

3.11.2 Groundwater

3.11.2.1 Environmental Values

A groundwater census has previously been completed for the existing Jellinbah Coal Mine. Groundwater yield from exploration holes and active mining pits has typically been very low and no significant groundwater has been encountered during the course of mining at the Jellinbah Central operation. Exploration has occurred over much of the Jellinbah Coal Mine area. The only aquifers intersected are coal seams that carry small amounts of saline water. Pit developments associated with the existing Jellinbah Coal Mine have encountered negligible groundwater resources and a limited monitoring program has been undertaken in accordance with the SWMP.

Within the Project area, groundwater is assessed to occur only within the Permian coal measures, with the units above either dry or non-existent over the majority of the area. Groundwater within Permian coal measures is assessed to be highly saline, and to have no environmental value (i.e. the groundwater is too saline for stock use). Groundwater in the region is not used by local industries or the community.

The alluvium in the region of the Project is considered to be a poor aquifer with a low long-term yield, precluding its value as a viable long-term water supply (Australasian Groundwater and Environmental (AGE) 2006). The environmental value of groundwater applicable to the Project is limited to the protection of aquatic ecosystems associated with alluvial aquifers associated with the Mackenzie River or other watercourses.

A groundwater assessment was undertaken in March 2016 by JBT Consulting Pty Ltd (JBT) (full report attached as Appendix B).

3.11.2.2 Groundwater Quality

Regional Groundwater

Figure 5 shows the location of private groundwater bores within approximately 25 km of the Project area, based on data obtained from the DNRM groundwater database (publication date 6 January 2016). The data has been classed according to the geology screened by the bore (Figure 6) and is shown in Appendix B. Interpretation of the data has been summarised by JBT (2016), and is shown below.

• Permian Sediments

Coal-bearing sediments of the Late Permian Blackwater Group, including Rangal Coal Measures, comprising feldspathic and lithic sandstone, carbonaceous mudstone, siltstone, tuff and coal seams. Includes the target coal seam for mining within the Project (Pollux Seam); Burngrove Formation, comprising mudstone, siltstone, sandstone, coal and tuff and Gyranda Formation which comprises siltstone and shale with minor tuff and volcanilithic sandstone and rare coal in the lower part (Banana Formation) and calcareous sandstone, mudstone and siltstone in the upper part (Wiseman Formation).

The groundwater database contains information on 70 bores within the Permian coal measures. Available water quality data for the Permian coal measures (from 31 bores) shows that the groundwater in the area is poor. Assuming an upper limit of 4,000 mg/L TDS for stock use5 (equivalent to an EC of ~6,000 μ S/cm) the range of EC values for registered bores within ~25 km of the Project area ranges from 1,328 – 38,400 μ S/cm with a mean of 9,951 μ S/cm and median of 7,600 μ S/cm. Only 12 out of 31 coal measures bores recorded an EC < 6,000 μ S/cm, making the



groundwater within the coal measures marginal to unsuitable for stock use, based on salinity criteria. The water quality in the Pollux Seam is between approximately 18,000 and 34,000 μ S/cm (4 samples), which is too saline for stock use.

• Triassic Rewan Group

Triassic sediments of the Rewan Group, which comprise lithic sandstone and green to reddish brown mudstone, and which occur in the eastern and northern areas of the Project.

The Rewan Formation, which is present in the extension area, is also assessed to be a poor groundwater resource. There are 17 Rewan Group bores within ~25 km of the Project area – for bores where measured water quality data exists (11 bores) the EC range is from 6,500 to 30,000 μ S/cm with a mean of 19,118 and median of 20,000 μ S/cm. Based on the criteria discussed above, groundwater within the Rewan Group sediments is assessed to be generally not suitable for stock use.

• Tertiary Sediments

Tertiary deposits comprising mudstone, sandstone, siltstone and conglomerate of the Duaringa Formation, as well as sediments that are derived from Tertiary weathering and remobilisation of older units.

There are 22 registered bores within Tertiary sediments within ~25 km of the extension area, mostly within the Duaringa Formation. Water quality data for this aquifer is sparse; only 3 of 22 bores record water quality data, with a range from 900 to 16,100 μ S/cm. Based on water level data obtained from the site visit of 2-3 December 2015, where the shallowest depth to water was ~40 m below ground level (which is below the base of Tertiary), it is assessed that the Tertiary sediments are likely to be dry within the Project area.

• Quaternary Alluvium

Unconsolidated soil, silt clay, sand and gravel associated with current surface drainage systems. Quaternary-age alluvium is associated with current surface drainage features such as Blackwater Creek and the Mackenzie River.

There are 33 registered bores within alluvial aquifers within ~25 km of the extension area. Of these, 13 have water quality information, with a recorded EC of between 456 and 5,410 μ S/cm, a mean of 1,620 μ S/cm, and median of 1,360 μ S/cm. The alluvial aquifer is assessed to be the only aquifer in the region to reliably contain stock-quality water. The measured EC of groundwater within the Mackenzie River alluvium (two samples) ranges from 536 to 780 μ S/cm, indicating that groundwater within the alluvium would be suitable for a range of purposes including stock use (based on salinity criteria alone). It is noted that there is no Quaternary alluvium in the Project area where mining is proposed to occur.

Salinity data for groundwater bores within the surrounding region indicate that the bore water is generally not suitable for livestock.





