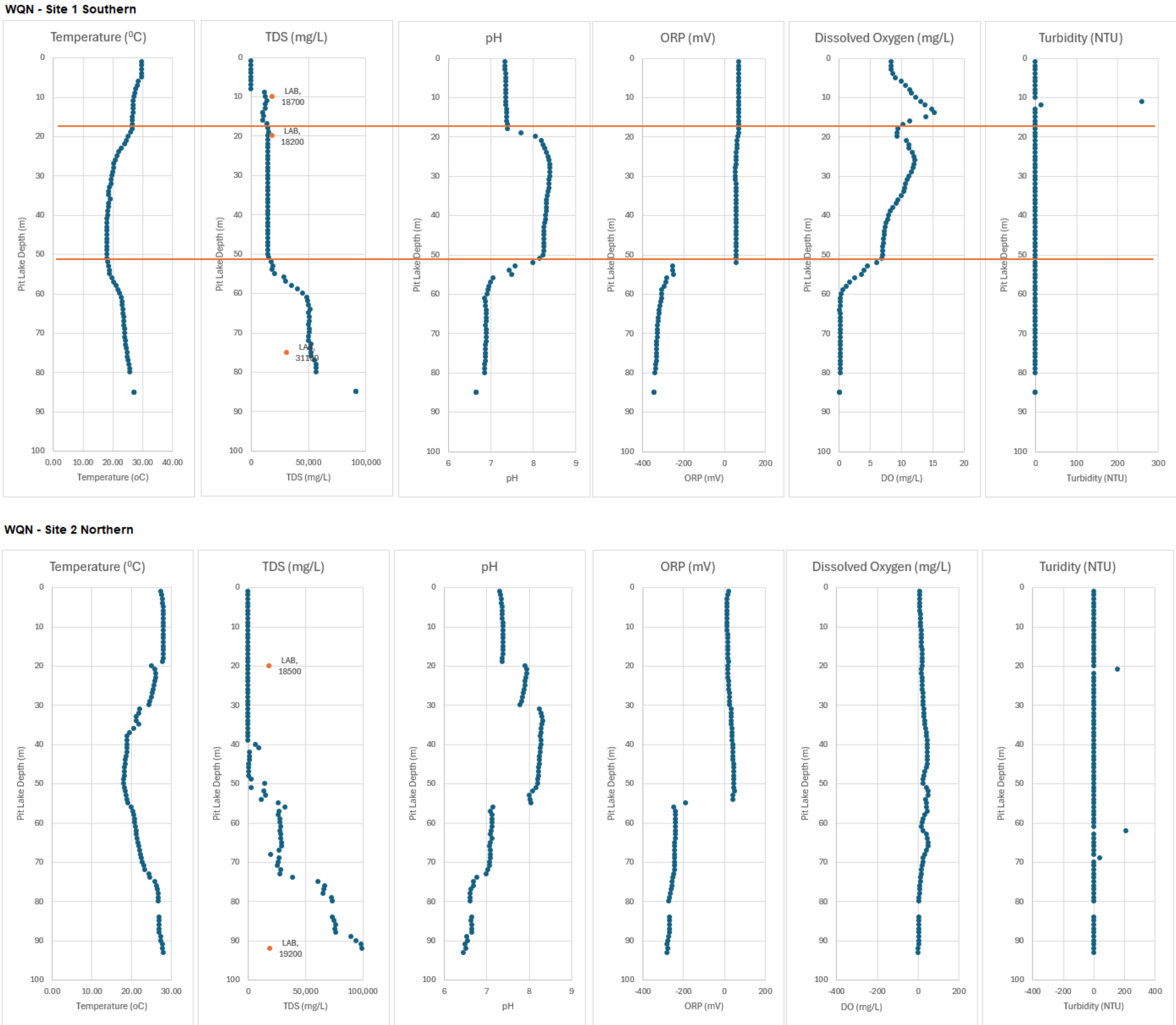


Figure 10 Western Queen North – Pit Lake Profile Plot

Table 12 Pit Lake Water Quality - Analyte Exceedances

Analyte	Criteria 1 Limit (mg/L)	Criteria 1 Exceedance Location	Criteria 1 Highest Exceedance %	Criteria 2 Limit (mg/L)	Criteria 2 Exceedance Location	Criteria 2 Highest Exceedance %
Aluminium	0.0008			5	WQN3	492
Antimony	0.009					
Arsenic				0.5		
Cobalt	0.0014	WQN3, WQS4	4,500	1		
Molybdenum	0.034	WQN1,2,5	112	0.15		
Uranium	0.0005	WQN1-5	1,800	0.2		
Vanadium	0.006	WQN1-5	1,833			
Zinc				20		
Sulfate as SO4 (Turbidimetric) (filtered)				1,000	WQN3	170
TDS				2,000	All	1,555

3.3 Groundwater

3.3.1 Groundwater Quality Profiles

Insitu field water quality measurements in existing bores (Camp Bore, WQSMB001, WQSMB002, WQSMB003, and WQSMB004) and were collected using a downhole Aqua TROLL 600 Multiparameter Sonde. All bores were located in the WQS area, with no existing bores located in the WQN area. Whilst groundwater levels were measured in open exploration holes, water quality profiles could not be completed in the angled open holes.

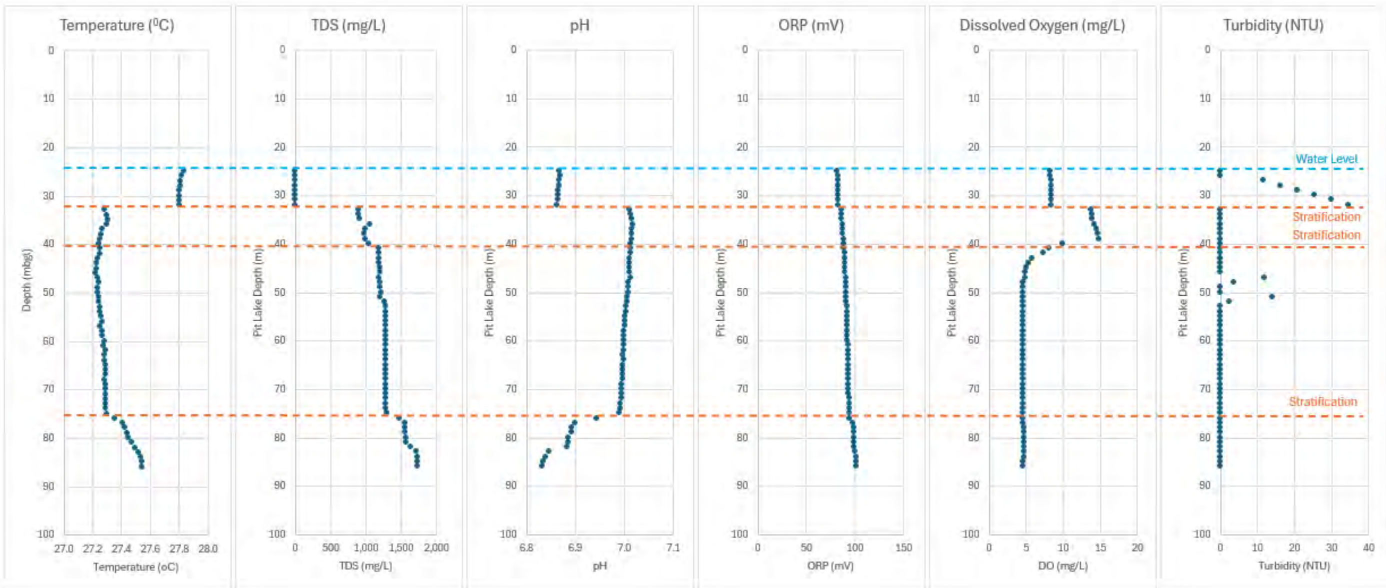
Measured parameters included temperature, salinity (TDS), pH, redox potential resistivity, dissolved oxygen, and turbidity. Profile plots are presented in Figure 10. The local groundwater quality data shows:

- Camp Bore likely represents natural groundwater quality and outside the potential influence of the pit lakes.
- Camp Bore salinity averages approximately 1,300 mg/L TDS throughout the water column, with a slight increase in salinity up to 1,700 mg/L TDS from 75m bgl.
- The general groundwater column quality is stratified with uniform salinity observed below about 45m depth (about 10m below the measured static water table).
- The groundwater column reports a general neutral pH (a general pH 6 to pH 7).
- Water quality spatial patterns appear to be the result of links to pit lakes. WQSMB001 reported salinity up to 12,400 mg/L TDS and likely a result of a direct geological structural linked to the pit lake.
- Dissolved oxygen concentrations in both ends of WQS and the southern end of WQN report increasing concentrations to 20 to 30m depths. This may indicate a rainfall recharge event occurred given this aligns with elevated turbidity in the water column.

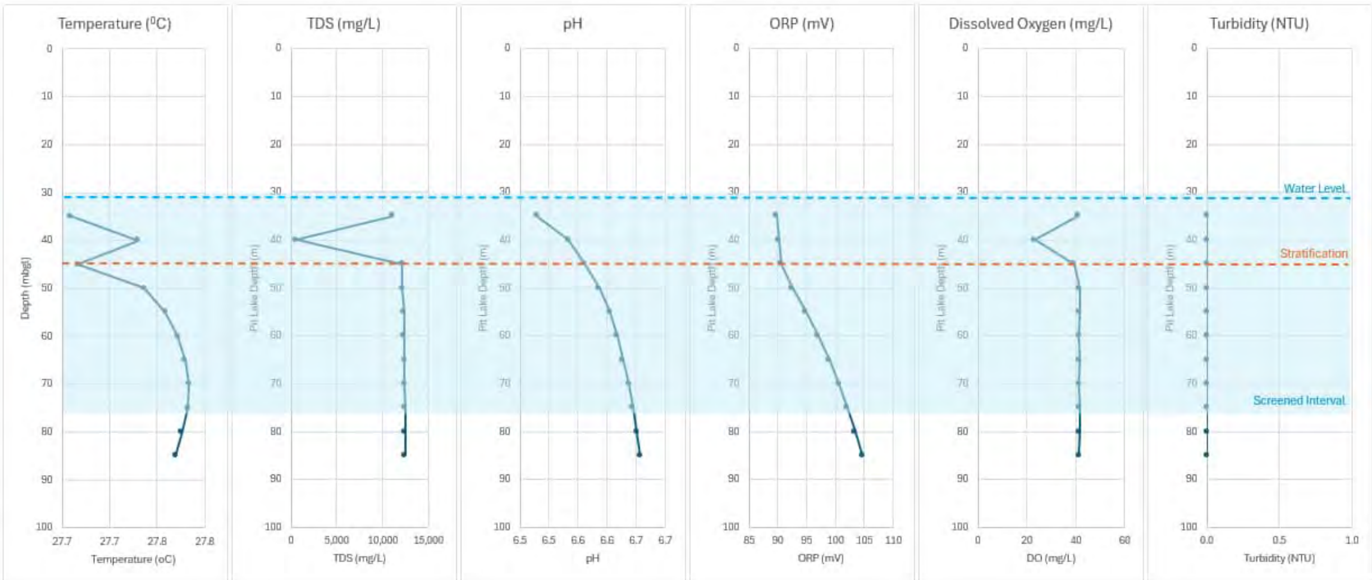
Groundwater quality profile results are presented on Figure 9.

In conclusion, native local groundwater salinity in the WQS area ranges between 1,300 and 1.700 mg/L TDS. These concentrations are significantly lower than pit lake measurements (18,000 mg/L).

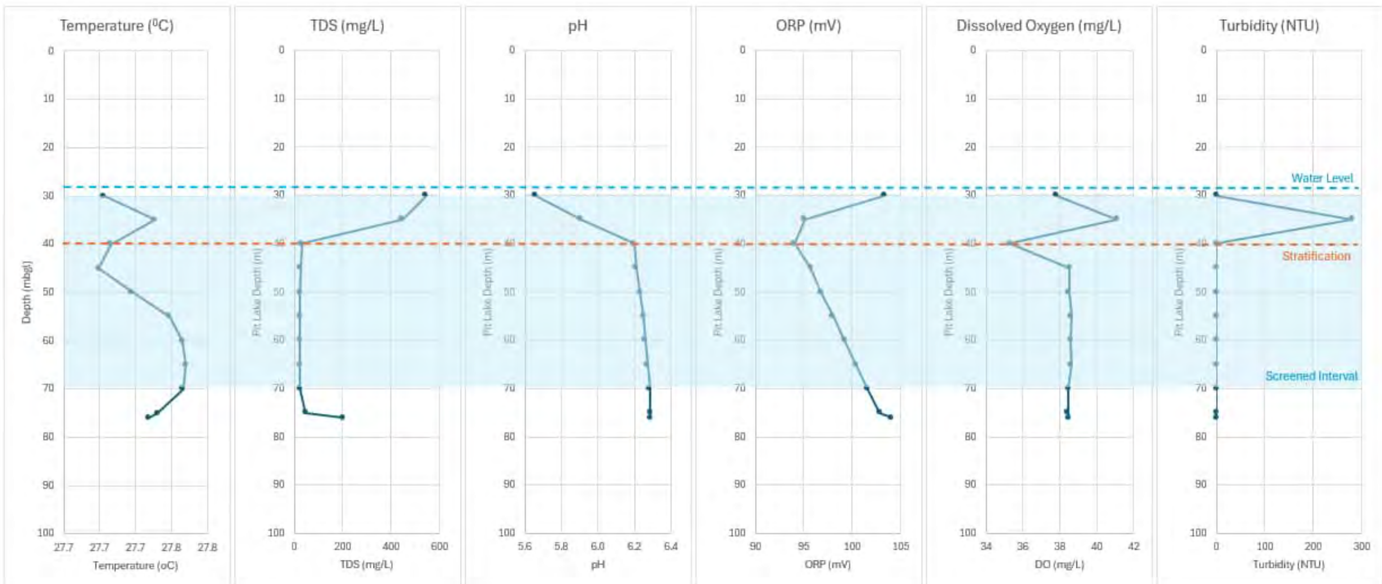
CAMP BORE



WQSMB001



WQSMB003



WQSMB004

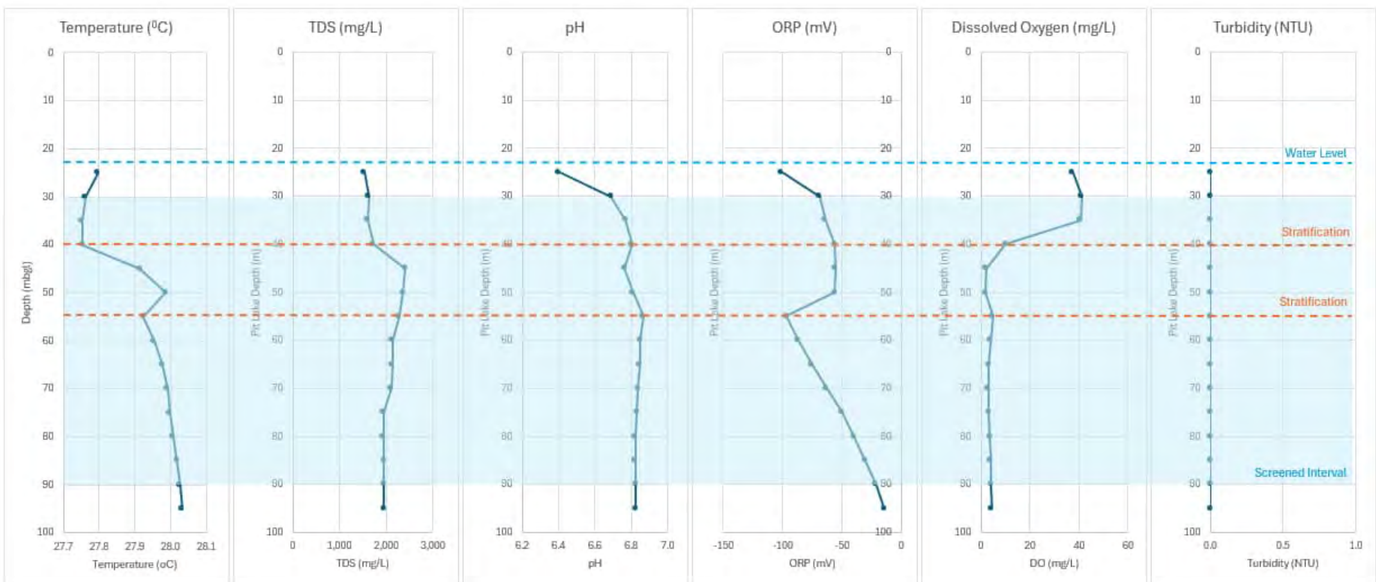


Figure 11 Groundwater Quality – Downhole Water Quality Profile Plots

3.3.2 Groundwater Levels

Based on the LIDAR elevation model surveyed in 2020, pit lake water levels were estimated to be 362m AHD in WQS and 362m AHD in WQN. Pit lake levels in past surveys in 2019 reported pit lake elevations of 361m AHD in WQS and 360m AHD in WQN.

Groundwater levels were also measured in selected open groundwater monitoring bores and exploration holes during the February 20205 site visit (Table 13).

Groundwater contours (Figure 8) were based on water levels within the existing monitoring bores surrounding WQS (WQSMB001-4) and in ongoing exploration holes on site. The exploration holes were drilled at 60º and have been vertically corrected to account for the drill angle. Groundwater levels ranged between 356.96 mAHD (WQRC222) in the north and 380.14 mAHD (WQRC205) in the centre of the site. Levels for WQS monitoring bores ranged from 363.12 (WQSMB003) in the northeast and 367.02 (WQSMB002) in the south. The general groundwater flow regime is from south to north.

3.1 Surface Water Catchment Reconnaissance

During the site visit several surface water features, creeks and the Sanford River were inspected historical discharge areas and make observations of local low-flow and flood plan catchment characteristics for potential locations for excess water discharge.

At the time of the reconnaissance, all creekbed locations inspected were dry, however there where was evidence of significant salt deposition observed in some local catchments, particularly within the Sanford Riverbed. These areas reported salt crust in main low-flow channels.

However, a surface water sample was later collected by Rumble Personnel on 18 April 2025 and sent to ALS Environmental Laboratory for analysis. Sample results report hypersaline water with a salinity concentration of 238,000 mg/L TDS, well above all project related pit water and groundwater. Water quality results are provided in Appendix A.

The remnants of a historical discharge pipeline infrastructure were identified approximately 1.2 km from the WQN open pit. Most pipelines were observed to be either above ground and damaged or below ground, partially exposed and infilled with sediment.

Locations and photographs of surface water features and historical discharge infrastructure observed during the site reconnaissance are presented on Figure 12 and Table 14.

