Yeelirrie Uranium Project

PUBLIC ENVIRONMENTAL REVIEW
ASSESSMENT NO. 2032
CMS 14381

RESPONSE TO COMMENTS FROM THE OFFICE OF THE EPA

This document provides the response to comments from the Office of the Environmental Protection Authority (EPA) regarding the Public Environmental Review document for the Yeelirrie Uranium Project proposed by Cameco Australia Pty Ltd

<table>
<tr><th>Office of the EPA comment</th><th>Proponent response</th></tr>
<tr><td colspan="2">EPA policy and guidance</td></tr>
<tr><td>The EPA is obliged to consider policy and guidelines during assessments. Please show in your Response to Submissions document how you have considered the relevant policies and guidelines outlined in Table 2 Preliminary key environmental factors and required work within the approved Environmental Scoping Document (Appendix A of the PER).</td><td>Cameco has undertaken a review of policy and guidelines relevant to the Project. A table listing the policies and guidelines, their requirements and how they have been addressed is included in Attachment 1.</td></tr>
<tr><td colspan="2">Subterranean Fauna</td></tr>
<tr><td>In providing this advice, the information included in the PER and its appendices, and information provided by the proponent during the site visit [16 November 2015] and meetings [27 August 2015; 17 November 2015] has been used.

The survey effort and methodology has been conducted in accordance with EPA Environmental Assessment Guideline 12 and Guidance Statement 54a for Subterranean Fauna. However, the following information is required to adequately assess the impacts to the subterranean fauna assemblage at Yeelirrie:

• A map and table that summarise survey effort, these should include a breakdown by survey phase, bore location, species recorded and number of specimens.

• A map illustrating the locations of boreholes that recorded nil results by sampling phase. Where nil results were recorded, an explanation for the absence of subterranean fauna.

• A map illustrating groundwater depth and indicating the areas that may be completely dewatered and those that will remain saturated.

• A discussion of the impacts to subterranean fauna from changes in hydrology and water chemistry.

The proposal has the potential to significantly impact the ecological function, diversity and viability of the subterranean fauna assemblage at Yeelirrie.

<u>Impacts</u>

The impacts to subterranean fauna from the proposal have been identified as habitat loss from excavation (mine pits), groundwater drawdown and impacts to habitat from ground disturbance, stockpiling, surface contamination and tailings. Impacts to habitat from changes in groundwater quality and water chemistry, in particular chloride and salinity, and alteration of hydrology from diversion as a result of the Tailings Storage Facility (TSF) are also expected. These impacts are considered below.

Excavation (mine pits)

The proposed mine pit is located within the central Yeelirrie calcrete and coincides with areas of high species richness, in particular for stygofauna species where at least 54% of species known from Yeelirrie have been recorded (Subterranean Ecology 2011). Mine pit extraction will remove an area of approximately 726ha (9km long and 1.5km wide) to a depth of 10m, which will be progressively backfilled with tailings (Executive Summary). Table 12-1 states that there is the potential for subterranean fauna species to recolonise areas that are backfilled. However, no evidence to support re-colonisation by subterranean fauna has been</td><td>Sampling occurred during eight events:

1. March 2009 – pilot stygofauna survey (16 pastoral bores and wells);

2. August 2009 – stygofauna survey of the deposit and central calcrete (31 bores);

3. November 2009 – stygofauna and troglofauna survey of all accessible drill lines (78 bores);

4. January 2010 – second round survey of accessible drill lines (148 bores);

5. March 2010 – third round survey of accessible drill lines (193 bores); and

6. September 2010 – fourth round stygofauna and troglofauna survey, regional drill lines only, and pastoral bores in granite aquifers (134 bores).

7. February 2015 – first round of reference sampling around the western and southern boundary of drawdown (20 bores)

8. June/July 2015 – second round of reference sampling around the western and southern boundary of drawdown (46 bores)

There were nearly 800 deliberately collected subterranean fauna samples collected from Yeelirrie by Subterranean Ecology (2011) (448 troglofauna samples and 347 stygofauna samples) collected over six rounds of sampling between 2009 and 2010. The Subterranean Ecology samples were collected in accordance with GS54A, which conforms to the approaches described in EAG12. Subsequently, Bennelongia (2015) collected a further 66 samples of stygofauna in two rounds of sampling in 2015, in accordance with EAG12. The number of stygofauna and troglofauna samples collected in each area is shown in Tables 1 and 2.

<table>
<tr><th></th><th colspan="8">Stygofauna</th><th colspan="4">Troglofauna</th></tr>
<tr><th>Site type/Area</th><th>R1</th><th>R2</th><th>R3</th><th>R4</th><th>R5</th><th>R6</th><th>R7</th><th>R8</th><th>R3</th><th>R4</th><th>R5</th><th>R6</th></tr>
<tr><td>Impact area</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Granite</td><td>1</td><td></td><td></td><td></td><td>3</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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Office of the EPA comment	Proponent response

provided. The construction of the TSF will create a permanent physical barrier to the distribution of subterranean fauna, including a barrier for gene flow, within the Yeelirrie calcrete.

Groundwater drawdown

Groundwater drawdown is predicted to directly impact stygofauna through the loss of habitat and may also cause changes in troglofauna habitat through changes in humidity (drying out). The proponent has used a precautionary groundwater drawdown threshold of greater than 0.5 metres to predict significant impacts to subterranean fauna (Figure 9-11 – 9-16). The modelling predicts that approximately 37% and 60% of the calcrete and playa areas respectively will experience groundwater drawdown of greater than 0.5 metres.

The PER states that 'across much of Yeelirrie, substantial drawdowns are likely to fully dewater the calcrete and cause major habitat loss for stygofauna', this includes the mine pit area (Figure 9-43).The PER also states that 'some calcrete and the underlying alluvium will remain saturated'. A map illustrating groundwater depth and indicating the areas that may be completely dewatered together with those that will remain saturated is required so the extent of groundwater drawdown impacts on subterranean fauna can be assessed.

Water chemistry and hydrology

The PER does not adequately discuss the impacts on subterranean fauna as a result of changes to water chemistry and hydrology. The PER acknowledges that the subterranean fauna habitats at Yeelirrie are highly variable and consist of a three-dimensional 'mosaic' and states that 'identifying occurrences of suitable habitat of microhabitats outside of the impact area is usually very difficult'. As the distribution of subterranean fauna species is likely to be dependent on variations in microclimates based on water chemistry, in particular salinity (S. Halse 17 November 2015), it is reasonable to expect that species will be sensitive to changes in water chemistry. The PER states that 'drawdowns may result in significant changes to groundwater salinities … because of the natural vertical gradients'. The impacts to subterranean fauna as a result of changes in water chemistry, in particular salinity and groundwater contamination i.e. chloride (see Section 9.5.5.3) need to be addressed.

Subterranean fauna microhabitats may also be altered as a result of changes in hydrology. The groundwater at Yeelirrie flows from north and south into the central catchment and then flows longitudinally west to east through the Yeelirrie Playa to Lake Miranda (Section 9.4 & 9.5; Appendix I1). The central catchment coincides with the proposed mine pit and development envelope (Figure 9-34). During the life of mine, bunds will be created to divert surface water runoff, and groundwater transmission into the mine pit and TSF will be prevented through the construction of low permeable clay walls. The impacts on subterranean fauna as a result of changes to hydrology and groundwater flows from modified surface water flows and the TSF should be addressed.

Management

Despite implementation of the proposed management, it is predicted that ten stygofauna and five troglofauna species currently known only from the area of groundwater drawdown are considered to be at risk of significant impact, without further information regarding their distribution. An additional 42 stygofauna and 23 troglofauna species are also likely to experience a reduction in habitat availability and habitat quality within the Yeelirrie playa and central drawdown areas (as extracted from Table 4 and 5 Bennelongia 2015).

The proposed management is insufficient and inappropriate to adequately mitigate the predicted impacts to subterranean fauna from the proposal. The PER acknowledges that the 'management options to protect subterranean fauna are difficult especially considering the uncertainty and limitations of the study and impact assessment'. The management proposed (Section 9.2.7) only addresses the impacts resulting from

North west												
Central		54	2	2	20	4						
South east	2	1		7	19	11			23	39	39	
Yeelirrie playa												
Reference area												
Granite	5			6	7	8	1	5		9	15	10
North west	1		7	17	22	23	1		6	27	35	16
Central	5	4		11	17	12	14	35	16	34	47	12
South east					2	2		6		1	14	6
Yeelirrie playa	2		19	16	20	13	4		14	36	36	13
Total	16	59	28	59	110	75	20	46	59	146	186	57

Some requested figures have been provided in Attachment 2. Cameco has provided the OEPA with the relevant spatial data in order to create the additional figures.

Maps and data showing sampling effort, holes that yielded no stygofauna or troglofauna, the saturated thickness of calcrete and predicted groundwater drawdown (thus showing the areas that may be completely dewatered and those that will remain saturated) are provided in Attachment 2 (Figures 1 to 4). A preliminary explanation regarding the absence of subterranean fauna is discussed on page 178 of the PER. In summary, many subterranean species occur at low abundance and are infrequently collected, even when present. Eberhard et al. (2009) showed that 12 samples collected at least a month apart are required to collect all the stygofauna species from a high-yielding bore. A further complication is that many bores are either constructed in a way that makes them unsuitable for subterranean fauna or do not intersect appropriate subterranean spaces. These bores never yield, even when adjacent bores consistently do so. Dillon et al (2009) also found that low rates of encountering stygofauna may be due to the construction of the bore which is not suitable for fauna to migrate into the standing water of the bore. Another potential reason for nil results is that fact that a number of bores were sampled with only about half the intensity of the main part of the palaeochannel. *Excavation (mine pits)*

The discussion in Table 12-1 refers to habitat that is not excavated but dewatered during the mining operation. The water table in these areas will recover post closure. The volume of habitat permanently lost due to the excavation of the mine pit is quantified in Attachment 3. It should also be noted that not all of the pit will be backfilled with tailings.

Groundwater drawdown, water chemistry and hydrology

Cameco have presented a detailed assessment of the impacts on subterranean fauna based on conservative values for key water balance and hydraulic parameters. This assessment and relevant commitments have been expanded in response to specific points raised in submissions to the PER. It is shown that the main impact results from PEC area

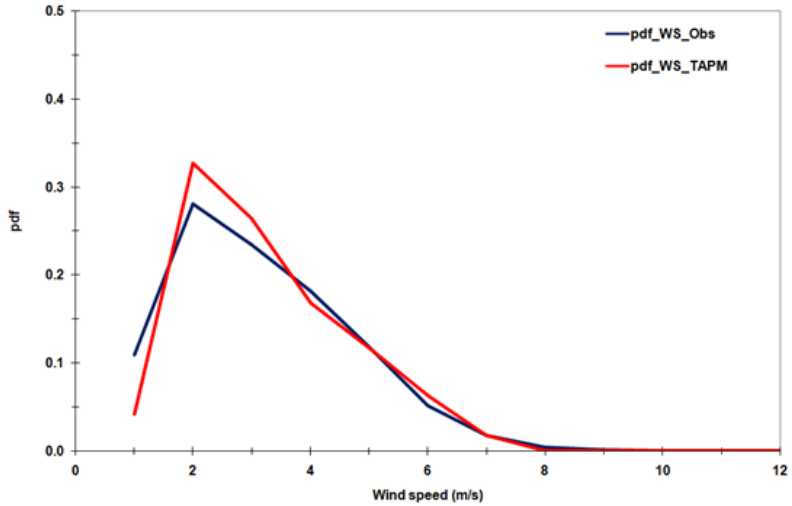
Office of the EPA comment	Proponent response
groundwater drawdown and is limited to the impacts to stygofauna. The proposed management does not directly address impacts to troglofauna (Executive Summary and Section 9.2.7). In addition, the proposed management does not address the potential impacts to habitat from changes to hydrology, contamination and backfilling with tailings. Additional management measures should be developed to address all potential impacts. Where impacts are unable to be adequately managed, avoidance should be implemented. Rehabilitation is an inappropriate management measure for Subterranean Fauna. The Executive Summary includes rehabilitation as a Management Measure for impacts to Subterranean Fauna, but the Table 12-1 Offsets Table states that environmental values (of subterranean fauna) cannot be rehabilitated and that 'successful rehabilitation of subterranean fauna has yet to be proved or attempted'. The PER proposes development of a Subterranean Fauna Management Plan (SFMP) which will include monitoring, setting of trigger criteria and contingency actions. Recognising the complexity of predicting the distributions of subterranean fauna in the Yeelirrie PEC, planned monitoring programs should include both bores where high and low species abundance has been previously recorded. It is essential that adequate baseline data, including water chemistry, is collected in advance of ground disturbance and dewatering. A copy of the proposed SFMP and Groundwater Management Plan should be provided for comment by TEB when available. REFERENCES Bennelongia (2012). *Subterranean Fauna assessment of the Kintyre uranium deposit*. Bennelongia Environmental Consultants Pty Ltd, Jolimont Bennelongia (2015). *Yeelirrie subterranean fauna assessment.* Bennelongia Environmental Consultants Pty Ltd, Jolimont Biota (2014). *Koodaideri iron ore Project troglofauna and bat impacts key findings.* Biota Environmental Sciences Pty Ltd, Leederville Subterranean Ecology (2011). *Yeelirrie subterranean fauna survey*. Subterranean Ecology Pty Ltd, Stirling Toro Energy Limited (2015). *Extension to the Wiluna Uranium Project Assessment No: 2002 (CMS14025) Public Environmental Review November 2015*. Toro Energy Limited, West Perth	habitat reduction resulting from drawdown. This impact is well defined, quantified and controlled. Water quality impacts from the TSF are shown to be minor and/or localised. Note that over the long term, the limited TSF impact on water quality is not dependent on constructed barrier walls, rather it arises primarily from the inherent low permeability of the tailings and secondarily from limited geochemical mobility of solute in the natural environment. The impacts of salinity and metal contaminants is discussed under Public Comment 3. While stygofauna species are likely to be sensitive to changes in water chemistry, it is expected that changes to water chemistry outside the predicted 0.5 m groundwater drawdown contour will be small and will have, at most, minor impact on species. The largest changes to water chemistry will be within the 0.5 m groundwater drawdown contour where it is accepted that impacts to stygofauna species will be severe and, for assessment purposes, any species restricted to this area is considered to be threatened. It is considered that the stygofauna species known only from within the 0.5 m contour actually have wider ranges, see responses to public Comments 11, 23, 26 and Attachment 3 for further discussion. As discussed in the PER, subterranean fauna is a significant aspect for the Project. As a result of comments, regulator meetings and addition information, Cameco has provided an updated subterranean fauna avoidance, minimisation, mitigation and offset measure document as Attachment 3. As a result, there are now 11 species of stygofauna and 1 species of troglofauna that are currently only known from the impact area. Cameco has also provided evidence of likely range extension of each of the 12 species in Attachment 3. Cameco considers that the avoidance, minimisation and mitigation measures outlined in Attachment 3 will allow the Project to be operated so that the risk to maintaining the representation, diversity, viability and ecological function at the species, population and assemblage level of subterranean fauna is low and therefore EPA's objective for this key environmental factor will be met. However, Cameco recognises that a level of uncertainty remains about the range of the potentially restricted species and therefore proposes an offset measure. It should also be noted that Cameco has installed a network of data loggers at Yeelirrie and continues to collect regular manual data in order to establish adequate baseline information.
Terrestrial Fauna	
In general, the impacts to vertebrate Terrestrial Fauna, as outlined in the PER, are low provided the proposed management measures are adequately implemented. However, the following management actions are required to be included to ensure that the EPA's objectives can be met: • Pre-clearance surveys are required for Malleefowl and Brush-tailed Mulgara. • Avoidance of significant populations of Brush-tailed Mulgara, where confirmed. • Mitigation for impacts of light on Black-flanked Rock Wallaby should also be considered. The Executive Summary includes 'light impacts on nocturnal species' as a potential impact. • Installation of suitable fauna egress in stormwater and surface water diversion channels is required. The Executive Summary states that 'entrapment of fauna in open excavations' is a potential impact. • Inspect and report on deceased or dying wildlife to determine likely cause of death is required. The PER makes the assumption that dead birds/animals found around evaporation ponds can be attributable to exhaustion (page 221 and 413) rather than direct contact with evaporation ponds.	**Vertebrate Fauna** Cameco believes that the potential impacts of light on the Black-flacked Rock Wallaby are negligible and do not warrant mitigation. As discussed in further detail in response to the DPaW comments, the Black-flanked Rock-Wallaby is a potential resident of the Barr Smith Range and most development is well away from this area, except for a very small (compared with total suitable habitat) quarry. It is anticipated that all quarry activities will be undertaken in daylight hours and therefore artificial light will only be utilised on very rare occasions. Cameco agrees and commits to the following management actions to ensure that the EPA's objects on Terrestrial Fauna are met:

Office of the EPA comment	Proponent response
The PER does not adequately discuss the impacts to SRE invertebrate fauna. The following information is required to complete the analysis: • Identify those species that will be directly impacted from habitat loss as a result of mine pit extraction and infrastructure, and those that may be indirectly impacted; • Consider the impacts to SRE species from flooding of habitat as a result of the establishment of surface water diversion (Table 9-34); • Discuss if avoidance of SRE species, in particular to those species currently only known from the development envelope, has been applied; and • Modify Figure 9-19 to distinguish between the locations of species of the same genus (for example *Kwonkan* sp. and *Aname* sp.). References: Master, P. (2013). *Ecology of Dasycercus spp.* Presentation at the Mulgara Threatened Species Workshop, Department of Parks and Wildlife, Kensington, 11 December 2013	• Pre-clearance surveys for Malleefowl and Brush-tailed Mulgara will be undertaken prior to commencement of ground disturbing activities. • Where confirmed during pre-clearance surveys, significant populations of Brush-tailed Mulgara and Malleefowl will be avoided where possible. If disturbance of significant populations are unavoidable then Cameco will seek approval from the Chief Executive Officer of the Environmental Protection Authority prior to commencing ground disturbing activities. If pre-clearance surveys identify active Malleefowl mounds, then clearing will be delayed until the completion of the annual breeding cycle. The mound would then be removed during the non-breeding period (c. February to May). • Installation of suitable fauna egress in all stormwater and surface water diversion channels. • Undertaking regular inspections of water management areas (evaporation pond, tailings ponds, stormwater infrastructure and the surface water diversion channel) for potentially trapped wildlife. The frequency of inspections will be outlined within the Fauna Management Plan. Cameco will report all confirmed wildlife deaths discovered during these inspections. **SRE Fauna** • Cameco has partly identified which SRE species will be directly impacted in Table 9-31 in the PER, which details whether or not species were collected inside or outside the footprint. However, comprehensive collection of SRE invertebrates to the point where precise patterns of distribution on the local scale in relation to the environment can be strictly defined is almost impossible. Therefore, the exact impact to SRE species cannot be determined. All SRE invertebrate species are likely to experience some direct impact (habitat loss) and some indirect impact (e.g. dust, hydrological change). In the case of the Shield-backed Trapdoor Spider, direct impacts are likely to only be from infrastructure, and indirect impact would be from dust and perhaps localised flooding (see Table 9-34 which discusses impacts on SRE invertebrates). The majority of the population of this species would be neither directly nor indirectly impacted as it occurs in areas outside the footprint. Species such as the four isopods, the pseudoscorpion and the centipede, and potentially the mygalomorph spiders recorded only in the footprint, are likely to experience the greatest proportional direct impact upon populations, but their lack of collection outside the footprint is almost certainly a sampling bias. Therefore they may also be at some risk of indirect impact. • Figure 9-19, Table 9-32 and Table 9-34 of the PER partially address the impacts of surface water diversion to SRE species. The extent of potential flooding (≥0.5m above baseline) during a 1:1000 year ARI event is shown in Figure 9-19 and the worst case impacts to VSAs within the study area is presented in Table 9-32. As presented in Figure 9-23 and in Appendix H1 of the PER a 1:1000 year ARI event will cause localised flooding without the Project. It should also be noted that a 1:1000 year event during the life of mine is unlikely, that the effects of flooding are likely to be temporary and that flooding does not necessarily result in a loss of SRE species. In addition to this the surface water diversion could even expand the range of species reliant on mesic conditions (e.g. the four isopod species). • Table 9-32 on page 218 of the PER provides a direct and indirect impacts for each VSA within the Study Area. This information has also been presented for specific SRE species in Attachment 4, the table within the attachment presents the preferred VSA(s) of each species, the area of these VSAs within the Project/Study Area and the area (and

