9.13 Regional and Cumulative Impacts

The Project is located approximately 660 km north east of Perth in the Murchison bioregion and in the Eastern Murchison (MUR1) subregion. Land use in the area surrounding the proposed site is typical to the Northern Goldfields area and consists predominantly of mining activities, pastoral stations and conservation reserves.

Other projects considered relevant to the assessment of regional and cumulative effects are those in the vicinity, with the potential to impact the same receptors, or use the same infrastructure as the proposed Project. There are no operating mining projects within a 50 km radius of Yeelirrie, while a number of operating mines (including Mt Keith, Leinster and Agnew) and a number of proposed projects (including the Wiluna Uranium Project) are within 150 km of Yeelirrie.

Potential regional and cumulative impacts to the key environmental factors have been assessed in consideration to the following key projects. The list is not intended to be exhaustive. Rather, it indicates the major projects that are most relevant to the Yeelirrie Project.

Mount Keith

The closest mining operation to the proposed Yeelirrie development is the Mount Keith nickel mine, operated by BHP Billiton Nickel West. Mount Keith is a large open-cut mine with a nickel concentrator about 65 km east of Yeelirrie.

Wiluna Uranium Project

Toro Energy Limited has been granted state and federal environmental approval to develop the Wiluna Uranium Project on the Lake Way playa, 15 km southeast of Wiluna, and 56 km northwest of the proposed Yeelirrie development.

Barrambie Vanadium Project

Neometals Limited proposes to develop the Barrambie Vanadium Project located 116 km south-east of Meekatharra, and 85 km west of the proposed Yeelirrie development.

Table 9-87 outlines the potential cumulative effects of these relevant projects with the Yeelirrie Project.

9.13.1 Land Systems

Land Systems mapped at a regional level by the Department of Agriculture, (Pringle *et al*.1994; Payne *et al*. 1998), provide an opportunity to compare impacts on vegetation types and fauna habitat. In addition to considering the cumulative impacts of the key aspects of the Project and the three relevant projects mentioned above, Cameco has also undertaken an assessment of Land Systems impact in the wider region. This assessment considered active, proposed and closed projects within the wider region and has been utilised to determine whether any particular land system is significantly affected by the cumulative disturbance in the region. While a Land Systems mapping approach might be considered too high level, it is the only regional level mapping available.

Sixteen land systems representing ten land types have been mapped at a scale of 1:500,000 over the Local Study Area at Yeelirrie. Table 9-2 (see Section 9-1) shows the sixteen land systems and the area and percentage of each land system that occurs within the Project Area. Four land systems of most interest are the Cosmos, Cunyu, Melaleuca and Mileura systems. These are amongst the four smallest by area within the region, however they are also those most represented across the Yeelirrie Project Area. They are associated with margins of salt lakes and occluded palaeodrainage channels, including calcrete drainage plains with mixed halophytic and non-halophytic shrublands. The systems are considered an uncommon and geographically isolated series of land systems and vegetation communities within the broader region (Western Botanical 2011).

