Decision Report

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6172/2018/1
Applicant	Mardie Minerals Pty Ltd
ACN	152 574 457
File Number	DER2018/001311
Premises	Mardie Trial Project Part of exploration tenements E08/1849 and E8/2741 MARDIE WA 6714
Date of Report	4 January 2019
Status of Report	Final

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1. Definitions of terms and acronyms

In this Decision Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
Applicant	Mardie Minerals Pty Ltd
ASS	Acid Sulfate Soil
BoM	Bureau of Meteorology
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
Decision Report	refers to this document
Delegated Officer	an officer under section 20 of the EP Act
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act
DMIRS	Department of Mines, Industry Regulation and Safety
DWER	Department of Water and Environmental Regulation As of 1 July 2017, the Department of Environment Regulation (DER), the Office of the Environmental Protection Authority (OEPA) and the Department of Water (DoW) amalgamated to form the Department of Water and Environmental Regulation (DWER). DWER was established under section 35 of the *Public Sector Management Act 1994* and is responsible for the administration of the *Environmental Protection Act 1986* along with other legislation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
HDPE	high density polyethylene
Issued Licence	The licence issued under Part V, Division 3 of the EP Act
Issued Works Approval	The works approval issued under Part V, Division 3 of the EP Act following the finalisation of this assessment
kVA	kilo-volt-ampere

Term	Definition
m^3	cubic metres
NaCl and/or salt	refers to sodium chloride also known as salt
Occupier	has the same meaning given to that term under the EP Act
PoW	Programme of Works
Prescribed Premises	has the same meaning given to that term under the EP Act
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Risk Event	As described in *Guidance Statement: Risk Assessment*
RO	Reverse Osmosis
TDS	Total Dissolved Solids
UDR	Environmental Protection (Unauthorised Discharges) Regulations 2004 (WA)
µS/cm	microsiemens per centimetre

2. Purpose and scope of assessment

Mardie Minerals Pty Ltd (Applicant) submitted an application (BCI, 2018a) on 10 August 2018 to the Department of Water and Environmental Regulation (DWER) for a works approval under the *Environmental Protection Act 1986* (EP Act). The Applicant is proposing to undertake a two year pilot trial (Mardie Trial Project) to gather data to enable more accurate implementation of the full scale Mardie Project, which is outside the scope of this assessment.

The Mardie Trial Project relates to the production of salt (NaCl); mixed potassium salts for further processing into sulphate of potash (K_2SO_4); and waste bitterns for characterisation.

The Mardie Trial Project is located approximately 100 kilometres (km) south-west of Karratha in the Pilbara region of Western Australia and aims to:

- Confirm the evaporation rates at each brine density stage during solar concentration and crystallisation;
- Calibrate the results using recorded atmospheric conditions to long term Bureau of Meteorology (BoM) records;
- Provide raw salt product samples for laboratory and pilot processing trials; and
- Produce samples of the resultant waste bitterns for characterisation.

This Decision Report assesses emissions and discharges associated with the construction, commissioning and operation of the Mardie Trial Project only. The full Mardie Project, is currently the subject of assessment by the Environmental Protection Authority (EPA) under Part IV of the EP Act.

This assessment has resulted in DWER issuing Works Approval W6172/2018/1 (Issued Works Approval) which is contained in Attachment 1.

2.1 Application details

Table 2 lists the documents submitted during the assessment process.

Table 2: Documents and information submitted during the assessment process

Document/information description	Date received
Applicant submission comprising: • DWER Application form; • Attachment 1A: Department of Mines, Industry Regulation and Safety mining tenement summary reports (tenements E08/1849 and E08/2741); • Attachment 1B Australian Securities and Investment Commission company extract; • Attachment 2: Premises maps x 2 and Test Pond access routes; • Attachment 3A: Flora and vegetation and terrestrial fauna values of the Mardie Project, Trial Pond Study Area; • Attachment 3A: Acid Sulfate Soils Investigation – Mardie Salt Project; • Attachment 3A: Mardie Project: Pilot Evaporation Pond Trial; • Attachment 3B Trial ponds GIS Data; • Attachment 5 Stakeholder Consultation; • Attachment 7 Acid sulfate soil map; • Attachment 8A Risk Register (Pdf version) and Risk Register (Excel version); and • GIS shape file data.	10 August 2018

3. Background

The Mardie Trial Project is located on exploration tenements E08/1849 and E08/2741 (Premises), which is owned and managed by the Applicant. The Applicant is a wholly owned subsidiary of BCI Minerals Limited.

The application is for a category 14 prescribed premises as defined in Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) and listed in Table 3.

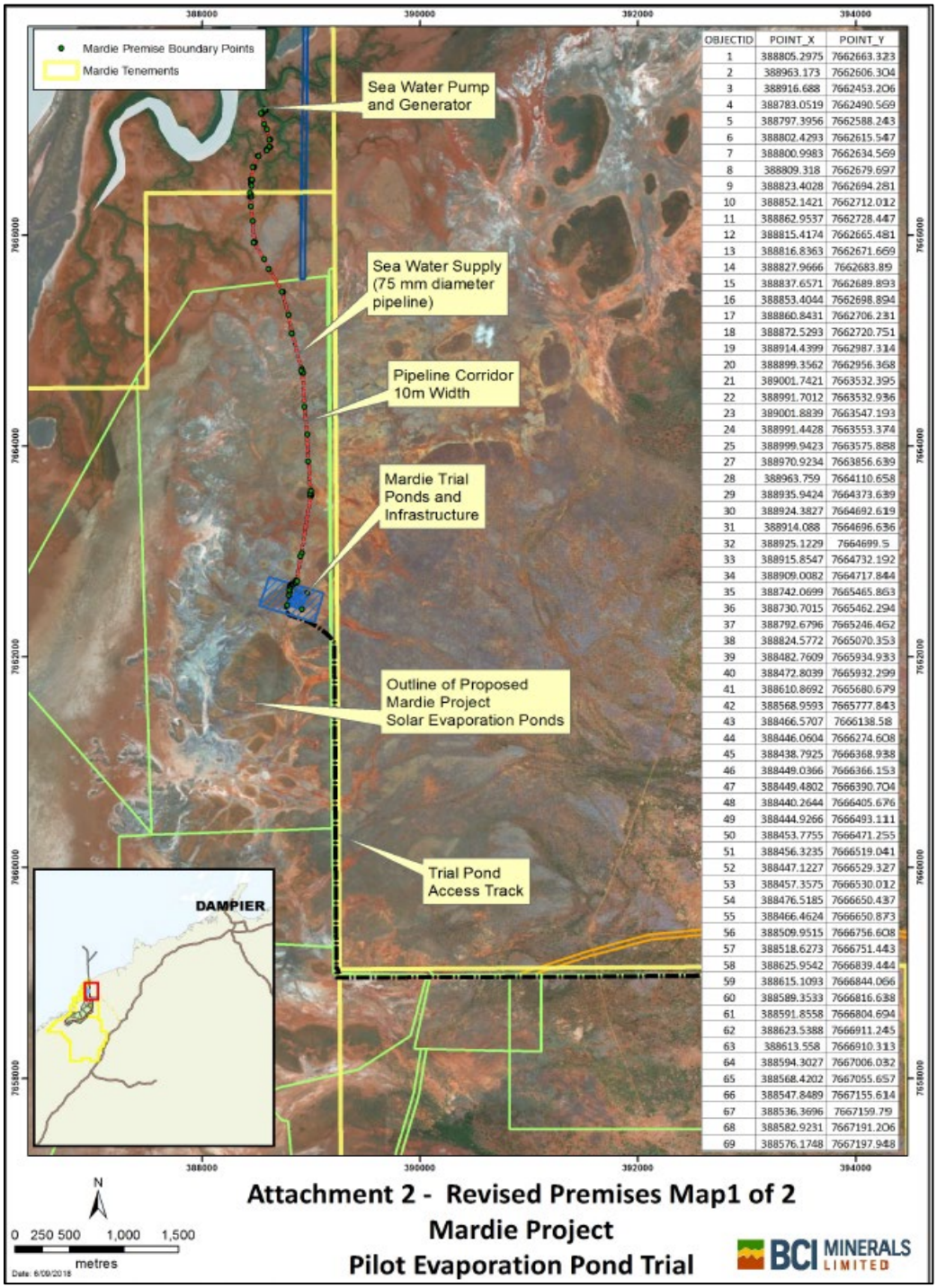
Table 3: Prescribed Premises Category

Classification of Premises	Description	Premises production or design capacity or throughput
Category 14	Solar salt manufacturing: premises on which salt is produced by solar evaporation	350 tonnes per year of salt and 7.5 tonnes per year of mixed potassium and magnesium salts