Office of the EPA comment	Proponent response

	percent) of a species' VSAs, which will or potentially will be impacted. Impact significance has been reassigned based on these percentages.
	• The reassigned impact significance levels are generally the same as previously stated (Table 9-34 of the PER) with the following differences:
	  • Impact previously thought to be Moderate, however now considered to be Minor to Moderate – the Isopod Platyarthridae/Bathytropidae;
	  • Impact previously thought to be potentially Moderate, however now considered to be Moderate – the barychelid mygalomorph spider and the cheiridiid pseudoscorpion.
	  • Impact previously thought to be Negligible, however now considered to be Minor - the isopod *Cubaris* sp. 2, the mygalomorph spider *Kwonkan* MYG210 and the mygalomorph spider *Kwonkan* MYG211 (but minor in PER).
	  • Impact previously listed as either Negligible (in PER Table 9-34) or potentially Moderate (PER Appendix G2), however now considered to be Moderate – the Tiger Beetle *Pseudotetracha helmsi*.
	  • Impact previously listed as either Minor (in PER Table 9-34) or potentially Moderate (PER Appendix G2), however now considered to be Moderate - the mygalomorph spider *Kwonkan* MYG172.
	  • Impact previously listed as either Minor (in PER Table 9-34) or potentially Moderate (PER Appendix G2), however now considered to be Moderate – the isopod *Cubaris* sp. 1.
	  • Note that three species, the Tiger Beetle *Pseudotetracha helmsi*, the mygalomorph spider *Kwonkan* MYG172 and the isopod *Cubaris* sp. 1, had different listings between the PER Table 9-34 and the PER Appendix G2, but the predicted impact upon all of these is now considered Moderate.
	• Specific management options that Cameco will implement to reduce impacts and protect SRE species are listed in Table 9-34 on page 228 of the PER.
	• Cameco has endeavoured to reduce the size of the Project footprint where possible. In addition to this, impacts to SRE species have been avoided by planning to construct all unnecessary infrastructure away from the calcrete, calcrete outwash and playa areas, where several of the SRE invertebrate species are recorded.
	• Figure 9-19 has been updated and is provided as Attachment 4.
	Cameco commits to undertaking an SRE survey prior to the commencement of ground disturbance activities in order to confirm the presence of the SRE species outside of the Project Area.

Air Quality and Atmospheric Gases	
Clearly show the locations of all potential sensitive receptors noting that camping areas and homesteads i.e. No-Ibla are included. Please confirm whether the maximum wind speeds (e.g. those associated with dust storms) in the region have been included in the dust modelling to determine worst case potential impacts on sensitive receptors.	Attachment 5 to this document clearly shows the location of No-Ibla Homestead, Dempsey Bore and other potential sensitive receptors. The figure also shows the location of the modelled maximum 0.5m drawdown contour, predicted maximum 2µg/m3 TSP Dust concentrations and the predicted maximum 24hr PM2.5 µg/m3 dust contours. The air quality assessment for the Project (Appendix L1; Katestone 2014a) was based on hourly meteorological data for one year to account for typical meteorological conditions likely to be experienced in the region. The meteorological data generated was evaluated against observational data recorded at five automatic weather stations and at Yeelirrie and Wiluna. The meteorological data accurately represented the type, magnitude and frequency of meteorological conditions that are likely to occur, including consideration of maximum wind

Office of the EPA comment	Proponent response
	speeds and dust storms in the region. The approach that was adopted is consistent with standard practice. The Figure below illustrates the frequency distribution of wind speeds for modelled data versus observational data. It demonstrates little variability between the modelled and observational data above 4 m/s. Exposed surfaces such as stockpiles and active pits will have higher dust emissions during strong winds compared with light winds. The dust emissions will also be transported over greater distances during periods of stronger winds due to the dust particles remaining suspended for longer. However, stronger winds will also cause greater atmospheric turbulence, resulting in greater dispersion and, therefore, lower ground level concentrations of dust. A stable atmosphere coupled with a low level jet is the dominant weather type in winter. These conditions can lead to worst case dispersion conditions for pollutants suspended in the atmosphere. These conditions have been represented in the meteorological and dispersion modelling. 
Inland Waters Environmental Quality	
It appears that not all bores that may be impacted have been identified i.e. bores on Youno Downs. Please ensure that the locations of all bores have been sought from the landowners and included in the assessment of impacts (both quantity and quality) to other users.	All neighbouring bores were identified in the original assessment and the locations of these bores were provided on the figures within Section 9.5 of the PER (Figures 9-39, 9-40, 9-41, 9-42, 9-44, 9-45 and 9-46). Cameco has also included a figure as Attachment 5 to this document that clearly identifies the location of Dempsey Bore and other neighbouring pastoral bores. The current modelled impact suggests that Project water supply will not impact Youno Downs Station. This is further discussed in response to submission 23 of Hydrological Processes.

Office of the EPA comment	Proponent response
	It should be noted that the conceptual borefield represents the areas that have been identified for water supply, while the modelled impact (0.5 m contour) reflects the specific bores within the conceptual borefield. Figures 9-39, 9-40, 9-41 and 9-42 in the PER illustrate the location of modelled supply wells.
Offsets	
Please note that the comments below are provided to ensure consistency with the WA Environmental Offsets Policy and WA Environment Offsets Guidelines, noting that the EPA has yet to consider the level of significant residual impact and whether an offset can be applied to counter balance the impact. Figure 3-19 of the PER should include the location of the mine pits, waste rock dump and support infrastructure in relation to the location of significant fauna to show how avoidance has been applied. Where possible waste dumps and infrastructure should be located to avoid significant fauna, in particular burrow clusters of the Shield-backed Trapdoor Spider and active Malleefowl mounds. The proponent should describe how avoidance of impacts on significant fauna species has been applied. Subterranean fauna: • Indirect Offsets have been proposed in the PER for loss of subterranean fauna habitat (including Priority 1 PEC Yeelirrie Calcrete), however no specific detail has been provided. The offsets table (pages 434) will need to provide more detail on the impact, mitigation actions and the proposed offset • It is noted that the proponent intends to further consult with the Department of Parks and Wildlife and the Office of the EPA to develop a suitable offset. An offset package will need to be finalised during assessment and will need to be demonstrated to meet the offset principles in the WA Offset Guidelines. Specifically, any offset needs to be relevant and proportionate to the residual impact to subterranean fauna. Flora and Vegetation: • Offsets have been proposed for clearing of the entire western population of the (DRF) Atriplex sp. Yeelirrie station (76ha, 80,542 plants (estimated), good to excellent condition). Other mitigation actions (Avoid/Minimise) are not proposed. • Translocation sites – The PER (p165) looked at two stations held by Cameco plus Lake Mason Station – only Lake Mason station was identified as suitable. Further information is required on the review of potential translocation sites (24.3ha identified as suitable, a further 59.4ha is to be explored to assess suitability) and an explanation on why sites originally identified on the two Cameco stations were not considered suitable. Further detail on specific actions, likely success and completion criteria and will also need to be provided.	Cameco has provided updated management and mitigation options for both *Atriplex yeelirrie* (Attachment 8) and Subterranean Fauna (Attachment 3). Additional information regarding avoidance of impacts on significant fauna species is discussed below. Cameco is committed to having further discussions regarding offsets, with the relevant regulators, prior to the final project recommendation.

Yeelirrie Uranium Project

PUBLIC ENVIRONMENTAL REVIEW
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RESPONSE TO SUMMARY OF PUBLIC SUBMISSIONS

Table of Contents

1. The proposal – General

No.	Submitter	Submission and/or issue	Response
1.	P&W	There are a number of management plans proposed to be developed for approval prior to the commencement of development of the Yeelirrie Project. As a number of these plans relate to conservation values for which Parks and Wildlife has responsibilities, it is recommended that any of these plans that are conditioned be developed or refined (and reviewed) in consultation with Parks and Wildlife. For example, the Flora and Vegetation Management Plan, Conservation Species Management Plan, Fauna Management Plan, Subterranean Fauna Management Plan and perhaps the water and fire management plans, depending on their objectives.	Understood and agreed. Cameco will develop management plans for key environmental factors in consultation with the relevant regulatory authority. For example, any plans that relate to conservation values will be developed in consultation with the Department of Parks & Wildlife (DPaW). Cameco would also accept Project conditions which required these Plans to be developed for the review of the relevant agency.
2.	P&W	The proposal includes a number of strategies or commitments that would require the allocation of additional resources to enable Parks and Wildlife to support or advise on implementation if the proposal was approved. Provision for assisting Parks and Wildlife by meeting the cost of the work associated with implementing strategies or commitments in the PER will need to be considered if the proposal is approved.	Understood. Cameco would be happy to discuss a fee for service arrangement or an offset which provides support for an officer working on Yeelirrie related matters.
3.	P&W	The proposal has no predicted direct or indirect impact on the adjacent former pastoral leases (Lake Mason, Black Range and Kaluwiri) that have been purchased and are managed for conservation, other than the potential for proposal(s) to translocate *Atriplex.* sp. Yeelirrie Station into the palaeodrainage channel at the former Lake Mason pastoral lease. These former pastoral leases were identified through the WA Government's Gascoyne Murchison Strategy as containing land systems and vegetation associations that are under-represented in the formal reserve system. Formal reservation of these areas for conservation would significantly increase the level of reservation of local ecosystems, habitats, communities and species in the Murchison 1 (MUR1) Interim Biogeographic Regionalisation for Australia (IBRA) bioregion, in which conservation reserves currently occupy only 1.37 per cent of the area of the bioregion by area (well short of the 15 per cent target).	Comment noted.

No.	Submitter	Submission and/or issue	Response
4.	DotE	For the purpose of the impact assessment presented in this document, a realistic worst-case scenario has been adopted, whereby 16 blasts are undertaken each year, using a total of about 70 tonnes of explosives and emulsion product. Information on how this 'realistic worst case scenario' of blasting requirements has been derived. i.e. what geological assumptions were used to derive this assumption?	Some areas of calcrete are consolidated and may require blasting. The scenario was developed based on an interpretation of drill log information. The deposit has been heavily drilled and the assessment is considered realistic for this stage of planning.
5.	DotE	Please clarify how close the Project is (in kilometres) to the nearest population centres.	As stated in the PER, on page 100, the nearest towns to the Project are Wiluna, approximately 90 km north, with a population of approximately 200, and Leinster, located approximately 115 km to the south east with a population of 700. The Mount Keith operation is located approximately 60 km to the east of the Project and has a fly-in-fly-out workforce of approximately 500.
6.	DotE	It is unclear where use of renewable energy sources mentioned in the Executive Summary is discussed in any detail. Ensure that energy supply measures identified in the Executive Summary are discussed in the appropriate Section of the PER.	Section 9.9.6 of the PER, management measures for the reduction of Greenhouse Gas (GHG) Emissions, presents the following list of measures to supplement energy supply: • Solar hot water systems and solar photovoltaic systems for the site administration and accommodation facilities; • Solar photovoltaic power systems for powering the remote groundwater wells and associated pumping stations; and • Consideration of biodiesel blends in the mining fleet and for the generation of on-site steam and electricity. Other measures include the capture of CO_2 gas from the power generators for use in the mineral processing plant. Energy supply options including the use of gas instead of diesel fired power generation will be further investigated during the Definitive Feasibility Study (DFS) for the Project.
7.	DotE	The PER does not provide a statement of Mineral Resources and Ore Reserves for the Yeelirrie Project. The document states production rates and proposed timing, but would benefit from the inclusion of a Resource Statement. A mineral resources and reserves table is available on the Cameco website. A statement of Mineral Resources and Ore Reserves for the Yeelirrie Project including uranium and vanadium estimates could be provided. While it is clear that vanadium recovery is not currently economically viable, there is the potential for change during life of the operation. Consideration could be given to a reassessment of the vanadium market and the technology of vanadium extraction from Yeelirrie at a later date.	The mineral resource estimate, reported in accordance to NI 43-1011 (and JORC Code 2) is presented in Section 2.2, Project Overview, on page 8 of the PER. As provided in the PER, the Mineral Resource and Ore Reserves for the Project is 127.3 Mlbs (57,742 tonnes) measured and indicated with an average grade of U3O8 of 0.16% or 1,600 ppm. The potential for vanadium recovery would be reviewed during the DFS and on an ongoing basis.

No.	Submitter	Submission and/or issue	Response
8.	DotE	The transport of uranium is of interest and concern to regulatory authorities and the public. Past experience demonstrates that a social licence to undertake such activity is important. Best practice experience shows projects are well served by minimising risk from the transportation component of the production cycle. Logistical and permitting circumstances at WA ports, which are much closer than Adelaide (for example, Port Hedland and Fremantle) preclude these ports as an option. Adelaide, rather than the other possible option of Darwin, is therefore left as the proposed destination. The relatively lengthy mileage to Adelaide (more than 1,500 kilometres further than WA ports), relative to WA options increases the risk of road accidents and could potentially raise public concerns with transportation of the product. The proponent will also be required to undertake separate environmental and approvals processes for the South Australian segments of the proposed transport route. Similar issues are faced by Toro`s Wiluna Project and Cameco's Kintyre Project. Consideration of the transport issue by the WA Government could yield a more optimal solution which could in turn result in lower personal and environmental risk and positive economic outcomes for the state along with potentially lower carbon dioxide emissions for road transport. Discussion around the flexibility of the proponent's transport route options should include the potential for export from a WA port.	Cameco agrees with the sentiment expressed in relation to the use of Western Australian ports for the export of uranium. However, there are two key issues which currently exclude WA ports from serious consideration. Firstly, the stated policy of the current State government is to not permit the export of uranium from a WA port. Secondly, the Yeelirrie Project alone would not produce a sufficient volume of product to justify a ship coming into a WA port. This could change if there were other producers in WA to make up the volume of product to justify shipping, however, Adelaide remains the most suitable port at this time. In time, with a change of government policy and sufficient production, Cameco would be happy to work with Industry and Governments towards a WA port, however it is not currently an option and was therefore not explored in the PER. While the proposal to truck uranium oxide may be new to Western Australia, it is important to remember that uranium is moved safely all over the world every day of the year. In Canada, Cameco regularly ships uranium oxide safely from our facilities by road without incident. In 2015, Cameco managed approximately 1,500 truckloads of product including all forms of uranium oxide U_3O_8, UO_3, UO_2, plus UF_6 finished fuel bundles and calcined material for recycling without incident. Cameco's approach to transporting Class 7 uranium material is consistent with the worldwide approach. The IAEA reports that since 1963, when transport standards for these goods were set, there has not been a transport accident involving Class 7 goods where there has been significant radiological or environmental impacts.
9.	DotE	More recent work on potential effects of climate change specific to the region could be included in this discussion. The Rangelands Cluster Report may provide further information for consideration of climate change effects. Watterson, I. et al. 2015, Rangelands Cluster Report, Climate Change in Australia Projections for Australia's Natural Resource Management Regions: Cluster Reports, CSIRO and Bureau of Meteorology, Australia http://www.climatechangeinaustralia.gov.au	Comment noted. Cameco discussed the implications of climate change on Project design and planning in Section 7.4.1 of the PER and considered the impacts of climate change on storm water management in Section 9.4.5. This was based on information available at the time of the development of the PER namely: • CSIRO, Australian Bureau of Meteorology (2007). Climate change in Australia: technical report 2007. CSIRO. 148 pp • Intergovernmental Panel on Climate Change (IPCC) (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp. (http://www.ipcc.ch/publications_and_data/ar4/syr/en/mains1.html) viewed 28 January 2015. The findings from the Rangelands Cluster report are similar to those presented in the CSIRO and BOM (2007) report.
10.	DotE	More up to date earthquake risk information may be used.	Comment noted. Cameco commits to using current seismic data in the future design of tailings storage facilities and other infrastructure.

No.	Submitter	Submission and/or issue	Response
		The current earthquake hazard map (2012) can be found at http://www.ga.gov.au/metadata-gateway/metadata/record/74811/ http://www.ga.gov.au/corporate_data/77399/Rec2013_041.pdf	
11.	DotE	Non-significant earthquakes not included. It is worth noting that there have been 4 recorded earthquakes within 80 km of Wiluna: Magnitude, location, date 2.5 42 km NE Wiluna, 23/11/1998 2.6 75 km ESE Wiluna, 21/07/1979 3.0 55 km SE Wiluna, 28/01/1978 2.4 42 km SE Wiluna, 20/01/1978	Comment noted. Cameco will prepare the detailed design of the tailings storage facilities in and other infrastructure in accordance with current Department of Mines and Petroleum (DMP) Guidelines. However, it should be noted that the Project is located in a part of Western Australia that experiences low seismic activity.
12.	CCWA	There is no Transport Management Plan provided, so there is scant detail on how Cameco will, seek to identify and manage the risks. For example: • What security measures will be in place? • What emergency response is available on the transport route? • How prepared and willing are emergency response units along the transport route to respond to an accident. • What are the high-risk parts of the route? • What communities are along any future transport route? • What are the most common causes of accident in trucks travelling long distances? In the PER Cameco state: *"Cameco has established a successful outreach program for first responders whereby representatives from Cameco conduct awareness sessions at strategic locations."* There is no further detail on how this has been advanced along the extensive transport route from Yeelirrie to Port Adelaide. There is no discussion on who the 'first responders' are likely to be, whether they are paid or volunteer services. Cameco has demonstrated that they have offered training but fail to describe in which way it was successful or any demonstration of the success of the training.	Detail of Cameco's Corporate Transport Standards, Emergency Preparedness and Response Program and Emergency Response Assistance Plan are provided in Section 2.4.5 of the PER. The communities present along the proposed transport route are shown in Figure 5-2 of the PER. Prior to commencement of operations Cameco will be required to develop a Radiation Protection Programme which outlines a Transport Management Plan and a Source Security Transport Plan for approval by the regulators, under the State Radiation Safety (Transport of Radioactive Substances) Regulations 2002. These documents will address the risks of transporting UOC from Yeelirrie to Port Adelaide. First responders are defined as Emergency Services personnel (Police, Fire, Ambulance and State Emergency Services) and will include paid and volunteer personnel. Cameco will provide the necessary training to respond to an incident relating to transport of UOC prior to commencement of transport of product. Cameco Australia will use the experience developed in Canada over 30 years of transport operations to develop and implement an effective Transport Management Plan tailored to local conditions with advice from State and Goldfields Emergency Management Committees. Cameco and the WA uranium industry group has previously met with the State Emergency Management Committee and will continue to engage and seek input to transport plans as the Project proceeds. **Radiological Risk to Human Health from Transport Operations** <u>Impact from Normal Operations</u> Uranium Ore Concentrate is classified as a low level radioactive product. Under normal operations the risk to human health from the transport of uranium ore concentrate is considered to be low to negligible (Section 9.6.5.1 pg 308 and Section 9.6.5.2 pg 316 of the PER). The possible worst case radiation dose to a member of the public can be considered by comparison to the dose received to the transport driver. Dose rates in the cabins of trucks carrying UOC have been measured to be approximately 0.15 µSv/hr. A typical trip could take up to 40 hours resulting in a maximum dose of 6 µSv per trip.