Table 13 Summary of Surface Water Sites

Site	Easting (mE MGA)	Northing (mN MGA)	Type	Description
CC1	505,958	6,957,903	Creek Crossing	Creek bed located near Yalgoo - Belele Well. No observed salt scalding.
CC3	504,789	6,963,963	Creek Crossing	Creek bed with observed salt scalding.
CC4-DL	506,937	6,962,515	Creek Crossing	Creek bed with observed broken PVC piping. Piping is noted to be infilled from silt build up.
CC5	501,928	6,963,722	Creek Crossing	Creek crossing with observed salt scalding.
CC6	500,662	6,965,010	Creek Crossing	Sandford riverbed with notably large salt deposits on dry riverbed (as of Feb 2025).
CC7	500,529	6,964,951	Creek Crossing	
DL1	510,536	6,958,151	Discharge Line	Historic concrete culverting along former drainage line.
DL2	511,846	6,956,626	Discharge Line	Historic PVC piping present (damaged) along former drainage line.
Sandford River	511,540	6,967,562	Ponded Water	Water Sample collected by Rumble Personnel (18/4/2025) and sent for laboratory analysis

Table 14 Western Queen Groundwater Levels (February 2025)

Location Name	Type	Easting (mE MGA)	Northing (mN MGA)	2025 LIDAR Ground Elevation (m AHD)	Base (mbgl)	Screened Interval (mbgl)	Top Of Casing (m)	Vertical Static Water Level (mbgl)	Static Water Level (m AHD)	Average In Situ Salinity (mg/L TDS)
WQN	Pit Lake	-	-	392.00	-	-	-	32.00	360.00	18,800
WQS	Pit Lake	-	-	390.00	-	-	-	29.00	361.00	18,400
Camp Bore	Production Bore	512,141	6,953,998	390.70	89.30	unknown	0.38	23.25	367.45	1,300
Yalgoo - Belele Well	Station Well	505,647	6,957,658	*385.00*	8.80	open hole	0.12	3.16	381.84	-
Yalgoo Budgery Well	Station Well	501,847	6,963,279	*365.00*	2.60	open hole	0.00	2.50	362.50	-
Yalgoo Wanrey Well	Station Well	506,495	6,962,017	*375.00*	6.07	open hole	0.76	-0.80	375.80	-
WQN - Unknown Bore	Monitoring Bore	512,645	6,995,628	390.92	20.00	open hole	0.00	15.02	375.90	-
WQSMB001	Monitoring Bore	512,560	6,954,786	394.19	78.20	30-78	0.30	30.46	363.73	12,500
WQSMB002	Monitoring Bore	512,363	6,954,398	389.72	28.30	30-90	0.60	22.20	367.52	-
WQSMB003	Monitoring Bore	512,617	6,954,686	391.40	74.00	30-72	0.30	28.10	363.30	-
WQSMB004	Monitoring Bore	512,239	6,954,579	389.33	90.40	30-90	0.00	22.70	366.63	2,000
WQRC205	Exploration hole	512,588	6,955,230	392.19	-	open hole	-	12.44	379.75	-
WQRC201	Exploration hole	512,658	6,955,453	391.98	-	open hole	-	29.08	362.90	-
WQRC198	Exploration hole	512,793	6,955,923	390.95	-	open hole	-	23.83	367.12	-
WQRC222	Exploration hole	512,980	6,955,907	392.42	-	open hole	-	33.25	359.17	-
WQRC-BK006	Exploration hole	513,096	6,956,203	391.76	-	open hole	-	32.02	359.74	-
WQRC-BK005	Exploration hole	513,077	6,956,198	391.60	-	open hole	-	31.95	359.65	-

magl – meters above ground level
mbgl – meters below ground level
m AHD – meters Australian Height Datum

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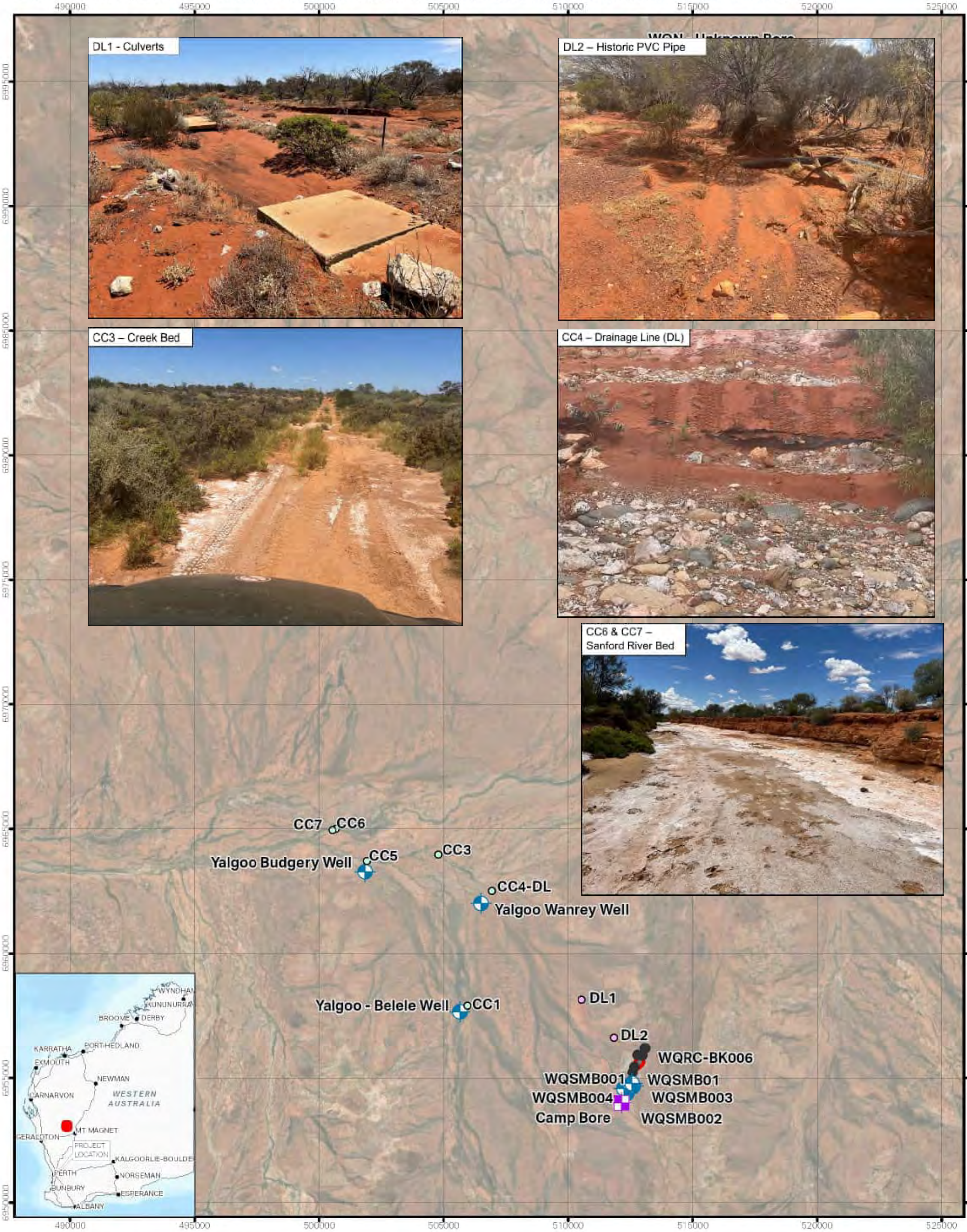

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GDA 1994 MGA ZONE 50

LEGEND

- Pit Outlines
- Exploration hole
- Monitoring Bore
- Production Bore
- Monitoring Bore
- Creek Crossing
- Discharge Line

Regional Bores and Surface Water Features

WESTERN QUEEN

Western Queen Dewatering Assessemnt

Figure

12

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4.0 Groundwater Assessment

4.1 Conceptual Hydrogeological Model

The conceptual hydrogeological model has been compiled based on findings from the literature review and site observations. The schematic cross section is presented on Figure 13.

- The average annual rainfall over the past 10 years is about 217.5mm, with an annual evaporation up to 2,600mm.
- In the Goldfields Region, groundwater is typically recharged by infiltration in elevated areas where fractured bedrock is exposed or in low-lying areas where surface water persists allowing prolonged periods for infiltration to occur. Groundwater flow generally follows topography to regional low-lying areas that form discharge zones (river pools, salt lakes and salinas).
- Infiltration from rainfall is inferred to recharge groundwater at very low rates. It is common in arid zones that recharge only occurs after rainfall events (over one or successive days) of about 50mm or more. In our experience net recharge often ranges between 0.5 and 1.0 percent of the annual rainfall. This is a however a simplification of actual conditions that result from infrequent large or prolonged rainfall events.
- The pre-mining water level was reported at about 355m RL (35mbgl) to the north of WQN and about 367m RL (23mbgl) in WQS.
- The pre-mining historical regional groundwater flow direction is in a north-north-east direct.
- Current (February 2025) local groundwater levels range from highest around the south (Camp Bore 367m AHD; 23.25mbgl) to 360m AHD (32.0 mbgl) to the north (WQRC-BK006).
- Stratigraphic units in order of increasing depth:
  - Alluvial and aeolian superficial sediments (**Aquifer were saturated**)- Local ferricrete formations may be preferential pathways that transmit rainfall recharge to low lying areas.
  - Saprolite clay (**Aquitard**) - Extremely weathered saprolitic clay that is normally of low to very low hydraulic conductivity and forms an aquitard when below the water table.
  - Saprock (**Aquifer where saturated**)– moderately weathered bedrock, varying between being an aquitard to aquifer of low to moderate hydraulic conductivity. Locally, the saprock interval maybe transmissive along contact zones and/ or fault or shear zones.
  - Fresh bedrock (**Aquitard**) - generally massive and non-fractured and is regarded as a regional aquitard that is expected to yield little groundwater.
- The alluvial sediments occur to a depth of about 5mbgl (385m AHD) on the northern side of WQS and about 27mbgl (363m AHD) on the southern side. Surface water infiltration into these shallow deposits is probably an important mechanism for local groundwater recharge.

Locally enhanced permeability along a north-south shear zone (Western Queen shear zone) may provide groundwater connectivity between WQN and WQS. Associated hydrogeological characteristics include:

- The fracturing intensity and saprock thicknesses were found to be widely variable between drillholes. Both were enhanced at contact zones between rock types and the Western Queen shear zone.
- Typical of fractured rock groundwater environments, aquifers associated with saprock, and geological structures are irregular, inhomogeneous, and anisotropic.
- Historical groundwater inflows at WQN and WQS were linked to lithological contact zones and rock fractures associated with local geological shear zones and structures.
- Based on AECOM's experience in similar settings in the Goldfields Region, the apertures of fractures in fresh bedrock and their transmissivity tend to decrease with depth.

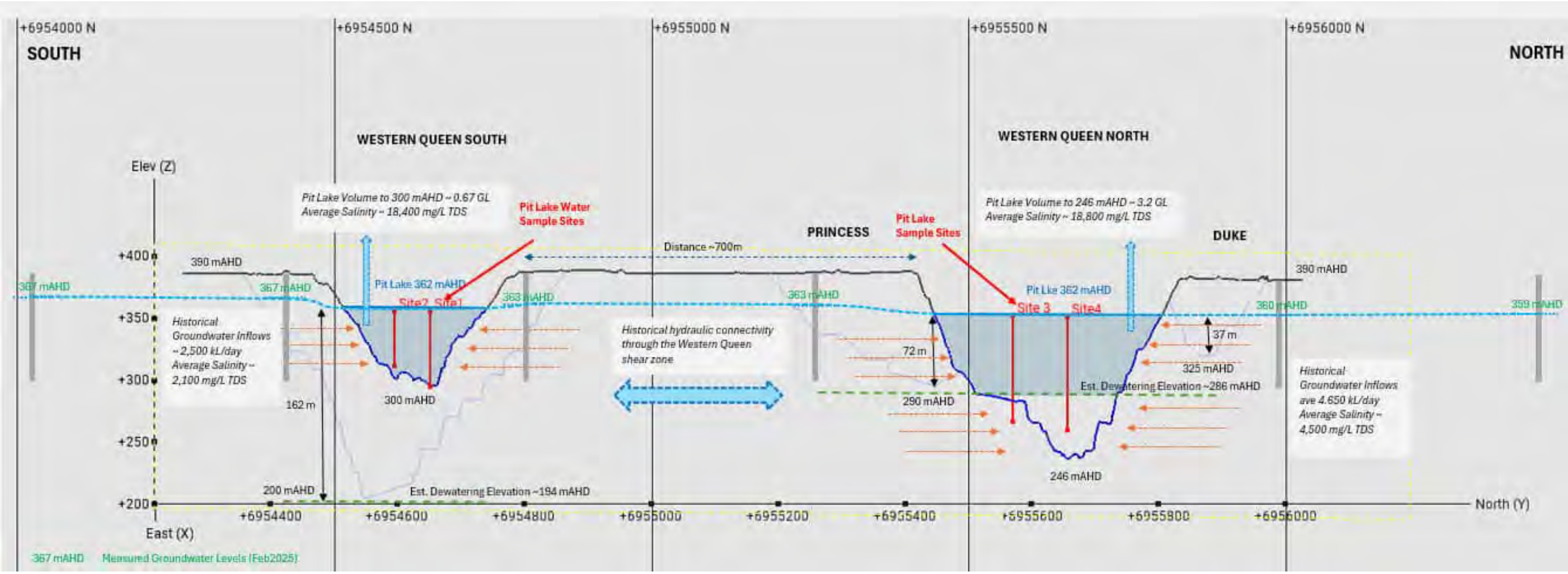

Figure 13 Conceptual Hydrogeological Model

- Current pit lake elevations are estimated at approximately 362m RL for both pits.
- Based on in situ water quality sampling, pit lake salinity is approximately 18,400mg/L TDS for WQS and 18,800mg/L TDS for WQN.
- Hydraulic properties derived from WQN pumping tests reported an adopted Transmissivity value of 75 m^2/day to 84 m^2/day and a Storage Coefficient of 0.013 (dimensionless).
- No aquifer tests have been reported at WQS, however the Specific Yield (Sy) of 0.02 was derived from WQN.
- The high transmissivity value of 84 m^2/day determined for WQN was not considered appropriate for WQS. An aquifer transmissivity of 30m^2/day and hydraulic conductivity of 0.5 m/day were estimated by Morgan (2000).
- Historical dewatering abstraction of up to 54 L/sec (4,650 kL/day) were reported from WQN (Morgan, 1999) and 30 L/sec or 2,500 kL/day during mining of WQS (Morgan, 2000).
- Historical groundwater is reportedly fresh to slightly brackish, sodium chloride type with TDS concentrations at WQN ranging up between 2,000 mg/L and 10,660 mg/L (average 4,500 mg/L TDS) and between 1,200 mg/L and 3,700mg/L (average 2,100mg/L TDS) at WQS. Groundwater is generally neutral to slightly alkaline pH (pH 7.9 to 8.1).
- Heavy metals are mostly below the detection limits set by ALS Environmental laboratory indicating that heavy metals are not of environmental concern.
- An east to west surface water drainage feature that once crossed the WQS pit is now bunded to divert flows around the WQS pit. Ponding behind this bund may be contributing to local recharge during higher rainfall events that could be expressing as seepage in the nearby wall of the WQS pit.

Figure 14 presents a schematic conceptual cross-section, focusing on the WQS hydrogeology.

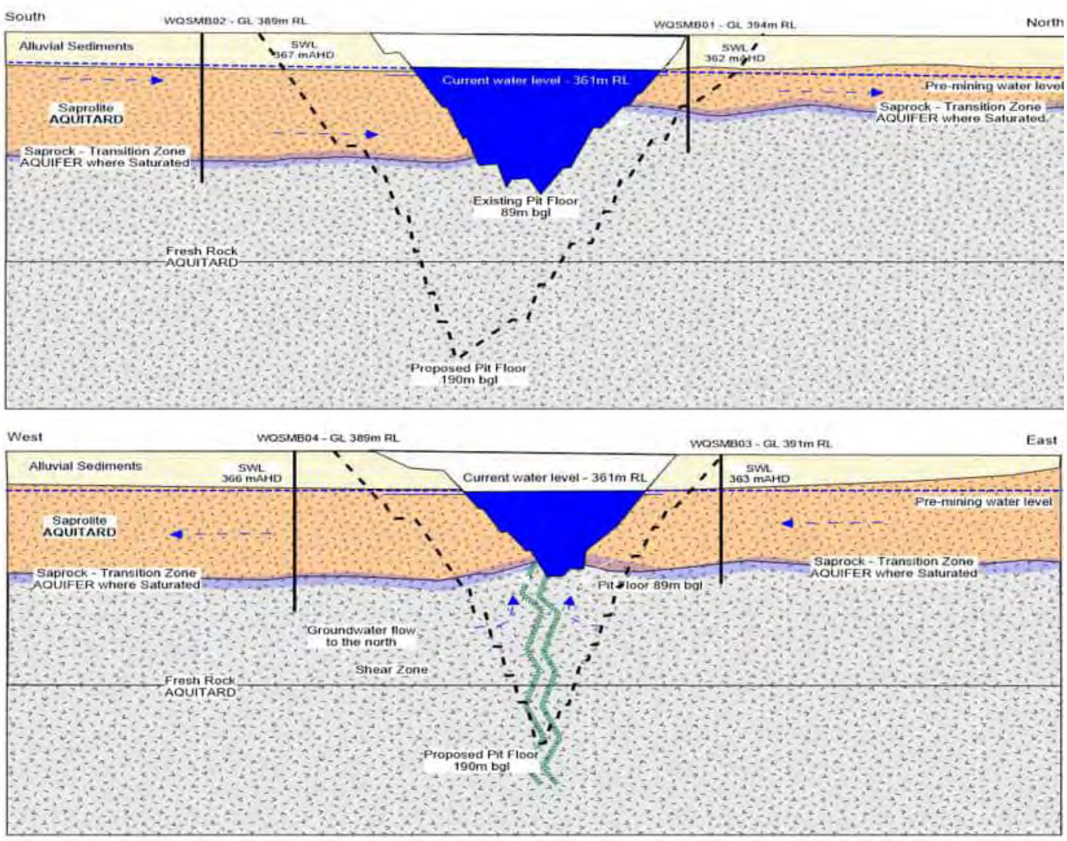

Figure 14 WQS - Conceptual Hydrogeological Cross Section

5.0 Dewatering Assessment

The following characteristics usually define cost effective and efficient dewatering strategies for typical fractured rock environments in the Western Australian goldfields:

- Aquifer zones are irregular, inhomogeneous and anisotropic, meaning dewatering must target sometimes narrow or discrete fractured intervals that are connected and drain to broader and less permeable materials beside and above them.
- Shallow water table aquifers within upper alluvial sediments (vuggy ferruginous clay) overlying saprolite can give rise to continuous seepage and rewetting of open pit walls where they are exposed.
- Abstraction from the saprock often drains relatively large volumes of groundwater stored in overlying saturated saprolite and transmits it as seepage to pit walls. Larger thicknesses of saturated saprolite along geological shears also store large volumes of groundwater but are of low permeability meaning flows from these deep structures can persist for longer periods than general saprock exposures elsewhere around the pit.
- Discrete zones of highly fractured rock along contact zones and geological shear zones and structures are often preferential and sometimes deeper flow paths for groundwater entering pits.
- The high degree of anisotropy and hydraulic connectivity between geological shears and structures can lead to discrete and sometimes irregular pathways for groundwater to enter pits.

5.1 Pit Lake Dewatering

Proposed mine development includes:

- Princess deposit south of the existing WQN pit
- Duke deposit north of the existing WQN pit
- Extension and deepening of existing WQS pit

The key focus for the proposed re-development is the WQS expansion. The smaller proposed WQN Princess and Duke cut-backs are still been evaluated and may have pit floors above the water table and therefore require minimal dewatering. The WQS expansion will be required the existing WQS pit to be dewatered with mining proposed to 200m AHD.

As part of the mining requirements to achieve required depths within WQS, the pit lake in WQS is proposed to be transferred to the pit lake in WQN. The elevated salinity (18,400 mg/L TDS) in WQS, is equivalent to water current stored in WQN, however has been deemed unsuitable for discharge direct to local creeks and streams. However, with a salinity concentration ranging between approximately 1,000 mg/L and 3,700 mg/L TDS and similar to local groundwater characteristics, managing future excess WQS groundwater inflows will also include discharge to local creeks.

