Application for Works Approval

Part V Division 3 of the *Environmental Protection Act 1986*

Works Approval Number	W6805/2023/1
Applicant	Devon Gold Project Pty Ltd
ACN	656 058 918
File number	DER2023/000241
Premises	Devon Gold Project Legal description: Part of mining tenement M39/500 and M39/1077 As defined by the coordinates in Schedule 2 of the works approval.
Date of report	17 July 2023
Decision	Works approval granted

Christine Pustkuchen

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A/MANAGER, RESOURCE INDUSTRIES
REGULATORY SERVICES

an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

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1. Decision summary

This decision report documents the assessment of potential risks to the environment and public health from emissions and discharges during the construction and operation of the Devon Gold Project (the Premises). As a result of this assessment, works approval W6805/2023/1 has been granted.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this decision report, the Department of Water and Environmental Regulation (the department; DWER) has considered and given due regard to its regulatory framework and relevant policy documents which are available at https://dwer.wa.gov.au/regulatory-documents.

2.2 Application summary

On 4 April 2023, Devon Gold Project Pty Ltd (the applicant) submitted an application for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act).

The application is to undertake construction and time limited operation of dewatering infrastructure at the premises, with a proposed mine dewatering discharge throughput of 1,100,000 tonnes per annual period. The premises is approximately 70 km south of the Laverton township.

The premises relates to the category and assessed production capacity under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in works approval W6805/2023/1. The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guideline: Risk Assessments* (DWER 2020b) are outlined in works approval W6805/2023/1.

2.3 Overview of premises and prescribed activities

The premises comprises the Devon open pit gold mine. The pit was initially dewatered and mined by GME Resources Ltd in 2015 and 2016 but had ceased in the same year. To facilitate recommencement of mining, the applicant is required to undertake dewatering of water stored in the existing underground workings and from the pit lake that has formed in the open cut pit void.

Dewatering activities of up to 180,000 tonnes per annual period were previously authorised under licence L8915/2015/1, which had expired on 21 February 2019. Similar to previous approvals, the applicant proposed to discharge the mine dewater onto Lake Carey, adjacent to the open pit.

The proposed dewatering infrastructure was proposed to be constructed in two stages, which is described in Table 1.

Table 1: Details of proposed dewatering activity

Factors	Stage 1 – Pre-mining phase	Stage 2 – Mining phase
Purpose	To dewater pit lake to base of existing open pit, at approximately 355 mRL (Figure 1).	To maintain groundwater drawdown during ongoing development of the open pit cutback, down to approximately 315 mRL (Figure 1).

Factors	Stage 1 – Pre-mining phase	Stage 2 – Mining phase
Method	Via submersible pump, mountain on a pontoon. Water will be drawn under the pit lake surface.	Passive collection of groundwater into pit sumps and pumped to the surface, where it is treated in either a settling pond or sedimentation tank to reduce sediment load.
Discharge location	Lake Carey, beyond the shore zone, via discharge diffuser situated atop rock mattress.	
Estimated duration	Three months	16 months
Estimated dewatering volume	366,000 m^3 *1* (Figure 1)	948,000 m^3 *2* (Figure 1)

Note 1: Pit lake volume estimated to be 275,000 m^3, with assumed hydraulic conductivity at 1.3 m/day and groundwater inflow rate at 45 L/s.

Note 2: Groundwater inflow assumed to be constant at 18.7 L/s for the first eight months of Stage 2 dewatering due to mining occurring above existing pit floor, with inflow rates increasing with each bench excavation, reaching an estimated maximum of 32 L/s at 315 mRL.

Following completion of the current mining program, ongoing dewatering will be undertaken to maintain dry working conditions within the open pit for exploration purposes. Based on a dewatering rate of 33 L/s, the ongoing dewatering throughput would be 1,041,000 m^3 per annum (Figure 1).

2.3.1 Sediment management

It was identified that there is potential for the mine dewater to contain suspended solids (i.e., sediments) during Stage 2 dewatering. Therefore, it was proposed that the mine dewater be treated through a settling pond to reduce sediment loading prior to discharge onto Lake Carey. This was not considered to be required during Stage 1 dewatering as the pump will be located near the water surface and likely has negligible sediment uptake.

The settling pond will be constructed on the uppermost bench within the open pit or adjacent to the pit. The pond will be divided into a dirty and clean water section by a central compacted embankment, with 700 m^3 and 1,300 m^3 of storage capacity, respectively. The two sections of the pond will be connected by a spillway in the central embankment. Clean water will subsequently be pumped to be discharged onto Lake Carey.

Alternatively, the applicant has also proposed the use of a portable sedimentation tank to reduce sediment load, which would be located either in the pit or on the surface adjacent to the pit. The tank separates, traps and retains soil and sediment, allowing clear water to be discharged.

At the time of the assessment, the applicant has not decided which treatment option to proceed with. As such, a risk assessment was undertaken for both controls, with the understanding that only one of them will be implemented.