No.	Submitter	Submission and/or issue	Response
		The public submitter would expect that any future Transport Management Plan would be made available for public scrutiny and comment.	Doses to the general public would be less than this and a number of situations can be considered. Firstly, for a person standing by the side of the road 5 m from the vehicle, every time a shipment passes. It is estimated that 100 shipments will be made per year, and conservatively assuming that each truck takes 30 seconds to pass, the total exposure time will be less than an hour over the year, and so the total dose will be less than 1 µSv/yr. Secondly, for a person in a car held up by traffic for an hour, 5 m behind a truck. Again the occupants would receive a dose less than 1 µSv. These are very small doses, around half of the typical daily dose from the natural gamma background and present negligible risk. In the Case of an Incident UOC is non-flammable, not explosive, insoluble and non-reactive in water. In the case of a severe accident, which resulted in the rupture of both the shipping container and the drums of product leading to product spilling onto the ground, the risk to the public would be managed by firstly establishing a cordon to provide some separation between the spilt material and the public. This would limit any dose by gamma radiation. The next step is to contain the spill by bunding it or covering it with a tarpaulin to ensure there is no dust so as to limit the contamination pathways of ingestion and inhalation. Standard PPE including a Tyvek coverall suit, respiratory protection and gloves can minimise the risk to first responders while they conduct clean up activities. While such an accident is unlikely, in the event of an incident, it is unlikely that significant doses would arise. Gamma doses are low and inhalation and ingestion are minimised by the correct use of PPE and present limited risk to the general public. UOC is a heavy powder which does not readily become airborne. As the material has a low level of radioactivity and the duration of any such exposure would be relatively short, the risk of a person receiving any significant dose is very small. Because of the radioactive property of uranium, any spilt product can be easily detected with a hand held meter, ensuring that total recovery can be readily achieved. In summary, the risk of significant exposure arising from an incident for both first responders and the general public is low.
13.	CCWA	The public submitter is of the view that Cameco has clearly stated that the uranium price does not warrant further development of new uranium mines. The long-term viability of new uranium projects is overstated and misleading. The following Section separates the reality from the rhetoric about the uranium industry. From the mid-2000s until the Fukushima disaster in 2011, expectations of a significant global expansion of nuclear power drove a sharp increase in uranium exploration, the start-up of numerous mines, and a uranium price bubble. However nuclear power has maintained its long-standing pattern of stagnation. Some uranium mines have shut down, some are operating at a loss. Uranium exploration has sharply declined. The uranium	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco's current position on the outlook of the uranium market is presented on our website: https://www.cameco.com/invest/markets

No.	Submitter	Submission and/or issue	Response
		price is lower than the average cost of production - and well below the level that would entice mining companies to invest capital in new projects. The public submitter has provided the following quotes: Energy consultants Julian Steyn and Thomas Meade wrote in *Nuclear Engineering International* in October 2014: *"The uranium market is characterised by oversupply, which is forecast to continue through most of the current decade. The oversupply situation has been exacerbated by the greater-than-initially-expected decline in demand following Fukushima as well as the increase in primary supply during the same period. Existing production capacity and output from mines under development could cause total supply to exceed demand through the year 2020.* Likewise, investment strategist Christopher Ecclestone from Hallgarten & Company wrote in November 2014: *"There has indeed been a nuclear winter verging on an Ice Age over the last few years with bad news heaped upon bad news within the context of a pretty dismal financing situation for mining all around. ... The yellow mineral had made fools and liars of many in recent years, including ourselves.* Likewise, RBC Capital Markets analysts said in June 2014 that worldwide supply currently exceeds demand, and that it does not expect the uranium industry's situation to improve until at least 2021 because of accumulated inventories. China, Japan and some other countries have amassed large stockpiles of uranium - industry analyst David Sadowski said in March 2014 that *"many utilities are sitting on near-record piles* "of uranium. China is the only country where significant nuclear growth can be anticipated in the coming 10-20 years. However, according to investment bank Macquarie, there are *"serious question marks"* about China's uranium requirements.17 Macquarie believes that China has enough uranium stockpiled to meet demand for about seven years at forecast 2020 consumption rates - which is around three times greater than the current consumption rate. Japan is estimated to have stockpiles of around 100 million pounds of uranium oxide. To put that in perspective, world uranium requirements for power reactors amounted to around	

No.	Submitter	Submission and/or issue	Response
		171 million pounds in 2014. It will likely take a decade - perhaps longer - before Japan's stockpile is consumed given the protracted nature of the reactor restart process in the aftermath of the Fukushima disaster. Even if all of Japan's 43 'operable' reactors were operating, it would take around five years to consume 100 million pounds of uranium oxide. Steve Kidd, an independent consultant and economist who worked for the World Nuclear Association for 17 years, wrote in *Nuclear Engineering International Magazine* in May 2014 that *"the case made by the uranium bulls is in reality full of holes"* and he predicts *"a long period of relatively low prices, in which uranium producers will find it hard to make a living"* Kidd states that most nuclear power growth to 2030 will be concentrated in China and Russia. But *"uranium demand will almost certainly fall in the key markets in Western Europe and North America",* he states, and in Japan it will take a *"long time to unwind the inventory accumulation".* Only low-cost uranium mining operations will prosper while others *"will struggle to stay in business and further mine closures ...are definitely on the horizon.* Kidd argues that a new era has emerged, where the uranium market is split into three: • China will favour investing directly in mines to satisfy its requirements - China is not going to 'play ball' with the established uranium market. • Russia will continue to be a significant nuclear fuel exporter but its own market will remain essentially closed to outsiders. Russia still has secondary supplies to tap into (plenty of surplus highly-enriched uranium remains to be down-blended) and will follow the Chinese and invest directly in uranium assets if their own domestic production remains constrained. • The established uranium producers will have the remainder of the market to satisfy and that will likely be declining in magnitude. In the US, the number of operating reactors will fall by 2030 and the overall European situation will be one of "gentle decline". Kidd pulls the threads of his argument together: *"This market segmentation and the way the Chinese and Russians will operate means that the two prime analytical devices utilised in the uranium market are both now useless. First, calculated annual world supply-demand balances (miraculously often showing a shortage after 3-5 years) are*	

No.	Submitter	Submission and/or issue	Response
		irrelevant in a segmented market, where key actors with expanding demand choose to go it alone. *For a time in the early 2000s, it looked as if a globalised world nuclear fuel market could emerge, but this has not happened and it is arguably now going into reverse. Secondly, uranium supply curves (based on mine cost data), demonstrating the need for higher prices as demand expands, are also invalidated. China and Russia (and probably India too, if it eventually gets its nuclear act together) will develop uranium assets wherever it best suits them. They have the confidence to bypass the conventional market, which could increasingly become merely a sideshow."* Kidd concludes: *"In this fifth age of uranium, prices will essentially be determined by the cash costs of production of operating mines (and not by the full costs of future mines). This means a reversion to the long period of low (but relatively stable) uranium prices of the late 1980s and 1990s (the third age), but at a higher level to reflect the greater level of production now, the escalation of mining costs and the movements in currency exchange rates. The shortages predicted by many analysts (leading to rapid price increases to provide good rates of return on their favourite projects) are purely a mirage.* ***The outlook is therefore not favourable for either current or prospective uranium producers. Only those with low-cost operations will prosper. Others will struggle to stay in business and further mine closures... are definitely on the horizon."*** With stagnant demand and large stockpiles, uranium miners have been left clutching at straws. Some hoped that supply from Russia might be curbed in response to Western sanctions, thus breathing some life into the uranium industry elsewhere - but that has not eventuated. Some hoped that dwindling secondary supply sources - in particular, the end of the US-Russia Megatons to Megawatts uranium down blending program - would breathe life into the uranium industry. But the end of the Megatons to Megawatts program has had little or no impact. Raymond James analyst David Sadowski noted in August 2014 *"The end of the Megatons to Megawatts high-enriched uranium (HEU) deal was long anticipated to usher in a new period of higher uranium prices. But the same plants that were used to down-blend those*	

No.	Submitter	Submission and/or issue	Response
		warheads can now be used for underfeeding and tails re-enrichment. In this way, the Russian HEU derived source of supply that provided about 24 million pounds (24 Mlb) to the market did not disappear completely; the supply level was just cut roughly in half." And if there was a shortfall, surplus weapons material is just one of the secondary sources that can reduce demand for primary mine production. Other secondary sources are underfeeding at enrichment plants (getting more uranium-235 from a given volume of uranium ore), re-enrichment of tails material, government and commercial inventories and uranium recycled from reprocessing plants. Steve Kidd argues that the replacement of inefficient gaseous diffusion enrichment plants with centrifuge enrichment plants is a "crucial" factor: *"Another crucial factor has been a fundamental realignment in the relationship between uranium and enrichment requirements. The closure of the inefficient gaseous diffusion enrichment plants removed the high marginal cost production which had propped up prices, while notably higher uranium prices in themselves encouraged the use of higher enrichment (through reducing the optimum "tails assay"). Enrichment is now expected to remain cheap and abundant as centrifuge plants are modular and capacity can be expanded relatively easily to meet demand, so this substitution of enrichment for uranium will continue to be important."* Huge stockpiles of depleted uranium represent *"an attractive resource while there is overcapacity in enrichment and cheaper prices",* Kidd states. Indeed some of the same enrichment plants that were used for the Megatons to Megawatts program are now being used for underfeeding and tails re-enrichment as David Sadowski noted in August 2014: *"The end of the Megatons to Megawatts high-enriched uranium (HEU) deal was long anticipated to usher in a new period of higher uranium prices. But the same plants that were used to down-blend those warheads can now be used for underfeeding and tails re-enrichment. In this way, the Russian HEU derived source of supply that provided about 24 million pounds to the market did not disappear completely; the supply level was just cut roughly in half."*	

No.	Submitter	Submission and/or issue	Response
		Just as the end of the Megatons to Megawatts program failed to boost uranium prices, so too the restart of reactors in Japan (the first restart was in August 2015) has done very little or nothing to boost prices.	
14.	CCWA	The public submitter has identified that Cameco has increased the mining rate and reduced the life of the mine for this Project. The mining rate has changed from 1.2Mtpa over 30 years to 2.4Mtpa over 17 years. The higher production rate will result in higher water demand, more ore produced and increased rates of transportation. These levels will exceed the limits of the key characteristics proposed in the BHPB Scoping document. In Section 5.2 "Evaluation of Project Alternatives" Cameco outline some of their mining specifications, but do not compare the proposed mining impacts of the BHP Billiton proposal. The increase in mining rate is likely to have an increase in impacts on water demand, water drawdown, long term impacts to groundwater, downstream impacts, groundwater dependant ecosystems, dust deposition on flora, dust pollution, risk of health and safety issues of dust, radon build up, dust pollution from stockpiles and the open pit. Cameo has relied on information and studies that were done for the BHP proposal in some instances. Some of this cannot and should not be used for a scaled up Project, for example the studies for ore stockpiles were done for smaller stockpiles over a longer period of time, whereas Cameco's stockpiles are larger for a shorter period of time. The economic drivers of this proposal are weak and this leads to further concerns about whether this Project could be vulnerable to premature closure or extended care and maintenance. The public submitter urges the EPA to consider the risks associated with the increased mining rate and recommend the proponent consider alternatives.	Cameco acknowledges that the Project is different from the former BHP Billiton project with an increased production rate and higher water demand resulting in a shorter project life. An amended project description reflecting the changes was submitted to the EPA and the EPA prepared the ESD. The PER has assessed the impacts of mining at the higher rate. Following acquisition of the Project, Cameco reviewed the technical studies undertaken by BHP Billiton before deciding that the proposed mining rate of 1.2Mta was both technically inefficient and financially unviable and 2.4Mta was determined to be the most effective and efficient rate of mining and processing. The EIA process involves assessment of Cameco's proposal and not the BHP Billiton proposal. The PER addresses the environmental impacts of the Cameco proposal (i.e. the Project). Where used, the BHP Billiton studies provide background or baseline data as distinct from an assessment of the Project. Cameco reviewed the studies undertaken by BHP Billiton and determined if they were relevant to Cameco's proposed Project. Where these studies were not relevant, or where there are gaps in information, Cameco commissioned a range of studies to confirm technical aspects and environmental impacts of the higher rate of mining. These included: • PFS level studies for mining and milling, including tailings management; • Groundwater modelling studies, to confirm the availability of water to meet the increased demand and the impact of the increased rate of abstraction on the environment water drawdown, including, long term impacts to groundwater, downstream impacts, groundwater dependant ecosystems; and • New air quality and radiation modelling, to provide advice on dust deposition, risk of health and safety issues of dust, radon build up, dust pollution from stockpiles. Biological studies completed by BHP Billiton were reviewed and in most instances additional field work was undertaken to verify or extend the results of the work completed. Cameco's proposed Project is being assessed against rigorous regulator guidelines at the increased production rate and higher water demand, as discussed in the PER.
15.	CCWA	The public submitter considers that the Yeelirrie State Agreement Act (the Act) is outdated and should be repealed as the Agreement fails to comply with contemporary policy and regulations.	Comment noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed. Also see the response provided to Comment No. 8 regarding ports for export of UOC.

No.	Submitter	Submission and/or issue	Response
		The Act continually refers to 'plans' that are not attached to the Act and do not correspond with current plans - making much of the Act incomprehensible. The Act provides commitments from the State government on infrastructure that may not be a current priority for public spending or need not serve the public interest. Other Sections giving exemptions on labour conditions, royalties and more are simply outdated. For example: Section 18. (5) (d) claims that *"The State shall construct or cause to be constructed new public roads suitable for the Corporation's operations here under in accordance with the requirements of the Commissioner of Main Roads..."*Public spending on infrastructure for a short-term mine with no immediate prospects and questionable long term prospects would be an unjustified use of public funds. Section 19. Suggests it may be possible to ship uranium out of Geraldton, Esperance or Fremantle. None of these ports are licensed to export uranium and both the WA Liberal and Labor parties have defended the view that uranium will not be shipped out of a WA port. Section 20 (2) (1) (c) requires that the Corporation abide by requirements of the State Energy Commission. The Act dedicates two pages to outlining the relationship that the Corporation should have with the State Energy Commission, which no longer exists. The State Energy Commission was delisted in 1995 - 20 years ago. The public submitter considers that the Yeelirrie Agreement should similarly be revoked as no longer relevant. Section 21. (3) claims that *'The State shall ensure that during the currency of this Agreement and subject to compliance with its obligations here under the* ***Corporation shall not be required to comply with the labour conditions*** *imposed by or under the Mining Act in regard to the Mineral lease."* This is reiterated in Section 21. (7) (a) which says *'The State shall ensure that subject to compliance with its obligations under this Agreement the Corporation shall not be required to copy with the labour conditions imposed by the Mining Act."* It is absurd that the proponent promotes this mine as important for job creation while benefiting from exemptions to labour conditions. It raises serious concerns to the health and safety	The *Environmental Protection Act 1986* (under which this environmental impact assessment is being carried out) prevails over any inconsistency with the Yeelirrie State Agreement: s. 5 of the *Environmental Protection Act 1986* and cl. 41 of Schedule 1 to the Yeelirrie State Agreement. The proposal does not include export through WA ports. The Yeelirrie mining tenements, although granted under the Yeelirrie State Agreement are generally subject to the terms of the *Mining Act 197*8. Accordingly, Cameco will need to comply with closure obligations under the Mining Act and associated current best practice regulatory standards.

No.	Submitter	Submission and/or issue	Response
		of workers and the commitment from both the company and the Government about safety and radiation protection along with the ability for workers to pursue compensation if they develop work related illnesses. This aspect of the Act further significantly undermines the projects justification and the social value and license. Section 21 (6) states: *"Notwithstanding the provision of this Clause the Corporation may with the consent of the Minister for Mines from time to time (with abatement of future rent in respect to the area surrendered but without any abatement of the rent already paid or any rent which has become due and has been paid in advance) surrender to the State all or any portion or portions (of reasonable size and shape) of the mineral lease."* This Section raises the very real concern that the company may be able to relinquish parts of the site without rehabilitation. The significant changes to legislation of requirements for mine closure are rehabilitation are also not reflected in the Act. Section 22 (1) refers to peppercorn leases - and other nominal fees for occupancy rights that are well below current property values and are out dated and should not be accepted. Section 25 (1) requires royalties at the rate of 3.5% of the f.o.b. value gross sales price for uranium oxide produced from the mineral lease (whether sold as such or converted outside Australia to uranium hexafluoride). This is much less than the 5% required under contemporary laws. The Yeelirrie State Agreement Act should be repealed. This would show a significant commitment from the government and proponent that should this mine be approved it would be expected to operate consistent with contemporary community expectations and legal and regulatory frameworks. The public submitter urges the EPA to support the rescission or, at minimum, review of the Yeelirrie State Agreement as it is not consistent with current best industry or regulatory standards and practice. The Agreement is also inconsistent with existing state government commitments, policies and community expectations.	
16.	CCWA; PS151;	The public submitter is very concerned about the deferral of management plans. Such an approach is neither credible nor transparent.	In the PER, Cameco has presented the results of detailed impact assessment studies and has discussed a framework for the management of each impact. The ESD required Cameco to prepare a Conservation Species Management Plan (Appendix E3 of PER) and a Mine Closure and Rehabilitation Plan (Appendix O1 of the PER) for the Project. Cameco

No.	Submitter	Submission and/or issue	Response
	Proforma 2	This is a poor process as it excludes the public from reviewing and having input into the management plans. The PER process is the only opportunity for the public to make comments on the plans. This means the public are effectively excluded from the process or reviewing and commenting on management plans. This process undermines the value of the community input into a number of specific areas where there is a high level of community interest and potential risk to the community. If the EPA recommends approval of the mine without management plans, which provide the information and evidence of how the company intends to manage the risks, they will be doing so without evidence. Decisions of this magnitude should not be based on faith, but good science. This aspect of the assessment process does not comply with the precautionary principle or transparent and inclusive practise. This process created duplication. Agencies and ministers who review and approve these documents then have to review and assess management plans at a later date. It creates uncertainty for the public about which agency has responsibilities to regulate or powers to enforce. The EPAs approval of a PER with only draft management plans or no management plans raises questions about the enforceability and legal standing of any future conditions or ambient conditions on those management plans by the EPA. The general pattern in this PER is to identify a problem, downplay the risk and assert that a future Management Plan will be sufficient to manage the risk. The public submitter does not consider this to be an effective way to consult with the public nor do we consider this to be a sufficient level of information for which the EPA can draw on to make a recommendation to the Minister on the merits of the proposal. The public submitter is unclear on how this PER is compliant with expectations under the EPBC Bilateral Agreement with the Commonwealth in this regard. We understand that the EPA PER process has been accredited by the Commonwealth which then allows for the Bilateral assessment to occur. However the lack of detail on the planned activity, risks and mitigating strategies across the board raises serious doubt whether this PER process is	anticipates that additional approved Management Plans will be required prior to the commencement of the Project at which time the Project design would be more fully developed, which will result in more detailed Plans being prepared. Cameco expects that these detailed Plans will need to be reviewed and approved by the appropriate agency and commits to working with the relevant agency/agencies to finalise the Plans. Cameco also expects that the requirement for the development and implementation of Management Plans will be established by a licence condition and would therefore be both binding and auditable. The EPA's prior assessment of Toro Energy Ltd.'s Wiluna project and Cameco's Kintyre project identified where the EPA's environmental objectives are met through the existing regulatory frameworks by relevant agencies. Where environmental management plans are required by conditions of environmental authorisations, both the *Environmental Protection Act 1986* and the *Environment Protection and Biodiversity Conservation Act 1999* provide power to impose such conditions. Such environmental management plans will be prepared in accordance with Environmental Assessment Guidelines 11 and 17. Further, the PER provides the environmental objectives and management outcomes that will be achieved by such environmental management plans, thereby enabling the EPA to properly assess the Project under Part IV of the Environmental Protection Act.