4. Overview of Premises

4.1 Construction, Commissioning and Operational aspects

The Applicant proposes to construct a nominal 1:10,000 scale system of ponds and crystallisers to confirm the evaporation rates at each stage of the solar evaporation process on the Premises at the same time recording atmospheric conditions and to prepare raw salt for pilot scale processing off-site. The Mardie Trial Project involves the construction of a seawater inlet and 4.8 km high density polyethylene (HDPE) pipeline linking to the Mardie Trial Project ponds as shown in Figure 1.



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24	388991.4428	7663553.374
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49	388444.9266	7666493.111
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55	388466.4624	7666650.873
56	388509.9515	7666756.608
57	388518.6273	7666751.443
58	388625.9542	7666839.444
59	388615.1093	7666844.066
60	388589.3533	7666816.638
61	388591.8558	7666804.694
62	388623.5388	7666911.245
63	388613.558	7666910.313
64	388594.3027	7667006.032
65	388568.4202	7667055.657
66	388547.8489	7667155.614
67	388536.3696	7667159.79
68	388582.9231	7667191.206
69	388576.1748	7667197.948

Figure 1: Location of the Mardie Trial Project ponds and seawater pipeline

The Mardie Trial Project ponds (processing site), will comprise of eight evaporation ponds (P1 to P8) and 11 crystallisers (C1 to C11) as shown in Figure 2.

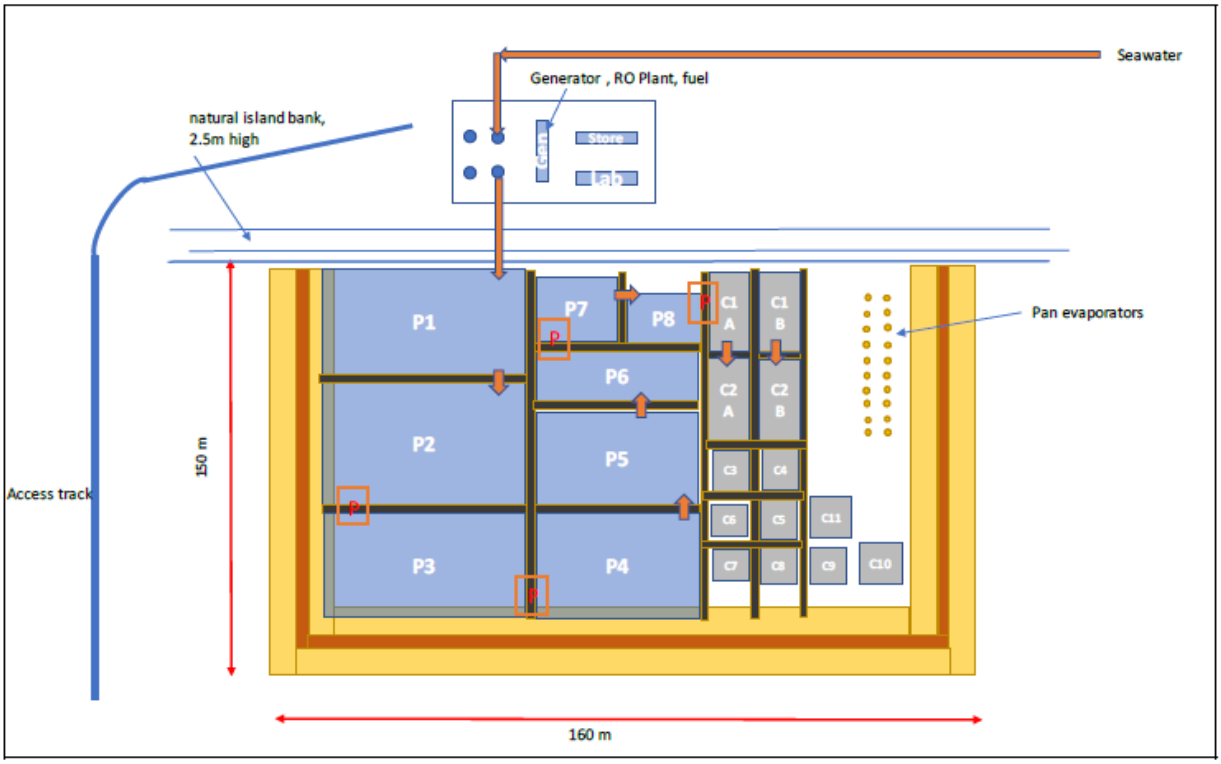

Figure 2: Layout of the Mardie Trial Project ponds

The internal dimensions of the ponds and crystallisers are listed in Table 4. A diesel powered generator (capacity of 7.5 kilo-volt-ampere (kVA)), store, laboratory, pump and pan evaporators will be located adjacent to the ponds and crystallisers.

Construction of the bunds wall, ponds and crystallisers will involve:

- Removal of the permeable surface gravel to a depth of 400-700 millimetres (mm) to expose the underlying clay;
- Construction of a clay bund wall from the exposed clay surface to a height of 2 metres (m) for the external bund wall and 1 m for ponds P1 to P7;
- Covering of the clay core in the bund wall with local gravel and fines that have been blended to form a compactable fill; and
- Lining the outside of the bund wall with local light weight rock armour.

Ponds P1 to P7 will be compacted clay at the foot of the walls to ensure there is a clay seal between the wall and underlying salt flats. Ponds P1 to P7 will be unlined, while P8 and all the crystallisers will be lined with 1 mm thick HDPE to prevent leakage and to allow the precipitated salts to be collected. The construction cross section is shown in Figure 3.

21 pan evaporators will be made of stainless steel to BoM specifications and used to simulate pond evaporation conditions and to facilitate weather data collection. The pan evaporators will measure freshwater, seawater and brine solutions representative of each pond and crystallisers step proposed for the full Mardie Project (BCI, 2018c).