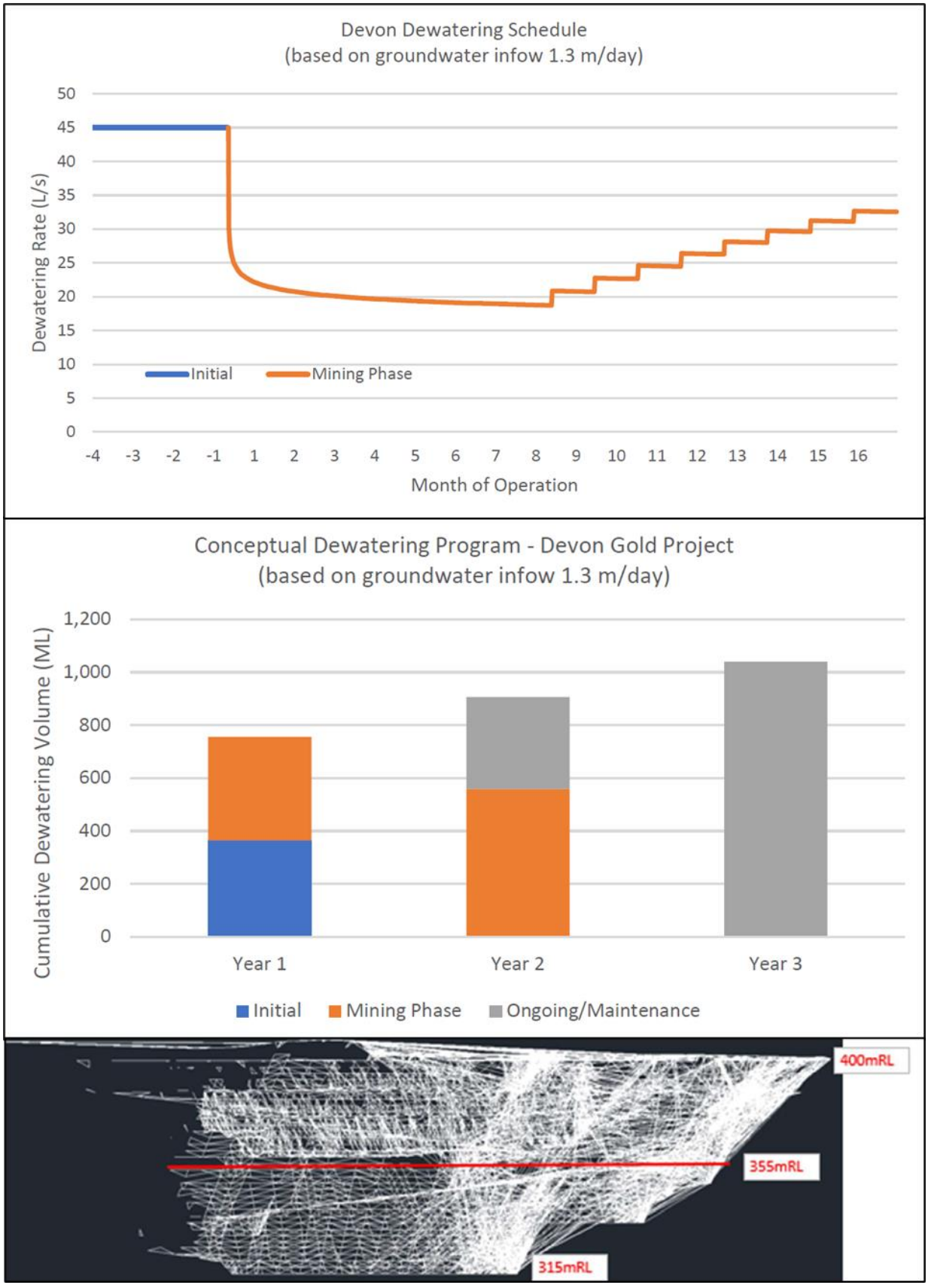

Figure 1: (Top) Estimated dewatering rate throughout project life, (middle) estimated annual dewatering volume throughout the project life and (bottom) proposed depth of open pit development (red line shows base of current pit)

2.3.2 Commissioning and time limited operation

The applicant has requested authorisation to undertake commissioning of dewatering infrastructure for one month and time limited operation for six months (i.e., 180 calendar days) under the works approval.

An environmental commissioning plan was submitted to support commissioning works, including monitoring water quality of mine dewater at the point of discharge, assessing equipment integrity (i.e., pipeline inspection) and pumping capacity (i.e., rate of mine dewater discharge).

The Delegated Officer considers the proposed commissioning activities can be adequately undertaken under time limited operation as they are similar to the proposed operational controls and monitoring during time limited operation. As such, commissioning activities were assessed under time limited operations and no commissioning phase is authorised under the works approval.

3. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk Assessments* (DWER 2020b).

To establish a risk event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

3.1 Source-pathways and receptors

3.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises construction and (time limited) operation, which have been considered in this decision report are detailed in Table 2 below. Table 2 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

Table 2: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Construction			
Dust	Installation of dewatering infrastructure, including pipelines; Construction of settling pond.	Air/ windborne pathway	None.
Sediment laden stormwater		Overland runoff during rainfall events	None.
Time limited operation			
Hypersaline mine dewater	Discharge onto Lake Carey	Direct discharge to land	• Use of discharge diffuser and rock mattress to minimise erosion and scouring of lake surface; • Outfall will be inspected daily to confirm

Emission	Sources	Potential pathways	Proposed controls
			structural integrity of rock mattress, check for signs of erosion and sedimentation and ensure that dewatering discharge is not pooling along the lake shore. • Use of settling pond or portable sedimentation tank to reduce sediment load of mine dewater prior to discharge during Stage 2 dewatering; • Undertake monitoring of discharge volume and mine dewater quality (at point of discharge); • Undertake monitoring of sediment quality and photographic assessment of erosion damage (at point of discharge); • Undertake photographic monitoring of riparian vegetation
Hypersaline mine dewater and impacted sediments		Ingestion of lake aquatic biota exposed to mine dewater	• Undertaken detailed environmental risk assessment (Environmental Innovations 2023; Mine Lakes Consulting 2023); • Undertake monitoring of sediment quality and mine dewater quality.
Hypersaline mine dewater		Vertical infiltration of mine dewater discharge	• Undertake monitoring of mine dewater quality (at point of discharge).
Hypersaline mine dewater	Transfer of mine dewater from mine pit to Lake Carey or settling pond	Pipeline leak or rupture	• Pipeline will be inspected daily; • Pipeline will be installed within the abandonment/flood bund or within road infrastructure corridor (e.g., road windrows and v-drain).
	Operation of settling pond	Overtopping	• Minimum freeboard of 500 mm will be maintained; • Pond will be inspected daily for structural integrity and freeboard; • Settling pond will be located either within the pit (on uppermost bench) or adjacent to the pit.
	Operation of sedimentation tank	Loss of containment	• Sedimentation tank will be located either within the pit or adjacent to the pit.

3.1.2 Receptors

In accordance with the *Guideline: Risk Assessment* (DWER 2020b), the Delegated Officer has excluded the applicant's employees, visitors, and contractors from its assessment. Protection of these parties often involves different exposure risks and prevention strategies and is provided for under other state legislation.

Table 3 below provides a summary of potential human and environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises *(Guideline: Environmental Siting* (DWER 2020a)).