No.	Submitter	Submission and/or issue	Response
		complaint with expectations under the EPBC Bilateral Agreement. The following is a list of management plans that have not yet been developed in relation to Cameco's proposal: • Groundwater Management Plan • Subterranean Fauna Management Plan • Flora Management Plan • Conservation Species Management Plan • Fauna Management Plan • Surface Water Management Plan • Dust Management Plan • Mine Closure Management Plan • Greenhouse Gas and Energy Management Plan • Cultural Heritage Management Plan • Fire Prevention and Management Plan • Radiation Management Plan • Transport Radiation Management Plan The public submitter urges the EPA recommend conditions for the management plans that have not been included in the PER, these could include: 1. That all future Management Plans be reviewed by the EPA. 2. That all Management Plans be open for public comment before any Government Department or Ministerial approval. 3. That any approved management plans must be complied with by the proponent and failure to comply with approved management plans be subject to penalties to the company and individuals within the company responsible for causing non-compliance. 4. That any conditions to the management plans must be adhered to.	
17.	CCWA	The public submitter notes that the EPA has previously expressed concerns about the cumulative environmental impacts of projects. The EPA stated that *"the key challenges we face is the need for focus on the cumulative impacts of human activities - a holistic, regional approach to address what could otherwise result in an environmental 'death by a thousand cuts"* Other regions are already experiencing the impacts of gold, nickel and lead mining and agriculture. With huge demands for water and only small rates of recharge, with impacts on salinity,	Regional and cumulative impacts of the Project in the Northern Goldfields is addressed in Section 9.13 of the PER. This includes consideration of the Toro Energy Wiluna Uranium Project. Other uranium projects are considered too distant from the Yeelirrie Project to have cumulative or regional impacts. The impacts of the Yeelirrie Project have been considered in conjunction with the assessed impacts of projects that are either: • In close proximity (e.g. Mount Keith); • Located in similar land systems or may impact on similar Land Systems (e.g. The Lake Way Project); or • Have similar Project aspect (e.g. Transport).

No.	Submitter	Submission and/or issue	Response
		erosion, land clearing and of course the radiological impact of uranium mining this Project would exacerbate the situation the EPA warned against. The public submitter urges the EPA and the proponent to consider this Project in conjunction with existing proposals and conditional approvals for uranium mines in the area - including Toro Energy's Wiluna Project and new proposals for the Wiluna extension. The proposed mine pits at Yeelirrie, Lake Way, Centipede, Millipede and Lake Maitland all occur in the Lake Miranda basin and are upstream from Lake Miranda. There is no identifiable discussion on the individual or cumulative impacts on Lake Miranda from any of the uranium proposals in the region. While there is a clear impact on the areas with proposed mines it is vital that the EPA consider downstream impacts - including on Lake Miranda. The public submitter also urges the EPA to consider the proponent's business model of 'expansion where possible' - as noted in the PER. Cameco outline a staged approach to mining and expansion at Rabbit Lake one of their many troubled mines in Canada. They state: *"the mine life at Eagle Point has been continuously extended through discovery of new underground ore zones."* This is a business model many mining companies adopt. This is the business model Toro Energy has already tried to implement by acquiring additional deposits in the region - like Dawson Hinkler, Firestrike, Nowthanna etc. It is a model that offers increased flexibility to the proponent at the clear expense of environmental, social and procedural certainty. Mine expansions bring extended impacts for extended periods of time; for example ongoing water extraction further depletes aquifers creating larger zones of water drawdown, increased seepage of tailings, ongoing land clearing etc. While there are constraints on the EPA's ability to predict these future expansion proposals the EPA does have the ability to apply conditions	The summary of the results are presented in Table 9-87 of the PER. The submitter's assertion that the proposed mine pits at Yeelirrie, Lake Way, Centipede, Millipede and Lake Maitland all occur in the Lake Miranda basin and are upstream from Lake Miranda is incorrect. Lake Way, Centipede, Millipede and Lake Maitland deposits do not occur in the Lake Miranda basin and are not upstream from Lake Miranda. These deposits occur within the Lake Way and Lake Carey catchments and therefore do not share surface or groundwater hydrology with the Yeelirrie Project. Cameco has considered the cumulative impact on matters including groundwater, surface hydrology, land systems and transport and has concluded the cumulative impact is low.
18.	CCWA	The public submitter urges the EPA to apply the precautionary principle and protect against the unacceptable risks presented by this proposal and recommend that this proposal not proceed and that any and all future uranium applications be subject to	The Precautionary Principle is addressed in Table 12-2 of the PER. Impacts and management of the following environmental factors listed in the submission are outlined in the PER as follows:

No.	Submitter	Submission and/or issue	Response
		assessment via Public Inquiry, as provided for in Section 40 (2) (a) of the EP Act 1986. The public submitter is of the view that should the EPA choose to recommend approval of this detail deficient application they should require the following conditions of the proponent: • Provide an unconditional performance bond that is equal to 100% of the expected mine closure and rehabilitation costs and that the adequacy of this amount be annually reviewed. • That all the pending management plans be made available for public comment as part of the assessment process before any approval by relevant Government agencies. • Provide alternative options with detailed analysis of environmental impacts for different scenarios of the rate of mining, including reducing the rate from 3 Mtpa to 1.5 or 2 Mtpa. • Install dust-monitoring stations at Noibla Homestead on Youno Downs Station and at the Youno Downs Homestead. • Ensure there is no offsite dust pollution and make any failure to realise this subject to penalty. • Install additional real time radon gas monitoring stations in multiple locations onsite, including around the ore stockpiles. • Ensure that the sourcing of water for the Project will have no impact on the quality or capacity of neighbouring stations access to water. • Provide analysis on the cumulative impacts from existing mining in the region, including focused analysis on the cumulative downstream impacts of mining operations on Lake Miranda.	• Closure and Rehabilitation (Section 9.12; Appendix O); • Dust (Section 9.8; Appendix L1); • Radiation / Radon (Section 9.6; Appendices J1 & J2); • Source water (Section 9.5; Appendix I1); and • Cumulative impacts (Section 9.13). Cameco will comply with Government policy on environmental performance bonds. Should the Project be approved, Cameco will comply with the requirements of the Ministerial approval in relation to the development and review of Management Plans. Cameco is seeking approval to mine Yeelirrie at a rate of 2.4Mta and the impact assessment presented in the PER was undertaken based on that rate. There is no benefit from undertaking an assessment of the environmental impacts on a higher or lower rate of mining. Cameco has completed air quality modelling which shows predicted Project related dust levels at No-Ibla and Youno Downs Homesteads to be very low and present no impact at these locations. The results of the additional modelling are included in Attachment 6. The proposed occupational and environmental radiation monitoring programs set out in Tables 9-61 and 9-63 describe the use of real time monitors for radon gas. As stated, monitoring will be conducted to fulfil two aims, to provide data to assess the doses received by workers; and to determine the effectiveness of radiation protection controls. To achieve these aims, radon monitors will be used across the site to establish levels and to determine areas of potential risk and will continue to be used where there is a potential risk to workers. The current groundwater modelling for the conceptual borefield, as presented on Figure 9-41 of the PER, shows no impact on Youno Downs. As presented in Attachment 5 the modelled 0.5m drawdown is outside of Youno Downs boundary. Should the final borefield be different from the conceptual model presented and should Cameco wish to obtain permission to explore for water on Youno Downs, Cameco would consult with the owners of that lease over access. If the Project operations were determined to have an impact on Youno Downs water supply, which based on the modelling is considered highly unlikely, then Cameco would undertake necessary works in order to protect and secure the Youno Downs supply.
19.	PND(WA)	Yeelirrie is one of a large number of potential uranium mines around the Goldfields. What of the cumulative impacts should one more go ahead?	Cumulative impacts are presented in Section 9.13 of the PER. Cameco believes that the cumulative impacts of the proposed uranium mines in the Goldfield region have been adequately discussed and that the combined impact is minor. The consideration of potential future uranium mines (i.e. for which there has been no referral under s. 38 of the *Environmental Protection Act 1986* (WA) are beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA).
20.	R Chapple; PS5; PS7; PS8; PS9; PS11;	Cameco state that it will provide management plans once the proposal is approved. This is unacceptable and should be included in the PER. Therefore, the EPA must reject the PER of at the very least insist Cameco provide management plans before any proposal is considered.	Detailed environmental studies of the Project area have been undertaken by Cameco and the previous proponents as outlined in Section 9 and the relevant appendices of the PER. See also the response provided to Comment No. 16. Those studies enable the Environmental Protection Authority to undertake an assessment in accordance with the legislative requirements of s. 44 of the Environmental Protection Act.

No.	Submitter	Submission and/or issue	Response
	PS12; PS13; PS14; PS15; PS17; PS18; PS21; PS24; PS25; PS27; PS28; PS29; PS31; PS35; PS37; PS38; PS39; PS42; PS45; PS47; PS48	The PER is inadequate. Not acceptable for Cameco to do the environmental studies after the approval.	Consistent with Environmental Assessment Guideline 17, management plans required as conditions of a Ministerial Statement may involve baseline and ongoing compliance monitoring.
21.	R Chapple	Cumulative impacts for several uranium projects in the Northern Goldfields has not been addressed.	Cumulative impacts are presented in Section 9.13 of the PER. Cameco believes that the cumulative impacts of the proposed uranium mines in the Goldfield region have been adequately discussed and that the combined impact is minor.
22.	PS35	No detail is provided as to how environmental monitoring will be implemented and whether it will be done by an independent entity. Concerns that monitoring will be reduced due to uranium mines only marginally being cost effective.	Should the Project be approved, environmental monitoring requirements of the Project will be prescribed in the Ministerial Conditions and the operating licence for the Project, issued under the EP Act. Proponents are required to submit an Annual Audit and Compliance Report (AACR) for licences issued under Part V of the EP Act. (Department of Environment Regulation, 2015; Annual Audit Compliance Reports: Guidelines for licences granted under Part V of the *Environmental Protection Act 1986*. Version: Draft released for consultation October 2015).
23.	PS151	The submitters asked Cameco where they would be fencing, however this could not be answered. This information should be provided as there are concerns with wildlife and cattle accessing areas that may be contaminated. Cattle being able to access these areas is of a concern as the Meat and Livestock Association is less likely to accept cattle in these circumstances and therefore affecting the livelihood of the pastoralists.	The Project is within the boundaries of Yeelirrie Station which is owned by Cameco. Yeelirrie Station has been destocked. Operational areas of the minesite will be fenced to exclude stray livestock and wildlife, however neighbouring pastoralists also have a responsibility to maintain their boundary fences to ensure their livestock do not stray onto neighbouring stations. As presented in Attachment 5, Yeelirrie and Youno Downs do not share a boundary; the Youno Downs boundary is 6 km from Yeelirrie's north western boundary. Cameco is of the view that the proximity of the Project would have no impact on the marketability of cattle in the area and that the 'no impact' case could easily be demonstrated using ERICA style modelling or similar. A summary of the issues and the impact of the project on cattle is presented in Attachment 11.

No.	Submitter	Submission and/or issue	Response
24.	PS151	The submitters understand that miners should not have an impact on the pastoral people (no social disruption). The submitter considers that there is no way Cameco can operate without impacting on their livelihood and social standing.	The boundary of the Pastoral Lease owned by the submitter is located approximately 30 km to the west of the Project. The Youno Downs homestead is approximately 70 km west of the Project and based on the air quality, radiation and noise studies completed by Cameco indicate that there will be no direct impact from the Project. The Youno Downs homestead is located on the Yeelirrie – Meekatharra Rd, which is a gazetted public road. The Project will generate additional traffic along this road, however Cameco will work with contractors to minimise the use of the public road, in particular by heavy vehicles. Based on the conceptual groundwater modelling presented in the PER, the nearest bore proposed by Cameco is approximately 5 km from the Youno Downs lease boundary. The modelled drawdown presented in Figure 9-41 and in Attachment 5 shows that the 0.5m drawdown is located 3 km outside of the Youno Downs boundary. On this basis, the Project as presented will have little to no impact on groundwater within Youno Downs pastoral lease. As presented in Attachment 6, Cameco has recently undertaken an additional air quality assessment to determine the dust impacts of the Project on both the Youno Downs and No-Ibla homesteads. Cameco is also happy to work with the submitter to install dust and radiation monitors at an appropriate location, however based on the modelling there would be little scientific value in the data. It should be noted that Cameco have already installed some long-term baseline radiation monitoring sites as outlined Section 9.6.6 and on Figure 9-58 of the PER.

2. Subterranean Fauna

No.	Submitter	Submission and/or issue	Response
1.	P&W	There could be more taxa present at Yeelirrie and at risk from the proposal as species accumulation curves did not appear to flatten off for Yeelirrie as a whole for both stygofauna and troglofauna, although the curves for the impact samples for stygofauna did.	There undoubtedly are more species in the wider Yeelirrie area than have currently been collected. It is almost impossible to collect all invertebrate species occurring within a large, species-rich area without a very intense sampling program across the whole area. However, and importantly for the assessment, the intensive sampling within the area of proposed groundwater drawdown appears to have recorded most of the stygofauna species occurring within this impact area. In total 25 stygofauna species were collected from the area of drawdown (including species caught by accident during troglofauna sampling) whereas when richness estimator algorithms were applied to the dedicated stygofauna sampling results from the same area only 23 species were expected to occur. The slightly different habitats accessed during the troglofauna sampling yielded a few extra species so that more species were collected than predicted to occur but the overall picture is of high sampling adequacy. The level of completeness of troglofauna sampling in the mine pit is difficult to gauge because idiosyncrasies in the pattern of troglofauna results led to the estimated number of species varying by a factor of 2. As is the case in many assessments of impacts on subterranean fauna, it is accepted that the documentation of troglofauna in the mine pit is not complete. As detailed in Attachment 3, Cameco propose additional avoidance, minimisation and mitigation measures for troglofauna, including the establishment of a Troglofauna Protection Area and additional habitat mapping.
2.	P&W	In considering a refinement of the Priority Ecological Community (PEC) boundary for Yeelirrie, based on the results	Cameco has followed the advice of the DPaW and defined the PEC as an area within the north-west and central sectors. There is support from sampling results for the existence of the PEC in this location. The SIMPROF testing by

No.	Submitter	Submission and/or issue	Response
		of the PER investigations, the recommendations and observations of the specialist consultants are of high importance. On page 14 of Appendix F1 of the PER, Bennelongia states that "*…there appears to be a richer 'community' in the northwest and central calcrete sectors than in adjacent parts of the study area and this richer area may perhaps represent the Yeelirrie PEC, with the bores at Yeelirrie playa perhaps sampling the Albion Downs PEC*". Based on the information available, this finding is supported by Parks and Wildlife as it is consistent with the department's approach of using the richer concentrations of taxa and habitat to better define PECs. In this context, it appears likely that the PEC would be better defined as the northwest and central calcrete Sections and on this basis, assessment of the impact of the proposal based on a refined boundary of the PEC comprising the higher richness areas of the northwest and central sectors (with a small buffer) is requested.	Subterranean Ecology (2011) based on sampling results suggests that a single stygofauna community extends west from near the eastern end of the proposed mine pit to drill line P, although the body of saturated calcrete ends around drill line A. The cluster analysis by Subterranean Ecology (2011) suggests the stygofauna community in the vicinity of the proposed mine pit and immediately west to drill lines F and H differs somewhat from the community between drill lines G and P farther west but SIMPROF testing showed these differences are not significant. Given the overall picture based on sampling results and its high concordance with the currently understood extent of saturated calcrete, it is proposed that the PEC can be defined by the extent of saturated calcrete. Thus, the core habitat of the proposed Yeelirrie stygofauna PEC extends from just inside the eastern end of the proposed mine pit to the north-western extent of saturated calcrete 27.7 km away (Attachment 2 Figure 5). It is proposed that the buffer around the Yeelirrie PEC should be 2 km beyond the eastern and western extent of the saturated calcrete body within the PEC and 1 km north and south of the calcrete body (Attachment 2 Figure 5). It should be noted, however, that stygofauna occur in the Carey Palaeochannel to both the east and west of the Yeelirrie PEC, with the Albion Downs PEC to the east of the Yeelirrie PEC sharing some of the same species. Consequently, the stygofauna are expected to be collected throughout, and beyond, the buffer zone around the proposed Yeelirrie PEC, at least in an east-west direction along the palaeochannel. The proposed Yeelirrie PEC is intended to cover only the area containing a stygofauna community with high species richness and a species composition that is typical of the Yeelirrie area, rather than encompassing all occurrences of stygofauna in the Carey palaeochannel in the vicinity of Yeelirrie. The proposed PEC occupies an area of approximately 4184 ha. The area of the PEC to the west of the 0.5 m drawdown contour is 2407 ha. Thus, 58% of the area of the PEC will remain undisturbed (or minimally disturbed along the 0.5 m contour). Groundwater salinity within the proposed Yeelirrie PEC varies within a fine-scale heterogeneous mosaic but falls mostly within the range of 4,000-30,000 µS/cm. Thirty-five of the 55 stygofauna species recorded by Subterranean Ecology (2011) were collected from within the proposed Yeelirrie PEC, with the syncarid *Atopobathynella* sp. S5 found both east and west of the proposed PEC and so also considered to occur within it. Thus, 64% of the species collected along the Carey palaeodrainage within the vicinity of Yeelirrie are found within the proposed PEC. Up to 27 species have been recorded per bore within the PEC. Six of the 10 stygofauna species reported by Bennelongia (2015) as known only from the modelled area of groundwater drawdown are known only from the proposed PEC. Three species (*Kinnecaris lined*, *Atopobathynella* sp. 'lineK', Enchytraeidae sp. Y4) are known only from the drawdown south-east and outside of the PEC, while *Novanitocrella* 'araia' sp. n. is represented by the type subspecies in the PEC and the subspecies *Novanitocrella* 'araia linec' ssp. n. in the south-eastern drawdown outside the PEC. Since submission of the PER, the taxonomy of *Schizopera akation* has been revised (the species was split into three species by Karanovic et al. 2015). *Schizopera* 'krypta' is the species known from the PEC. A list of the stygofauna species known from proposed Yeelirrie PEC is given below in Table 2. As a result of these changes there are now 73 species of stygofauna known from the study area, of which 11 species are currently only known from the area of impact (see Attachment 3 for updated discussion on the Project impact). **Table 2**. Stygofauna species of the Yeelirrie PEC.