Table 4: Mardie Trial Project ponds - internal dimensions

Pond	Length (m)	Width (m)	Area (m^2)	Fill Volume (m^3)
P1	50	26	1,292	650
P2	50	29	1,457	730
P3	50	26	1,300	650
P4	40	25	1,000	500
P5	40	23	924	460
P6	40	12	482	250
P7	20	15	305	150
P8	18	12	209	100
C1	20	19.5	390	195
C2	20	19.5	390	195
C3	10	7.3	73	37
C4	10	6.6	66	33
C5	10	6.1	61	31
C6	10	5.3	53	27
C7	10	4.6	46	23
C8	10	7.2	72	36
C9	10	11.5	115	58
C10	10	11.6	116	58
C11	10	9.6	96	48

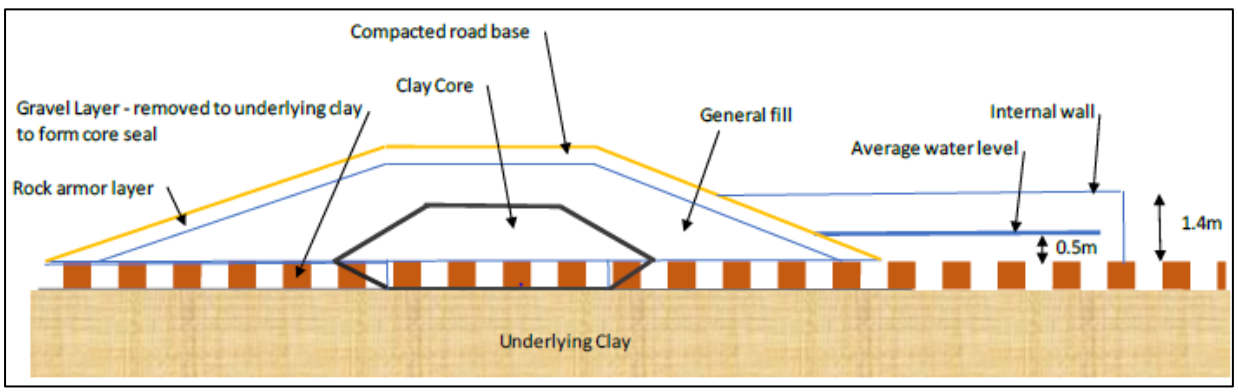

Figure 3: Bund wall cross sections

Following construction, seawater will be pumped into ponds P1 to P8 from the seawater inlet, filling the ponds to a depth of 500 mm. Approximately 22,000 cubic metres (m^3) of seawater is expected to be abstracted each year. As evaporation occurs, brine densities will increase in each pond. As each pond density reaches its design density it will be maintained by transferring brine from up and down stream ponds, using diesel powered pumps. Pond P8 will have a brine density just lower than when NaCl begins to precipitate. At this point the brine will be transferred from P8 to cystallisers C1 and C2 where high purity NaCl will be precipitated.

Figure 2 shows two parallel C1 (A and B) and C2 (A and B) crystallisers. This is to allow 50% of the crystalliser to be drained to C3 and allow the salt to be dry harvested using shovels and wheel barrows. The wheel barrow will move the salts to the location of the site bobcat, which will transfer the salt to plastic containers ready for loading onto a truck for transport to the off-site laboratory.

The brine will continue to be transferred to the downstream crystallisers C3 to C11, where salts will continue to be precipitated in a way that is representative of the full scale Mardie Project. The residual liquor will be transferred to containers and analysed off-site for potential by-products. The continuous flow of brine through the ponds and crystallisers will be monitored daily and seawater added into pond P1 to retain pond levels. No chemicals will be used in the process.

A reverse osmosis (RO) plant will be used to supply freshwater at a rate of 20 litres (L) per hour (L/hour), with the brine from this unit fed into the evaporation ponds.

The NaCl and mixed potassium and magnesium salts generated will be transported to Perth for testing in 1 tonne bulka bags, intermediate bulk containers or sealed 20 L plastic drums. Approximately 60 tonnes of waste NaCl and magnesium salts will be produced during the Mardie Trial Project, with these removed off site for analysis for potential by-products.

The Mardie Trial Project will also test the solar evaporation of seawater to a brine density of 1.328, which is past the density of bitterns (typically around 1.25) discharged from solar pond operations along the Western Australian coast.

Commissioning of the Mardie Trial Project will be authorised under the Issued Works Approval for a 3 month period following submission of the compliance report (refer to section 9.1.1). The Applicant has stated that commissioning will consist of two stages, pre-commissioning (electrical and mechanical testing of equipment) and load commissioning (test ponds operated to test and confirm all control functions including pumps and generators are working correctly).

4.2 Infrastructure

The Premises infrastructure as it relates to category 14 activities, is detailed in Table 5.

Table 5: Premises infrastructure

	Infrastructure	Site Plan Reference
	Prescribed Activity Category 14	
The Mardie Trial Project includes the construction of a system of ponds and crystallisers to confirm the evaporation rates at each stage of the solar evaporation process on the Premises at the same time recording atmospheric conditions to prepare raw salts for pilot scale processing off-site.		
1	Submersible seawater pump (1.8 kilowatt (kW)) and self-bunded generator	Figure 1: Sea Water Pump and Generator
2	Seawater pipeline (4.8 km long, 75 mm diameter HDPE)	Figure 1: Sea Water Supply (75 mm diameter pipeline)
3	Mardie trial ponds consisting of eight evaporation ponds (P1 to P8) and 11 crystallisers (C1 to C11)	Figures 1: Mardie Trial Ponds and Infrastructure Figure 2: P1 to P8 and C1 (A and B), C2 (A and B), C3 to C11
4	Evaporation pond pumps and weirs to control the flow of brine between the ponds	Figure 2
5	21 x Pan evaporators	Figure 2: Pan evaporators
6	7.5 kVA diesel powered generators	Figure 2: Generator
7	Water tanks for the storage of seawater to decant into pond 1 and supply the RO plant	Figure 2: 4 x Blue dots
8	20L/hr RO plant	Figure 2: RO Plant
9	Freshwater storage tank and dispensing pump	Not shown
10	Laboratory sea container and test equipment	Figure 2: Lab
11	Storage sea container (tools and maintenance equipment)	Figure 2: Store
12	Bunded fuel tank	Figure 2: Fuel
13	Mobile equipment (bobcat for minor pond maintenance, quad bike for seawater pump and pipeline operation, 4WD vehicle for general use and out-loading of raw salts)	Not shown
14	Standby portable pump for pond to pond transfers and stormwater management	Not shown

4.3 Exclusions to the Premises

The following are not included in this assessment:

- The full Mardie Project, which is the subject of assessment by the EPA under Part IV of the EP Act; and
- The transport of materials to and from the Premises, including salts produced.

5. Legislative context

Table 6 summarises approvals relevant to the assessment.

Table 6: Relevant approvals and tenure

Legislation	Number	Approval
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	EPBC 2018/8236	The Mardie Salt Project was originally submitted for assessment under the EPBC Act on 4 April 2018 (EPBC 2018/8183). This referral was subsequently withdrawn on 7 May 2018 as the project was amended to incorporate the proposed trestle jetty and to change the name to the Mardie Project. The application was resubmitted on 6 July 2018 (EPBC 2018/8236) and is still under assessment.
Mining Act 1978	Programme of Works (PoW) No. 75407 and PM450-316706 for the Mardie Project	Submitted for approval to the Department of Mines, Industry Regulation and Safety (DMIRS). Approval pending.
	Registration ID: 76118 for the Mardie Trial Ponds	Application submitted to DMIRS on 3 August 2018. The proposed activities have been deemed exploration as they are required to determine the volumes of material and efficiency of the process (DMIRS, 2018). PoW for use of ground disturbing equipment on E08/1849 and E08/2740 granted 3 October 2018.
Part IV of the EP Act (WA)	Assessment Number 2167 for the Mardie Project submitted to the EPA on 17 April 2018	Decision by the EPA pending.

5.1 Part IV of the EP Act

While the full Mardie Project has been referred to the EPA and is the subject of a current assessment (assessment number 2167), the Mardie Trial Project is not subject to assessment under Part IV of the EP Act, and as such this Works Approval has been assessed via 'early works'.