Table 15 presents a summary of current and proposed pit volumes and water storage capacities.

5.1.1 Western Queen North

5.1.1.1 Pit Volumes

To a low pit crest estimated at 390m AHD, WQN pit has a total volume of approximately 5,745,000 m^3. The pit currently holds approximately 3,177,000 kL or 3.2 Gigalitres (GL) of water (based on a pit lake elevation estimate of 362m AHD). For use as a future water storage facility, it is proposed to allow a total water storage capacity to within 3m of the low pit crest. At this proposed 1.5m below low pit crest elevation of 388.5m AHD, an additional water storage capacity of about 2,209,000 kL or 2.2 GL is available to manage project related excess water.

Table 15 Summary of Pit Lake Volumes and Water Storage Capacities

Void	Option	Total Current Pit Volume	Proposed Total Pit Volume	Current Stored Water Volume	Total Volume 1.5m Below Low Pit Crest of 390m AHD	Remaining Water Storage Capacity to 1.5m Below Low Pit Crest of 390m AHD
		m^3 (or kL)				
WQN	Current WQN	5,754,000	-	3,177,000	5,422,000	2,409,000
	Princess Deposit (290m AHD)	-	1,093,000	-	1,013,000	-
	Duke Deposit (325m AHD)	-	430,000	-	396,000	-
	WQN - including Extensions	**-**	**7,277,000**	**-**	**6,832,000**	**3,818,000**
WQS	WQS	2,122,000	-	672,000	1,913,000	1,344,000
	WQS Proposed Extension	**-**	**8,817,000**	**-**	**8,319,000**	**-**

Importantly, the 1.5m below low pit crest elevation allows for buffer capacity (about 330,000 kL) to negate any risk of overtopping from high rainfall events. Although the area is heavily degraded from past mining, this maximum pit lake water elevation minimises potential impacts on local vegetation as a result of the mounded groundwater (about 25m) within the pit (Figure 14).

5.1.1.2 Pit Water Quality

Based on laboratory results, the current pit lake water quality exhibits:

- TDS between 18,200 mg/L and 31,100 mg/L. The highest TDS value was encountered form the sample (WQN3) at 75m depth but was not the deepest sample taken (92m, 19,200 mg/L). It is possible this sample may have a higher TDS due to the sample bailer hitting the side walls of the pit. TDS concentrations have exceeded ANZECC 2000 Livestock DW Low Risk Trigger Values.
  - Excluding the sample at 75m, average TDS for the pit is 18,600 mg/L.
- pH ranging from 8.14 to 8.34. Generally, pH was found to be decreasing with depth of water.
- Exceedances in metal content compared to screened criteria mentioned in Section 3.2 and were found generally throughout the water column. Exceeded metal concentrations include Aluminium, Cobalt, Molybdenum, Uranium and Vanadium. There was also a sulphate exceedance noted in sample at 75m depth.

5.1.2 Western Queen South

5.1.2.1 Pit Volumes

Similar to WQN, WQS has an estimated low pit crest of 390m AHD, with a total current volume of approximately 2,122,000 m^3. The pit currently holds approximately 672,000 kL or 0.7 Gigalitres (GL) of water (based on a pit lake elevation estimate of 362m AHD).

With the proposed dewatering strategy of moving water stored in WQS to WQN, the 0.7 GL of water is significantly less that the available remaining capacity of WQN or 2.2 GL.

5.1.2.2 Pit Water Quality

Based on laboratory results, the current pit lake water quality exhibits similar water characteristics as WQN pit water and therefore concluded as like for like. Key WQS pit water quality characteristics include:

- TDS between 18,400 mg/L and 18,900 mg/L. The highest TDS value was encountered at the deepest point in the sampled water column (WQS2) at 50m. Average TDS is 18,725 mg/L.
- pH ranging from 7.63 to 8.22.
- Similar exceedances in metal content compared to screened criteria as reported for WQN. However, exceeded metal concentrations was only reported for Cobalt at 18m depth (WQS4).

5.2 Groundwater Modelling

A simplified analytical groundwater model was developed to determine indicative dewatering rates and drawdown extents for the proposed WQS development. These models incorporate the following:

- simplified geological layering and groundwater flow paths.
- an indicative groundwater table
- simplified pit voids and depths
- dewatering requirements based on indicative mine schedule for each open pit (Mega, 2025).

The lower- and upper-case range provides an envelope within potential groundwater inflows are likely to be within. Based on the above, Table 14 presents analytical model inputs and Table 15 presents a summary of the refined range of hydraulic properties for the key local aquifer units for each domain.

An analytical groundwater modelling solution, ANSDIMAT (www.ansdimat.com, 2024), was used to predict groundwater inflow to the proposed open pit.

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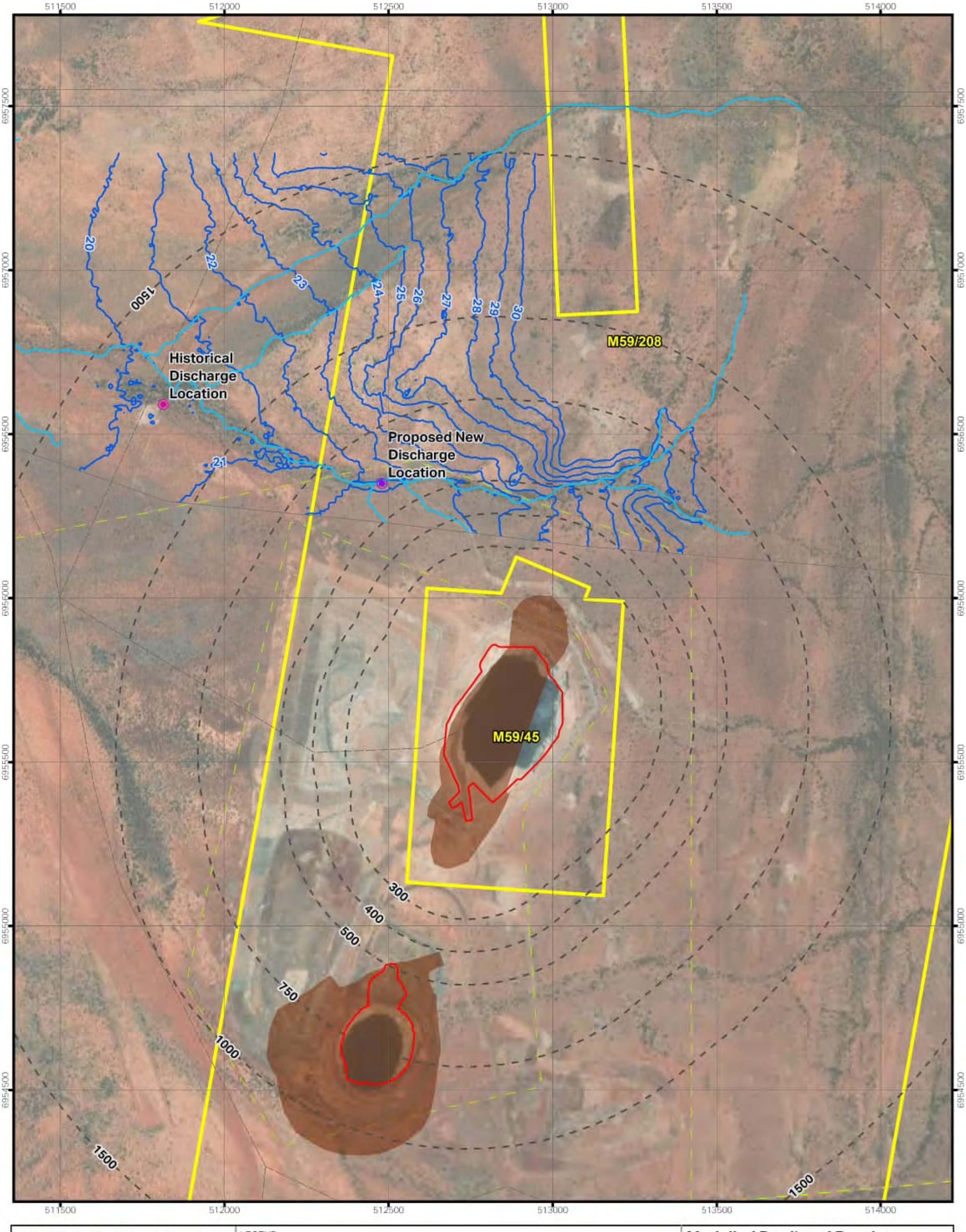

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DATE MODIFIED	05 JUN 2025	APPROVED BY	G.BROPHY

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0 100 200 300 400
metres
GDA 1994 MGA ZONE 50

LEGEND
- Western Queen Tenements
- Existing Pit Outline
- Proposed Pit
- Pit Buffers
- Impact Zone
- Model Drainage Lines
- Inferred Depth to Water Contours (m)
- Proposed New Discharge Location

Site_Labels (Query)
Label
- Historical Discharge Location

Modelled Predicted Depth to Groundwater Contours

WESTERN QUEEN

WESTERN QUEEN DEWATERING ASSESSMENT

Figure
15

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Table 16 Summary of Analytical Modelling Inputs

Proposed Open Pit	Est. Length	Est. Width	Est. Pit Area	Est. Ground Level Elevation	Est. Max Pit Floor Elevation	Est. Pit Dewatering Depth	Est. Depth to Water	Est. Groundwater Level Elevation	Est. Drawdown Required	Indicative Dewatering Durations	Saprolite/ Saprock Aquifer Thickness	Fresh Aquifer Thickness	Est. Fresh Rock Aquifer Thickness	Total Aquifer Thickness
	(m)	(m)	(m^2)	(m AHD)	(m AHD)	*(incl. +6m)* (m)	(m bgl)	(m AHD)	(m)	(Days)	(m)	(m)	(m)	(m)
WQS Development	550	390	214,500	390	200	196	28	362	168	608	60	135	78	195

Table 17 Summary of Local Domain Hydraulic Properties

Proposed Open Pit	Ave. Bulk Transmissivity (T) (m^2/day)		Ave. Bulk Hydraulic Conductivity (k) (m/day)				Specific Yield		Storage Coefficient
	lower	upper	lower		upper		lower	upper	
			k, m/day	kz, m/day	k, m/day	kz, m/day	Sy		
WQS Development	4	8	0.02	0.002	0.04	0.004	0.01	0.01	0.01

Key assumptions for the modelling are:

- Open pit dimensions were based on footprints provided as SHP file (*HMY_WQ_PitOutlines_region.shp,* provided February 2025).
- Proposed pit depths were based on the pit shells provided (*WQS_mga_pit1403-ascon-eom-final1.dtm,* provided February 2025).
- Proposed mine durations for WQS of 577 days (*WQ pit BENCH BY BENCH.xlsx*, Mega, 2025).
- Pseudo steady-state groundwater inflow rates have been based on final predicted inflows at the end of the indicative mining duration. Higher short-term inflow rates are possible at the beginning of dewatering.
- Dewatering elevations set at 6 m below the maximum pit floor.

Bulk hydraulic conductivity estimated based on saturated thickness for each pit location.

Table 18 presents a summary of predicted range of groundwater inflows, with graphical plots of predicted groundwater inflows with time for each proposed open pit presented on Figure 16.

Table 18 Summary of Preliminary Dewatering Modelling Results

<table>
<tr><th rowspan="2">Deposit</th><th rowspan="2">Run No.</th><th rowspan="2">Conceptual Model</th><th rowspan="2">Simulation Type</th><th rowspan="2">Scenario[1]</th><th rowspan="2">Simulated Number of Bores</th><th>Drawdown</th><th rowspan="2">Estimated Dewatering Duration[2]</th><th colspan="2">Average Abstraction Rate</th></tr>
<tr><th>(m) +6m</th><th>(kL/day)</th><th>L/sec</th></tr>
<tr><td rowspan="2">WQS</td><td>1</td><td rowspan="2">Confined Partially Penetrating Strip no-flow boundary</td><td rowspan="2">2,500m wide strip no-flow boundary to promote flow along structural feature</td><td>Lower-case</td><td rowspan="2">6</td><td>195</td><td rowspan="2">608 days</td><td>2,300 to 3,200</td><td>27 to 37</td></tr>
<tr><td>2</td><td>Upper-case</td><td>195</td><td>3,600 to 5,800</td><td>42 to 67</td></tr>
<tr><td colspan="10">Note [1] – lower and upper-cases based on hydraulic property range
Note 2 - Mega, 2025</td></tr>
</table>

Observations from the WQS analytical groundwater modelling include:

- Higher predicted dewatering rates of between approximately 2,300 kL/day (27 L/sec) and 5,800 kL/day (67 L/sec) from the proposed WQS open pit due to a deeper proposed depth, larger excavated area/volume and dewatering elevation (200 mAHD).
- A total estimated annual abstraction volume of between:
  - 666 ML/annum and 1,300 ML/annum for a 1-year period.
  - 1,400 ML/annum and 2,700 ML/annum for a 1.6-year period.
- Predicted drawdown (1 m contour) extends up to 1.7 km in the lower-case and 2.0 km in the upper-case scenarios.
- Predicted drawdown will remain within the M59/208 lease boundary.

A plot of predicted drawdown extent for the lower-case scenario is presented on Figure 17.

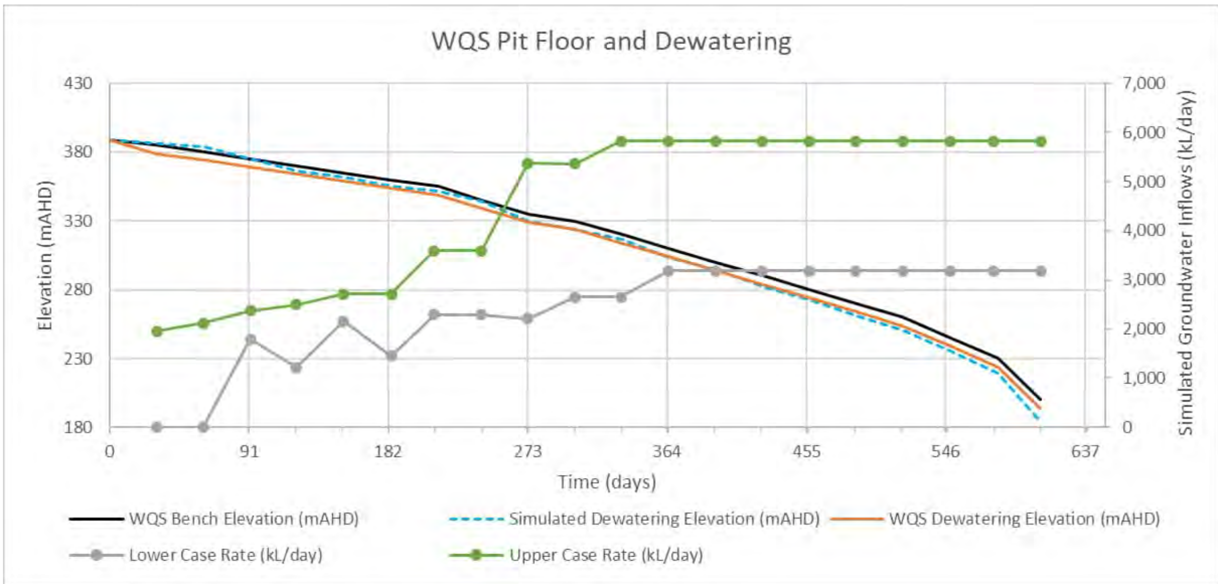

Figure 16 WQS Predicted Groundwater Inflows

A composite of predicted groundwater inflows for the proposed WQS mine schedule is presented on Figure 16**.** Abstraction rates with time, to meet the mine schedule are presented in Table 17. Based on the predictive modelling, an indicative reasonable case (lower-case) maximum abstraction is predicted to be up to about 1.0 GL/annum.

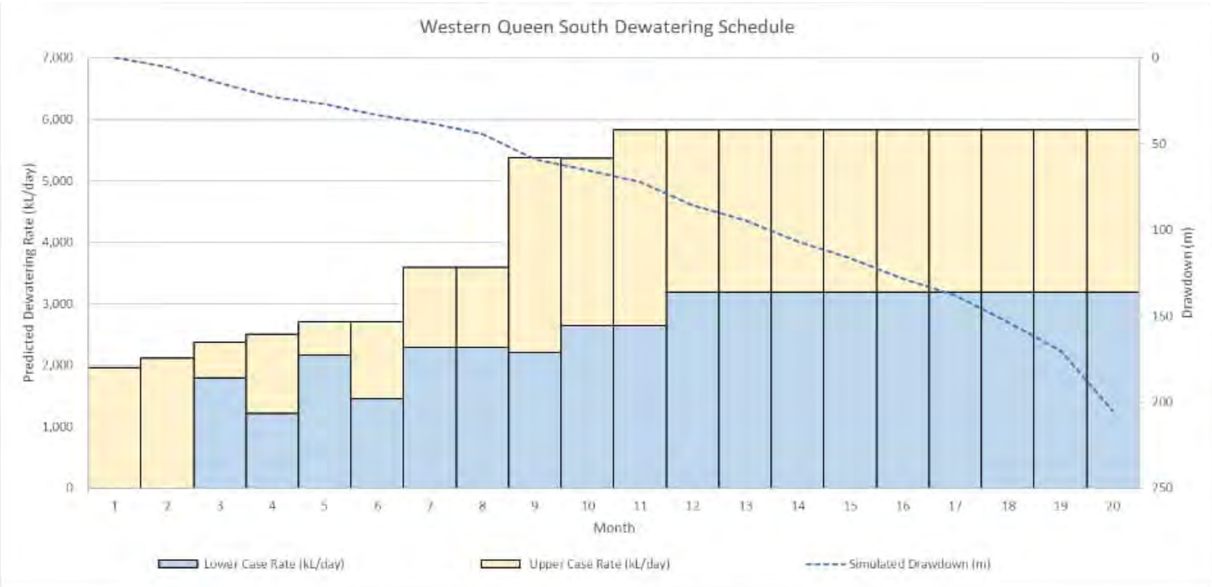

Figure 17 Predicted Dewatering Schedule

The combined lower- and upper-case predicted drawdown footprints for the WQS pit are presented on Figure 18. This figure shows the predicted drawdown forms a hydraulic sink and a capture zone that covers the following areas:

- WQN pit lake area, with potential drawdown up to 20m that may result in recirculation of stored water.
- The Camp Bore area with a water level drawdown up to 50m that may negate future use.
- The proposed excess water discharge location that may result in a proportion flowing back towards the hydraulic sink.