Table 9-87: Relevant projects included in the assessment of cumulative effects

Project, Owner and Status	Land Systems	Flora and Vegetation	Subterranean fauna	Terrestrial fauna	Hydrological Processes and Inland Water Quality (Surface Water)	Hydrological Processes and Inland Water Quality (Groundwater)	Radiological Environment	Noise	Air quality and GHG Emissions	Heritage (Aboriginal)	Transport and logistics
Mount Keith (BHP Billiton Nickel West) Operational	Operation does not occur on similar land systems.	Operation impacts different vegetation types and is outside of the predicted area of impact of the Yeelirrie Project	Groundwater abstraction from Albion Downs wellfield may impact groundwater dependent ecosystems in the Lake Miranda catchment	Operation is outside of the predicted area of impact of the Yeelirrie Project and impacts different habitat	Operation is within the Lake Maitland catchment and outside of the predicted area of impact of the Yeelirrie Project.	Groundwater abstraction from Albion Downs wellfield and Yeelirrie may interact.	N/A	Existing operation covered in baseline assessment	Existing operation covered in baseline assessment	Heritage sites are highly unique in their individual cultural significance and therefore cumulative impacts are highly unlikely. There are no regional scale features of ethnographic importance impacted.	Existing operation covered in baseline assessment
Wiluna Uranium Project (Toro Energy Limited) Approved	Operation may impact on sensitive land systems common to the Yeelirrie Project and within the Murchison bioregion	Potential cumulative impacts to communities associated with calcrete and those likely to be groundwater dependent vegetation.	Operation is outside of the predicted area of impact of the Yeelirrie Project and share no common groundwater source	Operation is outside of the predicted area of impact of the Yeelirrie Project but may impact similar habitat. Regional impact is low.	Operation is within the Lake Way catchment and outside of the predicted area of impact of the Yeelirrie Project	Operation is outside of the predicted area of impact of the Yeelirrie Project and share no common groundwater source	Operation is outside of the predicted area of impact of the Yeelirrie Project, nevertheless, may contribute to public perception	Operation is outside of the predicted area of impact of the Yeelirrie Project	Operation is outside of the predicted area of impact of the Yeelirrie Project		Operation proposes to share transport infrastructure, including ports, with Yeelirrie Project
Barrambie Vanadium Project (Neometals Limited) Approved	Operation may impact on sensitive land systems common to the Yeelirrie Project within the Murchison bioregion	Cumulative impacts to conservation significant flora species are not expected. Potential for cumulative effects on communities associated with calcrete.	Operation is outside of the predicted area of impact of the Yeelirrie Project and share no common groundwater source	Operation is outside of the predicted area of impact of the Yeelirrie Project but may impact similar habitat. ,Regional impact is low.	Operation is within the Lake Mason catchment and outside of the predicted area of impact of the Yeelirrie Project	Operation is outside of the predicted area of impact of the Yeelirrie Project and share no common groundwater source	N/A	Operation is outside of the predicted area of impact of the Yeelirrie Project	Operation is outside of the predicted area of impact of the Yeelirrie Project		Operation proposes to share transport infrastructure, including ports, with Yeelirrie Project

Table 9-88 shows the area of the Cosmos, Cunyu, Melaleuca and Mileura land systems and the area and percentage to be cleared by development of the Project. As presented, the impact is low with less than 1% on any of the Land Systems to be disturbed by the Project.

Table 9-88: Impacted land systems

Land System	Total Area of Land System Mapped (ha)	Total Area of Land System within Local Study Area (ha)	Total Area to be Cleared (ha)	Percentage within Local Study Area to be Cleared (%)	Percentage of mapped Land System to be Cleared (%)
Cosmo	19100	1797	0	0	0
Cunyu	66800	2857	316.6	11.08	0.47
Melaleuca	39600	3008	98	3.26	0.25
Mileura	125000	3796	940.5	24.78	0.75

Figure 9-71 illustrates the extent of the land system assessment undertaken by Cameco and the active, proposed and closed projects that impact on the four land systems of most interest. The assessment area covers four Department of Agriculture surveys (Murchison River Survey, Wiluna-Meekatharra Survey, Sandstone Yalgoo Paynes Find Survey and the North Eastern Goldfields Survey) for a total area of 33,314,274 ha. In addition to the Yeelirrie Project and from the available data there are twelve active, proposed or closed (shut or on care and maintenance) projects in the wider region that will impact on the four land systems. (Figure 9-64).

The cumulative impact from these projects on the four land systems is presented in Table 9-89.

Table 9-89: Cumulative impact on land systems

Land System	Total Area of Land System Mapped (ha)	Total Area to be Cleared by the Yeelirrie Uranium Project (ha)	Total Cleared or proposed to be Cleared by other Projects (ha)	Percentage Cleared or proposed to be Cleared (%)
Cosmo	19100	0	228	1.19
Cunyu	66800	316.6	288	0.91
Melaleuca	39600	98	0	0.25
Mileura	125000	940.5	767	1.36

As evident by the figures presented in Table 9-89 the cumulative impact to the sensitive Land Systems would be minor.