5.2 Contaminated sites

The Applicant reports that there are no contaminated sites on the Premises, and none are recorded on DWER's database.

5.3 Part V of the EP Act

5.3.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations. The guidance statements which inform this assessment are:

- *Guidance Statement: Regulatory Principles* (July 2015);
- *Guidance Statement: Setting Conditions* (October 2015);
- *Guidance Statement: Licence Duration* (August 2016);
- *Guidance Statement: Decision Making* (February 2017);
- *Guidance Statement: Risk Assessments* (February 2017); and
- *Guidance Statement: Environmental Siting* (November 2016).

5.3.2 Clearing

The clearing of native vegetation is not approved under the Issued Works Approval.

6. Consultation

The application was advertised in the West Australian on 15 October 2018 and on the Department's website on 10 October 2018 for a 21 day comment period. A letter inviting comment was also sent to the City of Karratha on 11 October 2018. No comments were received.

7. Location and siting

7.1 Siting context

The Premises is located approximately 100 km south-west of Karratha on the Pilbara coastline (Figure 4). The Premises overlies the Mardie Pastoral lease (Crown Lease CL453-1984), which is owned by CITIC Pacific Limited. The solar salt evaporators and concentrators are located approximately 5 km inland of the Indian Ocean. The workforce will consist of 1-2 people, who will be accommodated at either Mardie Station or at the Fortescue Roadhouse.

7.2 Residential and sensitive Premises

The distances to residential and sensitive receptors are detailed in Table 7.

Table 7: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Mardie Station	Approximately 8 km south-east of the Mardie Trial Project ponds
Sino Iron Project Mine Site, operated by CITIC Pacific Mining Management Pty Ltd	Approximately 22 km north-east of the Mardie Trial Project ponds
Fortescue Roadhouse	Approximately 28 km south-east of the Mardie Trial Project ponds

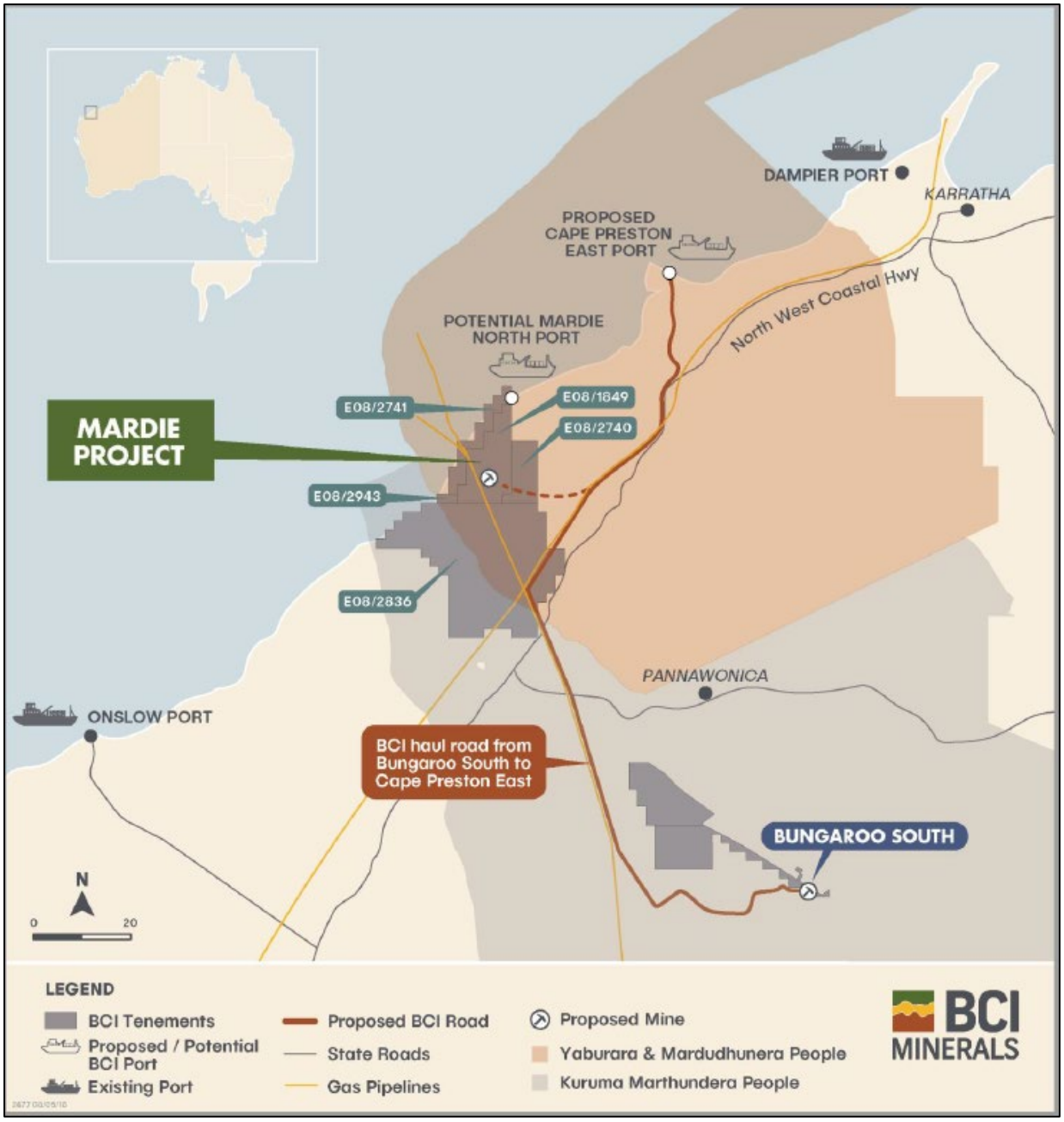

Figure 4: Regional location of the Mardie Trial Project

7.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or Emissions and Discharges from the Premises. The distances to specified ecosystems are shown in Table 8. Table 8 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

The table has also been modified to align with the *Guidance Statement: Environmental Siting.*

Table 8: Environmental values

Specified ecosystems	**Distance from the Premises**
Ramsar Sites in Western Australia	The Millstream Pools (draft proposed Ramsar addition) is located approximately 123 km south-east of the Mardie Trial Project ponds.
Department of Biodiversity, Conservation and Attractions Managed Lands and Waters	The Great Sandy Island Nature Reserve is located approximately 9 km west in the Indian Ocean.
Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs)	Phoenix, 2018 states the no TECs or PECs listed under the EPBC Act or *Wildlife Conservation Act 1950* are present within the Mardie Trial Project area. The buffer zone of the Priority 3(iii), PEC of the Horseflat Land System of the Roebourne Plains is located 30 km to the north east of the Premises (PEC, 2017).
Biological component	**Distance from the Premises**
Threatened/Priority Flora	The Mardie Trial Project is dominated by unvegetated mudflat/saltflat and to a lesser extent Spinifex (*Triodia sp.)* steppe and Mesquite (*Prosopis sp*.) shrubland. "*Mesquite is a Weed of National Significance (WoNS) and the mesquite infestation at Mardie Station is recognised as the largest single infestation in Australia*" (Phoenix, 2018). The nearest record of Priority or Threatened flora on DWER's database is a Priority 4 species (*Goodenia nuda*) 7 km north-east of the Mardie Trial Project ponds and a Priority 1 species (*Goodenia pallida*) 35 km north-east of the Mardie Trial Project ponds.
Threatened/Priority Fauna	DWER's database shows no Threatened Fauna within the Mardie Trial Project area. One Priority 1 species was identified (*Ozimops cobourgianus* – the Northern Coastal Free-tailed Bat) within the Mardie Trial Project area (Phoenix, 2018). While, it is known to be a mangrove specialist roosting solely within mangal communities in the north west of Western Australia, it is also known to forage in associated coastal terrestrial habitats. Phoenix, 2018 reported that the following were not identified in the survey but may exist in the Mardie Trial Project area: • Lakeland Down Mouse (*Leggadina lakedownensis*) - Priority 4; • Fork-tailed Swift (*Apus pacificus*) - Migratory bird; • Grey Falcon (*Falco hypoleucos)* – Vulnerable; and • Peregrine Falcon (*Falco peregrinus)* - Specially Protected Fauna.