Figure 5 Location of Water Bores in DNRM Groundwater Database and Aquifer Class (JBT 2016)

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Figure 6 Project Location and Surface Geology (1:100,000 Scale Digital Geology) (JBT 2016)



3.11.2.3 Groundwater Occurrence

On a site visit undertaken by JBT on 2-3 December 2015, the only area where groundwater seepage was observed was the northern area of the Jellinbah Plains pit. this seepage was occurring from the base of the Mackenzie River alluvium at the northern end of the pit, with groundwater pooling on lower benches due to downward seepage of water from the alluvium through the weathered zone of the Permian sediments. JBT noted that groundwater occurrence is limited to the area where Quaternary alluvial deposits occur (Figure 6). Since there are no Quaternary alluvial deposits in the Project area where mining is proposed to occur, it is anticipated that groundwater conditions in the Project will be similar to the Jellinbah Central pit (i.e. the pit will receive little if any visible groundwater seepage);

During the site visit of 2-3 December 2015, groundwater levels were taken from 20 geological exploration bores that had been drilled into the Permian coal measures within the existing Central North and proposed extension area (JBT 2016, Appendix B).

The following observations are made with respect to groundwater levels in the Project area and adjacent to the Jellinbah Central pit:

- The observations from the site visit are that the Jellinbah Central pits are dry and do not contain groundwater seepage.
- The depth to groundwater varies from approximately 40 m below ground level (mbgl) in bores that are located 1.5 to 2.0 km from Central Pit, to approximately 61 to 65 mbgl in bores that are adjacent to the Central Pit.
- Review of lithological logs for the exploration bores indicates that the observed groundwater level is below the base of both the Tertiary and Triassic Rewan Group sediments. It is therefore concluded that the Tertiary/Triassic strata are generally dry in the Project area and that that groundwater is likely to occur only within the Permian coal measures;
- From review of site contour data, it is concluded that the water level in the coal measures immediately adjacent to the pit is at approximately the level of the pit floor. This indicates that groundwater seepage to the pit is occurring; however, the observation that the pits are dry (i.e. that there is no visible groundwater seepage) indicates that the rate of groundwater seepage to the pits is extremely low, i.e. the rate of evaporation is higher than the rate of groundwater seepage, resulting in dry pits;
- The extension area is located between the existing Jellinbah Central and Jellinbah Plains pits, which are approximately 4 km apart at the closest points. If it is assumed that groundwater drawdown due to mining extends for a distance of 1.5 to 2.0 km from the pits, then it is likely that groundwater levels in the region between the Central North Pit and the Jellinbah Plains Pit have already been impacted to some degree by cumulative impacts from both the Central Pt and Jellinbah Plains Pit. Mining of the Project area will therefore occur within a region where groundwater levels are assessed to be impacted by existing mining operations.

3.11.3 Nature and Extent of Likely Impact

Proposed impacts of the Project were assessed against the significant impact criteria provided below.

3.11.3.1 Significant Impact Criteria

The Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources (DoE 2013) define significant impact criteria for the assessment of impacts to water resources as a result of a large coal mining development.



The Guidelines state that: an action is likely to have a significant impact on a water resource if there is a real or not remote chance or possibility that it will directly or indirectly result in a change to:

- The hydrology of a water resource; or
- The water quality of a water resource;

that is of sufficient scale or intensity as to reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes, or to create a material risk of such reduction in utility occurring.

Hydrological Characteristics of a Water Resource

A significant impact on the hydrological characteristics of a water resource may occur where there are, as a result of the action:

- a) Changes in the water quantity, including the timing of variations in water quantity;
- b) Changes in the integrity of hydrological or hydrogeological connections, including substantial structural damage (e.g. large-scale subsidence); or
- c) Changes in the area or extent of a water resource;

where these changes are of sufficient scale or intensity as to significantly reduce the current or future utility of the water resource for third party users, including environmental and other public benefit outcomes.

Hydrological characteristics include flow regimes, groundwater recharge rates, aquifer pressure, water table, surface-groundwater interactions, connectivity between river and floodplains, and connectivity between aquifers (DoE 2013).

Quality of a Water Resource

A significant impact on a water resource may occur where, as a result of the action:

- a) There is a risk that the ability to achieve relevant local or regional water quality objectives would be materially compromised, and as a result the action:
 - *i.* Creates risks to human or animal health or to the condition of the natural environment as a result of the change in water quality;
 - *ii.* Substantially reduces the amount of water available for human consumptive uses or for other uses, including environmental uses, which are dependent on water of the appropriate quality;
 - *iii.* Causes persistent organic chemicals, heavy metals, salt or other potentially harmful substances to accumulate in the environment;
 - *iv.* Seriously affects the habitat or lifecycle of a native species dependent on a water resource; or
 - v. Causes the establishment of an invasive species (or the spread of an existing invasive species) that is harmful to the ecosystem function of the water resource; or

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- b) There is a significant worsening of local water quality (where current local water quality is superior to local or regional water quality objectives); or
- c) High quality water is released into an ecosystem which is adapted to a lower quality of water.

These Guidelines state that water-dependent ecosystems are likely to be significantly impacted if water quality is predicted to change to a degree greater than that required for 'moderately to slightly disturbed' systems (DoE 2013).

IESC Information Requirements

In addition to the Significant impact guidelines 1.3: Coal seam gas and large coal mining developments - impacts on water resources (DoE 2013b), the Information Guidelines for the IESC advice on coal seam gas and large coal mining development proposals (IESC 2015) were also considered. Information required by the IESC in order to fulfil their advisory role to the DoE is detailed in Table 14 below.