9.13.2 Key Aspects

9.13.2.1 Flora and Vegetation

Cumulative impacts on Land Systems is expected to be minor and therefore potential cumulative impact to vegetation communities is also expected to be minor. There is expected to be no significant cumulative impact to conservation significant flora.

9.13.2.2 Subterranean Fauna

Stygofauna

The Project is located in the Yeelirrie Palaeodrainage System. The only other significant third party user in this system is BHP Billiton Nickel West groundwater production borefield known as the

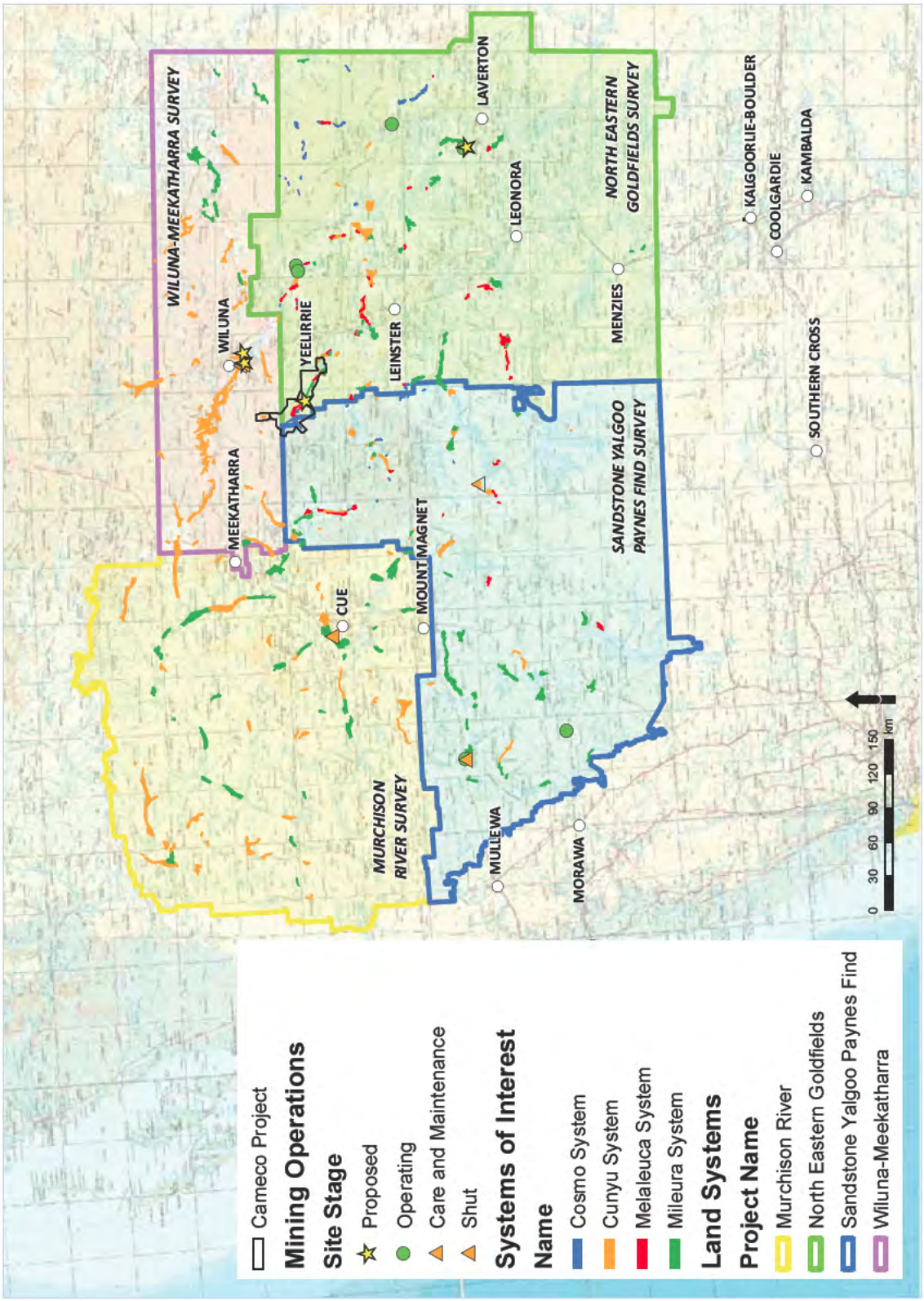

Figure 9-71: Land System Assessment

Albion Downs wellfield. The groundwater model developed and reported by Cameco (Section 9.5) was set up to simulate the combined impacts of the Project and Albion Downs wellfield. This simulation has been undertaken and reported using conservative assumptions relating to the connectivity of the two fields as well as to the future water abstraction from both fields.

Cameco considers that drawdown of 0.5 m more than the natural fluctuations as the threshold that will have an impact on stygofauna. Section 9.5.5.2 shows maximum drawdown with separation of the two cones of drawdown at the 0.3 m contour, and therefore no cumulative impact to stygofauna is expected. In addition to this, the incremental impacts of the Project on the area between the two fields, is highly manageable. Adjustments to the abstraction rates from the closer Yeelirrie bores can be used to further reduce the slight additional drawdown if ongoing monitoring shows that this is necessary.

Troglofauna

There are no other excavation activities planned or approved within the Yeelirrie Palaeodrainage System and therefore no cumulative impact to Troglofauna is expected.

9.13.2.3 Terrestrial Fauna

Table 9-90 lists the Conservation significant species recorded within the Study Area and their land system associations. There are no conservation significant fauna restricted to any of the four Land Systems discussed. Due to the isolated location of the Project there would be no cumulative effects to local populations of conservation significant fauna, or their preferred habitats.

Table 9-90: Conservation significant species