7.4 Groundwater and water sources

The distances to groundwater and water sources are shown in Table 9.

Table 9: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Public drinking water source areas	The nearest public drinking water source area is the Priority 1, Cane River Water Reserve which is located approximately 82 km to the south of the Mardie Trial Project ponds.	Onslow town water supply.
Major watercourses/waterbodies	The Indian Ocean lies approximately 5 km from the Mardie Trial Project ponds. The inlet from which seawater is to be drawn is 4.5 km north of the Mardie Trial Project ponds. The Mardie Trial Project area lies within the Saline Coastal Flat.	Marine and mangrove ecosystems.
Groundwater	The Applicant reports that the depth to groundwater varies between 0.3 – 0.8 m below ground level (mbgl), with salinity up to three times the level of seawater and ranging from 130,000 – 210,000 microsiemens per centimeter (µS/cm). The nearest bore lies approximately 2 km south-east of the Mardie Trial Project area based on DWER's data.	Water is not used for potable or industrial use. Marine water inundation occurs on the Premises.

7.5 Soil type

DWER's dataset identifies the soil type across the Mardie Trial Project area as salt flats, tidal swamps, and coastal dune sands: chief soils are saline loams (Um1.3) and (Um1.4) with shelly sands (Uc1.11, Uc1.13). Small areas of calcareous earths (Gc) and shallow loams (Um) are associated with marls (Northcote, 1960-68).

7.6 Acid sulfate soil (ASS)

The Premises overlies a high to moderate ASS risk area based on DWER's dataset. Construction of the proposed evaporation ponds for the Mardie Trial Project requires excavation of gravely surface soils to 700 mm depth.

Stantec Australia Pty Ltd (Stantec) were commissioned by the Applicant to undertake a Stage A - ASS investigation to identify the potential presence/absence of ASS and facilitate planning for future assessment (Stage B) if required (Stantec, 2017). A preliminary site inspection involved logging, sampling and analysis (field pH (pH_F) and field pH peroxide (pH_{FOX}) of 18 'near surface' soil profiles within potential disturbance areas associated with the project. The profiles were sampled to a maximum depth of 1 mbgl.

Stantec, 2017 states that field analysis of soil pH_F indicated all soil profiles were circum-neutral to strongly alkaline, and were consistent in pH_F throughout the sample locations and with depth (to 1 mbgl).

It is stated within Stantec, 2017 that "*the highly alkaline conditions indicate that the surface soil profiles within the Project area are not likely to be classed as Potentially Acid Sulfate Soils (PASS). Although an extreme reaction to the pH_{FOX} test was observed for the majority of*

samples, the reaction was likely to have been associated with other soil constituents such as organic matter or manganese, and is not considered to be problematic with respect to ASS as it caused samples to become more alkaline rather than acidic. Due to the low ASS risk of surface soils within the Project area, further investigations into the presence of ASS is not considered necessary, unless disturbance is planned at greater depths (>1 mbgl) or outside the current area of investigation".

The ASS investigation undertaken by Stantec, was referred to DWER's Contaminated Sites who advised that the soil investigations were undertaken in general accordance with the DWER guidelines for identification and investigation of ASS. "*In view of the minimal field heterogeneity, the chosen sampling locations and densities are acceptable for the pilot plant study*". "*Field pH ranged from 6.9 to 9.8 and pH in 30% peroxide ranged from 6.5 to 9.6. These observations demonstrate significant amounts of acid generating materials, such as pyrite, are not present in the investigated surface soils. Further laboratory based analysis on these soils for sulphides is not warranted*" (DWER, 2018).

DWER, 2018 states that based on the information provided, ASS requiring acidity management are not present in the surface soils. However, the finding of this investigation do not rule out occurrence of PASS material below the one metre depth of investigation.

7.7 Meteorology

BoM classifies the Premises as being in an arid low rainfall grassland climate zone with hot humid summers. BoM data from the nearby Mardie Station shows annual rainfall to be 278.7 mm, with 87% of this falling between January to June and 54% in the three months of January to March (Figure 5). Evaporation greatly exceeds rainfall in every month, while average maximum temperatures are above 30ºC for every months except June to August.

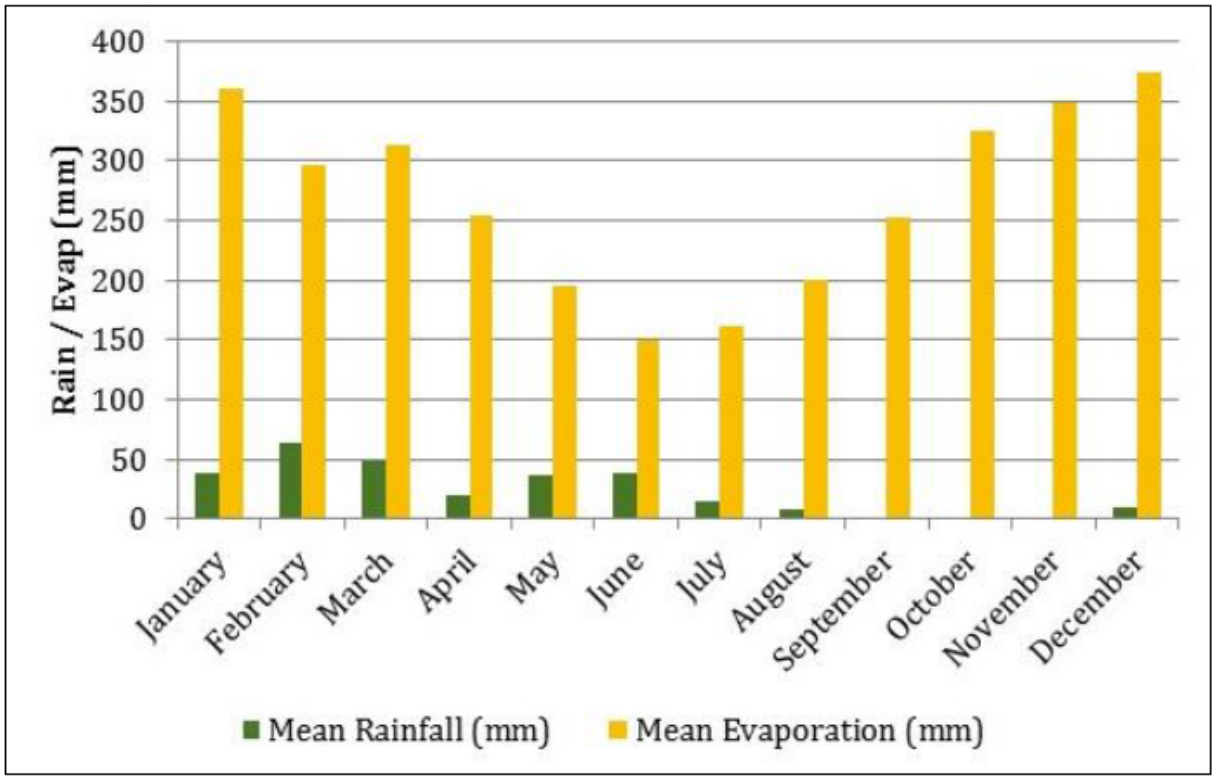

Figure 5: Rainfall and evaporation (BCI, 2018a)

8. Risk assessment

8.1 Determination of emission, pathway and receptor

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

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. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through the tables.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Tables 10 and 11 below.