Table 19 Summary of WQS Predicted Dewatering Rates

Time (days)	Simulated Drawdown (m AHD)	Model results- Lower case (kL/day)	Model results- Lower case (L/sec)	Model results- Upper case (kL/day)	Model results- Upper case (L/sec)
31	0	0	0	1,959	23
61	5	0	0	2,116	24
92	15	1,795	21	2,376	28
122	22	1,218	14	2,502	29
153	27	2,157	25	2,710	31
184	33	1,450	17	2,710	31
212	38	2,292	27	3,598	42
243	44	2,292	27	3,598	42
273	59	2,215	26	5,375	62
304	65	2,648	31	5,362	62
334	72	2,648	31	5,831	67
365	85	3,187	37	5,831	67
396	94	3,187	37	5,831	67
426	107	3,187	37	5,831	67
457	116	3,187	37	5,831	67
487	128	3,187	37	5,831	67
518	138	3,187	37	5,831	67
549	154	3,187	37	5,831	67
577	170	3,187	37	5,831	67
608	205	3,187	37	5,831	67

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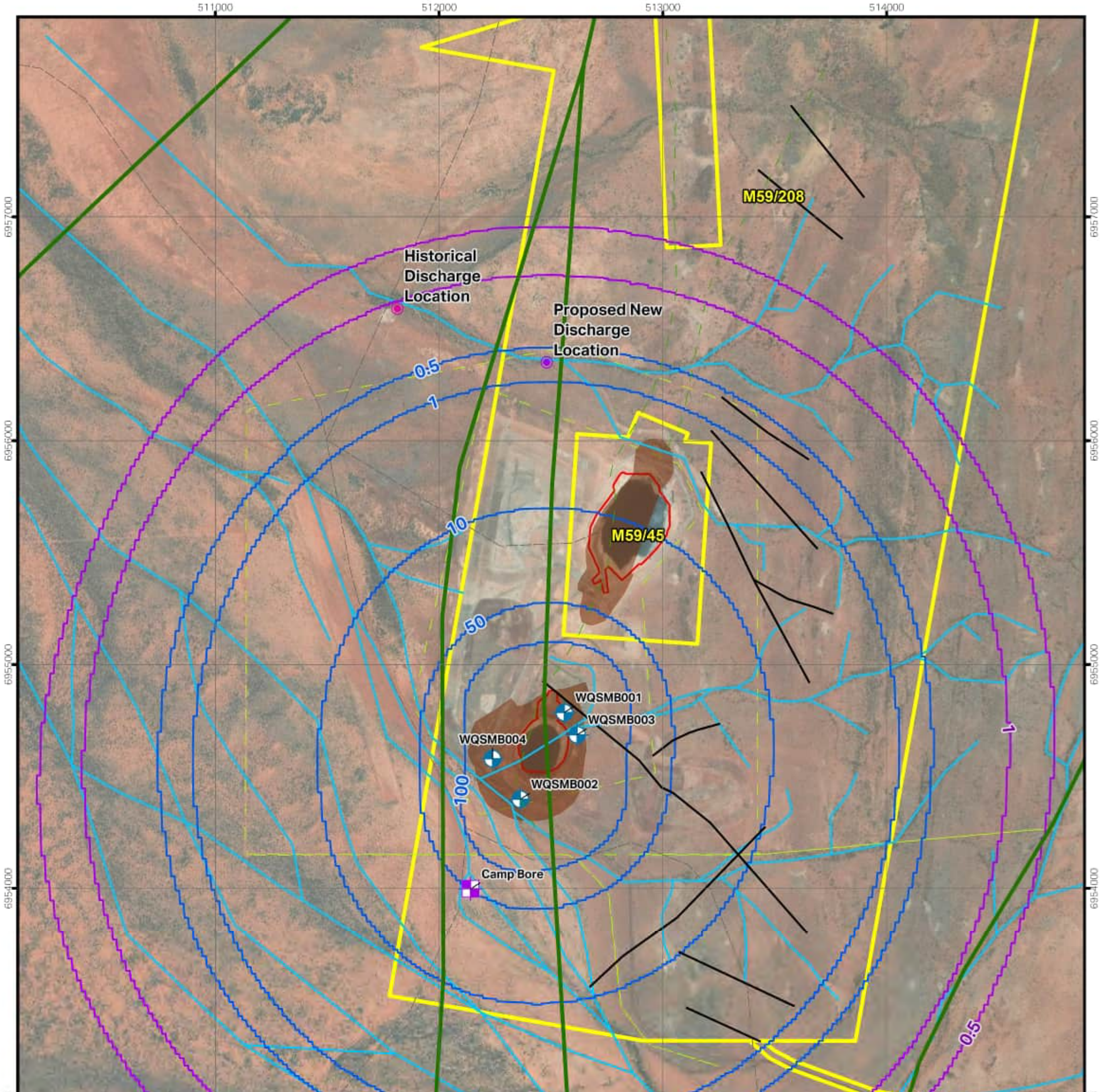

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DATE MODIFIED	05 JUN 2025	APPROVED BY	G.BROPHY

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0 100 200 300 400 metres

GDA 1994 MGA ZONE 50

LEGEND

- Western Queen Tenements
- Existing Pit Outline
- Proposed Pit
- Drainage Lines
- Fences
- Existing Monitoring Bore
- Existing Production Bore
- Modelled Lower Predicted Groundwater Contours
- Modelled Upper Predicted Groundwater Contours
- Historical Discharge Location
- Proposed New Discharge Location
- Inferred fault
- Shear
- Regional Structures (500k)

Modelled Predicted Groundwater Contours

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WESTERN QUEEN DEWATERING ASSESSMENT

Figure 18

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6.0 Fractured Rock Dewatering Options

Advanced pit dewatering and mine water management aims to improve mine production safety and efficiency by creating dry, stable operating environments. The following presents dewatering options based on:

- local groundwater conceptual hydrogeological model.
- an understanding that the local hydrogeological characteristics and dewatering options and opportunities are formed around low permeability and low groundwater yielding, compartmentalised fractured rock environments.
- historical dewatering strategy and reported challenges and geotechnical issues.
- experience from other Western Australian Goldfields operations in similar hydrogeological conditions, whereby nuisance groundwater impacts the mine's productivity.

The benefits of efficient mine dewatering include maintaining workable dry conditions to avoid flooding and provide more efficient operational conditions such as improved trafficability and digging, better blasting conditions, and reduced moisture content of ore, product and waste. In addition, where possible, effective advanced dewatering promotes more geotechnically stable conditions by reducing in-pore water pressures, allowing steeper side slopes and increased factors of safety, and reducing erosion and piping of weak zones in slopes.

6.1 Defining Options

Following completion of the hydrogeological assessment, it is apparent that local characteristics will drive the success of future dewatering management options to minimise groundwater related impacts to mining productivity. These characteristics include:

- The key groundwater flow paths to the pits are oriented vertically and horizontally along zones of fractured rock associated with rock contact zones and faults.
- A deeper fractured rock environment with a high degree of spatial variability in permeability as evident in drilling and by slug tests during site investigation.

Importantly, depressurisation and dewatering management options are based on identified constraints and success factors including:

- efficiency of groundwater recovery i.e. design based on yields.
- optimal spacing of drain holes (if required) based on targets identified from available datasets.
- location of dewatering options / methods based on other constraints i.e. mine schedules, and long-term access.
- passive (gravity drainage to a central sump/s) vs. active abstraction (sump or bore abstraction).
- dewatering systems compatible with mine closure.
- constructability i.e. accessing groundwater in a fractured, compartmentalised bedrock environment.

Several potential dewatering methods identified include:

- **Option 1: Dewatering Bores** – to abstract groundwater from deeper flow paths in-pit or ex-pit, depending on their depth, interconnectedness and permeability. Their effectiveness can be limited in deep fractured rock settings due to the low hydraulic conductivity and often compartmentalised nature of these aquifers. In-pit bores are often sacrificial and only effective for short periods.
- **Option 2: Shallow Sumps** – to intercept gravity drainage from seeps and drain holes on the pit floor.
- **Option 3: Preferentially Sloped Pit Floor** – to allow for gravity drainage across a sloped pit floor to strategically placed sumps, potentially on deep permeable structures to intercept groundwater inflows.

- **Option 4: Horizontal Drain Holes** – to gravity drain and depressurise rock contacts and fault zones behind pit walls to improve geotechnical stability using a system of closely spaced interconnected drain holes.

Several management options were considered to meet the project objectives. These are defined in the following section.

6.1.1 Option 1: Dewatering from Bores

Historically, dewatering at WQN was initially undertaken using dewatering bores installed external to the open pit development. To complement these bores, dewatering was also achieved through pumping from an existing open shaft. In-pit sumps pumping was also completed as a final strategy. There are no historical reports reporting the using of horizontal drains in WQN.

The main dewatering strategy undertaken for WQS was the use of in-pit sump pumping. No dewatering bores were installed following little success in intersecting holes with suitable yields. It was apparent that higher than expected groundwater inflows were encountered as mining progressed through the Saprock/ Transitional material. Significant pit wall instability was reported during mining of WQS.

To complement WQS sump pumping, horizontal drainholes were also installed to reduce pit wall pore pressures noting groundwater inflows averaging around 2,600 kL/day (30 L/sec) for the duration of mining.

Based on the propagation of groundwater level drawdown during initial test pumping and dewatering, it was reported connectivity between WQN and WQS was evident.

With the above in mind, potential ex-pit dewatering bore locations should be established during the period of pit lake pumping and drain-down. These bores should be equipped to maintain dewatered conditions once the void has been drained. Investigations should be targeted based on historical findings such as, in order of priority:

- Target for one bore north and one bore south of WQS along the north-south shear zone.
- Test the potentially high yielding zone on the South-east of WQS pit.
- Target south of WQN to capture potential groundwater flows from the mounded WQN pit lake to minimise water flow back to WQS via the known shear zone.
- All investigation holes should target shears and structural features at depth to allow long-term dewatering below the proposed pit floor.

If groundwater exploration proves successful (based on sufficient yields and aquifer thickness), separate production bores should be drilled and cased using nominal 200mm steel casing. Production dewatering bores should be equipped with electrical submersible pumps, flow meters and dip tubes to allow measurement of groundwater levels.

Typical bore construction details include:

- Nominal depths typically 80m deep but up to 200m deep if deeper fractured rock zones intersected.
- Drill at nominal 150mm diameter to assess groundwater yields are suitable for production bore installation.
- Ream exploration bore to nominal 300mm diameter hole.
- Install 200 mm diameter casing with a minimum of four slotted lengths (4 x 6m) spread over the water bearing zone identified from the exploration hole results.
- Hang the casing under tension and backfill the annulus with gravel.
- Develop the bore until non-turbid water flows.
- Perform pumping tests to determine pumping duty rate and drawdown influence for efficient dewatering.

Figure 19 presents a typical fractured rock dewatering bore design.

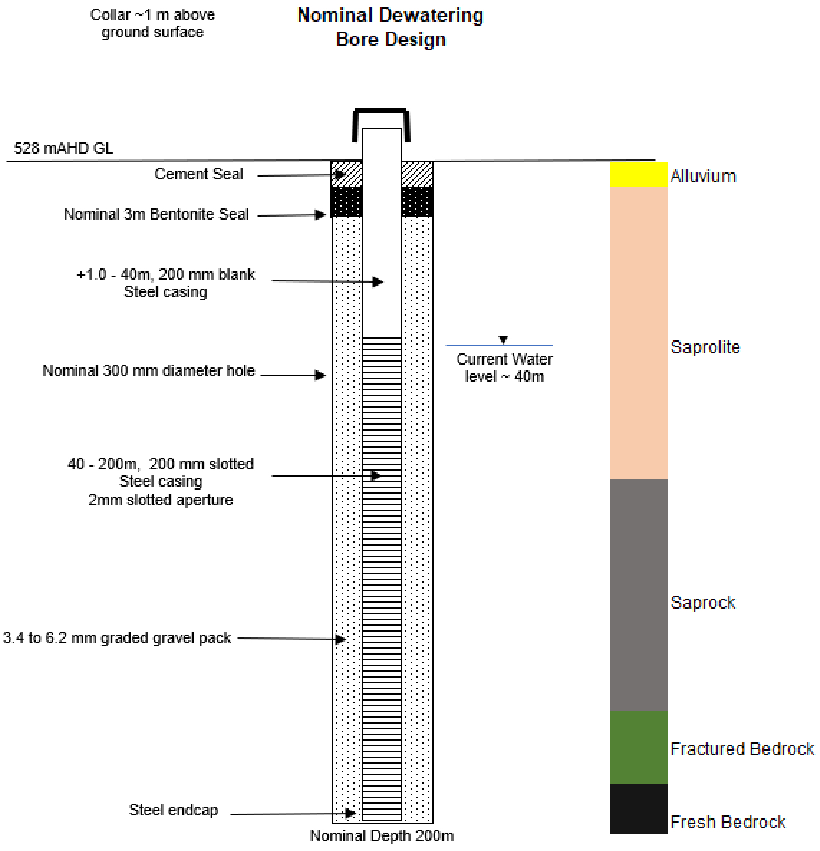


Figure 19 Dewatering Bore Conceptual Design

6.1.1 Option 2: Dewatering from Shallow Sumps

The shallow sumps are aimed at targeting both localised groundwater and surface water drainage on the pit floor only. Ideally shallow sumps should:

- be situated in low-lying areas on the pit floor to allow for passive gravity drainage.
- include a sump pumping system that maintains a pumping water level of about 3.5 mbgl i.e. not allowing the sump to fill before it is emptied, to promote drainage of the pit floor.
- be connected to direct the abstracted water to a dedicated tank or turkey's nest outside the open pit via a rising main pipeline. As mining progresses to deeper depths, a booster pumping system may be required to transfer all sump abstractions from the pit.
- receive gravity-fed drainage from horizontal drain holes (if required) via dedicated collector pipelines.
- include infrastructure to record the abstraction rate and volume data to allow for efficient management and regulatory reporting.

Due to the nature of the bedrock material, it is likely a rock breaker would be required to extend sumps to the maximum depth possible. This may need to be preceded by targeted blasting where sump locations can be maintained for longer periods.

Based on historical exploration and the nature of the fractured bedrock, sump pumping rates up to 2,600 kL/day (30 L/sec) may be required in the short-term (if not external bore dewatering bores are installed). Local experience suggests the rates will decline as the local groundwater storage is removed. Therefore, a pumping system capable of variable pumping rates will be required to meet the dewatering objective.

Figure 20 presents the conceptual shallow sump design.

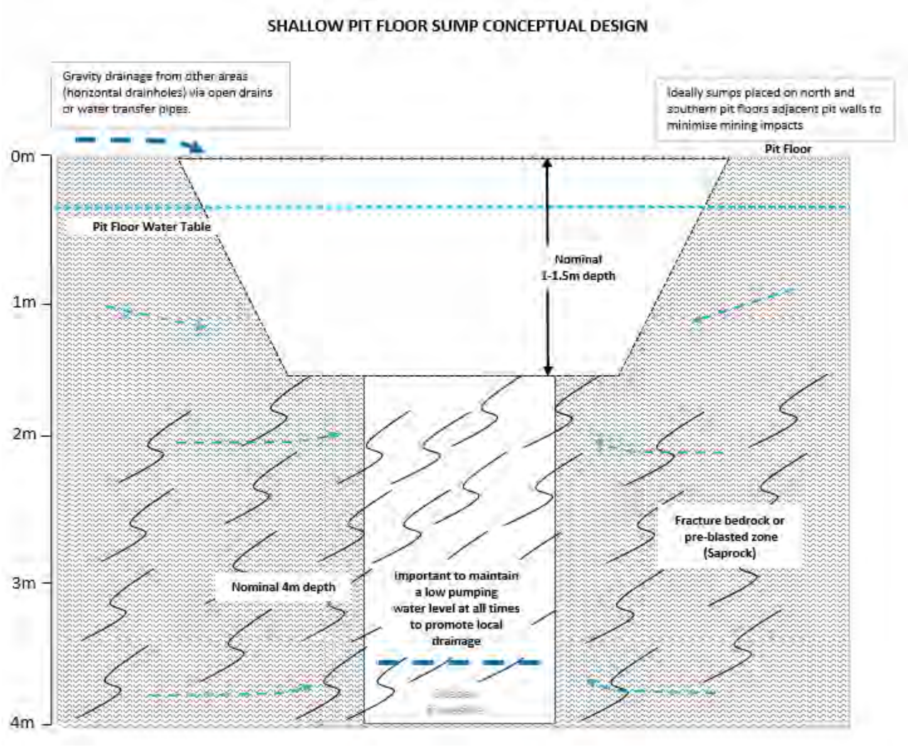


Figure 20 Shallow Sump Conceptual Design

6.1.1 Option 3: Preferentially Sloped Pit Floor

In compartmentalised, fractured rock environments where the fractures are poorly interconnected this can be a challenge. To achieve passive drainage of the pit floor, sump locations should not only target local groundwater flow features i.e., faults where possible, but also be designed in the lowest areas of the pit floor.

An opportunity to have a slightly sloped pit floor or advanced mining in one or both ends of the pit may be advantageous for maximising mining productivity. This approach would allow groundwater levels to be pumped and maintained at lower elevations result in dry pit floor areas.

The effectiveness of this option may be constrained by how many permeable fractures are exposed across the pit floor that the sloped pit can direct the inflows to. Another potential constraint will be to maintain positive drainage to the sumps in a dynamic pit floor setting.

6.1.2 Option 4: Pit Wall Depressurisation via Horizontal Drain holes

A previously undertaken in prior mining campaigns at Western Queen, a depressurisation strategy to improve geotechnical stability by lowering pore pressures in the saprolite and saprock units was accomplished using horizontal drain holes. These drain holes are drilled into the pit slopes to allow water pressures to reduce passively by bleeding off small quantities of shallow groundwater into the pit.

Few details are available with the previous implementations of horizontal drains, however, drain holes should:

- be targeted towards rock contact and / or fault zones.
- be drilled to target the zones between 50 mbgl and 75 mbgl and hole depths of up to 50m.
- be drilled at a slightly upward angle (5 degrees) into the pit face to allow groundwater to free drain out into the pit.
- be drilled at hole collar spacings in the range of 20 to 50 m depending on azimuth of adjacent holes.
- include sealed headworks to allow discharges to be piped to the pit floor sump.

Uncontrolled groundwater flows from horizontal drain holes may pose a future pit wall stability risk in areas of highly weathered material. Figure 21 presents a typical horizontal drain hole design system concept.

6.2 Assessment of Options

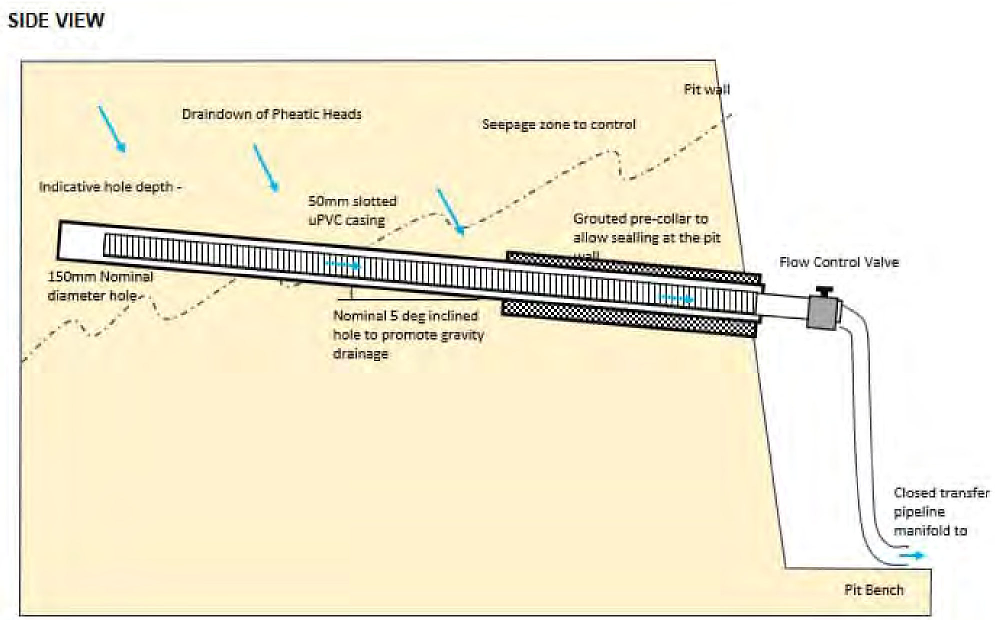
The options considered include:

- **Option 1: Dewatering Bores** – to abstract groundwater from deeper flow paths in-pit or ex-pit, depending on their depth, interconnectedness and permeability. Their effectiveness can be limited in deep fractured rock settings due to the low hydraulic conductivity and often compartmentalised nature of these aquifers. In-pit bores are often sacrificial and only effective for short periods.
- **Option 2: Shallow Sumps** – to intercept gravity drainage from seeps and drain holes on the pit floor.
- **Option 3: Preferentially Sloped Pit Floor** – to allow for gravity drainage across a sloped pit floor to strategically placed sumps, potentially on deep permeable structures to intercept groundwater inflows.
- **Option 4: Horizontal Drain Holes** – to gravity drain and depressurise rock contacts and fault zones behind pit walls to improve geotechnical stability using a system of closely spaced interconnected drain holes.