Species	Status in area	Habitat	Associated Land System
Leipoa ocellata Malleefowl Vul (EPBC) S1 (WCA)	Resident/ Recorded	Dense Acacia shrublands	Yanganoo, Sherwood and part Bullimore
Petrogale lateralis Black-flanked Rock-Wallaby Vul (EPBC) S1 (WCA)	Resident/ Old records (BCE 2011a; 2015a)	Rocky outcrops with caves and rock piles associated with the Barr Smith Range.	Sherwood
Merops ornatus Rainbow Bee-eater Mig (EPBC) S3 (WCA)	Regular migrant/ Recorded (BCE 2011a; 2015a)	Sandy- loam soils.	Bullimore, Desdemona
Apus pacificus Fork-tailed Swift Mig (EPBC) S3 (WCA)	Irregular visitor/ Recorded (BCE 2015a)	Not applicable: aerial species	All
Migratory waterbirds	Vagrants to irregular visitors, usually in very small numbers	Seasonal waterbodies	Cunyu, Mileura
Ardeotis australis Australian BustardP4 (DPaW)	Resident/ Recorded (BCE 2011a; 2015a).	Spinifex sand plains.	Bullimore
Amytornis striatus Striated Grasswren P4 (DPaW)	Resident/ Not recorded.	Spinifex sandplains with an overstorey of shrubs, usually mallee eucalypts.	Bullimore

Species	Status in area	Habitat	Associated Land System
Dasycercus blythi Brush-tailed Mulgara P4 (DPaW)	Resident/ Recorded (BCE, 2011a; 2015a)	Spinifex sand plains, mulga shrubland and open woodland.	Bullimore, Yanganoo
Sminthopsis longicaudata Long-tailed Dunnart P4 (DPaW)	Resident/ Not recorded.	Rocky ridges, stony slopes with Spinifex.	Sherwood
Nyctophilus major Inland Long- eared Bat P4 (DPaW)	Resident/ Recorded (BCE, 2011a)	Spinifex sand plains. May roost in tree hollows in E. gypsophila woodland.	Cunyu, Melaleuca
Burhinus grallarius Bush Stone-curlew	Resident/ Recorded (BCE 2011a; 2015a)	E. gypsophila woodland, dense Acacia shrublands, gnamma holes and Casuarina woodland.	All
Lophoictinia isura Square-tailed Kite	Resident/ Recorded (BCE 2011a)	E. gypsophila woodland and Mulga shrubland.	All
Antichinomys laniger Kultarr	Resident/ Not recorded.	Open plains.	Bullimore

9.13.2.4 Surface Water

There are no recently approved or proposed projects located within the Lake Miranda palaeochannel; therefore no cumulative effects to flow regime or water quality from the proposed development in conjunction with other activities are expected.