Table 10. Identification of emissions, pathway and receptors during construction and commissioning

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Construction, mobilisation and positioning of infrastructure	Vehicle movements on unsealed access roads	Noise	No residences in proximity	Air / wind dispersion	None	No	No receptor present.
		Dust			None	No	No receptor present.
	Earthworks, construction of ponds, pipelines, and associated infrastructure	Noise	No residences in proximity	Air / wind dispersion	None	No	No receptor present.
		Dust	No residences in proximity		None	No	No receptor present.
			Flora and vegetation		Potential to be deposited on vegetation and may prevent photosynthesis and plant respiration	No	The Applicant has a PoW for the Mardie Trial Project area. The construction of the ponds and laydown of pipeline will occur within an area that has been cleared. There are no TECs or PECs within the Mardie Trial Project location.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Scouring	Mudflats	Direct impact to the mudflats	Excavation of mudflats impacting on marine and/or terrestrial ecosystems	No	The Applicant has a PoW for the Mardie Trial Project area. The construction of the ponds and laydown of pipeline will occur within an area that has been cleared.
		ASS	Groundwater Marine ecosystem including fish and aquatic organisms	Excavation and exposure to air	Oxidation of sulphide minerals in the soil, reacting to form sulfuric acid Release of sulfuric acid and other heavy metals in the soil Seeping and acidifying groundwater, killing fish and other aquatic organisms	No	The Delegated Officer notes that the: • Applicant has stated that they will not excavate the evaporation ponds beyond 700 mm depth, unless further investigations are undertaken (refer to section 7.6); and • DWER, 2018 states that ASS requiring acidity management are not present in the surface soils (<1 mbgl).
	Storage and use of hydrocarbons and chemicals	Leaks, spills and breach of containment	Ecosystems adjacent to the area of spill or breach	Spills to ground or leak, overflow during filling or leak from pipework	Soil and/or groundwater contamination as well as biota impacts	No	The general provisions of the EP Act and *Environmental Protection (Unauthorised Discharges) Regulations 2004* apply, as does *the Dangerous Goods Safety Act 2004* and associated Regulations.
Commissioning of ponds and associated infrastructure	Generators and pumps	Noise	No residences in proximity	Air / wind dispersion	None	No	No receptor present.
		Combustion emissions	No residences in proximity	Air / wind dispersion	Reduced air quality	No	No receptor present.
		Diesel spills from generators	Ecosystems adjacent to where the spillage occurred	Direct discharges to land or marine ecosystem	Contamination of soil and groundwater	No	BCI, 2018b states that the seawater inlet generator will be self-bunded and installed on a bund for additional protection. The Delegated Officer notes that the general provisions of the EP Act and *Environmental Protection (Unauthorised Discharges) Regulations 2004* apply.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	Seawater pipeline	Pipeline flushing and testing resulting in the spillage of seawater by leaks, rupture or failure	Terrestrial and/or marine ecosystems adjacent to the pipeline Groundwater	Direct discharges to land and infiltration to groundwater	None	No	The Delegated Officer notes that the pipeline will transfer seawater and the pipeline route is across the mudflats which are inundated by seawater several times per month at high tide. Based on the above, the Delegated Officer considers that an environmental impact from the seawater pipeline is unlikely.
	Evaporation and crystalliser ponds	Bund wall failure from both land and sea inundation	Terrestrial ecosystems and groundwater	Direct discharges to land and infiltration to groundwater	Elevated salinity in underlying soils and groundwater	Yes – refer to section 8.4	Potential for elevated salinity in soils and water due to the release of brine.
		Pond overflows from over pumping	Terrestrial ecosystems and groundwater	Direct discharges to land and infiltration to groundwater	Elevated salinity in underlying soils and groundwater	Yes - refer to section 8.4	Potential for elevated salinity in soils and water due to the release of brine.
		Seepage of saline or hypersaline water through base or walls	Terrestrial ecosystems and groundwater	Infiltration to groundwater	Elevated salinity in underlying soils and groundwater	Yes – refer to section 8.4	Potential for elevated salinity in soils and water due to the release of brine.
		Airborne salt particulates from dry harvesting	No residences in proximity	Air / wind dispersion	None	No	No receptor present. The Delegated Officer considers the general provisions of section 49 of the EP Act sufficient to regulate suspended particle emissions during operation. Also, salt absorbs moisture so the generation of dust is unlikely.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Spillage of salt from dry harvesting	Terrestrial ecosystems	Direct discharges to land	None	No	The Delegated Officer notes that the salt will be dry harvested from the crystallisers, which are located within the Mardie Trial Project area. Any impacts to terrestrial ecosystems should be minor and short-term in duration. Based on the above, the Delegated Officer considers that an environmental impact is unlikely.
		Hypersaline water	Birds and other fauna	Direct ingestion	Ingestion of water would be toxic to birds and other wildlife due to the high level of total dissolved solids (TDS)	No	Due to the high level of salinity it is very unlikely that fauna and birds would be attracted to the ponds. It has been determined that wildlife will not drink hypersaline water greater than 50,000 milligram per litre (mg/L) (TDS) (MERIWA, Report No. 273). The salinity of the mudflats varies between approximately 71,500 mg/L and 115,500 mg/L TDS with the Mardie seawater averaging 69,000 µS/cm or approximately 37,950 mg/L TDS. The Delegated Officer considers that there is no need for further assessment.

Table 11: Identification of emissions, pathway and receptors during operation

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Solar salt manufacturing	Operation of generators and pumps	Noise	No residences in proximity	Air / wind dispersion	None	No	No receptor present.
		Post combustion emissions	No residences in proximity	Air / wind dispersion	Reduced air quality	No	No receptor present.
		Diesel spills from generators	Ecosystems adjacent to where the spillage occurred	Direct discharges to land or marine ecosystem	Contamination of soil and groundwater	No	BCI, 2018b states that the seawater inlet generator will be self-bunded and installed on a bund for additional protection. The Delegated Officer notes that the general provisions of the EP Act and *Environmental Protection (Unauthorised Discharges) Regulations 2004* apply.
	Storage and use of hydrocarbons and chemicals	Leaks and spills of hydrocarbons and chemicals	Ecosystems adjacent to where the spillage occurred	Spills to ground or leak, overflow during filling or leak from pipework	Soil and/or groundwater contamination as well as biota impacts	No	The general provisions of the EP Act and *Environmental Protection (Unauthorised Discharges) Regulations 2004* are sufficient to regulate hydrocarbon and chemical emissions during operation and commissioning.
	Seawater pipeline	Spillage of seawater through leaks, pipeline rupture or failure	Terrestrial and/or marine ecosystems adjacent to the pipeline Groundwater	Direct discharges to land and infiltration to groundwater	None	No	The Delegated Officer notes that the pipeline will transfer seawater and the pipeline route is across the mudflats which are inundated by seawater several times per month at high tide. Based on the above, the Delegated Officer considers that an environmental impact from the seawater pipeline is unlikely.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	Evaporation and crystalliser ponds	Bund wall failure from both land and sea inundation	Terrestrial ecosystems and groundwater	Direct discharges to land and infiltration to groundwater	Elevated salinity in underlying soils and groundwater	Yes – refer to section 8.4	Potential for elevated salinity in soils and water due to the release of brine.
		Pond overflows from over pumping	Terrestrial ecosystems and groundwater	Direct discharges to land and infiltration to groundwater	Elevated salinity in underlying soils and groundwater	Yes - refer to section 8.4	Potential for elevated salinity in soils and water due to the release of brine.
		Seepage of saline or hypersaline water through base or walls	Terrestrial ecosystems and groundwater	Infiltration to groundwater	Elevated salinity in underlying soils and groundwater	Yes – refer to section 8.4	Potential for elevated salinity in soils and water due to the release of brine.
		Airborne salt particulates from dry harvesting	No residences in proximity	Air / wind dispersion Discharges to land	None	No	No receptor present. The Delegated Officer considers the general provisions of section 49 of the EP Act sufficient to regulate suspended particle emissions during operation. Also, salt absorbs moisture so the generation of dust is unlikely.
		Spillage of salt from dry harvesting	Terrestrial ecosystems	Direct discharges to land	None	No	The Delegated Officer notes that the salt will be dry harvested from the crystallisers, which are located within the Mardie Trial Project area. Any impacts to terrestrial ecosystems should be minor and short-term in duration. Based on the above, the Delegated Officer considers that an environmental impact is unlikely.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Hypersaline water	Birds and other fauna	Direct ingestion	Ingestion of water would be toxic to birds and other wildlife due to the high level of total dissolved solids (TDS)	No	Due to the high level of salinity it is very unlikely that fauna and birds would be attracted to the ponds. It has been determined that wildlife will not drink hypersaline water greater than 50,000 milligram per litre (mg/L) (TDS) (MERIWA, Report No. 273). The salinity of the mudflats varies between approximately 71,500 mg/L and 115,500 mg/L TDS with the Mardie seawater averaging 69,000 µS/cm or approximately 37,950 mg/L TDS. The Delegated Officer considers that there is no need for further assessment.