Key considerations associated with each of the options are presented in Table 20.

A cost effective and efficient dewatering system may incorporate elements of several of the above options. Dewatering options are often implemented within a framework of adaptive management, with monitoring data used to guide refinement in the system through time.

In context to the local characteristics (fractured rock environment), the constructability and maintenance of sumps may be a challenge. Based on successful outcomes in similar environments from strategically placed sumps and bores, it is recommended to focus future dewatering management on refinement of these options within the context of short-term and medium-term mine planning.



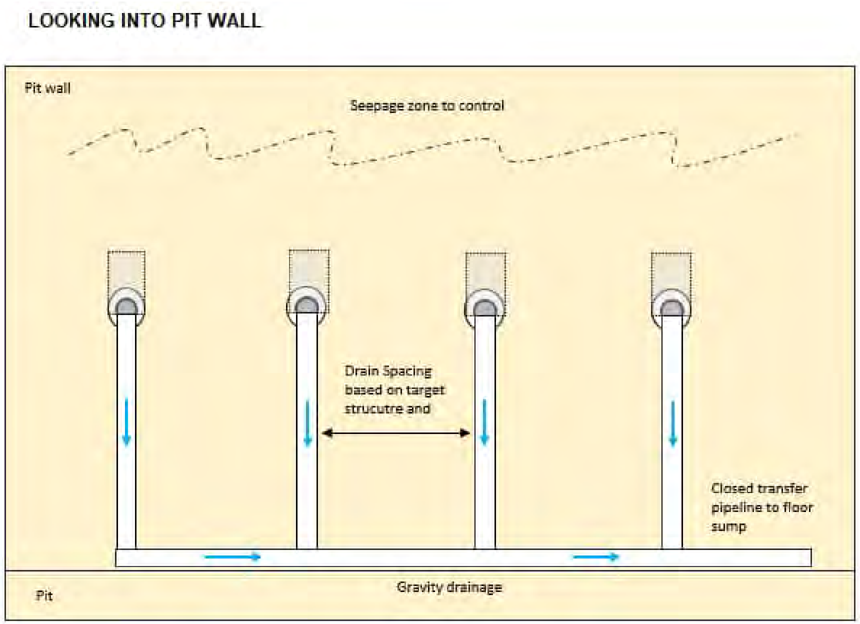


Figure 21 Horizontal Drain Hole Conceptual Design

Table 20 Dewatering Option Considerations

Key Consideration	Description
Short-term Mine Plan Reduces Water Logging of Pit Floors from Direct Inflow and Wall Seepages (0 to 0.5 year)	• Option 1 provides opportunities to dewater ex-pit via strategically placed bores assuming the intersected fractures are connected to deep fractures within the pit. • Option 2 provides a solution for shallower zones accessible from the pit floor. • Option 3 may not be feasible in early mine developments but could be increasingly effective as the pit depth progresses below the water table. • Option 4 addresses geotechnical drainage of groundwater inflows at elevated heads behind pit walls. A closed drainage system to an in-pit sump minimises uncontrolled water on pit walls and ponding on pit floors causing ponding and dewatering issues.
Medium-term Mine Plan Reduces Water Logging of Pit Floors from Direct Inflow and Wall Seepages (0.5 to 1.6 years)	• Option 1 with bores positioned outside active mine areas to provide ongoing dewatering as required. In low-permeability environments drawdown from the bores may be limited meaning they should be located within the pit. Ex-pit bores are most effective where the aquifers extend into the pit. Bores may also intercept groundwater flows within the saprock aquifer that would otherwise discharge into the pit, but this often constrained by saturated thickness and permeability. • Option 2 only provides a solution for the shallower flow paths on the pit floor and is likely to be effective at a local scale. • Option 3 provides opportunities to manage groundwater inflows by positive drainage towards one or both ends of the pit floor, minimising impacts to mine productivity. • Option 4 with pre-planned, passive gravity-drained water including controlled transfer to a sump can provide ongoing wall depressurisation and reduce ponding on pit walls and the floor. This option must be pre-planned before site access becomes limited.
Constructability	• All options will intersect varying degrees of fracturing and depth of fracturing. Some areas may intersect shallow fresh bedrock that will limit excavation depths achievable. • Option 1 requires prospective yields from suitable aquifer intervals from exploration drilled holes to allow efficient dewatering bore installations. • Option 2, and Option 3 may require excavation into fresh but fractured bedrock that can hard to excavate and will require a rock-breaker or similar method. • Option 3 will require incorporation into mine plans and schedules. • Option 4 requires installation of drain holes on pre-planned benches prior to pit floor elevations are progressed deeper. Drainages will need to be conducted to a sump that may require ongoing modification and maintenance.
Cost	• The concept level construction cost estimates are as follows: Option 1: $100,000/ 80 m deep steel cased ex-pit dewatering bore Option 2: $50,000/ shallow sump Option 4: $50,000/ 50 m deep drainhole

Key Consideration	Description
Risk	Key risks for each of the options are as follows: • Option 1: (dewatering bores) - variability in permeability of the fractured rock formation may lead to poor yielding dewatering bores and drawdowns that do not reach the pit. • Option 2 (shallow sumps): - effectiveness depends on permeability and connectedness of local fractures. - construction and cost risks associated with excavations. - maintenance of the sumps within active mine areas on pit floor. • Option 3: (preferentially sloped pit floor/ advanced mining) - Challenges with mining being able to implement option within a pre-existing mine plan and mining schedule. • Option 4 (horizontal drainholes): - construction and cost risks associated with collaring then casing deep horizontal drain holes. - limited interconnectivity within the fractured rock leading to low seepage recovery rates and variable depressurisation influence.

6.3 Mine Dewatering Risks

Consistent with other Goldfield WA mine developments, it is apparent, there is significant variability in the groundwater characteristics of the fractured rock environment. Historically, several areas intersected weathered and fractured bedrock of lower permeability resulting in lower rates of depressurisation behind the pit walls as dewatering progressed. Smaller drawdowns mean the phreatic surface may be close to the pit walls. This has in the past and may lead to future potentially higher geotechnical stability risks associated with hydraulic loadings in areas where seepage is still emanating from the pit walls.

Following this review, the key water related risks to the proposed open pit mine developments include:

- failure to achieve timely dewatering: potentially leading to a disruption meeting mine plans as per design, requiring systems that enable rapid upscale of capacity.
- maintaining adequate operational infrastructure to capture and removal of rainfall runoff and surface water flooding from high rainfall events within the pit in a timely fashion to minimise impacts on mining productivity.
- focusing on implementing a dewatering plan to manage low groundwater yields on the pit floor that result in impacts to mining productivity.
- not moving from a focus from intermittent shallow sump pumping to more of a focus on keeping groundwater levels well advanced of pit floor elevations to promote vertical drainage and dry mining conditions.
- not implementing successful depressurisation of pit walls to meet slope stability constraints i.e. the phreatic surface levels behind the pit walls.
- not implementing a closed capture and removal of ongoing groundwater inflows from spatially variable seepage zones within pit walls to limit ponding and erosion on inaccessible benches as the mine progresses with depth.

It is typical that a staged approach to mine dewatering and pit wall depressurisation is implemented along with targeted monitoring to allow the success and continual improvement of the plan.

7.0 Dewatering Management Strategy

Mining below the water table requires a mine dewatering plan or strategy that supports the capture and removal of groundwater (and surface water) inflows to facilitate dry mining conditions in active areas. It should also facilitate the depressurisation of unconsolidated soil material in the vicinity of open pit slopes and connected parts of the pit floors.

Because aquifers and aquitards do not release stored groundwater instantly, dewatering and depressurisation needs to be carried out ahead of mining to allow the flow system to drain before the inflows interfere with mining operations. The geotechnical stability on pit designs is dependent (to some degree) on drained or significantly depressurised slopes.

Similar to historical dewatering requirements, to enable re-mining of the WQS deposit, several groundwater related activities will be required including:

- pit lake dewatering
- advanced open pit dewatering
- management of excess abstracted mine water.

Figure 21 presents a schematic of the conceptual water management strategy.

Historical pit dewatering infrastructure (bores, sumps, horizontal drains, and creek discharge) at WQN and WQS were driven by estimates of potential groundwater inflow from initial desktop studies (Morgan, 2000, MWES, 2012b).

Furthermore, a geotechnical assessment completed in 2012 (Peter O'Bryan and Associates, 2012), included water related management recommendations that would drained/ depressurise the wall rock conditions. These recommendations included:

- drilling sub-horizontal (± 10^0) depressurisation (weep) holes once mining has progressed to the pre-mining water table. The initial depressurisation holes were to be drilled around the periphery of the pit at that level.
- The depressurisation holes were to be drilled to a length of ≥ 25m, which is inferred to be the minimum length which could conceivably be involved in slope instability.

It is important that the success and effectiveness of dewatering and depressurisation is monitored. Monitoring recommendations included:

- Installing several vertical groundwater monitoring bores (nominal 50mm diameter) along perpendicular transects nearby the main groundwater inflow zones and dewatering infrastructure (sumps, and bores) with monitoring bores located outside the pit crest and on suitable benches and the pit floor. Groundwater level monitoring aim at measuring groundwater level changes behind the pit wall.
- Installing several vertical groundwater monitoring bores (nominal 50mm diameter) parallel to the pit wall and near high groundwater inflow zones i.e. near horizontal drain holes, to determine the success of drain-down of water levels behind the pit walls. Monitoring results can help refine the dewatering/ depressurisation schemes as required to minimise potential future pit wall instability.

To complement the above historical recommendations, a conceptual dewatering scheme is outlined below.

7.1 Pit Lake Dewatering and Water Storage

To allow future deepening of the WQS open pit, the water stored within the existing pit will need to be removed. Historically, excess water has been stored within the WQN open pit located approximately 700m north of WQS. Based on the current pit lake level of 362m RL in WQS, an estimated stored water volume is at about 0.7 GL.

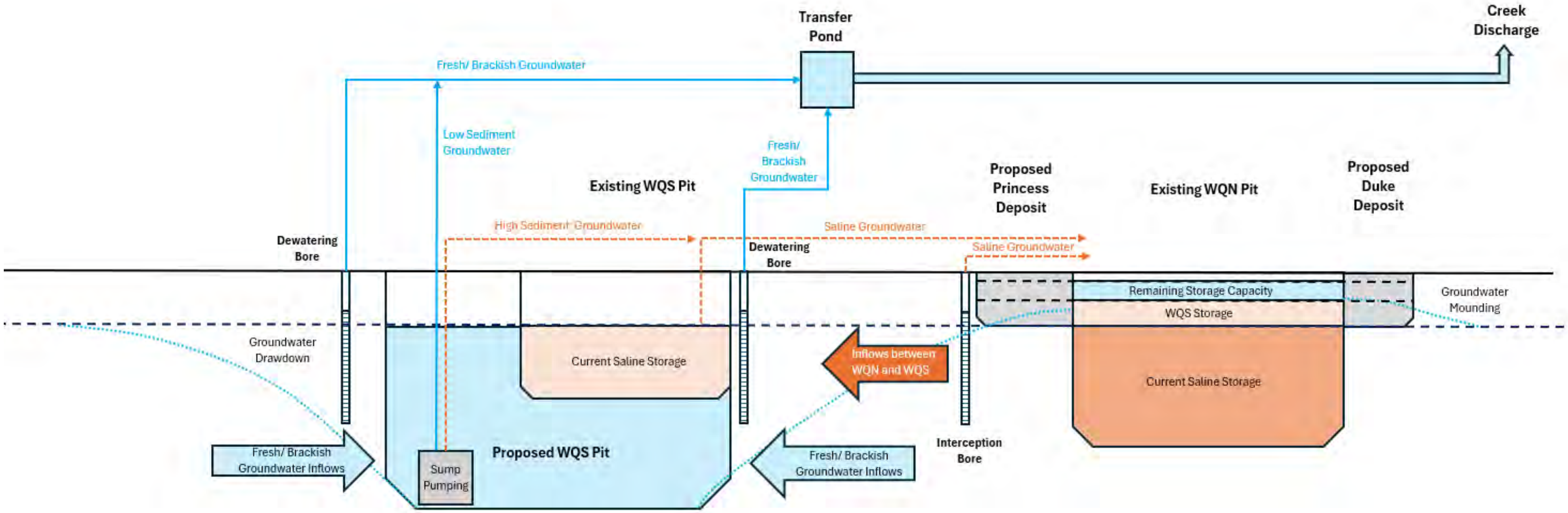


Figure 22 Conceptual Water Management Strategy Schematic

Pit lake dewatering is typically undertaken using a pontoon type pumping system. To minimise pit wall stability issues and allow groundwater water to drain and pore pressures to be lowered, it is recommended the pit lake be emptied over a period at least 90 days. Over the 90-day period an expected additional 0.2GL of dewater water from groundwater inflows is estimated, based on the assumed 2,200 kL/day, and an additional estimated 500 kL/day form interconnection between WQN and WQS. This equates to a total up to 1.0GL, that may require abstraction to allow access to the pit floor.

The water quality characteristics in both pits has been measured and are very similar and at lower pit lake elevations, suspended sediments will likely increase however, no environmental impact is foreseen with this water transfer strategy.

In our experience at other WA goldfields operations, the maximum pit lake elevation is defined by potential mounding related impacts on local vegetation and the groundwater resource, along with having enough remaining capacity to limit over-topping from high rainfall events. A high-level assessment of the propagation of predicted mounding from WQN reported groundwater levels are predicted to remain below about 20m bgl in the northern areas at distances of about 200m. Figure 14 presents predicted mounding controls to justify the 1.5m below the low pit crest of 390m AHD. Furthermore, at this proposed pit lake elevation, there is an estimated remaining storage capacity of about 330,000 kL.

With a reported current pit lake level in WQN of 362m RL the available storage volume in WQN is estimated at about 2.4GL, 1.5m below the current pit crest. With the proposed Princess and Duke pit developments, this may increase the total WQN storage capacity up to about 3.8 GL.

Transferring about 1.0GL (130 L/sec over a 90-day period) from WQS to WQN will reduce the remaining storage capacity to about 1.4GL, which allows for ongoing disposal of excess poorer quality mine water (>15,000 mg/L TDS) from dewatering WQS if required.

Based on the historical records for WQN, the current pit lake level (362m AHD) is above the assumed baseline groundwater level of about 355m RL. This suggests groundwater is already mounded relative to the regional water table and is currently in equilibrium with WQS current pit lake level (362m AHD). This will change as a result of water from WQS being stored in the WQN void.

There will be an expected change in cone of depression for both pits, with WQN shrinking and WQS expanding, due to the transfer of pit water. Due to the hydraulic connectivity of WQN and WQS through the Western Queen Shear Zone, it is also expected that groundwater inflows to WQS will increase in the North of the pit, and possibly in the region of the existing monitoring bore WQSMB001. WQSMB001 was the only monitoring bore that exhibited high TDS/ saline water quality. A strategically placed dewatering bore, close to WQN, may limit this recirculation back to WQS.

Although the immediate area around WQN is highly degraded in terms of vegetation as a result of historical mining operations, given the baseline groundwater was about 35mbgl, and the local vegetation had no dependency on groundwater it is unlikely that further mounding will cause impact to local vegetation while the water table remains below 3mbgl.

External groundwater level and quality monitoring may be required to confirm the extent and risks associated with mounding outside the open pit confines, particularly after the transfer of pit water from WQS to WQN.

Once the dewatering discharges to WQN cease, saprolitic and alluvial deposits that were temporarily saturated may become unstable as the pit lake level recovers if high hydrostatic pressures persist.

During abstraction, pumping rates and volumes should be recorded daily. Furthermore, survey of the pit lake elevation, at least weekly, will help predict remaining storage capacities and manage ongoing pit lake water transfers throughout the development.

7.2 Pit Dewatering

Based on previously reported dewatering challenges at WQS, the recommended dewatering strategy seeks to:

- Dewater ahead of mining to avoid difficult mining conditions i.e. boggy pit floor
- Lower pore pressures in the pit walls through targeted horizontal drains
- Control pit wall seepage and horizontal drain inflows through a closed collect system to minimise uncontrolled drainage to the pit floor and flows across benches
- Dewater using targeted ex-pit dewatering bores if feasible, to minimise disruption to mining.
- Targeting sumps in areas where inflows from geological shears will persist and pumping to minimise the accumulation of groundwater and surface water runoff.

Potential ex-pit dewatering bore locations should be established during the period of pit lake pumping and drain-down. These bores should be equipped to maintain dewatered conditions once the void has been drained. Investigations should be targeted based on historical findings such as, in order of priority:

- Target for one bore north and one bore south of WQS along the north-south shear zone.
- Test the potentially high yielding zone on the South-east of WQS pit.
- All investigation holes should target shears and structural features at depth to allow long-term dewatering below the proposed pit floor.

7.3 Integration with Mine Planning

A key consideration for the design and implementation of the dewatering system is the space available in-pit to install the water control infrastructure. This should integrate with mine planning and the geotechnical program, and consider the following:

- Provision for safely accessing areas for the drilling and installation of horizontal drainholes, pipelines and collection sumps, given the heavy vehicle production traffic, working below pit slopes and potentially on pit benches.
- Sequencing of the installation of the dewatering infrastructure (sumps, horizontal drainholes and bores) with the mining schedule.
- Provision of sufficient lead time for the installed system to achieve the targeted level of dewatering or depressurisation.
- Provision of ongoing access for maintenance of the dewatering and depressurisation infrastructure (i.e. pumps, generators, reticulation pipelines or drainage ditches).
- Carefully selecting locations of the dewatering and depressurisation installations so they will remain online and not be destroyed or decommissioned until they have served their purpose.
- Redundancy in the depressurisation infrastructure to allow for blockages and or unplanned destruction and access flexibility to accommodate changes to the mine plan.

Early planning and consideration of potential changes to the mine design usually alleviates many of the issues. While slope depressurisation is also a form of dewatering, inflows from the slopes can be managed if allowance for them to be collected and directed to sumps is allowed for in the mine plan. Access to and timely installation of in-pit dewatering infrastructure is a common challenge to open pit operations. In this case, target identification, timely site access, and longevity of dewatering infrastructure requires ongoing integration with the mine plan and operations.

The focus for Western Queen dewatering has been aimed at targeting potential seepage zones within the proposed pit to capitalise on opportunities to dewater by ex-pit dewatering bores, installing sumps and drain holes. Proposed options and plans are presented below.