Information Requirement	Relevant Section(s)
A description of the proposed project	Section 2.0
A description of impacts to water resources and water-dependent assets	Sections 2.3.3, 3.11.1.2, 3.11.2
Details of data, management and monitoring	Section 3.11.3
A risk assessment	Section 3.11.5

Table 14 IESC Information Requirements

Source: IESC (2015)

3.11.3.2 **Potential Impacts on Surface Water**

The potential surface water quality impacts from activities associated with the Project include:

- Surface water runoff containing elevated levels of sediment or contaminants from cleared areas, spoil dumps and stockpiles;
- Overflow of the contaminated water management system due to extreme rainfall events; and
- Spills of contaminants potentially resulting in contamination of surface water.

Development of the Central North Extension is not anticipated to pose any further risks to the downstream surface water environment beyond those already managed at the Jellinbah Coal Mine. The Project is a relatively small extension of the existing Jellinbah Coal Mine, located immediately to the north of the operational Central site and will not necessitate any substantial changes to current surface water management practices.

Overflows from the contaminated and clean water management systems are considered unlikely to occur as a result of the Project. Contaminated water storages have sufficient capacity to accommodate annual rainfall and continual monitoring of water levels and storage capacities throughout the year is undertaken to ensure adequate storage for the wet season and onsite water



use. The addition of the Central North Extension will not result in any substantial change to water quality or water management.

No additional regulated structures, contaminated water storages or release points are proposed. Any water released to the receiving environment will be via currently authorised release points at Jellinbah Coal Mine and in accordance with current EA conditions.

Site experience and monitoring indicates that the current SWMP is operating in accordance with its design intent with minimal risk of contaminated water release. Existing controls to manage sediment runoff are successfully achieving minimal impact on the receiving environment. Given the success of the current SWMP in managing site water runoff and releases, it is considered likely that the addition of the Central North Extension area, managed in accordance with an updated SWMP, will not result in any additional impacts to downstream waterways.

Geology

The coal being mined at the Jellinbah mine is in seams that dip to the east. The coal is at least 10m deep at its shallowest location and increases as the seam dips at anywhere between 2 degrees and 20 degrees. The initial overburden layers are made up of clays and sands before reaching siltstones and mudstones that are above the coal layers. Removal of most material is by blasting then loading and hauling with truck and excavator equipment. The overburden material is not considered acid forming or containing any known contaminants. Runoff from these areas can generally be managed with collection of sediment, as the material is considered highly dispersive and prone to erosion. As the material is generally non-acid forming, no procedures are required to manage or prevent acid rock drainage (UDP 2016, Appendix A)

Flood Mitigation Measures

The Jellinbah mine site has Blackwater Creek to the west and the Mackenzie River to the North. The South and Central sites are elevated above any potential flooding from these two watercourses. The Plains site encroaches on the flood zone of the Mackenzie River.

During a large flood event of the Mackenzie River, water would break the banks and extend over the flat terrain on either side of the river. This area includes the proximity of the Plains open pit. A levee has been constructed around the Plains open pit site to protect the operations from a flooding event of the Mackenzie River. UDP were advised the levee has been designed and constructed in accordance with appropriate engineering design and flood modelling.

Drains have been designed and constructed to divert water away from work areas and pit areas. These drains direct non mine affected water away from site and discharge into natural creeks and waterways (UDP, 2016).

At the time of the flood modelling, the Central North Extension Project was not included in the model, but given that the Project area is located further south than the Plains site, beyond the 1:1000-year flood limit, it is believed that extension of the existing levee is unwarranted.

Continual monitoring of water levels and storage capacities is undertaken to ensure adequate storage for the wet season and onsite water use. In the event of large rain events, the pits at Central and Plains sites can be used as temporary storages. After the wet season, when there is enough storage available in other dams, the pit water can then be removed.

Given the success of the SWMP in managing site water runoff and releases, it is considered likely that the addition of the Central North Extension area, managed in accordance with the updated SWMP, will not result in any additional impacts to surface water quality or management. No additional regulated



structures, contaminated water storages or release points are proposed. Any water released to the receiving environment will be via currently authorised release points at Jellinbah Coal Mine and in accordance with current EA conditions.

Based on the information presented above, in accordance with the criteria outlined in *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources* (DoE 2013), no significant impact on surface water is anticipated to result from development of the Project.

3.11.3.3 Potential Impacts on Groundwater

Potential groundwater quality impacts from the Project activities could include infiltration of process water, mine water or leachate to the groundwater from areas such as:

- Voids containing pit water or tailings;
- Spoil dumps and stockpiles; and
- Dams and ponds.

In addition, groundwater aquifers associated with the Project have the potential to interact with the Mackenzie River.

Proposed impacts of the Project on groundwater were assessed against the significant impact criteria provided above. Potential risks and magnitude of impacts to water resources caused by the Project are evaluated below.

The Groundwater Assessment undertaken by JBT established that four groundwater units have been identified within the Project area: Quaternary alluvium, Tertiary sediments, Triassic Rewan Group, and Permian coal measures (Figure 6). JBT (2016) concludes that any potentially impacted groundwater is only likely to occur in the Permian coal measures; Quaternary alluvial deposits occur only in the north-eastern area of the Central North Extension (which is not proposed to be mined), and a review of lithological logs for previous exploration bores indicates that the observed groundwater level is below the base of both the Tertiary and Triassic Rewan Group sediments (it is therefore determined that the Tertiary/Triassic strata are generally dry in the Project area).