Table 3: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	**Distance from prescribed activity**
None	N/A
Environmental receptors	**Distance from prescribed activity**
Native vegetation	Aerial imagery indicates that the premises contains minimal vegetation, likely due to previous clearing for mining activities (Figure 2). Native vegetation surrounds the premises boundary, comprising of saltbush and bluebush with scrub or open scrubs (e.g., *Atriplex maireana, Acacia aneura*, *Acacia* spp), with the north-eastern portion being the bare and poorly vegetated claypan of Lake Carey. Based on aerial imagery, remnant native vegetation abuts the western, northern and north-western portions of the premises boundary.
Conservation significant flora	While no sightings were recorded around the premises on Department of Biodiversity, Conservation and Attraction's (DBCA) Threatened and Priority Flora database, a 2022 flora survey identified two priority flora species around the premises. • *Eremophila* sp. Lake Carey (Priority 1) – approximately 2,300 individuals across 10 populations were found directly north-east, south and south-west of the premises boundary (Figure 2). The closest population abuts the north-eastern portion of the premises boundary (highlighted in red in Figure 2) and is part of the Lake Carey riparian vegetation community; • *Calandrinia quartztica* (Priority 1) – approximately five indiviuals in one population were found approximately 700 m north of the premises boundary. The population was found within a population of *Eremophila* sp. Lake Carey. A complete source-pathway-receptor linkage was not considered to exist for *C. quartztica* due to distance from the prescribed activities and was not considered in the risk assessment (i.e., only *Eremophila* sp Lake Carey was considered).
Fauna	Regional birdlife, especially waterfowl, are potential faunal receptors at the premises, as they may feed upon aquatic biota (e.g., fairy shrimp) during intermittent wetted periods at Lake Carey (MLC 2023). No sightings were recorded around the premises on DBCA's Threatened/ Priority Fauna database.
Surface water bodies	The premises is located on the western shore of Lake Carey, a large ephemeral salt lake in the region, with an area of approximately 750 km^2. The lake bed is typically dry, with regional-scale surface water flows entering the lake from its internally draining catchment only occasionally filling the lake to a depth of <0.5 m (John 1999). The lake currently receives mine dewater discharges from various mining operations further upstream of the premises. Numerous natural drainage lines drain into the clay pan throughout the

	length of Lake Carey, including at the southern portion of the premises. A hydrological assessment has been undertaken to manage flood risks (Environmental Innovations 2023).
Groundwater aquifer	The premises is located within the Goldfields Groundwater Area, within the Carey Paleochannel. The paleochannel consists of paleodrainage networks eroded into weathered Archaean bedrock and filled with basal Eocene fluvial channel sands, subsequently overlain by lacustrine clay. Groundwater at the premises is very shallow and hypersaline, due to its close proximity to Lake Carey. Groundwater was encountered during the excavation of a pit at depths shallower than 1 metre below ground level (mbgl). Local drilling data suggests that the mine pit is located on the western edge of the paleovalley, with only approximately 3m of lake sediment overlying the bedrock. Groundwater flow direction appears to be to the east, towards Lake Carey. Ionic groundwater composition is dominated by sodium and chlorine ions (Magee 2009). Water quality of Lake Carey is thought to be similar to the source of mine dewater, based on sampling works undertaken on the latter in 2022 and 2023.

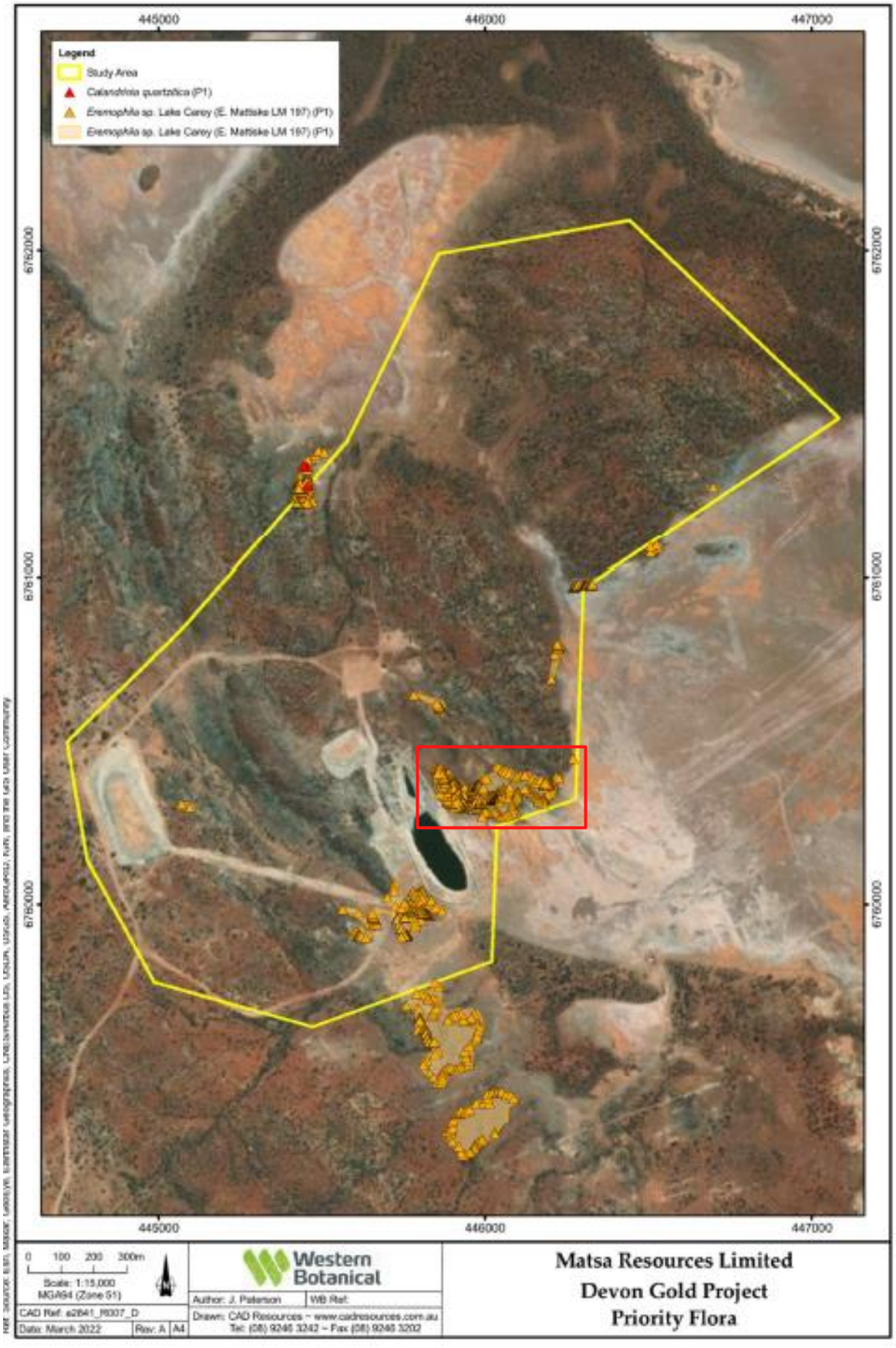

Figure 2: Priority locations for Priority 1 *Eremophila* sp Lake Carey (E. Mattiske LM 197) within the Devon Study Area

3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020b) for each identified emission source and takes into account potential source-pathway and receptor linkages as identified in Section 3.1. Where linkages are in-complete they have not been considered further in the risk assessment.