7.4 Stage 1- Short-term Plan – Dewatering Infrastructure Installation

- Mine Dewatering
  - Install Dewatering Bores

    Groundwater yields measured from historical dewatering suggest there are opportunities for operating dewatering bore(s) in the proposed WQS pit areas. In addition, a recovery bore is also recommended between WQN and WQS, to intercept increased groundwater inflow caused by the heightened pit lake in WQN (following water transfer from WQS). Further details for bore installations are provided in Section 8.0.
  - Install and Pump Shallow Sumps

    Given the low groundwater inflow volumes, install short-term in-pit sumps to gravity drain nearby pit floor areas. Sumps should be installed in areas at the lowest pit floor elevations and be configured to receive local groundwater and surface water runoff from pit walls and benches (where no horizontal drains are installed) via open drains and other sumps or piped drainage systems. Pumping water levels should be maintained at the lowest elevation possible and run continuously to allow for drainage beneath the pit floor. Allowing a sump to recover does not maintain an effective dewatering influence on the local aquifer.
  - Map wet and dry blast holes.

    As mining progresses, it is recommended to map groundwater occurrences to develop an understanding of the relationships between groundwater occurrence and geological and/or structural features. This should identify relationships to be established to guide sump locations and depths across the pit floor in the future. We recommend that the mapping records each hole as a simple visual traffic light (Red = wet; Amber= damp; Green= dry). The results can be interrogated in 3D along with other groundwater observations to optimise sump locations in the future.
- Geotechnical Depressurisation
  - Construct Permanent Drain Holes (if required)

    This task focuses on local groundwater bearing structures exposed at or nearby pit wall areas that yield long-term seepage inflows. Targets for horizontal drain holes should be based primarily on geotechnical risks and consider the results from monitoring data, and presence of saturated oxide materials. The drain holes should be constructed using casing and headworks that are installed to allow controlled discharge via a sealed transfer pipe to minimise future pit wall saturation and erosion from uncontrolled seepage over the pit walls. Gravity drainage from a manifold (where multiple holes are in proximity) to a sump at lower elevation will allow the water to be sustainably and continuously removed from the pit, in conjunction with surface water runoff.

7.5 Stage 2- Medium-term Plan – Infrastructure Upgrades and Maintenance

- Mine Dewatering Upgrades
  - Optimise Pit Floor

    Opportunities should be considered to promote in-pit drainage to one or more sumps. This may require the installation of deeper drains across the pit floor, potentially in previously blasted areas where the connectivity of the fractures will be higher. Such optimisations should, where possible be supported by directing groundwater (and surface water) inflows to deep sumps, also in areas where deeper blasting has occurred to increase fracture density and connectivity.

- Geotechnical Depressurization Upgrades
  - Construct Horizontal Drain Holes in High-Risk Areas (if required)

    Additional horizontal drain holes should be installed where there are unacceptable geotechnical risks. Additional holes should be equipped to monitor the phreatic surface and hence the presence of saturated oxide or otherwise weak materials.

7.6 Stage 3- Long term plan- Production bore dewatering

Using production bores to lower the surrounding water table by pumping groundwater from the surrounding area. This will decrease groundwater ingress to the open pit as well as serve to stabilise the pit wall.

- Pump rates for each pit are to be determined through pump tests.
- Environmental considerations require frequent monitoring (pH and salinity) of water extracted.
- Pump maintenance and infrastructure (power) is required.

8.0 Dewatering Bore Considerations

Given historical water related challenges that lead to cessation of mining due to pit wall stability issues, it is recommended a number of activities are undertaken to help inform local ground water conditions and implementation of a cost-effective solution for managing groundwater inflows during future development of WQS.

It is recommended to identify potential ex-pit dewatering bore locations during the period of pit lake pumping and drain-down. Investigations should be targeted based on historical findings such as, in order of priority:

- Target for one bore north and one bore south of WQS along the north-south shear zone.
- Test the potentially high yielding zone on the South-east of WQS pit.
- Test the potential of a recovery bore between WQN and WQS, to intercept increased groundwater inflow caused by the heightened pit lake in WQN.
- All investigation holes should target shears and structural features at depth to allow long-term dewatering below the proposed pit floor.

Any groundwater related drilling exploration could be aligned to ongoing mineral explorations programs. It is recommended that open hole conventional circulation type drilling method is used to identify aquifer intervals and test aquifer yields. The drill hole dimeter should be a minimum of 150mm to minimise backpressure restricting groundwater airlifts. Given we are targeting groundwater of various salinities, there may be a requirement to contain drill water in purpose dug sumps.

Based on our current understanding, indicative locations and nominal depths for the recommended vertical exploration holes and monitoring locations are provided in Table 21.

Table 21 Nominal Groundwater Exploration Locations – Pit Dewatering

Priority	Hole ID	Easting (MGA)	Northing (MGA)	Indicative Depth (m bgl)	Target
Indicative Dewatering Bore Locations					
1	Bore WQN1	512,633	6,955,156	120	WQN Water Interception
2	Bore N1	512,482	6,954,910	120	Northern Shear Target
3	Bore S1	512,397	6,954,299	120	Southern Shear Target
4	Bore S2	512,656	6,954,551	120	Southern Contact Target
Indicative Dewatering Monitoring Bore Locations					
1	MB1	512,219	6,954,320	120	South of WQS between pit and Camp Bore
2	MB2	512,150	6,964,800	120	West of WQS
3	MB3	512,677	6,954,750	120	East of WQS, contact zone
4	MB4	512,626	6,955,149	120	North of WQS, shear zone
Indicative Mounding Monitoring Bore Locations					
5	MB5	513,060	6,956,200	50	North of WQN, shear zone
6	MB6	513,224	6,955,691	50	Between WQN and proposed discharge location
7	WQN	512,645	6,955,628	20	West of WQN, existing bore

The following is recommended to assist with identifying aquifer intervals, yields and details for constructing dewatering bores:

- Lithological logging in a water context (both identification of wet and dry zones) – key observations to be recorded include degree of weathering, nature of fracturing, observed staining and apertures of fracture planes, zones of unfractured rock.
- Mapping aquifers and aquitards by identifying the base of saprolite and base of saprock
- Record first water strike (likely close to the nominal water table at about 23mbgl)
- Measure groundwater airlift yields after each 6m drill rod using a bucket (of known volume) and stopwatch at the drill rig cyclone or a V-notch weir.
- Measure field groundwater pH and salinity (as Electrical Conductivity) each 6m interval.
- Record any drillers observations regarding water occurrence, changes in penetration rate, intersected fractured zones.

Results of this site work will inform the final dewatering strategy and if ex-pit dewatering bores will be effective. If successful, dewatering bores can be planned at suitable adjacent locations. Dewatering bores should be constructed using nominal 200 mm steel casing, slotted between 25 and 80m)possibly up to 200m if deep structures are intersected) and stabilised back to surface using annular graded gravel pack. Bores should be completed in accordance with the "*Minimum standards for the construction of water bores in Australia*" (ADIA, 2020).

The above nominal details should be confirmed by a hydrogeologist on site and adjusted as required to construct the bores based on site-specific data.

With no existing monitoring bores located around WQN and the four existing monitoring bores within the proposed open pit development area at WQS, dedicated groundwater monitoring bores will be required. Indicative monitoring bore locations for dewatering, and mounding is presented in Table 21 and should be considered to allow groundwater levels for both operational (dewatering and geotechnical) and environmental purposes. Nominal bore construction should include:

- Nominal 50mm internal diameter class 9 uPVC blank casing
- Nominal 50mm internal diameter class 9 uPVC slotted casing. Slots can be hand cut or 1mm aperture.
- Backfill the annulus with graded gravel pack (nominal size 3.4-6.4mm).
- Backfill the annulus above gravel pack using bentonite pellets.
- Provide surface protection of PVC casing.

Following the completion of drilling, survey the collar location, top of casing elevation and ground elevation.

Each location will monitor the water table of the deep fractured rock aquifer.

Regulatory approvals will be required for all dewatering abstractions. Compliance monitoring will be required and generally linked to a site-specific Groundwater Operating Strategy (GOS). Monitoring commitments generally include measurement of abstraction rates and volumes (flow meters), groundwater levels (bores), sump levels, and quality (bores and sumps) to assess any changes to the groundwater resource during and after abstraction.

9.0 Excess Water Storage Options

Following disposal of higher salinity (18,000 mg/L TDS) WQS pit lake stored water (totalling about 1.0GL) to WQN, it is estimated WQN will have a remaining void capacity of about 1.5GL (without Duke and Princess extensions). With a predicted range of WQS groundwater inflows of between 2,300 to 4,500 kL/day, a total dewatering volume is predicted to be between about 1.4 and 2.7 GL over the anticipated 608 days of mining. Groundwater salinity in the WQS area has previously been report to average about 2,100 mg/L TDS (maximum 3,700 mg/L TDS).

With the above in mind, several alternative excess water management options have been identified and in order of priority, include:

- Mine water use – road watering, dust suppression, etc.
- Environmental discharge to local creekline – reserved for fresh brackish groundwater (<2,100 mg/L TDS).
- Additional Storage within WQN – reserved for water salinity above 15,000 mg/L TDS.
- Environmental discharge to the Sandford River – measure salinity over 200,000 mg/L TDS.
- Use of mechanical evaporators on WQN to allow more storage capacity (if required).
- Dedicated evaporation pond (if required).
- Future discharge to the Sandford River.

Having multiple water discharge options allows the project to manage water quality constraints (salinity) outside the priority option to discharge local groundwater to the environment via local creeklines.

9.1 Mine Water Re-use

Previously up to about 800 kL/day (10 L/sec) was used during mining for dust suppression on site (Morgan, 1999). Using these estimates for water usage, the total mine excess may average about 1.5 GL over the duration of mining, possibly up to 3.5 GL. Although not likely a uniform volume per day, this however this equates to an average excess of about 2,400 kL/day or 28 L/sec, possibly up to 5,800 kL/day or 67 L/sec.

Given the groundwater quality is fresh to brackish (1,200 mg/L to 3,700 mg/L TDS; average 2,100 mg/L TDS), it is proposed to discharge excess mine water to a local creekline to mitigate dewatering drawdown proportion.

In addition to local groundwater discharge, it has been recommended to install a dewatering bore south of WQN to minimise recirculation back to WQS of mounded water via the shear zone. It is anticipated abstraction from this bore may be used for mine water requirements and/ or redirected back to WQN.

9.2 Environmental Discharge

As a result of mine dewatering, predicted drawdown may propagate up to 2 km from the WQS open pit. To help mitigate some of the drawdown impacts, it is proposed to discharge excess water to a local creekline (indicative location 512,600mE, 6,956,288mN) within the drawdown capture zone (Figure 20).

A recent vegetation and fauna survey (Botanica, 2025) at the Western Queen project area did not identify any significant vegetation assemblages and a low risk of potential terrestrial groundwater dependent ecosystems (GDE) in the adjacent floodplain areas. The closest station well, Wanrey Well, is about 7 km northwest and down-gradient of the proposed outfall location.

Importantly, prior to discharge, all abstracted water will required retention within a suitably designed transfer pond to minimise sediment loads. Minimising sediment can be achieved through abstraction from production bores.

To assess the extent at the potential wetting front with discharging over the duration of the project, a surface water flood model was used. The model was based on a 1:20 year rainfall event. Details of the flood modelling are presented in a separate report, Western Queen Surface water Assessment, (AECOM, 2025). Model results are presented on Figure 21 and relevant findings from this assessment include:

- Under the lower discharge rate of 1,500 kL/day (total 1.0 GL), a wetted front extent of 1.75km is predicted and generally remains within the low flow channel.
- Under an estimated average discharge rate of 2,400 kL/day (total 1.5 GL), a wetted front extent of 2.0km is predicted.
- Under the extreme discharge rate of 5,800 kL/day (total 3.5 GL), should unforeseen higher dewatering rate occur, a wetted front extent of up to about 3.9km is predicted.
- Discharge generally remains within low-flow channels and in areas bounded by areas reporting degraded to good vegetation condition close to the proposed discharge location to very good further west of the project.

The wet weather assessment found that mine water releases do not affect baseline (non-mine-related) flooding conditions. This is because the mine's contribution—0.03 m^3/s (2,400 kL/day)—is negligible compared to the natural baseline flow of 1.75 m^3/s at the release point. Therefore, mine discharges during wet weather are not expected to adversely impact the receiving environment.

9.3 Existing Pit Storage

Following disposal WQS pit lake water to WQN, it is estimated WQN will have a remaining void capacity of between 1.4GL and 2.8GL (inclusive of Princess and Duke extensions). As part of the dewatering strategy, this capacity allows for unforeseen higher salinity or higher sediment loaded water to be transferred rather than discharging at the proposed creek outfall.

Based on the water balance, at the lower-case (1.4GL), the remaining storage capacity of WQN has the capacity to accommodate up to 86% of the predicted remaining excess water (2,400 kL/day) over the 608 days.

9.4 Mechanical Evaporators

If required, to allow further storage capacity in WQN, the implementation of mechanical evaporators could be included in the excess mine water strategy. Examples of mechanical evaporators include industrial-grade sprinklers and enhanced evaporators such as mister-fogger units.

- Sprinklers have a lower evaporative capacity primarily because they generate a larger droplet size, have a lower throughput rate and effective evaporative footprint than mister-fogger units. By way of an example, a recent project considered sprinkler array that, in an arid setting, could, under optimum conditions evaporate between about 550 kL/day that incorporated about 100 sprinklers discharging about 780 kL/day. To achieve this rate throughout the year, the number of sprinklers (and area) would be about 270 in the cooler months and 70 in the hotter months.
- Mister-fogger units are generally sold in sizes reflecting their fan throughput rate. The efficiency is mainly dependent on the discharge rate, droplet size and prevailing temperature, humidity, wind speed and operating time (hours per day). A recent project in an arid, east Pilbara setting considered units with throughputs of between 1,080 and 2,160kL/day and efficiency factors ranging from 30 to 60% (a likely performance envelope for this site). Monthly efficiencies will vary between cooler months with higher humidity and hotter months with lower humidity.

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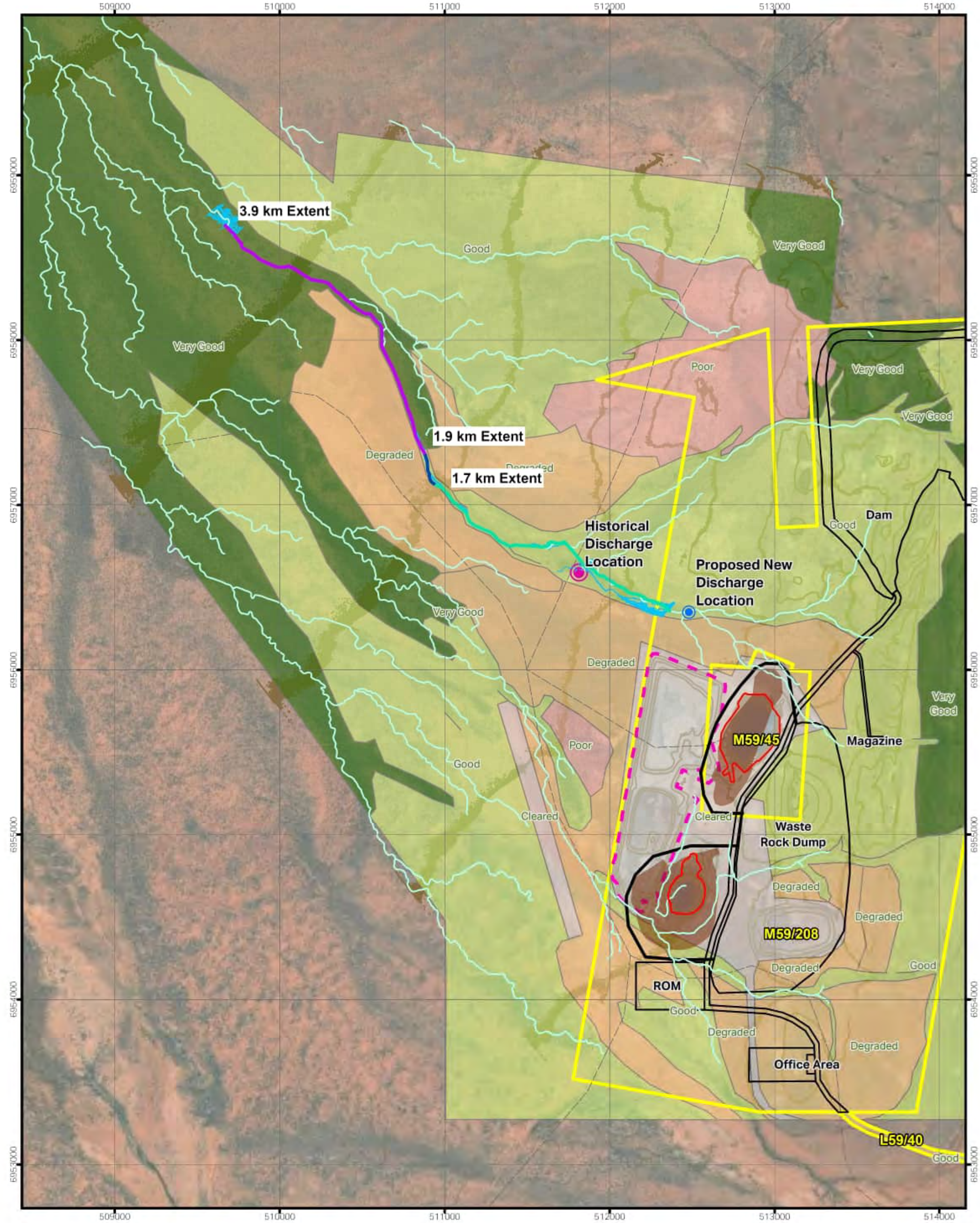

LEGEND

Western Queen Tenements
Existing Pit Outline
Proposed Pit
Proposed Site Layout
Existing Waste Dump
Contours

Modelled Flow Areas
Winter 5800 kl/day Extent
Winter 2400 kl/day Extent
Winter 1500 kl/day Extent

Vegetation Condition
Very Good
Good
Degraded
Poor
Cleared

AECOM Delivering a better world

PROJECT ID	60716551	CREATED BY	ROB.MCGREGOR
DATE MODIFIED	06 JUN 2025	APPROVED BY	G.BROPHY

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GDA 1994 MGA ZONE 50

Conceptual Creek Discharge

WESTERN QUEEN

WESTERN QUEEN DEWATERING ASSESSMENT

Figure
23

9.5 Potential Local Evaporation Pond

A further option to manage excess water if to construct an evaporation pond in the cranes pit area. Evaporation rates average around 250mm/month during the summer months and 100mm/month during the cooler winter months (Section 2.1). This option is yet to be developed further given the potential size required to allow adequate shortage capacity, potential design requirements and environmental impacts.

Examples of conceptual pond sizes are presented in Table 22.

Table 22 Potential Evaporation Pond Dimensions and Capacities

Rectangular Pond Dimensions (m)							
1m Depth			Area	2m Depth			Area
Length (m)	Width (m)	Volume (m3)	Hectares	Length (m)	Width (m)	Volume (m3)	Hectares
1,500	800	1,200,000	120	1,000	600	1,200,000	60
2,200	1,100	2,420,000	242	2,000	600	2,400,000	120
3,000	1,450	4,350,000	435	2,200	1,000	4,400,000	220

9.1 Sandford River Discharge

It is understood that discharge to the Sandford River was undertaken in the early periods of mine dewatering given limited options to develop the project with significant excess water management requirements. Little information is available outside a licenced approval to discharge 5,000 kL/day with a maximum salinity of 15,000 mg/L TDS, to a location about 9.3 km from the mine.

To complement the above, if higher salinity (>15,000 mg/L TDS), are encountered in volumes greater than the capacity of WQN or WQS, an alternative option may require evaluation. Historically, it was reported that the Sandford River is hypersaline.

This was further confirmed during the site reconnaissance in February 2025 where salt crusts had formed in the riverbed (Table 11). This information was complemented with a surface water ponded sample collected in April 2025 reporting a salinity concentration of over 200,000 mg/L TDS.