Mining at the Project is proposed to occur between the existing Central and Plains pits. A review of water level data from geological exploration bores within the Project area indicates that drawdown impacts from these existing mining operations may extend over a distance of approximately 1.5 - 2 km from the edge of their respective pits. As the distance from the Central pit to the Plains pit is approximately 4 km, it is considered probable that groundwater levels within the Project area (between the Central and Plains pits) are already experiencing cumulative impacts from existing mining operations. Whilst mining within the Project area may further impact the quality of the Permian coal measures, the water has been shown to have no environmental value because the groundwater is too saline for stock use.

The environmental value of groundwater in the area is limited to the protection of aquatic ecosystems associated with alluvial aquifers associated with the Mackenzie River or other watercourses (AARC 2015). Whilst the groundwater within the Quaternary alluvium may be of environmental value for ecosystem protection, Quaternary alluvium does not occur in the proposed mining area of the Project (mining will occur approximately 2.24 km south). On this basis, this environmental value is not considered applicable to groundwater at the Project.



The lack of current connectivity between the Mackenzie River and the mining operations is acknowledged by the current EA, and groundwater monitoring provisions are prescribed to ensure that this continues. The groundwater assessment by JBT (2016) concludes that based on the observation that groundwater underlying the Project area is of low quality and already impacted by surrounding mining operations, future monitoring of the groundwater within the Project area is not warranted. DEHP have accepted this finding and have not deemed it necessary to impose additional groundwater monitoring requirements for the project.

Based on the information presented above, no significant impact on groundwater is anticipated to result from development of the Project.

3.11.4 Management Commitments

3.11.4.1 Surface Water Management

Through ongoing implementation of the SWMP, Jellinbah will ensure that water quality, water access, and the physical, chemical and biological characteristics of the adjacent streams are not degraded by operations at the Project.

The SWMP (UDP 2016) has proven successful in managing water at Jellinbah Coal Mine and mitigating risks to surface water quality, and has been updated to include the new infrastructure associated with the Central North Extension. The following mitigation strategies relevant to the proposed Project will be implemented in accordance with the SWMP:

- Contaminated and uncontaminated sources of runoff are separated as much as possible;
- Clean water drainage is handled by designed dams and drains, prior to removal offsite to the natural waterways;
- Drainage systems are in place around the Jellinbah Coal Mine, allowing for natural flows to be diverted around the pit and any areas that may contaminate water and directed to catchment dams to collect sediment and minimise flows offsite;
- Contaminated water is managed by a selection of dams, pumps and pipelines, and consumed on site by recycling and evaporation;
- Drainage from rehabilitation areas and non-contaminating spoil dumps is dealt with separately from pit water or contaminated water; and
- A system of dams allows sediment to settle out of the water.

In addition, the Jellinbah Coal Mine operates in accordance with a number of management plans which assist in preventing environmental harm. These management plans include:

- A Chemical and Fuel Management Plan, which documents the procedures for preventing and cleaning up spills of contaminants. Control strategies assisting in the protection of downstream environmental values include:
 - Bunding of chemical and fuel storage areas in accordance with Australian Standard AS 1940 – Storage and Handling of Flammable and Combustible Liquids; and
 - Implementation of spill containment and notification procedures;



- An Erosion and Sediment Control Plan, which provides for the prevention and control of potential erosion at Jellinbah Coal Mine, preventing sedimentation of surface water. Control strategies and structures in place which assist in the protection of downstream environmental values include:
 - Diversion drains and banks to divert clean runoff into sediment detention basins before release to natural streams in receiving environment;
 - Sediment fences to slow the flow of water and catch sediments in erosion susceptible locations; and
 - Sediment control dams to intercept runoff and allow sediments in runoff to settle out before release to the receiving environment or recycling.

These management plans will be updated to reflect the addition of the Central North Extension prior to development in this area.

3.11.4.2 Groundwater Management Commitments

Groundwater Monitoring

As stated in JBT (2016b), no additional monitoring of groundwater quality is considered necessary for the following reasons:

- Based on the fact that groundwater underlying the Project area is of low quality and already impacted by surrounding mining operations, future monitoring of the groundwater within the Project area is not warranted;
- The principal indicator of groundwater impacts arising from a mining activity is a change in water level, for which the existing groundwater monitoring network in Jellinbah Coal Mine, required by the EA, is sufficient to ensure that there continues to be no connectivity between the Mackenzie River and the mining operations.

3.11.5 Assessment of Risk

The Information Guidelines for the IESC advice on coal seam gas and large coal mining development proposals (IESC 2015) were considered in assessing the potential impacts on water resources. A key information requirement for the IESC to fulfil its advisory role to the DoEE is the proponent's assessment of risk.

A qualitative risk assessment was conducted to determine the degree of risk associated with various potential impacts to water resources and the effectiveness of proposed management and mitigation strategies. The aim of the assessment was to:

- Assess the likelihood and consequence, and assign an overall risk level to each identified impact;
- Document management and/or mitigation strategies that are proposed to address potential impacts; and
- Reduce the level of risk associated with regional assets to an acceptable level.