Where the applicant has proposed mitigation measures/controls (as detailed in Section 3.1), these have been considered when determining the final risk rating. Where the delegated officer considers the applicant's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the works approval as regulatory controls.

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 4.

Works approval W6805/2023/1 that accompanies this decision report authorises construction and time-limited operations. The conditions in the issued works approval, as outlined in Table 4 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015a).

A licence is required following the time-limited operational phase authorised under the works approval to authorise emissions associated with the [ongoing] operation of the premises i.e. mine dewatering. A risk assessment for the operational phase has been included in this decision report, however licence conditions will not be finalised until the department assesses the licence application.

The conditions in the issued licence, as outlined in Table 4 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015a).

Table 4: Risk assessment of potential emissions and discharges from the premises during construction and operation

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Construction								
Construction of mine dewatering infrastructure, including pipeline, settling pond, portable sedimentation tank and discharge outlet	Dust	***Pathway:*** Air/windborne pathway ***Impact:*** Impacts to amenity and ecological health	Native vegetation, including priority flora Surface water bodies (Lake Carey)	None proposed	C = Slight L = Unlikely **Low risk**	Y	None	N/A
	Sediment laden stormwater	***Pathway:*** Overland runoff during rainfall events ***Impact:*** Impact to ecological health		None proposed	C = Slight L = Rare **Low risk**	Y	None	N/A
Operation (including time-limited-operations operations)								
Operation of dewatering infrastructure, including pipelines	Hypersaline mine dewater	***Pathway:*** Pipeline leak or rupture ***Impact:*** Direct discharge to land, resulting in impact to ecological health	Native vegetation, including priority flora Surface water bodies (Lake Carey)	Refer to Section 3.1	C = Minor L = Unlikely **Medium risk**	N	**<u>Condition 1</u>**: Construction requirements (Requirements to install HDPE pipelines in accordance with relevant AS/NZS standards) Condition 6: Operational requirements Condition 10: Photographic vegetation and erosion monitoring	The Delegated Officer understands the dewatering pipelines will not be installed with telemetry for leak detection due to the short distance to the discharge outfall. In considering the distance and presence of adequate bunding and v-drains, the Delegated Officer also requires the pipelines be installed in accordance with relevant Australian Standards to further minimise the risks of pipe failure during operations.
Operation of settling pond		***Pathway:*** Overtopping of	Native vegetation	Refer to Section 3.1	C = Slight L = Unlikely	Y	Condition 1: Construction	N/A

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
		settling pond ***Impact:*** Direct discharge to land, resulting in impact to ecological health			**Low risk**		requirements Condition 6: Operational requirements	
		Pathway: Vertical infiltration and lateral migration of stored water ***Impact:*** Impact to quality of groundwater resources and aquifer regime	Groundwater aquifer	Refer to Section 3.1	C = Slight L = Rare **Low risk**	Y	Condition 1: Construction requirements Condition 6: Operational requirements	N/A
Operation of sedimentation tank		***Pathway:*** Loss of containment, resulting in direct discharge to land ***Impact:*** Direct discharge to land, resulting in impact to ecological health	Native vegetation	Refer to Section 3.1	C = Minor L = Unlikely **Medium risk**	Y	Condition 1: Construction requirements Condition 6: Operational requirements	N/A
Discharge of mine dewater into Lake Carey	Sediment laden stormwater	***Pathway:*** Overland runoff due to direct discharge ***Impact:*** Impact to ecological health	Surface water bodies (Lake Carey)	Refer to Section 3.1	C = Slight L =Unlikely **Low risk**	Y	Condition 1: Construction requirements Condition 6: Operational requirements Condition 10: Photographic erosion monitoring	N/A
	Hypersaline mine dewater	***Pathway:*** Direct discharge at pipe outfall	Surface water bodies (Lake Carey)	Refer to Section 3.1	Refer to Section 3.3	Y	Condition 1: Construction requirements	Refer to Section 3.3.4

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
		Impact: Direct discharge to ephemeral surface water body, resulting in transport of contaminants, suspended solids and erosion impacts	Native vegetation, including priority flora Fauna, including waterfowls				Condition 6: Operational requirements Condition 7: Authorised discharge location Condition 8: Discharge monitoring Condition 9: Sediment monitoring Condition 10: Photographic vegetation monitoring	
		Pathway: Ingestion of lake aquatic biota exposed to mine dewater discharge ***Impact:*** Impacts to ecological health through bioaccumulation of contaminants	Fauna, including waterfowls	Refer to Section 3.1	Refer to Section 3.3	N	**Condition 8**: Discharge monitoring (Addition to alkalinity monitoring and targets for alkalinity and dissolved selenium concentrations)	Refer to Section 3.3.4
		Pathway: Vertical infiltration and lateral migration of stored water ***Impact:*** Impact to quality of groundwater resources and aquifer regime	Groundwater aquifer	Refer to Section 3.1	C = Minor L = Unlikely **Medium risk**	Y	Condition 8: Discharge monitoring Condition 9: Sediment monitoring	N/A

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guideline: Risk Assessments* (DWER 2020b).

Note 2: Proposed applicant controls are depicted by standard text. **Bold and underline text** depicts additional regulatory controls imposed by department.

3.3 Detailed risk assessment for direct discharge of mine dewater to Lake Carey

3.3.1 Background

As part of this application, the applicant has proposed to dewater from the Devon Gold Project's existing open pit and discharge the mine dewater at the adjacent Lake Carey. Lake Carey is a large salt lake that has historically received mine dewater from surrounding mining operations. The salt lake has an approximate surface area of 750 km^2 (Timms *et al*. 2006). Most of the lake bed is typically dry, with regional-scale surface water flows entering the lake from its internally-draining catchment. The influx of surface water occasionally fills the lake to a depth of less than 0.5 m (John 1999).