9.13.2.5 Groundwater

The Project is located in the Yeelirrie Palaeodrainage System. The only other third party user in this system is BHP Billiton Nickel West Albion Downs wellfield.

The groundwater model developed and reported by Cameco (Section 9.5) was set up to simulate the combined impacts of the Project and Albion Downs wellfield. This simulation has been undertaken and reported using conservative assumptions relating to the connectivity of the two fields as well as to the future water abstraction from both fields. The simulations demonstrate very limited overlap between the drawdown cones of the two fields and the DoW has advised in writing (email dated 29th April 2015) that the work presented by Cameco to assess groundwater impacts meets the requirements of a H3 level of assessment as outlined in DoW Operational Policy No. 5.12 (DoW, 2009).

Figures in Section 9.5.5.2 show maximum drawdown with separation of the two cones of drawdown at the 0.3 m contour. The impact on the area between the two developments arises primarily from Albion Downs abstraction, due to much lower intensity of abstraction associated with the Project (Yeelirrie abstraction is about one third of Albion Downs rates when expressed as total project volume or rate per kilometre of palaeochannel). Key areas of model conservatism are as follows:

- The model simulates a continuous hydraulic gradient through the major salina located between the two borefields, however static water level data (such as it is known from pre-Albion Downs records) suggests that net discharge at the salina means it acts as a hydraulic barrier effectively isolating the two parts of the groundwater flow system.
- Monitoring results have shown drawdown impact from Albion Downs is less than the model prediction in shallow aquifer between the two projects.
- Model simulation assumes continuing Albion Downs operation for full duration of Yeelirrie Project (until Year 2035) whereas current planned closure date for Mount Keith is 2021.

The incremental impacts of the Project on the area between the two fields, is highly manageable. Adjustments to the abstraction rates from the closer Yeelirrie bores can be used to further reduce the slight additional drawdown if ongoing monitoring shows that this is necessary. Further detail on the impacts of the Project on groundwater is provided in Section 9-5.

9.13.2.6 Radiological Environment

As discussed in Section 9.6.5.2 and Appendix J1 the extent of the Project's radiological impact on sensitive receptors is extremely low. The proposed Wiluna Uranium Project is located approximately 56 km from Yeelirrie and the project has no similar sensitive receptors with Yeelirrie. Areas of radiological impact associated with this proposed development would not likely extend further than 20 km from the project sites. The areas of radiological impact associated with this proposed project would not overlap with the Yeelirrie Project and therefore cumulative radiological effects are not expected.

Predicted effects to non-human biota would not extend a significant distance from the Project footprint. As discussed above, the distance between the proposed Yeelirrie development and other proposed uranium projects mean cumulative effects to non-human biota will not occur.

9.13.2.7 Noise

Sensitive receptors identified for the proposed development are not common to any recently approved or proposed projects. Therefore, cumulative impacts to noise for sensitive receptors from reasonably foreseeable projects are not expected.

9.13.2.8 Air Quality

Sensitive receptors identified for the proposed development are not common to any recently approved or proposed projects. Therefore, cumulative impacts to air quality for sensitive receptors from reasonably foreseeable projects are not expected.

9.13.2.9 Greenhouse Gas Emissions

The data presented in Section 9.9 and Appendix L2 show that, as a proportion of state, national and global emissions, the contribution of the Project to atmospheric greenhouse gas emission levels is very low. The exact quantity of additional greenhouse gas emissions likely to be released by reasonably foreseeable projects and activities cannot be known with certainty due to the variability in the publicly available information, however cumulatively their emissions are unlikely to result in a significant contribution to Western Australia's greenhouse emissions.