3.11.5.1 Methodology

The qualitative risk analysis was conducted in accordance with the Risk Management Standard 4360:2004 (Standards Australia / Standards New Zealand 2004) and HB203:2006 Environmental Risk Management Principals and Processes (Standards Australia / Standards New Zealand 2006).

The risk analysis framework utilised for the assessment is detailed in Table 15 (Measure of Consequence), Table 16 (Measure of Likelihood) and Table 17 (Risk Analysis Matrix).



Table 15	Measure	of Consequence
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Level	Descriptor	Environmental Impacts	Legal	Public / Media Attention	Financial Impact
1	Catastrophic	Significant extensive detrimental long term impacts on the environment, community or public health. Catastrophic and/or extensive chronic discharge or persistent hazardous pollutant. Damage to an extensive portion of aquatic ecosystem. Long term impact on water resource.	Licence to operate likely to be revoked or not granted.	Probable public or media outcry with national / international coverage. Significant green NGO campaign.	>\$1 million
2	Major	Off-site release contained with outside assistance. Short to medium term detrimental environmental impact off-site or long term environmental damage on-site.	May involve significant litigation and fines. Specific focus from regulator.	May attract attention of local and state media and local community groups.	\$500,000 – \$1 million
3	Moderate	Onsite release contained with outside assistance. Significant discharge of pollutant, a possible source of community annoyance. Non persistent, but possible widespread damage to land. Damage that can be remediated without long term loss or very localised long persistent damage.	Probably serious breach of regulation. Possible prosecution and/or fine. Significant difficulties or delays experienced in gaining future approvals.	May attract attention from local media, heightened concern by local community.	\$50,000 – \$500,000
4	Minor	On site release immediately contained without outside assistance. Ongoing or repeat exceedances of odour, dust or noise / vibration limits.	Minor on the spot fines or formal written correspondence from regulator.	Local community attention or repeated complaints.	\$5,000 – \$50,000
5	Insignificant	Negligible environmental impact. Minor transient release of pollutant including odour, dust and noise / vibration.	No serious breach of regulation. Minor licence non-compliances.	Local landholder verbal discussion / complaint.	Less than \$5,000

Source: Modified from Environmental Risk Management – Principles and Process. HB 203:2006 (Standards Australia / Standards New Zealand, 2006).



Level	Descriptor	Example	Frequency
А	Almost certain	Is expected to occur in most circumstances	> Once per year
В	Likely	Will probably occur in most circumstances	Once per year
С	Possible	Could occur	Once every 5 years
D	Unlikely	Could occur but not expected	May happen within Project life
E	Rare	Occurs in only exceptional circumstances	Not likely to happen within Project life

Table 16 Measure of Likelihood

Source: Modified from Environmental Risk Management - Principles and Process. HB 203:2006 (Standards Australia / Standards New Zealand, 2006).

	Consequences							
Likelihood	1	2	3	4	5			
	Catastrophic	Major	Moderate	Minor	Insignificant			
A - Almost Certain	E	Е	E	н	н			
B - Likely	E	E	Н	Н	М			
C - Possibly	E	E	Н	М	L			
D - Unlikely	E	Н	М	L	L			
E - Rare	н	н	м	L	L			

Table 17 Risk Analysis Matrix

Source: Modified from Environmental Risk Management - Principles and Process. HB 203:2006 (Standards Australia / Standards New Zealand, 2006). Key: E = Extreme risk; immediate action required. H = High risk; senior management attention needed. M = Moderate risk; management responsibility must be specified. L = Low risk; manage by routine procedures.

3.11.5.2 **Risk Assessment**

The likelihood and associated consequence value was determined for each hazard associated with the Project to qualify the level of risk associated with each event.

Prior to the application of control strategies, four hazards were assigned a medium risk rating and five were assigned a low risk rating. Following the application of control strategies, all risk categories were reduced. No high or medium risks remain for the Project following implementation of control strategies.

Table 18 indicates the hazards assessed, control measures applied to reduce the initial level of risk associated with each hazard and the residual risk rating following application if control measures.



Source of Risk			No Control S	Strategies In I	Place		Control Strategies In Place			
Environmental Aspect	Incident / Event	Potential Impact	Consequence	Likelihood	Risk Rating	Control Strategies	Consequences	Likelihood	Risk Rating	
Groundwater	Seepage from water storages	Contamination of groundwater	4	D	L	- Continuation of existing groundwater monitoring program in Jellinbah Coal Mine - Water storage monitoring program	4	Е	L	
	Groundwater Drawdown	Diminished water supply for ecosystems dependent on groundwater	4	E	L		4	E	L	
		Diminished water supply for other groundwater users	4	D	L		4	E	L	
Surface Water	Surface water inflow to final void during flood events	Release of contaminated / saline water to waterways	4	E	L	- SWMP in place - REMP for Jellinbah Coal Mine in place - Pit is located outside 1:1000-year flood extent	4	E	L	
	Increased sediment load in runoff entering creek	Degradation of water quality in Blackwater Creek, Mackenzie River and 5 Mile Lagoon	3	D	М	 Minimise the area of disturbance Local temporary erosion control measures Intercept runoff from undisturbed areas and divert around disturbed areas Where temporary measures are likely to be ineffective, divert runoff from disturbed areas to sedimentation basins prior to release from the site SWMP in place to control capture of potentially contaminated Water Erosion and Sediment Control Plan in place, as per EA requirements Implementation of the REMP 	4	D	L	
	Loss of catchment area draining to local drainage lines and wetlands	Impacts to ecological values	5	В	М	 Rehabilitation of Project site will minimise the capture of runoff into the final void REMP for Jellinbah Coal Mine in place 	5	С	L	