8.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 12 below.

Table 12: Risk rating matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with Table 13 below.

Table 13: Risk criteria table

Likelihood		Consequence		
The following criteria has been used to determine the likelihood of the Risk Event occurring.		**The following criteria has been used to determine the consequences of a Risk Event occurring:**		
			Environment	**Public health* and amenity (such as air and water quality, noise, and odour)**
Almost Certain	The risk event is expected to occur in most circumstances	Severe	• **onsite impacts**: catastrophic • **offsite impacts local scale**: high level or above • **offsite impacts wider scale:** mid-level or above • Mid to long-term or permanent impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are significantly exceeded	• Loss of life • **Adverse health effects:** high level or ongoing medical treatment • Specific Consequence Criteria (for public health) are significantly exceeded • **Local scale impacts:** permanent loss of amenity
Likely	The risk event will probably occur in most circumstances	Major	• **onsite impacts**: high level • **offsite impacts local scale**: mid-level • **offsite impacts wider scale**: low level • Short-term impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are exceeded	• **Adverse health effects:** mid-level or frequent medical treatment • Specific Consequence Criteria (for public health) are exceeded • **Local scale impacts**: high level impact to amenity
Possible	The risk event could occur at some time	Moderate	• **onsite impacts**: mid-level • **offsite impacts local scale**: low level • **offsite impacts wider scale**: minimal • Specific Consequence Criteria (for environment) are at risk of not being met	• **Adverse health effects:** low level or occasional medical treatment • Specific Consequence Criteria (for public health) are at risk of not being met • **Local scale impacts:** mid-level impact to amenity
Unlikely	The risk event will probably not occur in most circumstances	Minor	• **onsite impacts**: low level • **offsite impacts local scale**: minimal • **offsite impacts wider scale**: not detectable • Specific Consequence Criteria (for environment) likely to be met	• Specific Consequence Criteria (for public health) are likely to be met • **Local scale impacts:** low level impact to amenity
Rare	The risk event may only occur in exceptional circumstances	Slight	• **onsite impact**: minimal • Specific Consequence Criteria (for environment) met	• **Local scale**: minimal to amenity • Specific Consequence Criteria (for public health) met

^ Determination of areas of high conservation value or special significance should be informed by the *Guidance Statement: Environmental Siting.*

* In applying public health criteria, DWER may have regard to the Department of Health's *Health Risk Assessment (Scoping) Guidelines.*

"onsite" means within the Prescribed Premises boundary.

8.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment table 14 below:

Table 14: Risk treatment table

Rating of Risk Event	Acceptability	Treatment
Extreme	Unacceptable.	Risk Event will not be tolerated. DWER may refuse application.
High	May be acceptable. Subject to multiple regulatory controls.	Risk Event may be tolerated and may be subject to multiple regulatory controls. This may include both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls.	Risk Event is tolerable and is likely to be subject to some regulatory controls. A preference for outcome-based conditions where practical and appropriate will be applied.
Low	Acceptable, generally not controlled.	Risk Event is acceptable and will generally not be subject to regulatory controls.

8.4 Risk Assessment – Pond overflows and seepage

8.4.1 Description of pond overflows and seepage

During normal operation of the ponds, there will be no direct emissions to land or water.

The Mardie Trial Project will be located against an existing naturally formed raised island on the mud flats. The mud flat component is periodically inundated via the following:

- Tidal cycles for short periods on the highest tides several times per month; and
- Extreme rainfall events/cyclone/storm surge.

Pond overflows due to a breach of the bund wall, and/or pump failure; and seepage from the ponds may result in the release of brine and waste bitterns into soils and water.

8.4.2 Identification and general characterisation of emission

Release of brine with a high salinity concentration, and residual brine (bitterns) containing high concentrations of chlorides and sulfates of magnesium and potassium into soils and water.

8.4.3 Description of potential adverse impact from the emission

BCI, 2018a states that the Mardie Trial Project will test the solar evaporation of seawater to a brine density of 1.328, well past the density of bitterns discharged from solar pond operations along the Western Australian coast, which are typically around 1.25.

8.4.4 Applicant controls

Table 15 outlines the Applicant's controls for the Mardie Trial Project associated with pond overflows and seepage.

Table 15: Applicant's proposed controls for pond overflows and seepage

Site infrastructure	Construction
Pump and inlet system	Seawater inlet: • Located within a creek bed. Inlet system and pump: • A triple layered screen to prevent faunal entrapment. • High and low pressure safety switches. • Flow meter. • Seawater pump installed on raised ground above the calculated storm inundation water level. • Level switch to prevent it running without 600 mm of water.
Bund wall	• Clay wall to a height of 4.2 m Australian Height Datum. • Designed to protect against a 1:100 Average Recurrence Interval. • Clay core covered with blended gravel and fines to form a compactable fill. • Lined on the outside with light weight rock armour.
Pilot evaporation ponds and crystallisers	• Situated on the east side of a mud flat island within the bund wall. • Contained within a bunded area 180 m long x 120 m wide. • Ponds P1 to P7 unlined. • Ponds P1 to P7 compacted clay at the foot of the walls to ensure there is a clay seal between the wall and the underlying salt flats. • Pond P8 and all the crystallisers (C1 to C11) will be lined with a 1 mm thick HDPE membrane.
Supporting infrastructure	• Installed above the maximum flood level.

8.4.5 Consequence

The Mardie Trial Project is located in an area that will be periodically inundated by seawater. BCI, 2018a states that the salinity in the area varies between 130,000 µS/cm and 210,000 µS/cm, or up to 3 times the salinity of Mardie seawater which averaged 69,000 µS/cm.

The Delegated Officer notes the following:

- If the overflow is due to an extreme rainfall event/cyclone/storm surge, then the TDS in the water released will be diluted due to the significant volume of rainwater;
- Ponds P1 to P7 contain concentrated seawater the average of which, will not exceed the salinity of the underlying groundwater; and
- There are no TECs or PECs listed under the EPBC Act or *Wildlife Conservation Act 1950* present within the Mardie Trial Project area.