While it is a common practice in the Goldfields region, the discharge of mine dewater and its impacts on the environmental quality and value of salt lake environments are not well understood (OES 2009). That being said, distinct differences in water quality, sediment quality and benthic diatom populations have been observed between areas immediately surrounding dewatering discharge outfalls and those unaffected by discharge further away (Gregory *et al*. 2009). However, these differences seem to disappear shortly following a lake-filling event. Furthermore, there is a need to better consider the cumulative impacts on a salt lake system as a whole, taking into consideration the impacts from existing discharge operations.

Current national water quality guidelines places emphasis on environmental assessments being site-specific, risk-based and following a multiple lines-of-evidence approach.

To support this application, the applicant completed a quasi-quantitative risk assessment matrix (Figure 3), outlined in the *Development of Framework for Assessing the Cumulative Impacts of Dewatering Discharge to Salt Lakes in the Goldfields of Western Australia* (OES 2009). The resultant risk rating for the proposed activities was **low risk**, which '*poses minimal threat of irreversible impact to the salt lake and are likely to proceed with little restriction…these operations should continue to be monitored…*' (Environmental Innovations 2023).

In addition to that, an environmental risk assessment using source-pathway-receptor modelling was undertaken by the applicant to identify the relevant risks to sensitive receptors in this salt lake environment (MLC 2023).

Original Status Score Matrix

Cumulative % of Lake Impacted	Score	Lake Size	Score	Unique Physical Conditions	Score	Unique Biological Conditions	Score	Information Collected: Water Regime	Score	Water/Sed Quality	Score	Biota	Score
> 80 %	60	> 500 km^2	1	No	1	No	1	Comprehensive studies completed	1	Comprehensive studies completed	1	Comprehensive studies completed	1
31 - 80%	40	100 km^2 - 500 km^2	40	Yes	100	Yes	100	Basic studies completed	5	Basic studies completed	5	Basic studies completed	5
1 - 30%	60	10 - 100 km^2	60	Insufficient Information	100	Insufficient Information	100	No studies completed	20	Oppurtunisitc study completed	10	Oppurtunisitc study completed	10
0%	80	< 10 km^2	80							No studies completed	20	No studies completed	20

Dewatering Discharce Score Matrix

Cumulative Discharge Volume (ML/year)	Score	Proximity to Other Discharges	Score	Salinity of Discharge (mg/L)	Score	Concentration of Metals	Score	Discharge Site	Score
<1000	1	> 20 km	1	Hyposaline (3 000 - 20 000)	1	Similar to Natural Values	1	Open Playa	1
1 000 - 5 000	5	1 - 20 km	5	Mesosaline (20 000 - 50 000)	5	Unknown or Exceed Natural Values	10	Creekline Opening	5
5 000 - 10 000	10	< 1 km	10	Hypersaline (> 50 000)	10			Embayment	10
> 10 000	20								

Overall Risk of Dewatering Discharge to Lake Carey

Original Status Score	Dewatering Discharge: <23	24 - 42	>43
<167	L	L	M
168 - 288	L	M	H
>289	M	H	H

Figure 3: Score-based risk assessment of dewatering discharge to Lake Carey, based on framework detailed in OES (2009)

3.3.2 Source: Mine dewater from Devon Gold Project

Mine dewater from the Devon Gold Project open cut pit void is the primary contaminant source of concern. Currently, the pit footprint is approximately 3.7 ha, with the pit crest being relatively flat and intersecting the bed of Lake Carey and some of the surrounding low hills at elevations between 397 mAHD and 405 mAHD. Discharge is currently expected to last 19 months, though the applicant had also considered the need for continued dewatering and discharge beyond that period to maintain dry working conditions for exploration.

Water samples collected from various locations and depths of the pit lake in 2022 and 2023 (MLC 2023) found that:

- There were no thermal or chemical stratification of various pit lake depths;
- Pit lake water was hypersaline with total dissolved solids (TDS) measured at approximately 120,000 mg/L (Table 5). Salinity was likely influenced by evapoconcentration of groundwater inflows with the pit voids currently acting as a terminal evaporative sink. The TDS of the pit lake water was within the historic TS range of Lake Carey (i.e., between 56,000 mg/L to 204,000 mg/L [DOW 2015]);
- Oxidation-reduction potential was moderately oxidising across the water column, but increased with depth at the northern portion of the pit lake, indicating higher groundwater inflow in this area, presumably from a rock fracture;
- Major ion concentrations were high, dominated by marine salts (i.e., chlorine, sodium, magnesium, sulfate), which is typical of natural salt playa lakes in the region (Williams 1986). Nevertheless, major ion concentrations were extremely consistent across all samples, with no variation by sampling location and/or depth;
- The relatively high concentrations (i.e., exceeded ANZG 2018 marine water quality guideline values) of cadmium and manganese detected may reflect the elevated geochemistry in the region, as elevated cadmium and manganese were also observed at Lake Carey (DOW 2015) (Table 5).

In a separate monitoring event during May 2022, a pit lake water sample was found to be comparable to groundwater sampled from a nearby bore, both of which were similar to samples previously collected from Lake Carey in terms of salinity and major ion composition (Environmental Innovations 2023) (Table 5). This is likely due to the regional groundwater flow direction to the east, towards the salt lake system and varying degrees of hydraulic connectivity of the shallow unconfined alluvial aquifer (i.e., 3 to 5 metres below ground level) (MLC 2023).

Static leachate testing was undertaken on sediment samples collected on a transect away from the proposed discharge outfall. Water from the pit lake was used as the leaching fluid to simulate the effects of mine dewater discharge on salt lake sediments. Metal and metalloid concentrations were detected at low concentrations, with most being below the limit of reporting, though it was noted that the limit of reporting had to be increased due to high TDS concentrations (Table 5). Further testing may be required to better assess the risk of this source.