Source of Risk			No Control Strategies In Place	Control Strategies In Place					
Environmental Aspect	Incident / Event	Potential Impact	Consequence	Likelihood	Risk Rating	Control Strategies	Consequences	Likelihood	Risk Rating
	Uncontrolled release from mine-affected dams	Contamination of receiving surface waters, including	3	D	М	 SWMP in place Operation of storages within appropriate 'Design Storage Allowance' each year Water storage monitoring program Implementation and compliance with operational plans for regulated structures, as required by the EA 	4	E	L
	Release from sediment dams		5	с	L		5	D	L
	Seepage from water storages	Contamination to surface water	4	D	L	 SWMP in place Water storage monitoring program Hazard Consequence Assessment of Water Storages Appropriate storage design by UDP 	4	E	L

4.0 CONCLUSION

4.1 POTENTIAL IMPACTS AND SIGNIFICANCE

4.1.1 Threatened Ecological Communities

Brigalow-dominant regrowth vegetation (Community 1) it is present in the Project site, covering an area of 14.65 ha. Although listed as a Threatened Ecological Community, the integrity of this community within the Project area is highly compromised due to small patch sizes, past and current disturbance and the highly fragmented context of the surrounding landscape. This community is surrounded by cleared pasture lands. Previous clearing in the immediate vicinity of each patch means that this community is now subject to edge effects and weed invasion. This community is also subject to low to moderate intensity cattle grazing, further enabling the introduction and spread of weeds. The ground layer has been modified by the invasion of Buffel Grass and Sabi Grass, while exotic cacti are present throughout the ground and shrub layers.

Owing to the small, disturbed, and fragmented nature of Community 1, this community offers limited ecological function at the regional, state or national level. The proposed impact represents 0.02 % of the extent of the Endangered RE 11.4.8 remaining throughout Queensland in 2015 (EHP, 2016). Given the extent of the impact and the ecological values of the proposed impact area, the Project is not expected to impose a significant impact on this Threatened Ecological Community.

In addition, as part of Jellinbah's offset requirements under the Queensland Offset Act, the final extent of Brigalow offset will be four times that of the area cleared. Under the *Queensland's Environmental Offset Policy* (QEOP), Jellinbah has committed to provide an equivalent Brigalow Community offset area of 58.6 ha (see section 3.8.3 for full details).

4.1.2 Water Resources

4.1.2.1 Surface Water

Surface water impacts and the potential for downstream contamination are managed through the Project's SWMP. Catchments of differing water quality are separated to prevent uncontrolled discharge of potentially contaminated water into the receiving environment. Based on current site experience and monitoring data, the implementation of the SWMP is considered adequate to mitigate the potential for adverse impacts to downstream water quality. The SWMP will ensure the Project maintains compliance with EA conditions pertaining to release and receiving water quality, which will ensure regional WQOs mandated by the Queensland EPP (Water) are achieved. No significant impact to surface water quality is anticipated.

4.1.2.2 Groundwater

The lack of current connectivity between the Mackenzie River and the mining operations is acknowledged by the current EA, and annual groundwater monitoring provisions are prescribed to ensure that this continues. The groundwater assessment by JBT (2016) concludes that based on the fact that groundwater underlying the Project area is of low quality and already impacted by surrounding mining operations, future monitoring of the groundwater within the Project area is not warranted. Groundwater monitoring, however, at the Jellinbah Coal Mine will continue to be carried out in accordance with the requirements of the EA.

Based on the information presented above, no significant impact on groundwater is anticipated to result from the development of the Project.



4.2 MITIGATION AND MANAGEMENT COMMITMENTS

Management strategies detailed throughout this MNES Assessment Report aim to minimise the likelihood of impacts to environmental values, including MNES. Strategies primarily target operational practices, particularly vegetation clearing and site water management.

A minimised clearing footprint and progressive rehabilitation will limit the area of land subject to disturbance at any one time, thereby minimising potential ecological impacts.

In accordance with Queensland legislation, environmental offsets will be implemented for significant residual impacts to the TEC Brigalow and other MSES that may arise as a result of the Project.

UPD (2016) were engaged to develop a SWMP for the Project, within the context of the existing Jellinbah Mine, to achieve the following outcomes:

- Divert clean catchment water around mining works to the extent practicable;
- Use / recycle lesser quality water in preference to higher quality water;
- Use potentially contaminated water in preference to imported raw water or uncontaminated water;
- Release water from site only in accordance with the conditions of the EA, such that the released water will not significantly impact on the values of the receiving waters or downstream properties;
- Manage water storages and transfers within the site in order to:
 - Maximise onsite storage to meet reasonably anticipated periods of wet and dry weather; and
 - Minimise disruption to mining operations.

In addition to a SWMP, Jellinbah has committed to regularly monitoring water storages, receiving waters and groundwater bores to ensure no significant impacts to these values are occurring.

4.3 CONCLUSION

It is not anticipated that the Jellinbah Central North Extension Project will constitute a 'controlled action' due to the fact that significant impacts to identified MNES, when assessed against the relevant criteria provided by DoEE, are considered unlikely to occur. Additionally, the Central North Extension is only a minor extension to the existing Jellinbah Coal Mine operations, and is not anticipated to have significant impacts beyond those which are successfully managed at the operation. The range of mitigation and management strategies discussed above and throughout this report will minimise the Project's potential to adversely impact environmental values.