No.	Submitter	Submission and/or issue	Response
			Species known only from the PEC are described as core species, while those also known from a wider area are described as widespread. Species known only from the area of groundwater drawdown are highlighted in yellow.

Species	Distribution
Enchytraeidae sp. Y2	core
Enchytraeidae sp. Y3	core
Enchytraeidae sp. Y5	widespread
Enchytraeidae sp. Y6	core
Enchtraeidae sp. Y7	widespread
Naididae sp. S4	widespread
Naididae sp. S5	core
Phreodrillidae sp. S8	widespread
Candonopsis sp. n. Y1	core
Dussartcyclops 'dostoyevsky' sp. n.	widespread
Halicyclops cf. eberhardi sp. A	widespread
Halicyclops cf. eberhardi sp. B	core
Dussartstenocaris idioxenos	core
Kinnecaris linesae	widespread
Kinnecaris uranusi	widespread
Nitokra yeelirrie	widespread
Novanitocrella 'araia' sp. n.	core
Pseudectinosoma 'penticos' sp. C	core
Schizopera krypta	widespread
Schizopera akolos	core
Schizopera emphysema	core
Schizopera kronosi	widespread
Schizopera leptafurca	widespread
Schizopera uranusi	widespread
Schizopera sp. 7439	core
Atopobathynella sp. S4	Widespread*
Atopobathynella sp. S5	core
Atopobathynella sp. Y2	core
Atopobathynella sp. Y3	widespread
Bathynellidae sp. S2	widespread
nr Phreatochiltonia sp. n. S1	widespread

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<tr><th>No.</th><th>Submitter</th><th>Submission and/or issue</th><th>Response</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>Philosciidae sp. n. Y2</td><td>core</td></tr>
<tr><td>Limbodessus sp. S1</td><td>widespread</td></tr>
<tr><td>Limbodessus sp. n. 'yeelirriensis'</td><td>core</td></tr>
<tr><td>Paroster sp. n. 'angustus'</td><td>core</td></tr>
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</td></tr>
<tr><td>3.</td><td>P&W; R Chapple; S Ludlam; Proforma 2</td><td>There is the potential for direct, indirect and secondary impacts beyond those predicted in the PER and for these impacts to be significant for the PEC and component taxa. Noting the conservation values of the PEC, the full suite of potential impacts on the PEC and component taxa should be considered in the assessment. It may therefore be considered appropriate to engage a suitably qualified person to consider and provide supplementary advice on the risks affecting protection of the affected subterranean conservation values and their habitat for consideration by the proponent and the EPA.

The assessment in the PER does not appear to have fully considered the implications of changes to habitat in the short, medium or long term or from a combination of direct, indirect and secondary impacts. For example, the potential impact of replacing the calcrete with tailings (and any associated plumes) on the adjacent remaining community and component taxa or the potential impact of changing haloclines and chemoclines from groundwater abstraction and reinjection[1] are not discussed in the PER. It was anticipated that the PER would bring together the different sources of information to provide a fully considered assessment of the short, medium or long term impacts of the proposal from a combination of direct, indirect and secondary impacts.

Cameco has not identified the impacts of its proposal on subterranean fauna, such as habitat loss and degradation, ongoing mortality, species interactions, changes in hydrology, disturbance and bioaccumulation. This information should be provided.

The proponent has not provided any detail about the percentage of the habitat that supports the 15 species that will be lost. There is no evidence of a strategy to protect or relocate</td><td>Information regarding groundwater quality impacts was presented in Section 9.5.5.3 of the PER.

The contaminant plumes associated with the tailings storage facility will have no significant effect on subterranean fauna. The contaminant with most capacity to travel is chloride (salinity) and, based on a realistic infiltration rate from the sealed TSF of 0.1% of annual rainfall, Cl concentration will be elevated beyond baseline for a distance of approximately 55 km east of the TSF. However, concentrations will be increased by <5 mg/L throughout this distance, which represent increases with no biological effect. Changes would need to be two orders of magnitude larger to potentially affect freshwater species and three orders of magnitude larger to affect species occurring in the salinities typical of baseline conditions downstream of Yeelirrie (Attachment 2 – Figure 6). An unrealistic infiltration rate of 2.5% of annual rainfall would be required to increase downstream salinity by three orders of magnitude.

The three heavy metals mostly likely to be contaminants (U, V, Mo) will travel only 10's of metres beyond the sealed TSF and will be contained within the area of groundwater drawdown (which has been treated as an area of potential species loss in the assessment). This applies under all recharge scenarios.

Cameco consider that all other potential deleterious effects on stygofauna will be also confined to the area of modelled groundwater drawdown.</td></tr>
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No.	Submitter	Submission and/or issue	Response
		those species. There is no indication that the habitat of those 15 species will be restored at any time.	
4.	P&W; Proforma 2	The complexity of the hydrological parameters and physical parameters (including the presence of the calcrete and orebody which are influencing water chemistry) is likely contributing to the high species richness of subterranean fauna at Yeelirrie. In addition, the habitat at Yeelirrie appears to be restricted and unique and is understood to have experienced a long period of geological stability. The proposed mining activities could significantly alter the habitat parameters that particular subterranean fauna taxa are adapted to, in the short, medium and long term. For example, changes to the habitat can be caused by a range of aspects including, but not limited to: • physical disruption of the habitat (e.g. removal of the core geological unit for the PEC, the calcrete, by mining; disruption by vibration; diminished habitat integrity); and • changes to habitat quality (e.g. changes to quantity or quality of groundwater including from mixing during drawdown / reinjection or from changed chemistry by replacing the calcrete with tailings; changes in microclimate parameters like humidity for troglofauna). Impacts to altered habitat parameters have not been quantified or addressed	A commitment to manage and monitor reinjection so that it does not have an impact on troglofauna species in presented in Attachment 3. Modelling shows that the impacts of reinjection are contained to well within the 0.5m drawdown and therefore the impacts of reinjection to stygofauna have been considered. The submitter should refer to the response to Comment 2 above for information regarding the Yeelirrie PEC. Cameco has provided a number of management measures and commitments for protecting the areas of the PEC that are not impacted in Attachment 3. The submitter should refer to the response to Comment 3 above for information regarding impacts from solute plumes.
5.	P&W	It appears that assumptions have been made within the PER that some taxa have wide salinity tolerances based mostly on one measurement of salinity in a bore (when it is acknowledged that vertical salinity can vary by a factor of 3) without much knowledge of the depth that each taxon was collected from. Please provide evidence to support these assumptions.	Assumptions about salinity tolerances are derived from the pattern of salinity tolerance exhibited by surface species of crustaceans. The assumptions are based particularly on the results of Pinder et al. (2005), whereby a likely range of salinity tolerance was inferred for species based on the salinity in which they were found and the likely wider tolerance of a species found at this salinity. The assumptions were made to assist in providing an assessment of the likely distribution of species for which there was very limited sampling data. It is acknowledged that the species may have been recorded from a different salinity than that measured (in the top 1 m) if there was a halocline and the species occurred towards the bottom of the bore.
6.	P&W; S Ludlam	The basis for the 0.5m threshold is somewhat unclear and may be arbitrary or a proposed experimental level, rather than being based on a thorough understanding of the impacts of various drawdown levels on salinity gradients in the affected aquifer/s, or ecological impacts.	The main considerations for determining the acceptable threshold drawdown levels were: - Long-term recession groundwater levels; - Saturated calcrete thickness; and - Ability to monitor and manage. Regional data shows large spatial variability of rainfall associated with the major events and that above a certain rainfall threshold, substantial water level responses occur. This was evident at Yeelirrie when a cyclonic event in early

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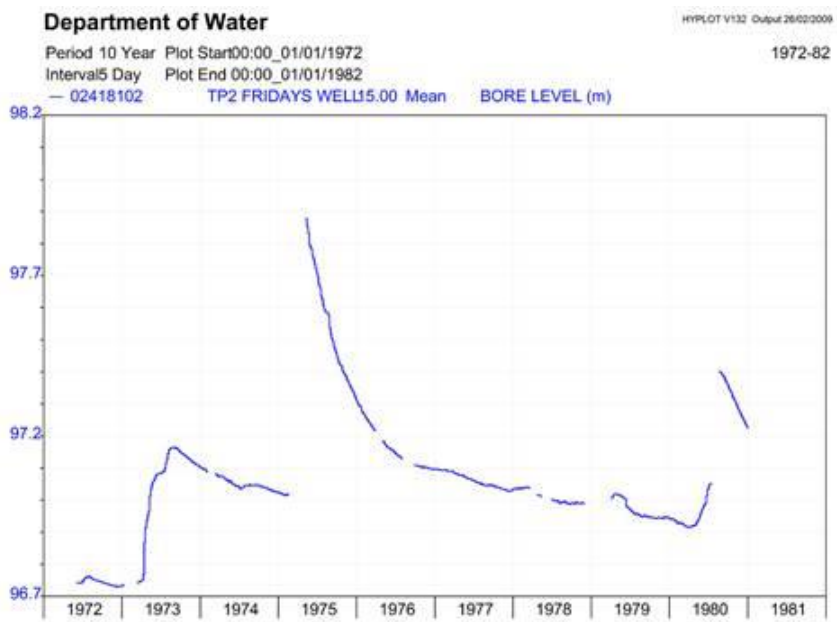
		The selection of this level of drawdown in determining risk and the potential for change in the haloclines / chemoclines affecting habitats critical to survival of stygofauna outside of direct impact zones needs to be better explained. The level of drawdown that would have an insignificant impact on subterranean fauna habitat is currently unclear, noting the apparent complexity of habitat at Yeelirrie, and the difficulty in confirming whether 0.5m is likely to represent the limit of impacts from mining related activities.	2015 increased water levels by approximately 2.5 m in the eastern part of the palaeochannel but caused little change in the west. Annual fluctuations of groundwater levels at Yeelirrie during the period 2011-2016 have mostly been low, covering a variation of less than 0.1 m within the calcrete, reflecting the absence of any very large and widespread rainfall/flooding event during that period. Considering the low frequency of large rainfall events resulting in catchment-wide groundwater recharge, longer term groundwater monitoring records are applicable. Larger fluctuations (recharge and recessional levels) are demonstrated in longer term data from Fridays Well, which is located in the Depot Springs calcrete aquifer (host to the Threatened Ecological Community stygofauna population), approximately 85km south of the Yeelirrie Homestead. Fridays Well represents a typical valley calcrete palaeochannel, which is hydro-geologically similar to the Yeelirrie system.  The hydrograph above shows the fluctuations measured at Fridays Well from 1972 to 1981 and illustrates long periods of very slow water level recession with sudden large rises in response to rare rainfall events when the threshold for recharge is exceeded. The concept and pattern of groundwater level response is further supported by the surface water modelling undertaken for the Yeelirrie PER. This shows that stormwater run-off and valley floor inundation occurs only in response to large and widespread rain events. The widespread flooding predicted by the surface water model would undoubtedly have a marked and widespread impact on groundwater table elevation such as is demonstrated in the hydrographs. It should also be noted that it takes quite some time (varying from months to greater than a year) for the water levels to return to previous levels after a significant recharge event.

No.	Submitter	Submission and/or issue	Response
			Mapping of the saturated calcrete has been undertaken and is presented in Attachment 2. Beyond the 0.5 m drawdown contour, there is very little impact on the habitat volume or area. Note that, the magnitude of drawdown threshold has only a modest impact on the preserved habitat – a reduction from a 0.5 to a 0.1m threshold would only result in 8% greater impact by area and 2% by volume. The additional figures presented in Attachment 2 show the depth of modelled saturated calcrete pre- and post-drawdown. Calculations on area and volume of the PEC, including Project impact, are also provided in Attachment 2. The adoption of a drawdown threshold at less than 0.5 m is not supported on hydrogeological grounds. Lithological description of drill samples at 1 metre vertical spacing has shown that vertical variations in lithology relevant to habitat (related locally to rock type/porosity/ permeability) generally occur gradually over more than one metre. The base of the habitat is not a sharp well defined geological contact to which a more precise control could be applicable. The ability to monitor and manage impact was another consideration when determining the appropriate threshold drawdown level. Cameco is confident that the 0.5 m threshold can be both monitored and managed. This would be difficult for a lower threshold and it should be recognised that for management and compliance purposes it is difficult to work on a finer scale than 0.5 m. As presented in Attachment 3, Cameco has provided a number of commitments for managing and monitoring the 0.5m drawdown. In summary, it is considered that drawdown of less than 0.5 m from the normal long term water level range, will not have habitat impacts which are clearly measurable or meaningful. The area naturally experiences substantially greater water level variability than has been measured during 2011-2016. The additional habitat which is controlled under a much lower threshold is not substantial by area or more particularly by volume. The managerial complexity of a threshold less than 0.5 m is not justified. Cameco considers 0.5 m an acceptable threshold drawdown limit and notes that a drawdown threshold of 0.5 m was also used in the assessment of the Toro uranium project.
7.	P&W	The modelling undertaken for Cameco appears to be based on a "…*relatively simple hydrological regime*…" and "…*of sufficient accuracy for any resource management or impact assessment matters relating to groundwater level and solute transport responses arising from proposed developments on the Yeelirrie Project tenements*" (Appendix I3, page 1). The model used does not appear to have been developed based on full consideration of the complexity of the hydrological environment at Yeelirrie or to model the potential influence that changes to particular hydrological parameters could have on the habitat and survival of subterranean fauna. The appropriateness and reliability of the parameters used in the groundwater modelling for predictions used to inform an assessment of impacts on the subterranean fauna community and the potential levels of uncertainty associated with modelling should be clarified and further considered, as necessary, as part of the assessment.	The model was peer reviewed for the OEPA and that review is included in the PER Appendix I3. The model is conceptually simple but highly detailed in structure including 9 layers, 905 columns and 332 rows, or up to 2.7 million cells (some inactive). This can be compared to the PRAMS model, used for water management in the Perth region, which includes 12 layers, 214 columns and 454 rows or 1.2 million cells. Development and calibration of the Yeelirrie model was very well supported by regional and local data sets. In particular the local calcrete aquifer hydraulic properties are well defined by extensive dewatering trials undertaken in the 1970's. The history of the Yeelirrie and other nearby projects and operations means that the groundwater aspects of the proposal are uniquely well informed by WA resource industry standards.

No.	Submitter	Submission and/or issue	Response
8.	P&W	The PER also does not provide a discussion on the potential practicality of managing the impacts of the proposal (particularly groundwater drawdown) on the physical and chemical habitat for the subterranean fauna community noting the potentially specific requirements of particular taxa. This is a crucial point in the assessment, as if the drawdown limits cannot be practically and reliably managed there is a risk that the impacts on subterranean fauna (and any other groundwater dependent ecosystems) will be significantly greater than predicted.	Cameco has provided additional avoidance, minimisation, mitigation and management commitments as Attachment 3. As discussed in the PER and in Attachment 3, Cameco will develop a Subterranean Fauna Management Plan and Groundwater Management Plan in order to manage the impacts of the proposal on the physical and chemical habitat for the subterranean fauna community. This includes a strong commitment to not exceeding the 0.5m drawdown as presented in the PER (Figure 9-17) and not having any Project impact on groundwater quality or absolute groundwater level (>0.5m) beyond the mapped 0.5m contour. Cameco is confident that groundwater abstraction can be operated and managed in order to meet the commitments.
9.	P&W	The PER has assessed the potential impact on troglofauna as the direct loss of habitat from excavation and drying of habitat at the edges of the active mine pit. The PER does not appear to have provided an assessment of the potential outer extent of all potential impacts on these fauna (such as groundwater drawdown, vibration or habitat fragmentation impacts) beyond the edges of the mine pits. It is acknowledged that there have been limited investigations into the potential for indirect impacts on troglofauna and that in particular there have been no investigations into indirect impacts on troglofauna in the Yilgarn calcrete environment, where troglofauna habitat is at shallow depth from the ground surface. The significance of the troglofauna community at Yeelirrie should warrant a precautionary approach however, based on suitable buffers to limit the potential for impacts of the proposal beyond direct removal of habitat.	Impacts on troglofauna through water level and water quality changes are assumed to be less severe than those on Stygofauna. The Yeelirrie proposal presents a low risk of other physical impacts (i.e. vibration related) since mining is shallow, low intensity and does not normally involve blasting. While there have been no studies in calcrete habitats of the likely impacts on troglofauna of groundwater drawdown, vibration and habitat fragmentation, these impacts are likely to be small and manageable. While the impact of drawdown on the structure of previously saturated habitat is unknown, the de-watered habitat represents potential additional habitat for troglofauna and any reduction in its suitability for troglofauna should not affect existing troglofauna populations. Existing troglofauna populations would be threatened only if there was a reduction in relative humidity in their original habitat as a result of groundwater drawdown. Troglofauna require a relative humidity of about 99-100% for long-term persistence, although they can forage in lower humidity for variable periods of time. It is suggested that relative humidity in existing habitat will remain suitable for troglofauna for the following reasons. In the windless, steady subterranean environment, two factors maintain 100% relative humidity for most of the subterranean profile. First, intense rain events saturate the surface profile. This rain then slowly drains through the subterranean profile, leaving some water in pore spaces as it moves towards the watertable. Second, there is diffusion of water vapour from the watertable back towards the soil surface. In general, the processes of rainfall recharge and water vapour diffusion maintain a relative humidity of 100% in the subterranean environment below the root zone (although no measurements have been made in calcrete habitats). Soil physics also suggest that relative humidity is quite insensitive to soil water and is likely to remain close to 100% after groundwater drawdown. Within the root zone, relative humidity may be reduced, depending on the intensity of plant transpiration. However, long-term persistence of perennial plants requires that they do not reduce pore water availability to the level described as the 'plant wilt point'. Relative humidity at wilt point is regarded as being 98.9% (Lal and Shukla 2004), which provides suitable habitat for troglofauna. Even if plant roots are transpiring water, humidity will remain above 99% after plants reach wilt point (Wild 1988) and groundwater abstraction should not affect troglofauna. The physiology of troglofauna suggests they require humidity of 99-100% but they can forage at lower humidity for variable periods (Howarth 1987). Thus, it is unlikely the lateral drying of habitat around mine pits would extend for more than a few metres. The effect of use of heavy machinery, excavation of the mine pit and limited amounts of blasting on troglofauna are expected to be small. Vibration decreases as the square root of the distance from source and it is considered that, with the exception of blasting, any impacts are unlikely to extend more than a few metres. The impacts of blasting are dependent on type of blasting and the quantity of explosives used but will, at most, extend only tens of metres. As