Table 5: Mean water quality and leachate concentrations at Devon Gold Project

Sample	Pit lake	Pit lake	Pit lake	Groundwater	Leachate
Sampler	MLC	MLC	EI[1]	EI[1]	MLC
Sample size	4	4	1	1	9
Sample Date	Jul 2022	Feb 2023	May 2022	May 2022	Feb 2023
Inorganics					
TDS	**119000**	**120000**	**190000**	**110000**	----
pH	**7.4125**	**7.44**	**6.6**	**6.7**	----
Alkalinity	**90**	**94.5**	----	----	**69.2**
Acidity	**39**	**39.5**	----	----	**45.9**
Major ions					
Calcium	**531**	**523.75**	**620**	**1000**	**423**
Chloride	**156000**	**161750**	----	----	**167444**
Magnesium	**7770**	**7633**	**6900**	**4100**	**8788**
Potassium	**1950**	**1937.5**	**1800**	**1300**	**2642**
Sodium	**107000**	**108250**	**110000**	**67000**	**112556**
Sulfate	**16900**	**17200**	**19000**	**13000**	**17067**
Metals and metalloids					
Aluminium	<0.5	<0.5	----	----	<5.2
Antimony	<0.05	<0.05	<0.005	<0.005	<0.52
Arsenic	**0.081**	**0.084**	**0.088**	**0.02**	<0.262
Barium	<0.05	<0.05	**0.038**	**0.033**	<5.2
Beryllium	<0.05	<0.05	<0.0025	<0.0025	<0.052
Boron	<2.50	<2.50	**0.81**	**0.73**	<5.2
Cadmium	**0.0133**[2]	**0.0131**[2]	**0.014**[2]	**0.0096**[2]	<0.052
Chromium(III)	<0.05	<0.05	----	----	<0.52
Chromium(VI)	<0.05	<0.05	----	----	<0.52
Chromium (Total)	----	----	<0.005	<0.005	----
Cobalt	<0.05	<0.05	**0.013**	**0.01**	<0.52
Copper	<0.05	<0.05	----	----	<0.52
Iron (total)	<2.62	<2.50	<0.05	<0.05	<2.62
Lead	<0.05	<0.05	**0.03**	**0.013**	<0.52
Manganese	**0.337**[2]	**0.311**[2]	**0.03**	**0.093**[2]	**1.08**
Mercury	<0.0005	<0.0005	<0.00005	<0.00005	<0.0050
Molybdenum	<0.05	**0.052**	<0.005	<0.005	<0.52
Nickel	<0.05	<0.05	**0.01**	**0.045**	<0.52
Selenium	<0.5	<0.5	**0.013**	**0.009**	<0.52
Silver	<0.05	<0.05	----	----	<0.52
Thallium	<0.05	<0.05	----	----	<0.52
Tin	<0.05	<0.05	----	----	<0.52
Uranium	<0.05	<0.050	----	----	<0.052
Vanadium	<0.5	<0.5	**0.013**	<0.005	<0.52
Zinc	<0.25	<0.25	**0.11**	**0.18**	<5.2

Note 1: EI = Environmental Innovations

Note 2: Exceeded relevant default guideline value for marine water (ANZG 2018).

3.3.3 Pathway and receptor

In the environmental risk assessment, the applicant identified several ecological receptors that may be impacted by the discharge of mine dewater from the Devon Gold Project (Table 6). The risk rating was determined in accordance with the department's *Guideline: Risk Assessments* (DER 2020b).

Table 6: Ecological risk assessment for discharge of mine dewater

Receptor	Exposure pathway	Risk rating	Rationale
Aquatic biota	Direct contact	C = Minor L = Unlikely **Medium risk**	Discharge footprint is likely to be relatively small, compared to salt lake footprint. Impacts are expected to be minimal. There is likelihood that runoff from significant rainfall events will cause migration of contaminants from the existing discharge footprint. However, surface water inflow is expected to dilute contaminant concentrations. Furthermore, static leach testing demonstrated limited leachability from salt lake sediments, though the limit of reporting was elevated. No conservation significant aquatic biota present at the salt lake.
Terrestrial native fauna	Direct contact Drinking water	C = Minor L = Rare **Low risk**	There is limited use of the impacted area for habitat or as a water source. The high salinity of surface water at the salt lake makes it unpalatable for fauna.
	Ingestion of lake aquatic biota	C = Minor L = Rare **Low risk**	Terrestrial fauna are unlikely to feed upon typically small abundances of invertebrates. Low primary productivity at the salt lake ecosystem limits food-chain length (and thus, trophic biomagnification) when wetted. The limited food resources limits time spent using lake as habitat.
Birdlife, including waterfowls	Direct contact Drinking water	C = Minor L = Unlikely **Medium risk**	Birdlife might attempt to forage at the salt lake or use it for predator avoidance. However, there is limited habitat opportunity and the high salinity of surface water at the salt lake makes it unpalatable for birdlife.
	Ingestion of lake aquatic biota	C = Moderate L = Unlikely **Medium risk**	Wading birds, including conservation significant species are unlikely to occur in the area. The limited food resources limits time spent using lake as habitat. However, waterfowl are likely to feed upon the small abundances of invertebrates if and when they occur (e.g., fairy shrimp). Low primary productivity at the salt lake ecosystem limits food-chain length (and thus, trophic biomagnification) when wetted. Bioaccumulation of contaminants should also be considered over the life of individuals.
Priority 1 flora	Direct contact	C = Minor L = Rare **Low risk**	Discharge footprint is likely to be relatively small, compared to salt lake footprint. Discharge through an outfall further from the shore zone minimises risk of discharge interacting with priority 1 flora near the riparian zone. However, surface water might reach the riparian zone during significant rainfall events. Surface water inflow is expected to dilute contaminant concentrations.

3.3.4 Risk assessment and additional regulation controls

Based on the risk assessment, there is a relatively greater risk of impact to birdlife (especially waterfowls) and the aquatic invertebrates that they use as a food source at Lake Carey.

Aquatic biota

A previous study of salt lakes in the Wheatbelt region of Western Australia found that, provided the discharge water contained residual alkalinity, no environmental impacts were observed on salt lake aquatic biota over a range of heavy metal concentrations (Degens *et al*. 2018). In the same study, a high level of mortality was observed for the studied salt lake aquatic biota that were tested. These findings indicated that in-field or laboratory measurements of bicarbonate ion concentrations and alkalinity could be used as a simple proxy for assessing the potential toxicity of mine dewater discharges at Lake Carey. Provided that sufficiently large residual concentrations of bicarbonate ions are maintained in the mine dewater, the concentrations of metals and metalloids that are present in the mine dewater are unlikely to cause significant long-term impacts on salt lake aquatic biota.

Based on the *Guideline: Treatment and management of soil and water in acid sulfate soil landscapes* (DER 2015b) and *Guidance for the dewatering of acid sulfate soils in shallow groundwater environments* (Shand et al 2018), an alkalinity (as $CaCO_3$) of 60 mg/L was considered '*adequate to maintain acceptable pH level in the future'*. Therefore, the Delegated Officer has conditioned alkalinity monitoring and an associated target level of 60 mg/L or greater in the works approval as additional regulatory controls for managing toxicity risks of mine dewater discharge on aquatic biota at Lake Carey.