The information presented in this MNES Assessment Report, together with the supporting specialist studies and the EPBC Referral Form, is considered to be sufficient to enable the DoEE to determine the outcome and approvals pathway for the Project.



5.0 **REFERENCES**

Atlas of Living Australia website at http://www.ala.org.au

Australasian Groundwater and Environmental (AGE) 2006, *Mackenzie South Project: Groundwater Impact Assessment*, report prepared for AustralAsian Resource Consultants Pty Ltd, February 2006.

AustralAsian Resource Consultants Pty Ltd (AARC) 2015a, *Environmental Authority Amendment – Supporting Information*, report prepared for Jellinbah Group Pty Ltd on behalf of Jellinbah East Joint Venture, September 2015

AustralAsian Resource Consultants Pty Ltd (AARC) 2015b, *Environmental Offsets Strategy*, report prepared for Jellinbah Group Pty Ltd on behalf of Jellinbah East Joint Venture, September 2015

AustralAsian Resource Consultants Pty Ltd (AARC) 2017, *Central North Extension Terrestrial Flora and Fauna Assessment,* report prepared for Jellinbah Group Pty Ltd, August 2017

Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*

Australian Coal Association Research Program (ACARP) 2001, *Monitoring and Evaluation Program for Bowen Basin River Diversions*, Project C9068, ACARP

Barker, R.M., Haegi, L., and Barker, W.R. in Wilson, A.J.G. (ed) (1999). *Flora of Australia 17B, Proteaceae 3 Hakea to Dryandra.*

Bean, A.R. (2004). The taxonomy and ecology of Solanum subg. Leptostemonum (Dunal) Bitter (Solanaceae) in Queensland and far north-eastern New South Wales, Australia. Austrobaileya 6(4), 639 – 816.

Cropper, S. (1993) Management of endangered plants, CSIRO Publications, Melbourne.

Curtis, L.K., Dennis, A.J., McDonald, K.R., Kyne, P.M. and Debus, S.J.S. 2012, *Queensland's Threatened Animals*, CSIRO Publishing, Collingwood

Department of Environment and Heritage Protection (EHP) 2013b, *Guideline: Model water conditions* for coal mines in the Fitzroy basin (ESR/2015/1561), Queensland Government

Department of Environment and Heritage Protection (EHP) 2014a, *Rehabilitation Requirements for Mining Projects (ESR/2016/1875)*, Queensland Government

Department of Environment and Heritage Protection (EHP) 2014b. Olearia macdonnellensis. Wetland Info. http://wetlandinfo.ehp.qld.gov.au/wetlands/ecology/components/species/?oleariamacdonnellensis

Department of Environment and Heritage Protection (EHP) 2016a, *Flying-fox roost monitoring and locations*. Available from: <u>https://www.ehp.qld.gov.au/wildlife/livingwith/flyingfoxes/roost-locations.html</u>.

Department of Environment and Heritage Protection (EHP) 2016b, Manual for Assessing Consequence Categories and Hydraulic Performance of Structures (ESR/2016/1933), Queensland Government



Department of Environment and Heritage Protection (EHP) 2016c, *Regional Ecosystems Descriptions Database (REDD), Version 10.0*, Queensland Government

Department of Mines and Energy (DME) 1995, *Mine Planning Guidelines for Assessment and Management of Saline and Sodic Waste*, Department of Mines and Energy, Queensland Government

Department of Natural Resources and Mines (DNRM) 2014, *Guideline – Works that interfere with water in a watercourse: watercourse diversions*, Queensland Government

Department of Science, Information Technology, Innovation and the Arts (DSITIA) 2012, *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland*, Queensland Government

Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) 2003, *Nationally threatened species and ecological communities – Brigalow Regrowth and the EPBC Act*, Commonwealth of Australia

Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) 2011a, Draft Referral guidelines for the nationally listed Brigalow Belt reptiles, Commonwealth of Australia

Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) 2011b, Survey Guidelines for Australia's Threatened Reptiles: Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999, Commonwealth of Australia

Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) 2011c, Survey Guidelines for Australia's Threatened Mammals: Guidelines for detecting mammals listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999, Commonwealth of Australia

Department of the Environment (DoE) 2013a, Significant impact guidelines 1.1: Matters of National Environmental Significance, Commonwealth of Australia

Department of the Environment (DoE) 2013b, *Significant impact guidelines 1.3: Coal seam gas and large coal mining developments – impacts on water resources*, Commonwealth of Australia

Department of the Environment (DoE) 2014b, *Conservation Advice: Elseya albagula*, Commonwealth of Australia

Department of the Environment (DoE) 2014b, *EPBC Act referral guidelines for the vulnerable koala*, Commonwealth of Australia.