No.	Submitter	Submission and/or issue	Response
			detailed in Attachment 3, Cameco propose additional avoidance, minimisation, mitigation and management measures for troglofauna, including the establishment of a Troglofauna Protection Area and additional habitat mapping.
10.	P&W	A number of specimens appear to have had their original Subterranean Ecology identifications reviewed by Bennelongia, in some cases reducing the number of taxa (e.g. *Schizopera akation* variants went from five taxa to one in the review). It is recommended that information is sought on whether taxonomic experts in the affected groups were consulted to clarify whether the updated identifications were based on the best possible information.	With one exception, where the Bennelongia (2015) report differed from Subterranean Ecology (2011) in the species listed it was because Bennelongia (2015) followed published taxonomy that differed from the identification framework used in Subterranean Ecology (2011). In the case of the example cited in the DPaW comment, Subterranean Ecology recognized four (not five) species within the *Schizopera akation* complex. These species were identified by DNA analysis. In a subsequent formal taxonomic description of the *Schizopera* species at Yeelirrie by some of the Subterranean Ecology team and its associates (Karanovic and Cooper 2012), *Schizopera akation* was formally published as a single, highly variable species. Bennelongia (2015) followed this most recent taxonomy. However, in January 2016 a pre-publication version of a paper by Karanovic et al. (2015) appeared online, in which *Schizopera akation* is separated into three species. This division occurred after submission of the PER and, in fact, is still not formally published at the time of writing this comment but it was suggested by one of the new species, *Schizopera* 'krypta', is an additional species restricted to the area of drawdown. In fact, Karanovic et al. (2015) show its range as extending west of the area of drawdown. Another species reduction was that Subterranean Ecology (2014) recognised two species in the *Nitokra yeelirrie* complex but these were formally described subsequently by Karanovic et al. (2014) as a single species and Bennelongia (2015) followed this taxonomy. The single exception, where Bennelongia (2015) combined species without formal taxonomic related to treating *Novanitocrella* 'araia' sp. n. and *Novanitocrella* 'araia linec' ssp. n. as a single species. No formal taxonomic work had been done on these taxa between the time of Subterranean Ecology's (2011) report and completion of the Bennelongia (2015) report. The reasons for combining the species were, firstly, that the assessment was based on species level analysis and *Novanitocrella* 'araia linec' ssp. n. is a subspecies. Secondly, based on the decisions made in Karanovic and Cooper (2012) and Karanovic et al. (2014), it was considered likely that the process of formal species description would result in a single species being recognised unless additional animals of *Novanitocrella* 'araia' sp. n. were found. It is now considered more appropriate to treat *Novanitocrella* 'araia' sp. n as a 'restricted' species in the PEC and *Novanitocrella* 'araia linec' ssp. n. as a 'restricted' species in the south-eastern drawdown. • *Novanitocrella* 'araia' sp. n. is known from a single animal collected at the western end of the proposed mine pit in bore YYA35. Given that the only described species of the genus, *Novanitocrella aboriginesi*, has a known linear range of about 20 km, it is expected that *Novanitocrella* 'araia' sp. n. will extend west of the mine pit into an area of undisturbed calcrete. It occurs about 1.5 km from the 0.5 m drawdown contour. • *Novanitocrella* 'araia linec' ssp. n. was collected as 123 animals in three samples from two nearby bores (YYHC0036C and 37C) in the drawdown to the south-east of the mine pit. While it is only 1.5 km south of the 0.5 km drawdown contour, habitat to the north is unlikely to be suitable and the likely distribution of the species outside the drawdown contour is unclear.
11.	P&W	The assessment on subterranean fauna taxa should consider not only of those taxa currently known only from the predicted impact zone, but also those taxa that have a high proportion of their currently known records / distribution in the predicted	Given the logistical difficulties associated with the sampling of subterranean fauna, ranges of species are likely to be substantially underestimated, as is acknowledged in EAG12 in relation to use of surrogates. In nearly all cases where a

No.	Submitter	Submission and/or issue	Response
		impact zone. This is particularly significant for taxa apparently endemic to the Yeelirrie area.	species has been collected outside the predicted impact zone, its actual range will be greater than sampling demonstrates. Even if stygofauna and troglofauna species occupy only a small area of habitat outside the predicted impact area, small populations are likely to be viable because of the constancy of subterranean habitat in terms of its structure and climate. For this reason, Cameco believes sufficient consideration has been given to species with a high proportion (but not all) of their known records in the predicted impact area. In response to an additional request from the submitter, Twenty-seven individuals of *Paroster* sp. n. 'angustus' were recorded from 17 sites. The two sites outside the 0.5 m drawdown threshold yielded 22% of all specimens collected and might be said to indicate that only 22% of the species population occurs outside the groundwater impact area. In fact one of the sites outside, which yielded one animal, is likely to be impacted by drawdown outside the 0.5 m contour because it is in very shallow saturated alluvium, meaning that only 19% of the known species population will experience no impact. While this level of impact may be seen as high for a vertebrate species, population sizes of small invertebrates are usually high and the viability of species populations are unlikely to be threatened by this scale of population reduction. Furthermore, it is likely that any additional sampling that shows wider distribution of *Paroster* sp. n. 'angustus' will increase the proportion of the population known from outside the impact area. The considerations described above are also likely to apply to other species that have been recorded mostly from the groundwater impact area at Yeelirrie.
12.	P&W	The PER includes a number of statements indicating that distributions of the subterranean fauna are expected to not be as restricted as the survey data indicates. These statements are poorly explained and not adequately supported by survey data and / or habitat related information. The ecological rationale for the statements about broader distributions is not clear. If the assumption is that faunal composition is sufficiently homogenous throughout the aquifer and that removing a third of the habitat will not cause a loss of a taxon, this appears to be contrary to conclusions in Appendix F2 (page 81) indicating that "*Based on regional results, it is highly likely that many of the species detected only in isolated calcrete habitats at Yeelirrie do not occur elsewhere in the region*" and is also contrary to the understanding that the habitat at Yeelirrie is complex.	There are two elements to the ecological rationale for species having wider distributions than documented. The first relates to the fine-scale heterogeneity of the habitat within the calcrete and associated habitat. This means a species may occur only in very small patches of habitat that have the right structural and chemical characteristics. The second relates to the heterogeneity being a repeated pattern across the calcrete so that if a species is recorded only in six patches of calcrete these patches are likely to be distributed through a substantial part of the calcrete (for example, the north-west or the centre) rather than being very tightly clustered together. The comment that "These statements are poorly explained and not adequately supported by survey data and / or habitat related information" was made in relation to four species. • *Halicyclops* cf. *eberhardi* sp. B (listed as sp. A in comment). It is agreed that more quantified information about the heterogeneity and complexity of habitats at Yeelirrie would be useful. This information is not available but the three dimensional complexity of some aquifers is well illustrated by Larned (2012). Because of scale issues, the mapping of the extent of calcrete in Attachment 2 shows only broad trends and cannot illustrate the extensive variation in calcrete composition and thickness that occurs over 10s of metres. • *Kinnecaris lined*. The statement in the PER summarises existing knowledge, which is limited for this particular species. • *Schizopera akolos* and *S. emphysema*. The PER considered that both species occupied relatively rare (or poorly sampled) microhabitats. Detailed phylogenetic analyses of these and other *Schizopera* species at Yeelirrie were conducted by Karanovic and Cooper (2012) and published in *Invertebrate Systematics*. They state in relation to *S. akolos* "… and *S. akolos* is probably a separate colonisation event in the Yeelirrie calcrete. The fact that *S. akolos* is very rare means that either we did not sample adequately its prime habitat (possibly the smallest crevices in the

No.	Submitter	Submission and/or issue	Response
			calcrete), or that this species is a relict here that has largely been replaced by invasions of other more recent arrivals or newly *in situ* evolved forms." The submitter should refer to Attachment 3 for addition information regarding the likely range of all species currently only known from the area of impact. Karanovic and Cooper (2012, p. 181) stated in relation to *S. emphysema* that "three other bores that are situated only a few metres from this one (YYAC1004A, B and D) have never produced any animals of this species, although some produced other copepod species found in YYAC1004C. Water chemistry shows no significant differences between these bores, but they are slotted at different depths, so one has to assume that bore YYAC1004C intercepted a larger cavity in this calcrete, which is a suitable habitat for this large species". The comment that statements about wider distribution of species within Yeelirrie contradict conclusions in Appendix F2 that many species at Yeelirrie do not occur elsewhere in the region is incorrect. Species found only in the Yeelirrie study area may be restricted to a portion of the Yeelirrie calcrete or may occur widely throughout it (such as the amphipod nr *Phreatochiltonia* sp. n. S1, which extends the full length of the calcrete and into the contiguous Yeelirrie playa, and the beetle *Limbodessus* sp. S1, which extends the full length of the calcrete).
13.	P&W	There are a series of inconsistencies between technical consultants' conclusions and statements within the PER in relation to the likelihood of species being restricted to the drawdown areas. The different interpretations between the specialist report(s) and PER are not explained. A review of the information and clarification of these types of statements should be requested.	These inconsistencies are acknowledged. They result from some revision by Bennelongia of the PER immediately prior to submission to better explain why wider ranges would be expected in some species. There was limited time to review and update the technical report by Bennelongia (2015) so that it contained the same reasoning. Bennelongia wrote the subterranean fauna PER chapter as well as preparing the 2015 technical report. It is considered that the statements in both the PER and Bennelongia (2015) report are valid; the technical report provides explanations of ranges that are more focussed on the fieldwork undertaken and the PER chapter contains some explanations with a stronger literature focus (e.g. the likely wider ranges of *Schizopera akolos* and *S. emphysema* because of their surface origins, as proposed by Karanovic and Cooper 2012).
14.	P&W	Page 189 of the PER refers to Pinder (2008) as evidence of research indicating that "…*subterranean oligochaetes, including enchytraeids, are thought to be widespread*". The paper referred to dealt only with phreodrilids and does not say that stygal oligochaetes tend to be widespread. The stygal phreodrilids discussed in that paper vary in their known distributions and wider comment on the distribution of other families was not made. Further, no justification or evidence is provided in the PER for the comment (page 189-190) that there is a belief that enchytraeid species are usually moderately widespread	With the exception of *Phreodrilus linnaei*, which is known only from one sample so range information is not available, the phreodrilids covered by Pinder's (2008) review are all widespread in the context of subterranean species ranges. Similarly, the naidid, three phreodrilid and two enchytraeid species covered by Brown et al.'s (2015) investigation of subterranean oligochaetes had widespread ranges in the context of subterranean ranges. The smallest recorded linear range (with a clustered sampling pattern) was 25 km for one of the phreodrilid species and the two enchytraeid species had linear ranges of 220 km in both cases. Thus, the only published information on the ranges of subterranean enchtraeids in WA suggests they are widespread in terms of the ranges of subterranean species. There is also some unpublished evidence (Subterranean Ecology 2011) including that from Yeelirrie, based on limited DNA analyses, that suggests subterranean enchytraeids may be quite speciose but these results do not provide enough records per species to conclude more than done in the PER about their ranges.
15.	P&W	The PER states that the residual risk of the proposal to subterranean fauna taxa and the PEC is Medium (PER, page 118). This conclusion is not supported by the available scientific evidence, there are some concerns with the	Additional avoidance, minimisation, mitigation and management commitments are presented in Attachment 3. The additional commitments include: • Establishment of a Troglofauna Protection Area;

No.	Submitter	Submission and/or issue	Response
		predictions and potentially significant implications of the proposal for conservation of subterranean fauna.	• Further optimisation of the groundwater model during prior to commencement of the Project; • Additional habitat mapping for both stygofauna and troglofauna; and • Development of an outcome-based Subterranean Fauna Management Plan in accordance with EAG17. Cameco considers that the avoidance, minimisation and mitigation measures outlined in Attachment 3 will allow the Project to be operated so that the risk to maintaining the representation, diversity, viability and ecological function at the species, population and assemblage level of subterranean fauna is low and therefore EPA's objective for this key environmental factor will be met. However, Cameco recognises that a level of uncertainty remains about the range of the potentially restricted species and therefore proposes an offset measure.
16.	DotE	Please demonstrate the practicability of the proposed mitigation measures for subterranean fauna. For example, through reference to the scientific literature or by presenting evidence from field trials. Details of subterranean fauna management plan including how habitat heterogeneity will be maintained and impacts of reinjection will be manage.	The submitter should refer to Attachment 3 and the comments above for information regarding this.
17.	DotE	Under the listed aspect "Radiation contamination of soils, surface water and groundwater" of Table 8.2, the management column makes no reference to controls or mitigations in relation to groundwater. It states "Implementation of radiation, dust and surface water management measures." Please demonstrate how groundwater contamination will be addressed or managed, particularly with respect to subterranean fauna.	Please refer to Section 9.5.5.3 of the PER, which presents transport plumes for Chlorine and Uranium. Refer also to response 3 for discussion of the biological effect of the contaminant plume.
18.	WAM	The subterranean fauna of the Yeelirrie site is by far the most diverse local subterranean fauna in the world. Furthermore, many of the species area themselves endemic to the site. The development of a shallow and thus extensive open pit mine in the core of this distribution will disrupt this community and is likely to lead to species extinction.	The documented richness of Yeelirrie for subterranean fauna species is partly attributable to the large area sampled and high sampling but it is acknowledged that Yeelirrie has a rich subterranean fauna community by current global standards. It is argued elsewhere that the level of disruption to the community will be of an acceptable level.
19.	WAM	The species density at Yeelirrie is at least 33 times that of the entire Pilbara, which itself is considered to be a 'global significant radiation of biodiversity'. Calculations using data Culver *et al.* show that both stygofauna and the total fauna of Yeelirrie exceed the species density of the richest areas of the contiguous states of the USA by more than an order of magnitude.	Yeelirrie is a discrete geological unit that provides suitable habitat for stygofauna. It is misleading to make comparisons between Yeelirrie and the whole Pilbara, which is a mixture of habitats of varying suitability for stygofauna and troglofauna. The number of stygofauna recorded from the richest bore at Yeelirrie (27 species) is only half that recorded from the richest bore on the Lower Robe floodplain in the western Pilbara (54 species). Almost as many stygofauna species are considered likely to occur in the Ethel Gorge TEC in the eastern Pilbara (78) as are estimated to occur at Yeelirrie (83) and the estimated number of troglofauna species in the Jirrpalpur and Packsaddle Ranges in the central Pilbara (82) is substantially higher than the estimated number of Yeelirrie (65).

No.	Submitter	Submission and/or issue	Response
20.	WAM	An extensive open pit will disrupt the hydrogeology and while the piezometric surface may recover in the medium term, it will be a much longer process to re-establish the fine grained salinity environment as groundwater flow paths are temporally very long.	As quantified in Section 9.2.6 of the PER Cameco agrees that the Project will have an impact on the local subterranean fauna population and that the areas impacted will take some time to recover.
21.	CCWA	The public submitter considers that the EPA should recommend that this proposal be rejected, on the grounds that the Yeelirrie Subterranean community (Priority 1 Priority Ecological Community (PEC)) comprises a series of highly endemic, diverse stygofauna and troglofauna species within multiple calcrete habitats. The impact of the mine and groundwater dewatering pose an unacceptable risk that could see a number of subterranean species become extinct. There is strong evidence that the Yeelirrie Subterranean Community (Priority 1 PEC) should be listed as a Threatened Ecological Community (TEC), given the highest diversity of any subterranean ecosystem in the region, (115 species), the highest rates of endemicity (only 4 species known from beyond Yeelirrie) and the threat of mining, which threatens to destroy the community and habitat. The Yeelirrie Subterranean community are 'Vulnerable', as it fits the definition in several areas, "adequately surveyed", (7 surveys sampling >250 bores), "facing a high risk of total destruction or significant modification in the medium to long-term future" and "because of existing or impending threatening processes". For this reason it should be listed as a TEC.	As presented in response to Comment 2 the boundary of the Yeelirrie PEC has been reviewed in consultation with the DPaW. Impacts to the PEC have been summarised in Attachment 3 and in response to Comment 2.
22.	CCWA; Proforma 2	It is believed that there is sufficient evidence in the Bennelongia and Subterranean Ecology work to show that a significant number of species only exist in the direct impact area of the mine. If the mine is approved these species could become extinct. The remaining 100 species that rely on the Yeelirrie subterranean ecosystem for their sole habitat could also be indirectly impacted. There are very few other subterranean ecosystems in WA that have been sampled as much or as systematically, as they were conducted before the new subterranean guidelines released in 2013, which allow for assumptions based on surrogates for	While agreeing that Yeelirrie has a rich subterranean fauna community, there is evidence that several other calcretes in the Yilgarn, especially between Lake Way and Lake Carey and eastwards, support the 'explosive' species radiations seen at Yeelirrie. This includes the calcretes around Lake Way itself, where 58 species of stygofauna have been recorded. When comparing calcretes, it should be recognised that the high sampling intensity and detailed identifications undertaken at Yeelirrie surveys resulted in much more complete documentation of its fauna than has occurred in other calcretes. While the detailed data from other calcretes are not available for rarefaction analysis, and variable taxonomic resolution would make such analyses difficult to interpret anyway, we suggest the richness collected in 10 samples at Yeelirrie and other rich calcretes would not differ greatly. The suggestion that the high level of species turnover between Yeelirrie and Albion Downs "provides confidence that it is unlikely that species known from the drawdown areas would be found elsewhere" is focussed on only one aspect of species distributions. In fact, species with localised distributions within the Yeelirrie calcrete can, and do, have part or all of their distributions outside the area of groundwater drawdown and therefore are not threatened by drawdown.

No.	Submitter	Submission and/or issue	Response
		species distribution that are untested or based on limited habitat data. A large number of drill holes were sampled across the palaeochannel and in different geological layers, allowing for a better than average taxonomic resolution of subterranean fauna. Genetic analysis has provided the ability to identify species in groups and to determine the differences between species living in different parts of the palaeodrainage system. The results of the surveys show that there is very high diversity of 115 species of subterranean fauna within the Yeelirrie area and they appear to be regionally significant. Bennelongia argue that this is due to the intensive surveying and use of genetic analysis and dismiss concerns implying that the extraordinary diversity at Yeelirrie would not seem so unusual if other areas were well sampled. This critical assumption lacks an evidence base. The assessment also argues that the current pattern of species distribution would appear more favourable if there were more sampling. These contrary positions do not stand up to scrutiny, and what is missing is an attempt to relate the species distribution patterns to the extent or quality of the subterranean habitat. If greater sampling occurred in the region it would be reasonable to expect even greater diversity from other calcrete habitats which are unlikely to show the species found at Yeelirrie. Surveys were carried out in calcrete habitats downstream from the Yeelirrie calcrete (at the calcrete playa) and further south east (interpreted as being associated with Albion Downs). These detected a very different subterranean fauna community with a high level of species turnover between central calcrete and areas further downstream. This provides confidence that it is highly unlikely that species known from the drawdown areas or the pit would be found elsewhere.	
23.	CCWA	If significant portions of the calcrete aquifer at Yeelirrie are destroyed by mining or fundamentally changed 11 species of stygofauna and 4 species of troglofauna will almost certainly become extinct, and the unique species community that makes up the current Priority 1 PEC will be diminished forever.	It is an unrealistic expectation that, because Yeelirrie is the most intensively sampled calcrete, the range of any species known only from one or two bores should be regarded as being restricted to those one of two bores. All abundance of species in all communities follows a Poisson distribution, with a few abundant species and a larger number of ever rarer species. This means that as sampling effort increases the number of species recorded increases, with a proportion of these species expected to be known only from a small number of holes. This is because the abundance of these species is so low that they are expected to be collected from only one hole, whatever their actual distribution. This is the reason EAG12 recommends the use of surrogates to infer the actual range of such species. Sampling will underestimate their range.