Birdlife

While direct contact with and drinking mine dewater is unlikely to occur and subsequently have low risks, a closer examination is required of the ingestion pathway for birdlife. In particular, transient waterfowls are likely to utilise invertebrate and other aquatic biota at Lake Carey as a food source. This source-pathway-receptor linkage is likely to vary temporally (MLC 2023). During rainfall and flooding events at the salt lake, primary productivity would increase, resulting in rapid biological activity and increase in aquatic biota populations. Subsequently, transient birds would then access the salt lake for food. During regular dry periods, food availability is likely to be low and a complete linkage is unlikely to be complete.

Nevertheless, the effects of biomagnification and bioaccumulation should be considered in assessing the risk of exposure to birdlife. In particular, selenium presents a significant risk due to its ability to biomagnify in local food webs and cause birth defects in hatching birds where this metalloid has undergone trophic transfer in a local food web (Ohlendorf *et al*. 2009).

Studies conducted on the Great Salt Lake in Utah, United States indicated that a selenium concentration of less than 27 µg/L would protect breeding bird populations from the effects of selenium toxicity in salt lake environments. This guideline value is assumed to also apply to Lake Carey due to similarities in salt lake environments and limited food web complexities. As populations of waterbirds appear to breed more frequently at the Great Salt Lake than at Lake Carey, this guideline value is considered to be highly conservative for the Lake Carey system.

Pit lake water monitoring by Environmental Innovations (2023) identified selenium concentrations below 27 µg/L (Table 5). However, not all pit lake water monitoring was analysed at an adequate limit of reporting to allow for this comparison (MLC 2023). Based on these findings, the mine dewater from the Devon Gold Project is unlikely to cause harm to birdlife.

Monitoring for heavy metals (especially selenium) should be implemented during the operation of the premises. While the monitoring of mine dewater discharge for selenium was proposed by the applicant, the Delegated Officer has conditioned a target of 0.027 mg/L or less for selenium. Water samples should be analysed at an adequate limit of reporting to enable this comparison, with consideration to the high TDS concentrations of the sample, which may result in matrix interference (MLC 2023).

4. Consultation

Table 7 provides a summary of the consultation undertaken by the department.

Table 7: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website on 1 June 2023.	None received.	N/A
Application advertised in West Australian on 5 June 2023.	None received.	N/A
Shire of Leonora advised of proposal on 31 May 2023.	None received.	N/A
Department of Mines, Industry Regulation and Safety (DMIRS) advised of proposal on 31 May 2023.	None received.	N/A
Applicant was provided with draft documents on 11 July 2023.	Applicant responded with comments on 13 July 2023. Refer to Appendix 1. Applicant waived the remainder of the consultation period.	Refer to Appendix 1.

5. Conclusion

Based on the assessment in this Decision Report, the Delegated Officer has determined that a works approval will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

References

1. Degens, B.P., Krasssoi, R., Galvin, L., Reynolds, B. and Micevska, T. 2018, *Net acidity indicates the whole effluent toxicity of pH and dissolved metals in metalliferous saline waters*. Chemosphere, 197, 492-500.
2. Department of Environment Regulation (DER) 2015a, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
3. DER 2015b, *Guideline: Treatment and management of soil and water in acid sulfate soil landscapes*, Perth, Western Australia.
4. Department of Water and Environmental Regulation (DWER) 2020a, *Guideline: Environmental Siting*, Perth, Western Australia.
5. DWER 2020b, *Guideline: Risk Assessments*, Perth, Western Australia.
6. Environmental Innovations 2023, *Hydrology Assessment*, East Perth, Western Australia.
7. Gregory, S.J., Ward, M.J. and John, J. 2009, *Changes in the chemistry and biota of Lake Carey: a large salt lake impacted by hypersaline discharge from mining operations in Western Australia*. Hydrobiologia, 626, 53-66.
8. John, J. 1999, *Limnology of Lake Carey with special reference to primary producers,* Proceedings of the Salt Lake Ecology Seminar, Perth, Western Australia.
9. Magee, J. 2009, *Paleovalley groundwater resources in arid and semi-arid Australia – a literature review*, National Water Commission, Geoscience Australia, Perth, Western Australia.
10. Mine Lakes Consulting (MLC) 2023, *Devon Mine Dewatering Environmental Risk Assessment (ERA)*. Perth, Western Australia.
11. Ohlendorf, H.M., DenBleyker, J., Moellmer, W.O. and Miller, T. 2009. *Development of a site-specific standard for selenium in open waters of Great Salt Lake, Utah*, Natural Resources and Environmental Issues, 15, Article 4.
12. Outback Ecology Services (OES) 2009, *Development of Framework for Assessing the Cumulative Impacts of Dewatering Discharge to Salt Lakes in the Goldfields of Western Australia*, Department of Water, Perth, Western Australia.
13. Shand, P., Appleyard, S., Simpson, S.L., Degens, B., Mosley, L.M. 2018, *National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments*, Department of Agriculture and Water Resources, Canberra, Australian Capital Territory.
14. Timms, B., Datson, B. and Coleman, M. 2006, *The wetlands of the Lake Carey catchment, northeast Goldfields of Western Australia, with special reference to large branchiopods*, Journal of the Royal Society of Western Australia, 89: 175.

Appendix 1: Summary of applicant's comments on risk assessment and draft conditions