9.13.2.10 Terrestrial Environmental Quality

No cumulative impacts to terrestrial environmental quality from the Project in conjunction with other activities are expected due to the remoteness of the Project.

9.13.2.11 Heritage (Aboriginal)

Heritage sites are highly unique in their individual cultural significance. The Yeelirrie Project does not have a significant impact on cultural heritage sites, and as there are no regional scale places of ethnographic significance, that intersect Yeelirrie and any other Project, so no cumulative effects are expected.

9.13.2.12 Other

Transport

There are numerous projects proposed for development in the Mid-West region which, individually, are unlikely to impact traffic flows, but may present some cumulative impact.

Traffic volumes for the Goldfields Highway were assessed by Arup (2011) for BHP Billiton. The daily two-way traffic volume for the Goldfields Highway near Mount Keith was assessed to be 482 vehicles. Arup also estimated the increase from the Yeelirrie Project during the operational phase to be approximately 18.8 vehicles per day representing an increase of approximately 4 percent in the traffic flows for this route. This should be able to be absorbed within the available capacity along this route.

Extrapolating from the Yeelirrie estimates and allowing for two more projects to come into operation with no net loss from other operating projects that use the Goldfields Highway, the overall increase would be approximately 12 percent above the current flow.

It is unlikely that this increase would be of a magnitude that would lead to significant changes to the current levels of service for road users.

Transport of UOC

Each of the proposed Western Australian uranium projects is planning to utilise either Port Adelaide and/or the Port of Darwin to export UOC. To assess a worst-case scenario for cumulative impacts to transport, port infrastructure and capacities, it was assumed that all containers from all projects would be exported from the Port of Adelaide. If all four projects (Mulga Rocks (Vimy), Wiluna (Toro), Kintyre and Yeelirrie (Cameco) currently under consideration were to get into production they may produce up to 10,000 tonnes of UOC per year.

If this volume was to be trucked to the Port of Adelaide in shipping containers on two trailer road trains it would take approximately 260 vehicle movements, or 5 trucks each week.

The product from these projects would constitute a 0.2% increase in the number of container movements through Port Adelaide compared to 2010 movements. This increase is within the capacity of the port, and is therefore unlikely to result in a significant impact.

In summary, the cumulative transport movements relating to the development of new projects and the movement of UOC is unlikely to lead to significant changes to the current levels of service for road users.

Community Perception

The development of multiple uranium projects in Western Australia may affect community perceptions, in particular in relation to transport and emergency response and Cameco will work with local communities and other companies in the industry to ensure a high level of industry planning and co-operation and community education and engagement.

9.13.3 Summary of the assessment of regional and cumulative effects with other projects

Table 9-91 summarises the outcomes of the assessment of cumulative effects for the Yeelirrie Uranium Project with consideration to other Projects that may be developed within a similar timeframe.

Table 9-91: Summary of potential cumulative effects of the proposed development

Aspect	Cumulative effect
Terrestrial Fauna Surface Water Radiological Environment Noise Air Quality Greenhouse Gas Emissions Terrestrial Environmental Quality Heritage (Aboriginal)	Due to the isolated location of the Project and the absence of other developments in the vicinity, there would be no expected cumulative effects.
Vegetation and flora	Cumulative impacts on Land Systems are expected to be minor and therefore potential cumulative impact to vegetation communities is also expected to be minor. There is expected to be no cumulative impact to conservation significant flora.
Subterranean fauna	Cumulative impact to stygofauna is manageable and therefore no additional impact is expected.
Groundwater	Minor cumulative impact with the Albion Downs Wellfield is expected. The incremental impacts of the Project on the area between the two fields, is considered to be readily manageable.
Transport	Minor traffic increase in the mid-west region is expected, however it is unlikely that this increase would be of a magnitude that would lead to significant changes to the current levels of service for road users. Minor cumulative effect on the Port of Adelaide is expected, however the increases are within its capacities, and are therefore unlikely to result in a significant impact to existing users or the public..