Due to the perceived challenges with managing excessive salt loadings with discharge of higher salinity water (>15,000 mg/L TDS), this option has not been progressed.

10.0 Operational Monitoring Requirements

10.1 Groundwater Operating Strategy

Under Statewide operational policy 5.08 – Use of operating strategies in the water (DWER, 2011), applicants for water licenses may be required to submit an operating strategy to address water management issues. The operating strategy presents the licensee's commitments and responsibilities in managing the impacts of taking and using water on the environment and other water users. A strategy often includes the licensee's proposed monitoring schedule, and contingency plans developed to protect the environment (including other water users), and the licensee's reporting commitments.

In context with the proposed Western Queen project, as a general guideline DWER will require a strategy where:

- The taking of water may impact upon the environmental values or other water users.
- The volume of water to be taken is significant, generally where the allocation sought is greater than 1.0 GL/annum.
- The water resource being accessed requires stringent management.
- Water is abstracted from several sources or from a large number of bores and requires careful management.
- In the opinion of the department, it is necessary to fulfil the requirements of the Rights in Water and Irrigation Act, 1914.

Given mine dewatering requirements is estimated at 1.0 GL/annum, which will be drawn from , open pits, potential dewatering bores and in-pit sumps, a Groundwater Operating Strategy (GWOS) will be required.

10.2 Preliminary Groundwater Monitoring Program

Monitoring is required before abstraction commences to establish baseline conditions and during operations to identify impacts upon the groundwater environment. Groundwater monitoring should:

- Identify any dewatering of the aquifers associated with mine dewatering.
- Identify any impacts upon the aquifers associated with dewatering activities.
- Identify drawdowns at any environmentally sensitive areas or impacts to the groundwater resource.

A recommended monitoring program includes:

- pit lake weekly abstraction pumping rates and volumes.
- WQN monthly surveyed pit lake elevation.
- weekly groundwater levels in proposed monitoring bores.
- weekly abstraction rates and volumes from dewatering bores, horizontal drains, and sumps.
- Weekly groundwater salinity prior to discharge to the environment.
- quarterly abstracted groundwater quality (pH, electrical conductivity, total dissolved solids, major ions, and dissolved metals).

11.0 Predicted Water Table Recovery on Closure

Following mine closure and cessation of mine dewatering, the extent of the residual drawdown impact zone formed by the extended area and depth of WQS pit is required to assess post-closure impacts and risks for Western Queen. A preliminary mine pit lake water balance assessment has been undertaken to provide an indicative estimate of the rate at which available waters (groundwater and rainfall runoff) will inflow into the various pit voids after mine closures. Results of the water balance assessments identified that the residual post-closure drawdown footprint associated with the pits will create a hydraulic sink.

To provide a potential range of pit-lake filling rates and final levels, average rainfall of 217 mm/annum was used which represented the average for the last available 10 years (2014 – 2023, BoM Station No. 7095). It is noted that the range of rainfall experienced over these years (146 mm to 295 mm, 10th–90th percentiles) could represent a fluctuation of potential pit-lake post-closure water levels.

11.1 Predicted Water Table Recovery and Quality on Closure

A basic lumped-parameter Mine Water Filling Model (MIFM) (Banks, 2001) was used to provide an indicative transient assessment of the proposed final void pit-lakes. This model was applied to guide how quickly and to what elevations, the final void may be inundated by surface water and groundwater water inflows. This model relied on three key concepts:

- The steady-state aquifer inflow rates of the main hydro-stratigraphic units and head-dependence of groundwater these inflow rates.
- The cross-sectional area of the void at different water level elevations.
- Surface area–dependent water exchanges within the final void due to rainfall, runoff, and evaporation effects.

Predictive assessments of rates of filling of the final void have been completed, by applying the summarised water balance parameters. The model concept was programmed into a computer spreadsheet environment that provided graphical output of transient pit-lake water level elevations. Each assessment extended to steady-state conditions, thus providing estimates of the final pit-lake level and salinity. Outcomes from the model included:

- Transient changes in pit-lake levels based on balances between groundwater inflows, runoff, and evaporation losses.
- Pit-lake salinity based on the quality of the current pit lake, groundwater inflows and runoff and the concentration effects of evaporation.

The volumes and surface areas of each pit were calculated based on the open pit shell data (*WQ PITS - WESTERN QUEEN PITS_02 PIT DESIGN_QUEEN241028_DTM.dxf,* provided April 2025). The open pit shell data was used to calculate 1m vertical elevation increments in the void volumes and surface areas.

Evaporation was calculated by applying 2,200 mm/annum (pan evaporation rate) to pit lakes. The corresponding evaporation losses at given surface areas was used as a quantitative check against the indicative groundwater inflows and water balance results.

11.2 Post-Closure Pit Lake Level

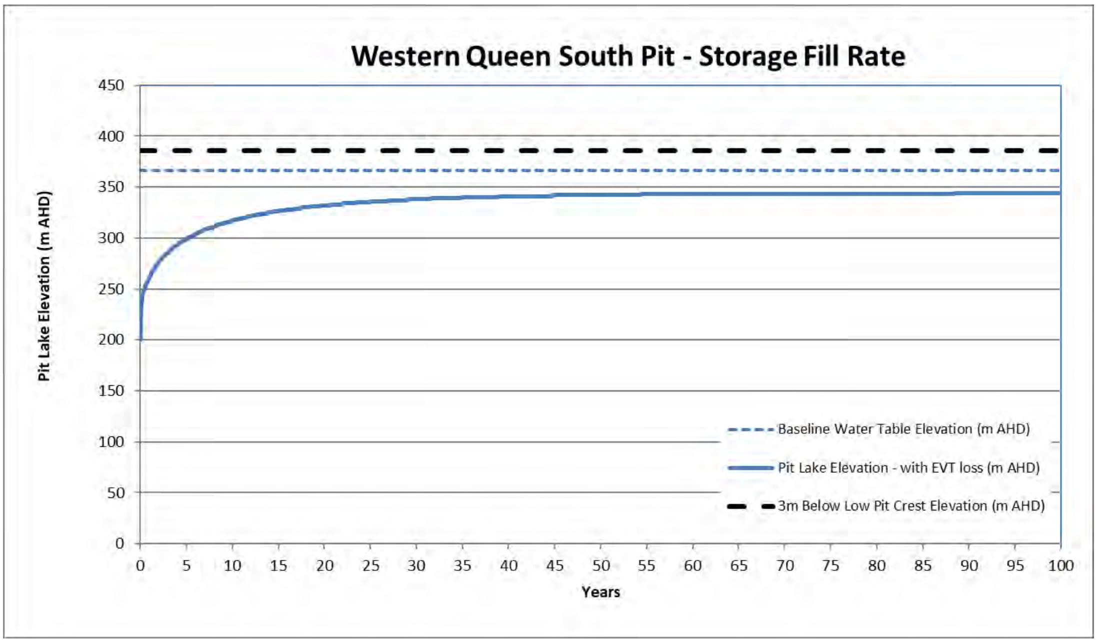
Detailed results of pit lake water balance for the WQS open pit are presented below. As WQN development is yet to be finalised, results have not been modelled. The WQS pit would result in pit lake levels below surrounding baseline groundwater levels, due to groundwater inflows at or close to evaporation losses. A summary of residual pit lake drawdown is presented in Table 23.

Findings from the WQS water balance assessment include:

- The open pit will potentially take close to 54 years to fill to steady-state conditions.

- A final pit lake elevation of 343m AHD, equivalent to the surface area whereby evaporation losses equal water inflows, is predicted.
- An average residual post-closure drawdown of 23m below the baseline groundwater table and will form a hydraulic groundwater sink.
- Long-term evaporative losses from the pit lake surface area are estimated at about 8,429 kL/annum.
- With groundwater inflow salinity concentrations up to 3,700 mg/L, the residual mine pit lake salinity is expected to become saline at around 30,000 mg/L after approximately 86 years post-closure.

Hydrographs of the WQS pit lake filling, and estimated salinity are shown on Figure 24**.**



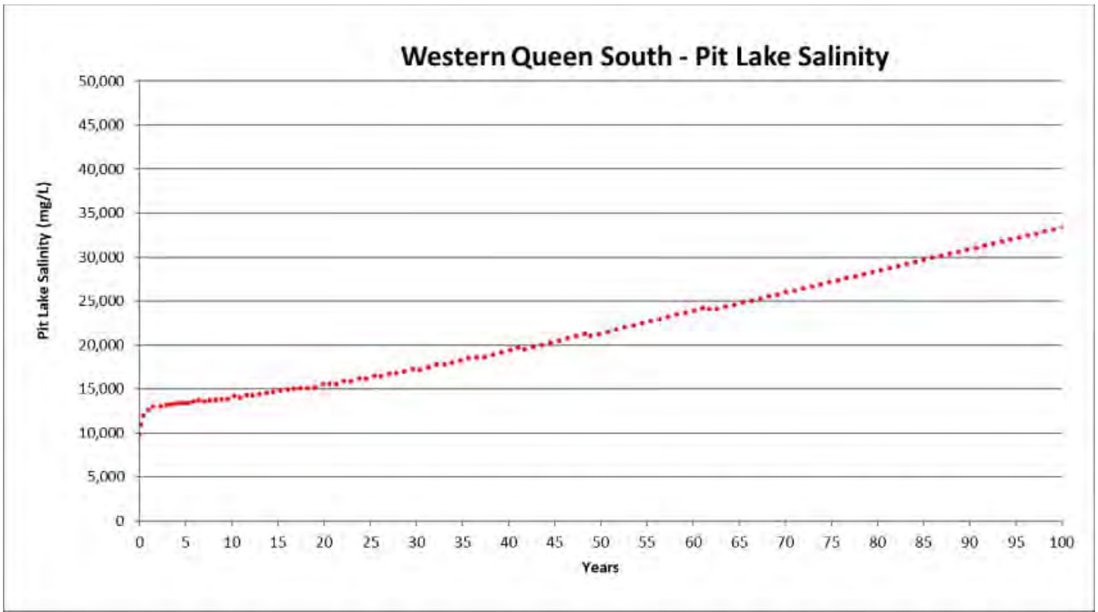


Figure 24 WQS Pit – Post- Closure Residual Pit Lake Fill Rate and Salinity

Table 23 Summary of Residual WQS Pit Lake Drawdown

Description	WQS Pit
Max Pit Lake Fill Level (m AHD)	343
Years to Reach Steady State	55
Estimated Residual Pit Freeboard - Overtopping (low pit crest to maximum fill level)(m)	55
Residual Difference from Baseline (m)	18
Final Pit Surface Area (m^2)	224,688
Residual Evaporation Loss (kL/annum)	8,429
Post-Closure Groundwater Flow	Groundwater Sink
External Factors	None
Potential for poor water quality to develop due to evapo-concentration	Potential
Potential to contaminate groundwater if quality is poor and level is too high	None
Potential for unstable materials to release; Solutes through oxidation, weathering, and erosion	Unknown
Potential for geotechnical pit wall instability	Potential on NE face, where historical failures have occurred.
Potential for human and birdlife interaction	Unknown
Post-Closure Volume of Freeboard – Overtopping (m^3)	5,393,724
Pit Lake Over-Topping during extreme climatic events	Unlikely
Potential for post-closure environmental impacts	Unlikely
Comments	Closure assessment may need to be revisited if more groundwater inflows are encountered during mining.

12.0 Conclusions

The proposed Western Queen Development includes the development of up to four open pits (WQS, Princess, Duke, and Cranes deposits). Historical mining at both WQN and WQS have resulted in pit lakes formation that required dewatering prior to proposed open pit development.

Conceptual Groundwater Model

Based on the literature review, the conceptual hydrogeology of the project includes:

- The local ground elevation around 390m AHD.
- The pre-mining water level was reported at about 355m RL (35mbgl) to the north of WQN and about 367m RL (23mbgl) in WQS.
- Regional groundwater flow generally follows topography and flows to regional low-lying areas in the west associated with present day drainages and ultimately discharges towards the north-western Sandford River.
- The average annual rainfall is about 217 mm, with annual evaporation up to 2,600 mm.
- Stratigraphic units in order of increasing depth:
  - Alluvial and aeolian superficial sediments (Aquifer where saturated) - Local ferricrete formations may be preferential pathways that transmit rainfall recharge to low lying areas.
  - Saprolite clay (Aquitard) - Extremely weathered saprolitic clay that is normally of low to very low hydraulic conductivity and forms an aquitard when below the water table.
  - Saprock (Aquifer where saturated) - moderately weathered bedrock, varying between being an aquitard to aquifer of low to moderate hydraulic conductivity. Locally, the saprock interval maybe transmissive along contact zones and/or fault or shear zones.
  - Fresh bedrock (Aquitard) - generally massive and non-fractured and is regarded as a regional aquitard that is expected to yield little groundwater.
- The alluvial sediments occur to a depth of about 5mbgl (385m AHD) on the northern side of WQS and about 27mbgl (363m AHD) on the southern side. Surface water infiltration into these shallow deposits is probably an important mechanism for local groundwater recharge.
- The fracturing intensity and saprock thicknesses were found to be greater at contact zones between rock types and the mineralised zones.
- The high transmissivity value determined for WQN of 84 m^2/day was not considered appropriate for WQS. An aquifer transmissivity of 30m^2/day and hydraulic conductivity of 0.5 m/day were estimated by Morgan (2000).
- Based on in situ water quality sampling, pit lake salinity is approximately 18,400mg/L TDS for WQS and 18,800mg/L TDS for WQN.
- Historical dewatering abstraction of up to 54 L/sec or 4,650 kL/day were reported from WQN (Morgan, 1999) and 30 L/sec or 2,500 kL/day during mining of WQS (Morgan, 2000).
- Historical groundwater is reportedly fresh to slightly brackish, sodium chloride type with TDS concentrations at WQN ranging up between 2,000 mg/L and 10,660 mg/L (average 4,500 mg/L TDS) and between 1,200 mg/L and 3,700mg/L (average 2,100mg/L TDS) at WQS. Groundwater is generally neutral to slightly alkaline pH (pH 7.9 to 8.1).

Pit Lake Water Transfer

WQN currently holds approximately 3.2 Gigalitres (GL) of water and an additional water storage capacity of about 2.4 GL to a point 1.5m below the pit crest. With the proposed Princess and Duke pit developments, this may increase total WQN capacity up to 3.8 GL.

The WQS pit currently holds approximately 672,000 kL or 0.7 Gigalitres (GL) of water (based on a pit lake elevation estimate of 362m AHD). To allow future deepening of the WQS open pit, the water stored within the existing pit will be transferred to WQN.

The water quality characteristics in both pits have been measured and are very similar. However, at lower pit lake elevations, suspended sediments will likely increase, though no environmental impact is foreseen with this water transfer strategy.

To minimise pit wall stability issues and allow groundwater to drain and pore pressures to be lowered, it is proposed the pit lake be emptied over a period at least 90 days. Over the 90-day period an expected additional 0.2GL of dewatered water from groundwater inflows is estimated, based on the assumed 2,200 kL/day inflows, and an additional estimated 500 kL/day form interconnection between WQN and WQS. This equates to a total of up to 1.0GL (about 130 L/sec), that may require abstraction to allow access to the WQS pit floor.

The maximum WQN pit lake elevation has been defined by potential mounding-related impacts on local vegetation and the groundwater resource, along with having enough remaining capacity to limit over-topping from high rainfall events. A high-level assessment of the propagation of predicted mounding from WQN reported groundwater levels are predicted to remain below about 20m bgl in the northern areas at distances of about 200m.

Groundwater Dewatering

Simplified analytical groundwater models have been completed to determine indicative dewatering rates and maximum drawdown extents for WQS. Dewatering for WQN will require the pit lake to be partially lowered and the proposed Cranes development is above the water table. Findings from the predictive WQS groundwater modelling are summarised below.

Table 24 Summary of Predicted Dewatering Estimates

Deposit	Estimated Dewatering Duration[1]	Predicted Steady-State Abstraction Range		Predicted Total Project Abstraction Volume	Predicted Drawdown Distance - 1 m contour	Comments
		(kL/day)	L/sec	(GL)	(m)	
WQS	608 days	2,300 to 5,800	27 to 67	1.4 to 2.7	1,700 to 2,000	Drawdown will propagate to the adjacent WQN and proposed discharge location
Note [1] – MEGA, 2025						

Based on the modelling, an indicative reasonable case (lower-case) maximum abstraction is predicted to be up to about 1.5 GL/annum.

Dewatering Strategy

The recommended dewatering strategy should seek to dewater ahead of mining to avoid difficult mining conditions, i.e. boggy pit floor, lower pore pressures in the pit walls through targeted horizontal drains, and control pit wall seepage and horizontal drain inflows through a closed collect system to minimise uncontrolled drainage to the pit floor and flows across benches.

Dewatering options considered include:

- Option 1: Dewatering Bores – to abstract groundwater from deeper flow paths in-pit or ex-pit, depending on their depth, interconnectedness, and permeability. Their effectiveness can be limited in deep fractured rock settings due to the low hydraulic conductivity and often compartmentalised nature of these aquifers. In-pit bores are often sacrificial and only effective for short periods. Opportunities to dewater in advance of mining from bores exist as per details in Section 6.1.1.
- Option 2: Shallow Sumps – to intercept gravity drainage from seeps and drain holes on the pit floor.

- Option 3: Preferentially Sloped Pit Floor – to allow for gravity drainage across a sloped pit floor to strategically placed sumps, potentially on deep permeable structures to intercept groundwater inflows.
- Option 4: Horizontal Drain Holes – using a system of closely spaced interconnected drain holes to gravity drain and depressurise rock contacts and fault zones behind pit walls to improve geotechnical stability.

Mine Water Management Strategy

Several alternative excess water management options have been identified and in order of priority, include:

- Mine water use – road watering, dust suppression, etc.
- Environmental discharge to local creekline – reserved for fresh to brackish groundwater (<2,100 mg/L TDS).
- Additional storage within WQN – reserved for water salinity above 15,000 mg/L TDS.
- Use of mechanical evaporators on WQN to allow more storage capacity (if required).
- Dedicated evaporation pond (if required).
- Future discharge to the Sandford River.

Having multiple water discharge options allows the project to manage water quality constraints (salinity) outside the option to discharge local groundwater to the environment via local creeklines.

Following disposal of higher salinity (18,000 mg/L TDS) WQS pit lake stored water (totalling about 1.0GL) to WQN, it is estimated WQN will have a remaining void capacity of about 1.5GL (without Duke and Princess extensions). With a predicted range of WQS groundwater inflows of between 2,300 to 4,500 kL/day, a total dewatering volume is predicted to be between about 1.4 and 2.7 GL over the anticipated 608 days of mining.

Previously up to about 800 kL/day (10 L/sec) was used during mining for dust suppression on site (Morgan, 1999). Using these estimates for water usage, the total mine excess may be up to about 1.5 GL over the duration of mining. Although not likely a uniform volume per day, this equates to an excess of up to about 2,400 kL/day or 28 L/sec.

Mine Water Management – Environmental Discharge

Groundwater salinity in the WQS area has previously been reported to average about 2,100 mg/L TDS (maximum 3,700 mg/L TDS) and is of high quality (lower salinity) than that measured in other areas within the Western Queen areas. With this in mind, excess groundwater is proposed to be discharged to the environment over a duration of up to about 1.7 years.

A recent vegetation and fauna survey (Botanica, 2025) at the Western Queen project area did not identify any significant vegetation assemblages and a low risk of potential terrestrial groundwater dependent ecosystems (GDE) in the adjacent floodplain areas. The closest station well, Wanrey Well, is about 7 km northwest and down-gradient of the proposed outfall location.