No.	Submitter	Submission and/or issue	Response
		There is a precedent around the Bennelongia report using assumptions about species being widespread but without the evidence. Yeelirrie is the most thoroughly sampled area for subterranean fauna in the region. If species have not been found despite intensive sampling then the precautionary principle should be used and assume they are not widespread.	
24.	CCWA	In addition to impacts of drawdown, there is also impacts from the movement of the chemical plume coming from tailings and backfilled pits for over 500 years. This plume is likely to threaten subterranean fauna at zone 6 "South east" and Zone 7 "Yeelirrie Playa". Other factors that may impact subterranean fauna which have not been addressed in the assessment is changes to salinity, total dissolved oxygen and acidity.	The submitter should refer to the response to Comment 3 above. It is likely that the potential impacts to subterranean fauna as a result to changes in total dissolved oxygen and acidity will be localised and confined to the area of modelled groundwater drawdown. However, there is not sufficient biological information available to adequately assess the impacts of total dissolved oxygen and acidity. It is agreed that Stygofauna can tolerate low dissolved oxygen.
25.	CCWA	The assessment has only addressed the groundwater drawdown as a management strategy and this has not been done convincingly. Some alternative options have been discredited as too expensive. Other options have been considered and appear to reduce impact but cannot mitigate it. Exclusion zones have been discounted altogether as the habitat is interlaced with the mining deposit and exclusion zones may be the only option to adequately conserve some of the species, particularly troglofauna. It is suggested that based on the current assessment, it is near impossible to meet the EPA's objectives for subterranean fauna. It is suggested that the proposal be rejected on the grounds that in its current form, it is likely to cause the extinction of at least 10 species of stygofauna and 5 species of troglofauna.	The submitter should refer to the updated management and mitigation commitments in Attachment 3.
26.	CCWA	The Bennelongia report identifies that out of 70 stygofauna species, 11 are only in the direct impact area and groundwater drawdown zone. The *Atopobathynella* sp. 'line K' has only been found in one bore. The current assessment claims that the species could be found elsewhere because it is one of five species of this genus found at Yeelirrie. There is no evidence presented to support the use of the two more widespread species of this genus as surrogates. In a bid to downplay the risk of extinction the	The use of related species at a site to infer the likely range of another species is recommended by EAG12, which states "Where a reasonable amount of sampling is unlikely to reveal the full range of a species because of demonstrated low capture rates in the habitat sampled, surrogates can be used to estimate whether the habitat is restricted. A surrogate can be based on either biological features of a species … A biological surrogate is a species, preferably with similar morphological characteristics, that is likely to have similar trophic and dispersal attributes to the species found in low abundance." Thus it is considered the use of the range characteristics of the two *Atopobathynella* species collected from more than one hole to provide information about the likely range of *Atopobathynella* sp. 'line K' complies with the practice recommended in EAG12.

No.	Submitter	Submission and/or issue	Response
		current assessment uses assumptions about habitat and uses 'surrogates' to argue that each of these species are likely to be more widespread beyond the impact zone. This is nothing more than conjecture unless there is some kind of evidence that the species and the surrogate share behavioural or ecological traits that would support the assumption that their ranges will be similar. Given that such a thorough survey has been undertaken, then if the species were more widespread, surely they would have been found. In the baseline report both *Novanitocrella*: N. 'araia' sp.n. and N. 'araia linec" sp.n. were both reported. These seem to have merged into one species in the current assessment. Both forms appear to be restricted to the drawdown area, therefore are equally threatened by the mining proposal. *Enchytraeidae* sp. Y4 and Y6 were identified from a small subset of a much larger cohort, as many specimens were unable to be identified. Why, between the baseline survey and the assessment was there no further attempt to conduct additional genetic analysis to better define the species ranges of these taxa? Without this data it is only speculation that they 'most likely' occur throughout the Yeelirrie calcrete. The current assessment of *Schizopera akolos* and *S. emphysema* is confusing and inconsistent, between Table 4 and 6 and the text in Bennelongia 2015 report. Table 4 and the text surrounding Table 6 seems to indicate that these species are regarded as possibly restricted to the impact zone, yet Table 6 says 'not restricted'. There does not seem to be any evidence to justify that these species are not restricted. The qualifying remark regarding the potential existence of heterogeneous microhabitats appears to suggest a more complicated habitat for these species that would increase the likelihood of them being restricted. The *Schizopera* (sp. 7439) was only detected from a genetic sub-sample. The argument in the assessment assumes that this sub species is less likely to be restricted, based on speculation. This goes against the precautionary principle, where the lack of full scientific certainty regarding the distributions of these species should not be used to prevent implementation of measures necessary to conserve these species.	It has been acknowledged previously (comment 10) that *Novanitocrella* 'araia' sp. n. and *Novanitocrella* 'araia linec' ssp. n. were treated as a single species in the PER and baseline report. Treatment of these two taxa as separate species would increase the number of species currently only know from the area of impact by one. • *Novanitocrella* 'araia' sp. n. is known from a single animal collected at the western end of the proposed mine pit in bore YYA35. Given that the only described species of the genus, *Novanitocrella aboriginesi*, has a known linear range of about 20 km, it is expected that *Novanitocrella* 'araia' sp. n. will extend west of the mine pit into an area of undisturbed calcrete. It occurs about 1.5 km from the 0.5 m drawdown contour. • *Novanitocrella* 'araia linec' ssp. n. was collected as 123 animals in three samples from two nearby bores (YYHC0036C and 37C) in the drawdown to the south-east of the mine pit. While it is only 1.5 km south of the 0.5 km drawdown contour, habitat to the north is unlikely to be suitable and the likely distribution of the species outside the drawdown contour is unclear. No genetic analysis was undertaken on the *Enchytraeidae* sp. Y4 and Y6 due to the age of samples and therefore the low likelihood of being able to extract DNA. *Schizopera* sp. 7439. As this species is known from a single sample, with identification based on a single individual, the probability that collection of additional specimens will increase its range is high. While nothing definite can be concluded about its range, there is evidence that a significant proportion of the Schizopera species at Yeelirrie are widespread. A westward range extension of about 5 km would mean this species occurs outside the area of groundwater drawdown. This range fits with the three new species of *Schizopera akation* described by Karanovic et al. (2015) by splitting the former wide ranging *Schizopera akation* sl. The new species have linear ranges of 7 km, 7.5 km and 27 km. Subterranean Ecology did not refrigerate their stygofauna samples and it is unlikely that DNA could be successfully extracted from such small animals stored at room temperature 5-6 years after collection. Furthermore, it is considered that the explanations for likely wider ranges were adequate. It is agreed that there is confusion in text as a result of late changes in the Bennelongia (2015) report and PER. Comment 12 addresses the ranges of the two species with reference to the detailed discussion of the ranges of both species in Karanovic and Cooper (2012). The submitter should refer to Attachment 3 for a revised impact discussion and additional management and mitigation commitments.

No.	Submitter	Submission and/or issue	Response
		The current assessment of the species mentioned above is seriously flawed and there is currently no reasonable argument or weight of evidence to suggest that any of the 10 species of stygofauna are found anywhere, other than in the central drawdown area.	
27.	CCWA	There is concern that five species of troglofauna could suffer critical impacts or become extinct if the proposal is pursued. *Trichorhina* sp. N. F, *Tyrannochthonius* sp.n. Y1, *Austrohorous* sp.n Y1, *Pauropoda* sp. S6B and *Symphyla* sp. Y7. *Tyrannochthonius* sp.n. Y1 and *Austrohorous* sp.n Y1 were both loosely assessed as 'Not restricted' based on a single line of citation from a study in 2007 or 2008, which stated that 'Available data from other studies shows that subterranean pseudoscorpions are usually relatively widespread….in a common karst system'. This is a massive oversimplification of the issues involved, as the calcretes at Yeelirrie are not Karst system, but a series of discontinuous calcrete islands, and there is plenty of evidence to show that some pseudoscorpions are restricted. *Pauropoda* sp. S6B and *Symphyla* sp. Y7 have also been found in the north western corner of the proposed pit. The current assessment has stated that "given the close proximity of all four species to the edge of the pit, the range of this specie is likely to extend outside the pit and impact zone". This argument is weak and appears to be based on solely on conjecture rather than a more detailed examination of the species potential ranges or habitat preferences. There is no evidence provided about the suitability or connectivity of habitat beyond the proposed pit, or evidence of any troglofauna species existing in other similar habitat within the Yeelirrie palaeodrainage system or beyond. Out of 100 drill holes and 448 troglofauna samples in this area, these four species have only been found in the northwest corner of the proposed pit. Based on current evidence, It is difficult to see how the EPA objectives could be met for the troglofauna that only exist within the Yeelirrie mine pit.	As discussed above, Cameco has presented updated management and mitigation measures in Attachment 3. This includes the commitment to establishing a Troglofauna Protection Area in the north west corner of the mine pit. Covering an area of 10.5ha and containing approximately 1% of the total resource, the protection area will be maintained for the life of mine unless additional habitat mapping indicates that the four troglofauna species (Tyrannochthonius sp. n. Y1, Austrohorus sp. n. Y1, Pauropoda sp. S6B and Symphyla sp. Y7) that are currently only know from the area are likely to occur outside. If additional habitat mapping is successful in determining the four species then Cameco will seek approval from the Chairman of the Environmental Protection Authority to mine the additional 10.5ha. The establishment of the protection area means that only one troglofauna specie (*Trichorhina* sp. n. F) is now only known from the impact area. *Trichorhina* sp. n. F is represented by a single animal within the proposed mine pit. As discussed is the PER, Section 9.2.6.4, It is likely *Trichorhina* sp. n. F will have a small range but further sampling may show it occurs outside the mine pit due to the fact that *Trichorhina* sp. n. G, occurs in multiple bores with a linear range of about 14 km, however it is restricted to the northwestern part of the Yeelirrie calcrete.

No.	Submitter	Submission and/or issue	Response
28.	CCWA	The evidence provided is based on weak arguments, selective quotations and assumptions that do not stand up to closer examination and should not satisfy the EPA. In past assessments where a singleton has not been able to be identified beyond the impact area a 500m exclusion zone has been placed around the location where a troglofauna species was found and restricted. As the pits are proposed to be tailings storage facilities and toxic/radioactive chemicals have a deleterious impact on fauna within the nearby subterranean habitat, it is expected that a continuous calcrete habitat would be required to be preserved between the location of each of five troglofauna species and the remaining unaffected habitat beyond the mine pit and various tailings plumes. Without this there is a risk of extinction for the five troglofauna species. The public submitter urges the EPA to recommend the Yeelirrie proposal be rejected on the grounds that there are unacceptable risks to subterranean fauna that could result in one or multiple species of stygofauna and troglofauna becoming extinct.	As discussed above in response to Comment 27, Cameco has presented updated management and mitigation measures in Attachment 3 including the commitment to establishing a Troglofauna Protection Area in the north west corner of the mine pit. The proposed Troglofauna Protection Area contains four of the five troglofauna species that are currently only known from the mine pit (Tyrannochthonius sp. n. Y1, Austrohorus sp. n. Y1, Pauropoda sp. S6B and Symphyla sp. Y7) and provides a minimum 50 m buffer to the known location of each species. Covering an area of 10.5ha and containing approximately 1% of the total resource, the protection area will be maintained for the life of mine unless additional habitat mapping confirms that suitable habitat extends past the area of impact for the four species of troglofauna. If additional habitat mapping is successful in demonstrating range extensions for the four species then Cameco will seek approval from the Chairman of the Environmental Protection Authority to mine the additional 10.5ha. Cameco is aware that the proposed water reinjection point is within close proximity to the Troglofauna Protection Area, which could also impact on the species. Cameco is committed to developing a comprehensive groundwater monitoring program, as part of the Subterranean Fauna Management Plan and Groundwater Management Plan, which will include monitoring of water reinjection and developing agreed trigger levels to ensure protection of specific troglofauna species. The establishment of the protection area means that only one troglofauna species (Trichorhina sp. n. F) is now only known from the impact area. Trichorhina sp. n. F is represented by a single animal within the proposed mine pit. More information regarding the likely range extension of Trichorhina sp. n. F is presented in Attachment 3.
29.	CCWA	The drawdown of water provides the greatest risk to Subterranean fauna. This is expected to have a residual impact of 500 years post mining. The Sections of the PER about groundwater and drawdown do not describe the impact on stygofauna habitat, but refer to Section 9-2 on subterranean fauna. In Section 9.2 Cameco assert that as the calcrete layer is shallow they have taken a precautionary approach to reduce drawdown to 0.5m. This figure is not specifically compared to the actual depth of calcrete habitat in any area where the PEC stygofauna community occurs, therefore its relevance is questionable. It is also unclear what the maximum drawdown level is and where and for how long this will occur. Other parts of the PER suggest the drawdown will be greater than 1m and in other areas, particularly the northern bores it is suggested that drawdown might be as much as 5m. Page xxxii states the Maximum groundwater drawdown in the Western, Northern and Eastern brackish well fields will be approximately	With regards to the submitters comment that drawdown of water is “expected to have a residual impact of 500 years” Cameco has conservatively assessed that all areas within the >0.5 m drawdown will experience permanent loss but as identified by the submitter these areas can potentially recover. The recovery of the water table post mining is presented and discussed in Section 9.5.5 of the PER and further in Appendix I1. Recovery has only been modelled for 500 years post mining, but indicates: • Groundwater levels recover significantly within 50 years following cessation of the Project. • The water table at the pit/TSF location recovers to baseline levels within 100 years, but small residual drawdowns of 0.3 to 0.5 m below the baseline elevations would persist in the area of the nearby eastern and northern wellfield for more than 200 years. • Within the TSF area, the water table eventually recovers to levels about 0.5 m below the baseline elevations. This suggests a new steady state would occur locally due to the different geological properties of the TSF. • There would be some change in the down-valley groundwater flow path at the local scale in the vicinity of the pit; however, no discernible change in groundwater flow is expected at the catchment scale. The response to Comment 6 describes the justification and (more importantly) the impact of using 0.5 m drawdown as the threshold beyond it is considered habitat loss will deleteriously impact on stygofauna species. Given that the assessment has treated all areas with >0.5 m drawdown as areas where stygofauna species will be impacted, the extent of further drawdown within the >0.5 m contour will have no effect on the assessment of impacts on stygofauna.

No.	Submitter	Submission and/or issue	Response
		2, 5 and 3m respectively. Around the pit the drawdown will be 7m. In the Section on groundwater recovery (Page 283) it appears that 0.5m is the recovery level of groundwater post mining. Cameco identify figure 9-16 to show the proposed maximum water drawdown. This cross Section is a different scenario to that in figure 9-43, that also shows the expected maximum groundwater drawdown. Figure 9-43 indicates that the water table will drop below the calcrete and carbonated clay quartz into sandy alluvium, silty sand, silty sandstone and clayed alluvium, silty clay and sandy clay zones. There is no clear indication where in these cross Sections the primary and secondary subterranean fauna habitat is. The key question is where is the habitat? What percentage of the habitat will be affected by dewatering/drawdown and mining, and what percentage of the habitat will be unaffected? These questions have not been answered satisfactorily.	The responses to Comments 2 and 3 provide greater impact discussion around the Yeelirrie PEC. This information should also address the submitters concern regarding where the primary habitat is located and what percentage will be impacted and unaffected. Figure 9-16 shows the longitudinal cross-section down the palaeochannel which Figure 9-43 illustrates the traverse cross section in the north west corner of the proposed pit. Both figures illustrate the same drawdown. The submitter should refer to the insert map for more information.
30.	CCWA	The recovery of the habitat post mining may also be impacted by radioactive or toxic substances from mine waste or tailings. The prime subterranean habitat is to become a series of tailings cells and dumps for processed material, waste rock and contaminated materials. No attempt has been made to reinstate any kind of suitable habitat for subterranean fauna in the mine area. The toxic chemicals and radiation that has been modelled to leach from the tailings will eventually contaminate groundwater or other areas of the paleo system, some of which have their own unique subterranean fauna communities. No attempt has been made to assess or address these indirect impacts on subterranean fauna communities within the contamination zone from the tailings dumps despite containing unique endemic species that are not known to occur in the region.	The submitter should refer to the responses to Comments 2, 3 and 29 above.
31.	CCWA	This Project aspect poses a risk to ground water dependent ecosystems. The post-mining pit would in essence become a radioactive or 'contaminated materials' waste dump. The public submitter does not expect that the proposal for the pit, during or after mining, will ever become suitable habitat for subterranean	Cameco agrees that the section of mine pit that will be backfilled with tailings will never be suitable subterranean fauna habitat. It should be noted that the proposal for an in-pit engineered tailings storage facility eliminates the need for an above ground facility, decreasing the overall footprint of the mine and also allows for the mining area to be returned to near pre-mining conditions post-rehabilitation. Refer to Section 5.2.2 of the PER for more information.