Department of the Environment and Energy (DoE) 2015, Species Profile and Threats Database, Commonwealth of Australia

Department of the Environment (DoE) 2015a, *Submitting a referral under the EPBC Act – A fact sheet for a person proposing to take an action*, Commonwealth of Australia

Department of the Environment (DoE) 2015b, *Referral guideline for management actions in grey*headed and spectacled flying-fox camps, Commonwealth of Australia

Department of the Environment (DoE) 2015c, *Referral guideline for 14 birds listed as migratory species under the EPBC Act (draft)*, Commonwealth of Australia



Department of the Environment (DoE) 2015d, Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species, Commonwealth of Australia

Department of the Environment (DoE) 2015e, *Directory of Important Wetlands in Australia – Information Sheet – Lake Elphinstone, QLD*, Commonwealth of Australia

Department of the Environment (DoE) 2016a, *Outcomes-based Conditions Policy: Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia

Department of the Environment (DoE) 2016b, *Outcomes-based Conditions Guidance: Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia

Department of the Environment (DoE) 2016c, *EPBC Act Referral guideline for the endangered northern quoll Dasyurus hallucatus*, Commonwealth of Australia

Department of the Environment and Energy (DoEE) 2017a, *Species Profile and Threats Database*, Commonwealth of Australia

Department of the Environment and Energy (DoEE) 2017b, *Numenius madagascariensis* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017c, *Calidris ferruginea* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017d, *Chalinolobus dwyeri* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017e, *Dasyurus hallucatus* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017f, *Delma torquata* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017g, *Egernia rugosa* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017h, *Elseya albagula* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017i, *Erythrotriorchis radiatus* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017j, *Furina dunmalli* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017k, *Geophaps scripta scripta* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017I, *Grantiella picta* in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017m, *Lasiorhinus krefftii* in Species Profile and Threats Database, Department of the Environment, Canberra.

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Department of the Environment and Energy (DoEE) 2017n, Lathamus discolor in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) 2017o, Lerista allanae in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017p), Neochmia ruficauda ruficauda in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017q), Nyctophilus corbeni in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017r), Pedionomus torquatus in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017s), Petauroides volans in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017t), Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017u), Poephila cincta cincta in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017v), Pteropus poliocephalus in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017w), Rheodytes leukops in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017x), Rostratula australis in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment and Energy (DoEE) (2017y), Turnix melanogaster in Species Profile and Threats Database, Department of the Environment, Canberra.

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2009, Significant impact guidelines for the endangered black-throated finch (southern) (Poephila cincta cincta), Commonwealth of Australia

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010a, Survey Guidelines for Australia's Threatened Birds: Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999, Commonwealth of Australia

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2010b, Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999, Commonwealth of Australia

Environment Australia 2001, Brigalow (Acacia harpophylla dominant and co-dominant) information sheet, Commonwealth of Australia

Environmental Protection Agency (EPA) 2009, A study of the cumulative impacts on water quality of mining activities in the Fitzroy River Basin, Queensland Government



Forster, P. and Holland, A. (2006). *National Multi-species Recovery Plan for the cycads, Cycas megacarpa, Cycas ophiolitica, Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi and Macrozamia macrozamia platyrhachis.* http://www.environment.gov.au/system/files/resources/7f73872d-5d61-42a6-ab64-d38e980f010c/files/cycads.pdf

Garnett, S., Szabo, J. and Dutson, G. 2010, *The Action Plan for Australian Birds 2010,* CSIRO Publishing, Canberra

Geoscience Australia 2015, Floods Public Search – Water Observations from Space, Commonwealth of Australia

Great Barrier Reef Marine Park Authority (GBRMPA) 2009, *Great Barrier Reef Outlook Report 2009*, Australian Government, Great Barrier Reef Marine Park Authority, November 2009

Independent Expert Scientific Committee (IESC) 2015, *Information Guidelines for Independent Expert Scientific Committee advice on coal seam gas and large coal mining development proposals*, Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development

International Erosion Control Association (IECA) 2012, Best Practice Erosion and Sediment Control Guideline, IECA

JBT Consulting Pty Ltd (JBT) 2016, *Groundwater Assessment & Response to EHP Information Request*, report prepared for Jellinbah Group Pty Ltd, March 2016

Marchant, S. and Higgins, P.J. (eds) 1993, *Handbook of Australian, New Zealand and Antarctic Birds*, Oxford University Press, Melbourne

Menkhorst, P. and Knight, F. 2011, A Field Guide to the Mammals of Australia, Oxford University Press

Neldner, V.J., Wilson, B.A., Thompson, E.J. and Dillewaard, H.A. 2012, *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland*, version 3.2, Queensland Herbarium, Queensland Department of Science, Information Technology, Innovation and the Arts, Queensland Government

Pilgrim, D.H. (ed) 1998, Australian Rainfall & Runoff – A Guide to Flood Estimation, Institution of Engineers, Australia, Barton, ACT, 1998

Pizzey, G. and Knight, F. 2007, *The Field Guide to the Birds of Australia*, HarperCollins Publishers Pty Ltd

Queensland Herbarium (2012). Specimen label information, Queensland Herbarium.

Queensland Herbarium (2011). Specimen label information, Queensland Herbarium.

Threatened Species Scientific Committee (TSSC) 2013, *Commonwealth Conservation Advice for Brigalow Ecological Community*. Canberra: Department of Sustainability, Environment, Water, Population and Communities

UDP Group Services Pty Ltd (UDP 2016) *Surface Water Management Plan Including Central North* report prepared for Jellinbah Group Pty Ltd, September 2016



Wang, J. (1995). *Logania diffusa*. Species Management Manual. Department of Natural Resources, Brisbane.



Appendix A Site Water Management Plan Including Proposed Central North (UDP 2016)

А



Appendix B <u>Groundwater Assessment & Response to EHP</u> Information Request (JBT 2016)

В



Appendix C <u>Central North Extension Terrestrial Flora and Fauna</u> <u>Assessment (Reissued August 2017)</u>



Appendix D Database Search Results