Condition	Summary of applicant's comment	Department's response
----	The applicant responded to the department's outstanding matters, including queries and request for updated figures and monitoring location coordinates.	The department has determined that the information received was adequate and have made the necessary changes to the works approval, based on the information and figures received.
Condition 1	For the Stage 1 pipeline in Table 1, the applicant clarified that the pipeline was not intended to be installed within the abandonment bund, but rather, between the abandonment bund and the pit crest.	The department has amended the construction requirements in Table 1 to clarify this.
	For the Stage 2 dewatering infrastructure in Table 1, the applicant specified that a sump pump will be used, instead of a submersible pump.	The department has amended the construction requirements in Table 1 to clarify this. This change in equipment does not impact the outcome of the risk assessment undertaken.
	For Stage 2 pipeline in Table 1, the applicant requested the term 'existing open pit' be replaced with 'open pit'.	The department has replaced the term 'existing open pit' with 'open pit' for construction/installation requirements for Stage 1 pipeline, Stage 2 pipeline, settling pond and sedimentation tank in Table 1. The use of the word 'existing' was conditioned based on the understanding that the existing open pit footprint would not change. However, the department understands that it is not the case, based on the updated figure provided by the applicant.
	For Stage 2 pipeline in Table 1, the applicant confirmed the department's query on whether the Stage 2 pipeline will connect to the Stage 1 pipeline, with the same flow meter being used.	The department determined that the existing conditions were adequate and compatible with this proposed configuration. No changes were made.
	For the settling pond and sedimentation tank in Table 1, the applicant provided an updated figure to show the general area where the infrastructure (and dewatering pipeline) could be constructed. The larger footprint for construction was due to uncertainty in where this infrastructure would be constructed. For the Stage 2 pipeline, the pipeline configuration will change depending on pit development.	The department has accepted the updated figure and expanded premises boundary. The environmental siting and risk assessment in section 3.1.2 and 3.2 of this Decision Report was updated accordingly based on these changes in premises boundary and proposed infrastructure locations. There were no modifications to the risk ratings as a result of these changes.

Condition	Summary of applicant's comment	Department's response
Condition 3	The applicant pointed out a referencing error in condition 3(c).	The department has corrected this typological error.
Condition 10	The applicant pointed out the mismatch in monitoring parameters between riparian vegetation monitoring sites and the dewatering discharge outfall in Table 6.	The department has corrected this mismatch. The monitoring parameters now corresponded to the correct monitoring locations.
	The applicant queried whether erosion monitoring and vegetation monitoring would need to be undertaken once during time limited operation, in addition to the monitoring event prior to the commencement of time limited operation.	As time limited operation is only authorised for up to 180 calendar days under the works approval, the department has decided that erosion and monitoring would not be required under time limited operation, requiring only baseline (pre-discharge) monitoring be undertaken. As a licence application could be submitted upon commencement of time limited operation, erosion and vegetation monitoring may not have been undertaken. A monitoring event that occurs shortly after operation has commenced may also not be accurate and may be of less value than a monitoring event undertaken after a certain period (i.e., enough time for any potential impact to occur). In line with the applicant's proposed monitoring program, the department intends to condition routine erosion and vegetation monitoring in the licence.

Appendix 2: Application validation summary

SECTION 1: APPLICATION SUMMARY (as updated from validation checklist)		
Application type		
Works approval	☒	
Date application received		4 April 2023
Applicant and premises details		
Applicant name/s (full legal name/s)		Devon Gold Project Pty Ltd
Premises name		Devon Gold Project
Premises location		Mining tenements: M39/500 and M39/1077
Local Government Authority		Shire of Leonora
Application documents		
HPCM file reference number:		DER2023/000241
Key application documents (additional to application form):		• Attachment 1A – Proof of Occupier Status • Attachment 1B – ASIC Extract • Attachment 2 – Premises boundary • Attachment 3A – Environmental Commissioning Plan • Attachment 3B – Proposed Activities • Attachment 6A – Emissions and Discharges • Attachment 7 – Environmental Siting • Attachment 8A – Hydrology Assessment Memo • Attachment 8B – Devon Mine Dewatering Environmental Risk Assessment (ERA) • Attachment 10 – Proposed Fees
Scope of application/assessment		
Summary of proposed activities or changes to existing operations.		***Works approval*** Construction, commissioning and time limited operation of Category 6 activity up to 1,100,000 tonnes per annual period, involving: • Dewatering pipeline; • Two-stage settling pond (or sedimentation tank); • Dewatering discharge outfall at Lake Carey.

Category number/s (activities that cause the premises to become prescribed premises)

Table 1: Prescribed premises categories

Prescribed premises category and description	Proposed production or design capacity	Proposed changes to the production or design capacity (amendments only)
Category 6: Mine dewatering	1,100,000 tonnes per annual period	N/A

SECTION 1: APPLICATION SUMMARY (as updated from validation checklist)		
Legislative context and other approvals		
Has the applicant referred, or do they intend to refer, their proposal to the EPA under Part IV of the EP Act as a significant proposal?	Yes ☐ No ☒	Referral decision No: N/A Managed under Part V ☐ Assessed under Part IV ☐
Does the applicant hold any existing Part IV Ministerial Statements relevant to the application?	Yes ☐ No ☒	Ministerial statement No: N/A EPA Report No: N/A
Has the proposal been referred and/or assessed under the EPBC Act?	Yes ☐ No ☒	Reference No: N/A
Has the applicant demonstrated occupancy (proof of occupier status)?	Yes ☒ No ☐	Mining lease / tenement ☒ M39/500, M39/1077 Expiry: 19 December 2034
Has the applicant obtained all relevant planning approvals?	Yes ☐ No ☐ N/A ☒	Approval: N/A Expiry date: N/A If N/A explain why? Premises is located on mining tenement and regulated under the *Mining Act 1978*.
Has the applicant applied for, or have an existing EP Act clearing permit in relation to this proposal?	Yes ☒ No ☐	CPS No: 10225
Has the applicant applied for, or have an existing CAWS Act clearing licence in relation to this proposal?	Yes ☐ No ☒	Application reference No: N/A Licence/permit No: N/A
Has the applicant applied for, or have an existing RIWI Act licence or permit in relation to this proposal?	Yes ☒ No ☐	Application reference No: Licence/permit No: GWL181591(2)
Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the EP Act)?	Yes ☒ No ☐	Name: Goldfields Groundwater Area Type: Proclaimed Groundwater Area Has Regulatory Services (Water) been consulted? Yes ☐ No ☐ N/A ☒

SECTION 1: APPLICATION SUMMARY (as updated from validation checklist)		
Is the Premises situated in a Public Drinking Water Source Area (PDWSA)?	Yes ☐ No ☒	Name: N/A Priority: N/A Are the proposed activities/ landuse compatible with the PDWSA (refer to WQPN 25)? Yes ☐ No ☐ N/A ☒
Is the Premises subject to any other Acts or subsidiary regulations?	Yes ☒ No ☐	*Mining Act 1978* *Rights in Water and Irrigation Act 1914*
Is the Premises within an Environmental Protection Policy (EPP) Area?	Yes ☐ No ☒	N/A
Is the Premises subject to any EPP requirements?	Yes ☐ No ☒	N/A
Is the Premises a known or suspected contaminated site under the *Contaminated Sites Act 2003*?	Yes ☐ No ☒	Classification: N/A Date of classification: N/A