Based on this information, pond overflows and seepage of brine and waste bitterns will result in low level on-site impacts. Therefore, the consequence is **minor**.

8.4.6 Likelihood of Risk Event

Based on the Applicant controls (detailed in Table 15) and quality of the underlying groundwater, an environmental impact from pond overflows and seepage will probably not occur in most circumstances. Therefore, the likelihood of the consequence is **unlikely**.

8.4.7 Overall rating of pond overflows and seepage

Comparison of the consequence and likelihood ratings described above with the risk rating matrix (Table 12) determines the overall rating for the risk of pond overflows and seepage is **medium**.

8.5 Summary of acceptability and treatment of Risk Events

A summary of the risk assessment and the acceptability or unacceptability of the risk events set out above, with the appropriate treatment and control, are set out in Table 16 below. Controls are described further in section 9.

Table 16: Risk assessment summary

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
1.	Pond overflows and seepage.	Bund wall failure from both land and sea inundation. Pond overflows from over pumping. Seepage through base and walls of the ponds.	Direct discharges to land and infiltration to groundwater.	Refer to Applicant controls as detailed in section 8.4.4.	Minor consequence Unlikely likelihood **Medium Risk**	Acceptable subject to Applicant's controls conditioned. Submission of compliance documentation to ensure that the infrastructure has been constructed as per assessed design. Authorised emissions and infrastructure and equipment control requirements on Licence.

9. Regulatory controls

The risks are set out in the assessment in section 8 and the controls are detailed in this section.

9.1 Works Approval controls

In accordance with the *Guidance Statement: Risk Assessments*, DWER has had regard for the Applicant's proposed controls (refer to section 8.4.4). These controls, which are based on the Applicant's commitments, will be included in the Issued Works Approval as specified infrastructure to be constructed.

9.1.1 Works approval reporting

The Applicant will be required to submit compliance reporting for the Mardie Trial Project. A suitable qualified engineer will be required to confirm each item of infrastructure specified in the works approval has been constructed to the specified requirements.

Commissioning of the Mardie Trial Project is authorised under the Issued Works Approval for a 3 month period or until an Issued Licence for the Premises is granted. The Applicant is required to submit a compliance report within 30 days of the construction of the Mardie Trial Project.

The Applicant will require an Issued Licence, prior to the operation of the Mardie Trial Project.

9.2 Licence controls

The Issued Licence will include conditions relating to authorised emissions; and infrastructure and equipment controls to manage the risk of emissions during operation of the Mardie Trial Project at the Premises.

It should be noted that these controls are not final and will be subject to compliance with conditions of the Issued Works Approval and may change if additional information becomes available to further inform the risk assessment (as per *Guidance Statement: Risk Assessments*).

9.2.1 Licence reporting

An Annual Audit Compliance Report will be required to be submitted as a condition of the proposed Issued Licence.

10. Determination of Works Approval conditions

The conditions in the Issued Works Approval in Attachment 1 have been determined in accordance with the *Guidance Statement: Setting Conditions*.

Table 17 provides a summary of the conditions to be applied to this Issued Works Approval.

Table 17: Summary of conditions to be applied

Condition Ref	Grounds
Infrastructure and Equipment Conditions 1, 2, 3, 4 and 5	These conditions are valid, risk-based and contain appropriate controls to ensure linkage between the Works Approval and the EP Act.
Emissions Condition 6	This condition is valid, risk-based and consistent with the EP Act.
Record-keeping Conditions 7 and 8	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.

DWER notes that it may review the appropriateness and adequacy of controls at any time and that, following a review, DWER may initiate amendments to the works approval under the EP Act.

11. Applicant's comments

The Applicant was provided with the draft Decision Report and draft Works Approval on 22 November 2018. The Applicant did not provide comments on the draft documents.

12. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this

Decision Report (summarised in Appendix 1).

Based on this assessment, it has been determined that the Issued Works Approval will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Alana Kidd
Manager, Resource Industries
Delegated Officer
under section 20 of the *Environmental Protection Act 1986*

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Cyanide Ecotoxicity at Hypersaline Gold Operations, Report No. 273 (Executive Summary, Volume II – Phase II (Definitive Investigation)), Minerals and Energy Research Institute of Western Australia, August 2008	MERIWA, Report No. 273	accessed at http://www.cyanidecode.org
2.	Flora and vegetation and terrestrial fauna values of the Mardie Project, Trial Pond study area, prepared by Phoenix Environmental Sciences Pty Ltd for BCI Minerals Ltd, August 2018	Phoenix, 2018	DWER records (DWERDT88334)
3.	FW: Contaminated Sites advice request – W6172 Mardie solar salt trial project – ASS assessment, Department of Water and Environmental Regulation, dated 30 October 2018	DWER, 2018	DWER records (A1733867)
4.	Guidance Statement: Environmental Siting, Department of Environment Regulation, November 2016	Guidance Statement: Environmental Siting	accessed at www.dwer.wa.gov.au
5.	Guidance Statement: Decision Making, Department of Environment Regulation, February 2017	Guidance Statement: Decision Making	
6.	Guidance Statement: Regulatory principles, Department of Environment Regulation, July 2015	Guidance Statement: Regulatory principles	
7.	Guidance Statement: Risk Assessments, Department of Environment Regulation, February 2017	Guidance Statement: Risk Assessments	
8.	Guidance Statement: Setting conditions, Department of Environment Regulation, October 2015	Guidance Statement: Setting conditions	
9.	Identification and investigation of acid sulfate soils and acidic landscapes, Department of Water and Environmental Regulation, 2015	DWER, 2015a	
10.	Mardie Project Pilot Evaporation Pond Trial, Appendix 3A (Proposed Activities), Works Approval Application: Category 14, BCI Minerals	BCI, 2018a	DWER records (A1714296)

	Document title	In text ref	Availability
	Limited, August 2018		
11.	Mardie Trial Ponds works approval application – Requests for information, received from Les Purves (BCI Minerals), 12 September 2018	BCI, 2018b	DWER records (A1719453)
12.	Northcote,K.H. with Beckmann,G.G., Bettenay,E., Churchward,H.M., Van Dijk,D.C., Dimmock,G.M., Hubble,G.D., Isbell,R.F., McArthur,W.M., Murtha,G.G., Nicolls K.D., Paton,T.R., Thompson,C.H., Webb,A.A. and Wright,M.J. (1960-1968). Atlas of Australian Soils, Sheets 1 to 10. With explanatory data (CSIRO Aust. and Melbourne University Press: Melbourne)	Northcote, 1960-68	accessed at http://www.asris.csiro.au
13.	Priority Ecological Communities for Western Australia Version 27, Species and Communities Branch, Department of Biodiversity, Conservation and Attractions, 30 June 2017	PEC, 2017	accessed at: https://www.dpaw.wa.gov.au
14.	RE: Applicant Notification – W6172/2018/1 – Draft Instrument and Decision Report, received from Michael Klvac (BCI Minerals), 11 December 2018	BCI, 2018c	DWER records (A1747346)
15.	RE: Mardie Trial Ponds works approval application – Request for information, received from Department of Mines, Industry Regulation and Safety, 26 October 2018	DMIRS, 2018	DWER records (A1732559)
16.	Stage A: Acid Sulfate Soils Investigation – Mardie Salt Project, prepared by Stantec Australia Pty Ltd for BC Iron Limited, October 2017	Stantec, 2017	DWER records (A1726668)

Attachment 1: Issued Works Approval W6172/2018/1