Surface water modelling was undertaken to assess sensitivity of the predicted wetting front extent with discharge rates. The model was based on a 1:20 year rainfall event and relevant findings from this assessment include:

- Under the lower discharge rate of 1,500 kL/day (total 1.0 GL), a wetted front extent of 1.75km is predicted and generally remains within the low flow channel.
- Under an estimated average discharge rate of 2,400 kL/day (total 1.5 GL), a wetted front extent of 2.0km is predicted.

- Under the extreme discharge rate of 5,800 kL/day (total 3.5 GL), should unforeseen higher dewatering rate occur, a wetted front extent of up to about 3.9km is predicted.

The wet weather assessment found that mine water releases do not affect baseline (non-mine-related) flooding conditions. This is because the mine's contribution—0.03 m³/s (2,400 kL/day)—is negligible compared to the natural baseline flow of 1.75 m³/s at the release point. Therefore, mine discharges during wet weather are not expected to adversely impact the receiving environment.

Post Closure - Residual Drawdown

Results of the post closure water balance identified that the residual post-closure drawdown footprint associated with the WQS pit will create a hydraulic sink. Details are provided below:

Table 25 Post Closure – Residual Drawdown

Description	WQS Pit
Max Pit Lake Fill Level (m AHD)	343
Years to Reach Steady State	55
Estimated Residual Pit Freeboard - Overtopping (low pit crest to maximum fill level)(m)	55
Residual Difference from Baseline (m)	18
Final Pit Surface Area (m^2)	224,688
Residual Evaporation Loss (kL/annum)	8,429
Post-Closure Groundwater Flow	Groundwater Sink
External Factors	None
Potential for poor water quality to develop due to evapo-concentration	Potential
Potential to contaminate groundwater if quality is poor and level is too high	None
Potential for unstable materials to release; Solutes through oxidation, weathering, and erosion	Unknown
Potential for geotechnical pit wall instability	Potential on NE face, where historical failures have occurred.
Potential for human and birdlife interaction	Unknown
Post-Closure Volume of Freeboard – Overtopping (m^3)	5,393,724
Pit Lake Over-Topping during extreme climatic events	Unlikely
Potential for post-closure environmental impacts	Unlikely

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14.0 Standard Limitations

AECOM Australia Pty Limited (AECOM) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Rumble Resources Ltd and only those third parties who have been authorised in writing by AECOM to rely on the report.

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The methodology adopted and sources of information used by AECOM are outlined in this the Report.

Where this report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information unless required as part of the agreed scope of work. AECOM assumes no liability for any inaccuracies in or omissions to that information.

This Report was prepared between February and June 2025. The information in this report is considered to be accurate at the date of issue and is in accordance with conditions at the site at the dates sampled. Opinions and recommendations presented herein apply to the site existing at the time of our investigation and cannot necessarily apply to site changes of which AECOM is not

aware and has not had the opportunity to evaluate. This document and the information contained herein should only be regarded as validly representing the site conditions at the time of the investigation unless otherwise explicitly stated in a preceding section of this report. AECOM disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. The borehole logs indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the uniformity of conditions and on the frequency and method of sampling as constrained by the project

budget limitations. The behaviour of groundwater and some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this report and our experience. Future advances in regard to the understanding of chemicals and their behaviour, and changes in regulations affecting their management, could impact on our conclusions and recommendations regarding their potential presence on this site.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, AECOM must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time.

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Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.

Appendix A

Laboratory Results

CERTIFICATE OF ANALYSIS

Work Order	: **EP2502565**	Page	: 1 of 8
Client	: **AECOM AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: Julian Fowler	Contact	: Natalie Duncan
Address	: LEVEL 15 58 Mounts Bay Road PERTH WA, AUSTRALIA	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 60745106	Date Samples Received	: 21-Feb-2025 11:30
Order number	: 60745106	Date Analysis Commenced	: 21-Feb-2025
C-O-C number	: ----	Issue Date	: 28-Feb-2025 14:41
Sampler	: Julian Fowler		
Site	: Western Queen		
Quote number	: EN/004/23		
No. of samples received	: 9		
No. of samples analysed	: 9		

Accreditation No. 825
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ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- As per QWI – EN55-3 Data Interpreting Procedures, Ionic balances are typically calculated using Major Anions - Chloride, Alkalinity and Sulfate; and Major Cations - Calcium, Magnesium, Potassium and Sodium. Where applicable and dependent upon sample matrix, the Ionic Balance may also include the additional contribution of Ammonia, Dissolved Metals by ICPMS and H+ to the Cations and Nitrate, SiO2 and Fluoride to the Anions.
- EK061G/EK067G (TKN/TP): LOR for samples EP2502565-005 and -008 raised due to possible sample matrix interference.
- EG020: Metal LOR raised for various elements on various samples due to high TDS content.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	WQS1	WQS2	WQS3	WQS4	WQN1
			Sampling date / time	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00
Compound	CAS Number	LOR	Unit	EP2502565-001	EP2502565-002	EP2502565-003	EP2502565-004	EP2502565-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	7.86	7.78	7.63	8.22	8.14
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	24600	25000	25700	25100	25900
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	18400	18900	18800	18800	19200
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	82	99	62	81	90
Total Alkalinity as CaCO3	----	1	mg/L	82	99	62	81	90
ED040F: Dissolved Major Anions								
Silicon as SiO2	14464-46-1	0.1	mg/L	64.7	67.4	66.3	66.9	49.4
ED040T: Total Major Anions								
Silicon	7440-21-3	0.05	mg/L	31.0	32.6	32.8	32.1	25.1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	830	830	846	855	984
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	8580	8140	8310	8440	8720
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	619	629	640	644	583
Magnesium	7439-95-4	1	mg/L	602	613	622	626	580
Sodium	7440-23-5	1	mg/L	3650	3750	3770	3790	4090
Potassium	7440-09-7	1	mg/L	101	103	103	104	94
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	0.02	<0.02	0.04	0.05	0.10
Antimony	7440-36-0	0.001	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Arsenic	7440-38-2	0.001	mg/L	<0.002	<0.002	<0.002	0.008	<0.002
Boron	7440-42-8	0.05	mg/L	1.04	1.02	1.09	1.33	1.39

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	WQS1	WQS2	WQS3	WQS4	WQN1
			Sampling date / time	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00
Compound	CAS Number	LOR	Unit	EP2502565-001	EP2502565-002	EP2502565-003	EP2502565-004	EP2502565-005
				Result	Result	Result	Result	Result
EG020T: Total Metals by ICP-MS - Continued								
Barium	7440-39-3	0.001	mg/L	**0.234**	**0.238**	**0.249**	**0.261**	**0.222**
Beryllium	7440-41-7	0.001	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	7440-43-9	0.0001	mg/L	<0.0002	<0.0002	<0.0002	**0.0015**	<0.0002
Cobalt	7440-48-4	0.001	mg/L	<0.002	<0.002	<0.002	**0.006**	<0.002
Chromium	7440-47-3	0.001	mg/L	<0.002	<0.002	<0.002	**0.006**	**0.002**
Copper	7440-50-8	0.001	mg/L	**0.005**	**0.004**	<0.002	**0.006**	<0.002
Manganese	7439-96-5	0.001	mg/L	**0.002**	**0.058**	**0.004**	**0.008**	**0.023**
Nickel	7440-02-0	0.001	mg/L	<0.002	**0.004**	<0.002	**0.008**	**0.004**
Lead	7439-92-1	0.001	mg/L	<0.002	<0.002	<0.002	**0.006**	<0.002
Selenium	7782-49-2	0.01	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Vanadium	7440-62-2	0.01	mg/L	<0.02	<0.02	<0.02	<0.02	**0.02**
Zinc	7440-66-6	0.005	mg/L	<0.010	<0.010	**0.016**	**0.011**	**0.060**
Molybdenum	7439-98-7	0.001	mg/L	**0.015**	**0.015**	**0.016**	**0.016**	**0.037**
Strontium	7440-24-6	0.001	mg/L	**10.5**	**11.0**	**11.1**	**11.3**	**9.00**
Thallium	7440-28-0	0.001	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Uranium	7440-61-1	0.001	mg/L	<0.002	<0.002	<0.002	<0.002	**0.005**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG050T: Total Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
EG051GUF: Ferrous Iron by Discrete Analyser - Unfiltered								
Ferrous Iron	----	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EG053TG-MS: Total Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.0**	**1.0**	**1.0**	**1.0**	**1.6**
EK055G: Ammonia as N by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	WQS1	WQS2	WQS3	WQS4	WQN1
			Sampling date / time	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00
Compound	CAS Number	LOR	Unit	EP2502565-001	EP2502565-002	EP2502565-003	EP2502565-004	EP2502565-005
				Result	Result	Result	Result	Result
EK055G: Ammonia as N by Discrete Analyser - Continued								
Ammonia as N	7664-41-7	0.01	mg/L	**0.08**	**0.44**	**0.11**	**0.07**	**0.29**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.02**	**0.01**	**0.05**	**0.05**	**0.24**
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**1.28**	**0.98**	**1.17**	**1.17**	**8.19**
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**1.30**	**0.99**	**1.22**	**1.22**	**8.43**
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.4**	**0.8**	**1.0**	**0.6**	**1.0**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**1.7**	**1.8**	**2.2**	**1.8**	**9.4**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**1.36**	**1.39**	**1.36**	**0.02**	<0.02
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**0.01**	<0.01	<0.01	<0.01
Reactive Phosphate	14625-44-2	0.10	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**261**	**249**	**253**	**258**	**268**
ø Total Cations	----	0.01	meq/L	**242**	**248**	**250**	**251**	**257**
ø Ionic Balance	----	0.01	%	**3.81**	**0.26**	**0.70**	**1.24**	**2.12**

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	WQN2	WQN3	WQN4	WQN5	----
			Sampling date / time	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	----
Compound	CAS Number	LOR	Unit	EP2502565-006	EP2502565-007	EP2502565-008	EP2502565-009	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.31**	**8.18**	**8.34**	**8.23**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**24900**	**43700**	**24700**	**25000**	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**18500**	**31100**	**18200**	**18700**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	**2**	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**92**	**152**	**88**	**89**	----
Total Alkalinity as CaCO3	----	1	mg/L	**93**	**152**	**91**	**89**	----
ED040F: Dissolved Major Anions								
Silicon as SiO2	14464-46-1	0.1	mg/L	**53.7**	**48.5**	**53.0**	**54.8**	----
ED040T: Total Major Anions								
Silicon	7440-21-3	0.05	mg/L	**26.1**	**104**	**25.8**	**27.0**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**940**	**1700**	**934**	**935**	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**7990**	**14000**	**8010**	**8310**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**580**	**582**	**577**	**589**	----
Magnesium	7439-95-4	1	mg/L	**571**	**789**	**565**	**576**	----
Sodium	7440-23-5	1	mg/L	**3850**	**8240**	**3850**	**3870**	----
Potassium	7440-09-7	1	mg/L	**116**	**287**	**116**	**117**	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.03**	**24.6**	**0.19**	<0.02	----
Antimony	7440-36-0	0.001	mg/L	<0.002	<0.002	<0.002	<0.002	----
Arsenic	7440-38-2	0.001	mg/L	<0.002	**0.005**	<0.002	<0.002	----
Boron	7440-42-8	0.05	mg/L	**1.41**	**1.39**	**1.44**	**1.44**	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	WQN2	WQN3	WQN4	WQN5	----
			Sampling date / time	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	----
Compound	CAS Number	LOR	Unit	EP2502565-006	EP2502565-007	EP2502565-008	EP2502565-009	--------
				Result	Result	Result	Result	----
EG020T: Total Metals by ICP-MS - Continued								
Barium	7440-39-3	0.001	mg/L	**0.228**	**0.394**	**0.203**	**0.233**	----
Beryllium	7440-41-7	0.001	mg/L	<0.002	<0.005	<0.002	<0.002	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0002	**0.0004**	<0.0002	<0.0002	----
Cobalt	7440-48-4	0.001	mg/L	<0.002	**0.063**	<0.002	<0.002	----
Chromium	7440-47-3	0.001	mg/L	**0.003**	**0.901**	**0.008**	**0.003**	----
Copper	7440-50-8	0.001	mg/L	<0.002	**0.112**	<0.002	<0.002	----
Manganese	7439-96-5	0.001	mg/L	**0.008**	**0.668**	**0.006**	**0.003**	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	**0.372**	**0.004**	<0.002	----
Lead	7439-92-1	0.001	mg/L	<0.002	**0.010**	<0.002	<0.002	----
Selenium	7782-49-2	0.01	mg/L	<0.02	<0.02	<0.02	<0.02	----
Vanadium	7440-62-2	0.01	mg/L	**0.03**	**0.11**	**0.02**	**0.03**	----
Zinc	7440-66-6	0.005	mg/L	**0.023**	**0.071**	**0.011**	<0.010	----
Molybdenum	7439-98-7	0.001	mg/L	**0.037**	**0.033**	**0.034**	**0.038**	----
Strontium	7440-24-6	0.001	mg/L	**7.69**	**7.30**	**7.06**	**8.24**	----
Thallium	7440-28-0	0.001	mg/L	<0.002	<0.002	<0.002	<0.002	----
Uranium	7440-61-1	0.001	mg/L	**0.005**	**0.009**	**0.005**	**0.006**	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG050T: Total Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EG051GUF: Ferrous Iron by Discrete Analyser - Unfiltered								
Ferrous Iron	----	0.05	mg/L	<0.05	**3.41**	<0.05	<0.05	----
EG053TG-MS: Total Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	<0.10	**55.3**	**0.37**	<0.10	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.6**	**1.5**	**1.6**	**1.6**	----
EK055G: Ammonia as N by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

			Sample ID	WQN2	WQN3	WQN4	WQN5	----
			Sampling date / time	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	18-Feb-2025 00:00	----
Compound	CAS Number	LOR	Unit	EP2502565-006	EP2502565-007	EP2502565-008	EP2502565-009	--------
				Result	Result	Result	Result	----
EK055G: Ammonia as N by Discrete Analyser - Continued								
Ammonia as N	7664-41-7	0.01	mg/L	**0.04**	**1.03**	**0.03**	**0.04**	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	14797-65-0	0.01	mg/L	**0.25**	**0.19**	**0.22**	**0.28**	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**8.35**	**6.54**	**8.27**	**8.29**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**8.60**	**6.73**	**8.49**	**8.57**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.7**	**3.8**	**0.8**	**0.6**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**9.3**	**10.5**	**9.3**	**9.2**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.04**	**0.12**	<0.02	**0.02**	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	**0.04**	**0.01**	**0.01**	----
Reactive Phosphate	14625-44-2	0.10	mg/L	<0.10	**0.12**	<0.10	<0.10	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**247**	**433**	**247**	**256**	----
ø Total Cations	----	0.01	meq/L	**246**	**460**	**246**	**248**	----
ø Ionic Balance	----	0.01	%	**0.09**	**2.95**	**0.30**	**1.50**	----

CERTIFICATE OF ANALYSIS

Work Order	: **EP2507111**	Page	: 1 of 5
Client	: **AECOM AUSTRALIA PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: Julian Fowler	Contact	: Natalie Duncan
Address	: LEVEL 15 58 Mounts Bay Road PERTH WA, AUSTRALIA	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: ----	Telephone	: +61-8-9406 1301
Project	: 60745106 - 3.1	Date Samples Received	: 07-May-2025 09:30
Order number	: 60745106 -3.1	Date Analysis Commenced	: 07-May-2025
C-O-C number	: ----	Issue Date	: 15-May-2025 12:15
Sampler	: Simon Davies		
Site	: Western Queen		
Quote number	: EN/004/23		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Canhuang Ke	Inorganics Supervisor	Perth Inorganics, Wangara, WA
Chris Lemaitre	Laboratory Manager (Perth)	Perth Inorganics, Wangara, WA
Daniel Fisher	Inorganics Analyst	Perth Inorganics, Wangara, WA
Efua Wilson	Metals Chemist	Perth Inorganics, Wangara, WA
Niamh Carthew	Inorganic Chemist	Perth Inorganics, Wangara, WA

General Comments

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Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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~ = Indicates an estimated value.

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- EG020: Metals LOR for sample EP2507111-001 raised due to high TDS content.
- EG051GUF (Unfiltered Ferrous Iron): LOR raised for sample #1 due to possible sample matrix interference.
- EG035: LOR raised for Hg on sample EP2507111- 001 due to high TDS content.
- EG035: Poor matrix spike recovery obtained for Mercury on sample EP2507111- 001 due to possible matrix interference. Results have been confirmed by re-preparation and re-analysis.
- ED040: SiO2 LOR raised for sample EP2507111-001 due to possible matrix interference.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.
- ED045G: The presence of Thiocyanate, Thiosulfate and Sulfite can positively contribute to the chloride result, thereby may bias results higher than expected. Results should be scrutinised accordingly.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			*Sample ID*	Sanford River	----	----	----	----
			Sampling date / time	18-Apr-2025 14:30	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*	EP2507111-001	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.79**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**227000**	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**238000**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**106**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**106**	----	----	----	----
ED040F: Dissolved Major Anions								
Silicon as SiO2	14464-46-1	0.1	mg/L	<5.0	----	----	----	----
ED040T: Total Major Anions								
Silicon	7440-21-3	0.05	mg/L	**63.1**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**8370**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**143000**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**1940**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**4160**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**88100**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**1460**	----	----	----	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**34.2**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L	<0.052	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L	<0.052	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.052	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	Sanford River	----	----	----	----
			Sampling date / time	18-Apr-2025 14:30	----	----	----	----
Compound	CAS Number	LOR	Unit	EP2507111-001	--------	--------	--------	--------
				Result	----	----	----	----
EG020T: Total Metals by ICP-MS - Continued								
Barium	7440-39-3	0.001	mg/L	**0.488**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0090**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.086**	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.052	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.052	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.052	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**1.27**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.498**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.052	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.52	----	----	----	----
Strontium	7440-24-6	0.001	mg/L	**40.4**	----	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.052	----	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.052	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.52	----	----	----	----
Zinc	7440-66-6	0.005	mg/L	<0.262	----	----	----	----
Boron	7440-42-8	0.05	mg/L	**19.7**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0005	----	----	----	----
EG050T: Total Hexavalent Chromium								
Hexavalent Chromium	18540-29-9	0.01	mg/L	**0.02**	----	----	----	----
EG051GUF: Ferrous Iron by Discrete Analyser - Unfiltered								
Ferrous Iron	----	0.05	mg/L	<1.00	----	----	----	----
EG053TG-MS: Total Ferric Iron by ICPMS and DA								
Ferric Iron	----	0.05	mg/L	**56.7**	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.6**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser								

Analytical Results

Sub-Matrix: WATER
(Matrix: WATER)

				Sample ID	Sanford River	----	----	----	----
				Sampling date / time	18-Apr-2025 14:30	----	----	----	----
Compound	CAS Number	LOR	Unit		EP2507111-001	--------	--------	--------	--------
					Result	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser - Continued									
Ammonia as N	7664-41-7	0.01	mg/L		**0.46**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		**0.81**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**22.0**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**22.8**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**7.7**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**30.5**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**1.25**	----	----	----	----
Total Phosphate	----	0.10	mg/L		**3.82**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		**0.01**	----	----	----	----
EN055: Ionic Balance									
ø Total Anions	----	0.01	meq/L		**4210**	----	----	----	----
ø Total Cations	----	0.01	meq/L		**4310**	----	----	----	----
ø Ionic Balance	----	0.01	%		**1.16**	----	----	----	----

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