No.	Submitter	Submission and/or issue	Response
		fauna. Detailed analysis or description articulating whether or not this habitat will be lost forever has not been provided.	
32.	S Ludlam;	The Yeelirrie uranium mine proposal is likely to make a number of subterranean fauna extinct. This aspect of this proposal makes it impossible for the EPA to achieve its objectives in relation to the conservation of subterranean fauna. Yeelirrie has extremely high diversity and short-range endemism of the subterranean fauna making it highly likely that many restricted species of stygofauna and troglofauna are going to suffer high or critical impacts as a result of mining. 15 species (10 stygofauna and 5 troglofauna) are critically in danger of becoming extinct if this proposal is approved.	The submitter should refer to the response to other comments above, in particular comment 2, and note that Cameco has committed to additional management and mitigation measures for subterranean fauna, Attachment 3.
33.	S Ludlam;	Enough information has been provided to place the 15 species on the Threatened species lists under the *Wildlife Conservation Act 1950* and/or the *Environment Protection and Biodiversity Conservation Act 1999*. Given this, the EPA should assess these species as equivalent to Threatened species.	As presented in Attachment 3, Cameco has further reduced the Project impact to subterranean fauna through additional management and mitigation measures. As discussed in the PER and in response to Comments above, Cameco has utilised EAG12 to provide discussion on the likelihood that the species currently only known from the impact area have range extensions beyond the area of impact. The submitter should refer to the response to Comments above for more information.
34.	PS18; PS39; PS41; PS42; PS46	Impacts to subterranean fauna that are only known from the pit area. The EPA is obliged to ensure that biodiversity is not lost. Further targeted surveys should be carried out outside of the pit areas prior to ground disturbing activities in order to find the 15 species. The period of the survey and number of rounds should be agreed with the WA Museum. Alternatively, a significant offset should be developed. The Bennelongia report is one of the poorest reports I've seen on subterranean fauna. It includes numerous sweeping statements without reference or supporting data. The survey and analytical methods are not detailed and this makes it difficult to compare the outcome of the surveys with those of Subterranean Ecology's surveys. Data disclosure has also been patchy with none of the DNA sequences published in either the Bennelongia report or the Subterranean Ecology report. This data should have been made available to review. Without this and descriptions of methods of sampling the reports cannot be adequately reviewed or compared.	The submitters should refer to the response to other comments above, in particular comment 2, and note that Cameco has committed to additional management and mitigation measures for subterranean fauna, Attachment 3. This includes the commitment to undertake more habitat sampling prior to commencement of the Project. Cameco strongly disagrees with the comments regarding the quality of work presented. As discussed in response to OEPA Comment on subterranean fauna, sampling was undertaken in accordance with GSA54 and EAG12. Statements regarding inferred surrogates were also made in accordance with EAG12, as discussed in response to Comment 26. The term widespread is defined in the subterranean fauna assessment (Appendix F1 to the PER)

No.	Submitter	Submission and/or issue	Response
		The term 'widespread' is used inappropriately to describe the distribution patterns of locally endemic species after Bennelongia redefine the terms on page 6 of their report. Bennelongia's definition requires the presence of records of species in two or more of any or their defined areas/sectors. In subterranean fauna and short range endemic reports, the term widespread is used to imply species with distributions that are greater than those defined by Harvey (2002) for SRE's. The entire survey area is well within the defined limits of short range endemism (<100km2). A species restricted to the survey area, but recorded from all the nominated sectors would still be range restricted, NOT widespread. There is no logical reason given for this and doing so significantly undermines the HIGH levels of endemicity of both troglofauna and stygofauna at Yeelirrie. Cameco has only provided general management measures to minimise the potential impacts to these species. Can Cameco be sure that that the proposed management measures will ensure none of the subterranean fauna species only known from the mine pit and drawdown areas are lost as a result of the Project? I would recommend that the EPA and Environment Minister deny approval of the Project until Cameco can demonstrate that no subterranean fauna will go extinct as a result of dewatering and mining from the Yeelirrie orebody.	

3. Flora and Vegetation

No.	Submitter	Submission and/or issue	Response
1.	P&W	The complete removal of the western genotype represents an extreme and unacceptably high level of risk to the conservation of the western genotype in the wild. This current level of impact cannot be supported by P&W. Can the proposal be amended to reduce the impacts on *Atriplex* sp. Yeelirrie Station to ensure that a self-sustaining population of the western genotype conservation unit is retained in situ?	Cameco has considered the potential to retain some of the western genotype population in situ but considers that a remnant population would not be sustainable. None of the sub-populations of the Western Genotype occur on the margins of the orebody. This means that any remnant population would be in the middle of the mine and at closure surrounded by a large area of mine tailings with changed surface and groundwater hydrology. On this basis Cameco considers a remnant population is unlikely to be self-sustaining and the option was not considered viable. Cameco has also considered the proposal of a staged approval approach to mine development dependant on demonstration of successful establishment of viable self-sustaining populations. However, as there are many factors

No.	Submitter	Submission and/or issue	Response
			associated with this goal that are outside of Cameco's control, this approach would not provide the long term security of access to the deposit that is required before a final investment decision could be considered. Cameco would not be opposed to a conditioned staged approach to clearing the *Atriplex* population on the orebody, based on the implementation of the commitments made by Cameco. This approach may provide a level of confidence to Agencies that tasks that are important to the successful translocation of *Atriplex*, have been completed as outlined in the Management Plan before the population was fully cleared. Since submitting the PER, Cameco has undertaken further work to consider the range of options available to enhance the likelihood of successful translocation to replace the population to be removed by mining. The discussion and commitments are presented in Attachment 8.
2.	P&W	*Atriplex* sp. Yeelirrie Station currently has an International Union for Conservation of Nature (IUCN) threat category ranking of vulnerable. The complete loss of the western genotype coupled with continued decline of the eastern genotype, including with respect to area, extent and/or quality of habitat, and potentially number of individuals or area of occupancy, could lead the taxon meeting the IUCN criteria for listing as critically endangered. Arresting the decline of the eastern genotype could reduce the potential for the threat category to change to this extent.	At this time, there is no evidence to support the claim that the Eastern population is in decline. While the condition of the *Atriplex yeelirrie* (*A. yeelirrie*) sub-populations within the eastern genotype's area of occupancy has been assessed in 7 quadrats (Western Botanical 2015, WB844), the areas of differing vegetation condition rating at this site have not been mapped specifically and no conclusion can be drawn on the relative areas of occupancy of differing condition ratings of *A. yeelirrie* health. However, the majority of area of occupancy of *A. yeelirrie* within the eastern population is considered, based on the recent surveys, to be in good to excellent condition. Further there was no detected difference between the western and eastern populations of *A. yeelirrie* for any of the measured variables and no difference in plant density once the outlier sites were accounted for. The western and eastern populations of *A. yeelirrie* can be considered equivalent in adult plant characteristics (Western Botanical 2015, WB844, pages 17 - 19) based on sampling conducted to date. While some parts of the eastern population are acknowledged as degraded, the processes involved in influencing this are not well understood and not fully quantified, i.e. the areas of differing condition rating have not been fully mapped. There is little human influenced activity at this site and the mechanisms for changes in vegetation condition are probably related to natural processes such as heavy rainfall events, flooding and inundation events, drought events, periodic natural changes in salinity within the palaeochannel and Playa System. For example, as soil moisture content for the eastern genotype is higher than for the western genotype, degraded areas may be associated with some plants being more susceptible to inundation rather than the entire population being in decline (Western Botanical report (Appendix E7) in Section 3.3.1, p. 25). The evidence of cattle within the eastern population was observed, however, *A. yeelirrie* has been observed regenerating strongly following grazing by cattle (G Cockerton pers. obs.). Yeelirrie Station has been officially destocked since before it was purchased from BHP Billiton in 2012. Prior to the purchase of the Project by Cameco, pastoral leases owned by BHPB were operated collectively and there is no boundary fencing between Yeelirrie, Yakabindie and Albion Downs pastoral leases, so it has been impossible to exclude livestock despite Yeelirrie being destocked. While the eastern population is located more than 3 km within Yeelirrie Station, a stock watering point operated by BHP Billiton's pastoral group is located within Yeelirrie resulting in cattle grazing within Yeelirrie and in and around the eastern population.

No.	Submitter	Submission and/or issue	Response
			Cameco is committed to excluding grazing of the eastern population. We have commenced discussions with BHPB over decommissioning or moving the watering point and about upgrading existing fences and installation of boundary or enclosure fencing to exclude cattle from neighbouring properties from the eastern population. These discussions are ongoing. Cameco has also budgeted to commence fencing of the area in coming years, see Attachment 8 for more information.
3.	P&W	The proposed full removal and translocation of the western genotype of *Atriplex* sp. Yeelirrie Station represents a high risk strategy with a low likelihood of success. It is probable that if the habitat requirements of this taxon had allowed it to readily establish viable, self-sustaining populations on other landforms or in other areas in the past, the distribution of the taxon would not be as restricted as it currently is.	Translocation of *A. yeelirrie* is one option adopted by Cameco and is seen as a viable and effective mechanism of offsetting the impacts of mining the western population. Cameco acknowledges that investigations and reporting on only one set of sites at Lake Mason has not provided complete confidence that translocation can be achieved with an acceptable level of risk. Since submitting the PER, Cameco has identified further possible sites and undertaken additional surveys and soil sampling of these places to demonstrate that further potential sites are available. Cameco considers there are now up to four locations where translocation is feasible. These include the sites at Lake Mason, a new location on Yakabindie Station and reintroduction to two areas of specifically designed and environmentally engineered mine voids early in the mine development program. The details of the additional work completed (the new Proposal) at each site is presented in Attachment 8. Each site has challenges related to topography, soil characteristics or land tenure and these issues are also considered. Cameco believes the commitment to translocation over multiple sites rather than just one site reduces the risk and increases the likelihood of success. There are also a number of other factors and proposals which Cameco believes go towards minimising the risk and increasing the chances of success of translocation which should be further considered. These include project timing, commitment to implementation, eco-physiological research and trials program and seed collection as outlined below: **Project timing** One aspect of the Yeelirrie Project not presented in the PER is the long lead time for the Project. The long planning timeline and the fact that some of the Western population would not be disturbed until after halfway through the mining schedule means there is a long lead time for Cameco to undertake works and demonstrate successful translocation before the last of the *A. yeelirrie* within the Western population would be removed. That is, the removal of the western population can also be staged as a risk minimisation strategy. Following approval, if Cameco were to move directly into a definitive feasibility study and then into design and construction there would be a four to five year delay before the commencement of ground disturbing activity within the mine open pit area. Other than for the purposes of translocation, the Western population would not be disturbed during this time. Under the mine plan, mining will commence in the south eastern end of the open pit. The southernmost populations of the *A. yeelirrie* will be cleared during year 1 but the last area would not be cleared until year 8 of mining. This means there is at least between 10 and 12 years of Project implementation before the last sub populations of *A. yeelirrie* would be cleared providing a significant period for the completion of the proposed eco-physiological studies and commencement of translocation field trials.

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<tr><th>No.</th><th>Submitter</th><th>Submission and/or issue</th><th>Response</th></tr>
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Eco-physiological research and trials program

Cameco proposes a comprehensive research and trials program. The program which is presented as Appendix 2 of Attachment 8 of the Response to Submissions, includes laboratory based research and field trials that will support proposed broad translocation programs.

Seed Collection

Seed collection of the western genotype of A. yeelirrie has already commenced and will be continuing to ensure (i) adequate seed resources from the western population is retained in long-term ex-situ seed storage and (ii) is available for translocation and rehabilitation programs. Seed from the eastern population will also be collected for storage to protect against the impact of a catastrophic event on that population.

Test results presented in the PER show that seed holds its viability at least in the short to medium term and Cameco commits to working with the Seed Bank to establish a seed collection and conducting storage and viability testing.

Commitment to implementation

<table>
<tr><td>Phase 1 - Post approval and pre commitment to Definitive Feasibility Study</td></tr>
<tr><td>Year 1-3: A budget of $50,000.00 per year for three years has been allocated to advance preliminary investigations.

Year 1. (2016) Cameco will commence the translocation trial program outlined in Section 3.1.1 above.

Year 2. Continue with the trial program. Undertake a population survey of the Eastern and Western populations.

Year 3. Continue with the trial program as required. If funds are available commence the research program outlined in Section 4 above.</td></tr>
<tr><td>Phase 2 –DFS</td></tr>
<tr><td>Complete the research program
Continue to monitor the trial program
Secure access to translocation sites
Seed translocation sites</td></tr>
<tr><td>Phase 3 – Post commencement of Mining</td></tr>
<tr><td>Year 2 of mining: backfill south-eastern mining cell and seed
End of mining: backfill north-western mining cell and seed</td></tr>
</table>
</td></tr>
<tr><td>4.</td><td>P&W</td><td>The habitat requirements of Atriplex sp. Yeelirrie Station require further investigation.</td><td>Agreed. Cameco acknowledges that more work on the habitat requirements of A. yeelirrie is required.

Cameco has given consideration to the proposal previously submitted to BHP Billiton – Ecophysiology, Seed Biology and Translocation of A. yeelirrie – A research program to guide post mining restoration, and has prepared a revised</td></tr>
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No.	Submitter	Submission and/or issue	Response
		Without a comprehensive understanding of habitat requirements for the taxon, predictions of whether adequate potential habitat exists within Lake Mason (or outside the taxon's current range) are considered unreliable. Without scientific investigation of the ecophysiology of the taxon in relation to inundation, tolerable ranges for salinity, and other physical and chemical soil characteristics, statements of inferred limitations or determinants of the taxon's distribution have limited reliability. Field observations (as reported in Appendix E7) described the area where *Atriplex* sp. Yeelirrie Station occurs as a complexity of habitat soil stratigraphy characters within the clay flats and palaeochannel and indicate that this fine scale variation can influence variation in plant density and plant characters. Without investigation of the factors influencing this apparent fine scale variation, the optimal / critical habitat for the taxon cannot be reliably discerned. Given the unusual and specific properties of the soil profile of *Atriplex* sp. Yeelirrie Station and the uncertainty as to what inundation periods *Atriplex* sp. Yeelirrie Station requires, it is unclear whether mounding of the soil could replicate the conditions in which this taxon naturally grows. An assessment of the potential impacts on Lake Mason and the associated vegetation and flora would also need to be undertaken prior to commencement of habitat modifications.	program for consideration. This is included in the new proposal as Appendix 2 of Attachment 8 of the Response to Submissions.
5.	P&W	The elevated salt levels at Lake Mason and their implications for establishment and long term survival of *Atriplex* sp. Yeelirrie Station could also be an issue in understanding habitat and potential suitability for a translocation site, but this aspect is not discussed in the PER in detail.	Cameco recognises that not all of the soils data collected during the field investigations was reported in the PER and that further analysis has been conducted since lodging the PER. It should be noted that the elevated salt levels recorded at Lake Mason are similar to salinity ranges seen in a number of the sampling locations at natural sites containing healthy *A. yeelirrie* where the average salinity recorded in the upper 0.5 m of profile were within the range of 800 to 1,200 mS/m. Cameco recognises that salinity and other soil characteristics require further additional work to better understand both the requirements and the constraints to translocation. Additional work is presented in the Proposal presented in Attachment 8.
6.	P&W	There is an apparent deficiency in the area / amount of inferred habitat that has been identified by the proponent as suitable for translocating *Atriplex* sp. Yeelirrie Station compared to the amount that is proposed to be impacted.	Cameco acknowledges that the areas of sites investigated and presented in the PER are not sufficient to replace all of the areas of the western population and since releasing the PER we have continued to look at other locations and details of these areas are presented in the Proposal. While it is accepted that further sites need to be identified, the site investigation work undertaken to date demonstrates that the site characteristics of the Project area are not unique.

No.	Submitter	Submission and/or issue	Response
7.	P&W	The difference in species diversity and assemblage between the natural and rehabilitation populations may indicate that, as with other translocated rare species, that *Atriplex* sp. Yeelirrie Station cannot withstand competition with more adapted species and persist outside of its natural habitat.	The differences in observed soil type and associated species between the natural populations of *A. yeelirrie* and the southern stockpile rehabilitation area indicate that while *A. yeelirrie* was able to establish in this area, it is probably not a suitable site for long term survival of the species. The soil supporting natural populations of *A. yeelirrie* is a medium to heavy alkaline and slightly saline smectite clay with a high moisture content, while the soil of the southern stockpile rehabilitation area is a dry non-saline silty sand. Occurrence of *A. yeelirrie* at this site is acknowledged as accidental and an artefact of the rehabilitation program implemented in 2005. It is also obvious that many of the species that provide competition at the rehabilitation site would not establish in the saline soils similar to the natural habitat of the *A. yeelirrie* and therefore the competition would not be from the same species.
8.	P&W	Whilst the presence of *Atriplex* sp. Yeelirrie Station in areas rehabilitated following mineral exploration activities indicates that initial conditions were suitable for plant establishment, the two demographic studies (Appendix E7 and E8) have identified that the 'rehabilitation population' displays: - Poorer (disproportionate) health / condition of the plants when compared to the natural populations. - Poor seedling recruitment. - Lower density of plants than was expected (<12 per cent of the expected number of adult plants per plot and <21 per cent of the expected number of seedlings per plot). - Reduction in overall population size with the number of plants persisting in the rehabilitation area reduced by 35 per cent between August 2014 and March 2015. On this basis, the long term viability of *Atriplex* sp. Yeelirrie Station plants as a population at the rehabilitation site has not yet been established and the trends in data available suggest that this population may not persist.	Agreed, however the presence of *A. yeelirrie* in these areas also indicates that it can persist in what would be considered highly unsuitable soil conditions. For example soil water holding capacity at the rehabilitation site was much lower than in natural sites (3% PAW in subsoil in comparison to an average of over 20% in natural sites). This argues against ruling out sites which are not 'very similar' to native sites without compelling reasons or trials. Cameco believes that the updated management and mitigation proposal (Attachment 8) presents a number of options which are likely to be successful. The rehabilitation site was never put up as a demonstration of a suitable translocation site, however, it does show that *A. yeelirrie* was able to establish from seed on strongly contrasting, non-saline soil types, with plants persisting for a period of 9 years. Cameco will continue to take observations from the rehab population to track its response to seasonal conditions and seedling recruitment.
9.	P&W	Plants of the taxon appear to be long lived, made up of male and female plants (dioecious) and the natural populations have a naturally low recruitment rate. As such, the number of individuals established in a translocated population would need to be at least double that required for a monoecious (male and female on a single plant) species that was being translocated. In addition, the ratio of male to female plants would need to be similar to the natural population (in this case, 1:1).	Understood. The measured male to female plant ratio in natural populations met the expected value of 50:50% (PER page 141). These populations have arrived at this status naturally. *A. yeelirrie* regenerates from seed and is not regarded as significantly clonal. It is expected that any new populations of *A. yeelirrie* will be established from seeds applied in direct seeding. It is also expected that the male to female ratio of resulting seedlings will approximate the expected 50:50 value. The numbers of plants in natural populations did not discriminate sexes and overall population numbers are of equal sex ratio. The numbers of plants that may be targeted in rehabilitation or translocation should at least aim to mirror the number of plants reported in the baseline assessment of *A. yeelirrie* on the Yeelirrie orebody area (84,510 plants, being

No.	Submitter	Submission and/or issue	Response
		High levels of seedling mortality have been observed in the natural populations and recruitment appears to be highly variable across the natural populations, possibly due to highly site specific hydrological factors and soil properties (that are not understood) affecting the germination, establishment and survival of young plants. In highly variable environments such as Yeelirrie or Lake Mason, establishing populations that are able to cope with this variability, with enough individuals of the correct male to female ratio and effective recruitment would be a challenge.	50% male and 50% female (PER, page 141). It is not expected that male to female plant ratios in rehabilitation or translocation will be difficult to achieve given adequate sample size. High levels of seedling recruitment were observed in August 2014 (PER, page 141) while these small seedlings to 5 cm high were absent in subsequent site assessment in March 2015. Deaths of these small seedlings probably occurred due to a period of extended inundation following a high cyclonic rainfall event in January – February 2015. The presence of mature plants of *A. yeelirrie* on low soil mounds in its natural habitat may indicate the species preferentially establishes in areas where the micro-topography of the soil protects young seedlings from extended inundation.
10.	P&W	The Soil Water Group report (Appendix E5) provides no explanation of how this analysis was undertaken or what characteristics were used to define the 'optimal' translocation sites at Lake Mason. Additionally, other available information presented in PER Appendices (e.g. Appendix E9) appears to conflict with a suggestion that sites 4, 5 and 6 provide optimal habitat.	The use of the sub-optimal and optimal wording was intended to indicate which sites were considered to be more suitable as potential translocation sites relative to each other, not to state that the sites were ideal or that translocation was guaranteed to succeed at these sites. The criteria for defining which sites are better or worse than each other will be clearly laid out and presented in parallel with the new data and statistical analysis discussed. Additional soil testing has been completed as part of the response to submissions and the results are included as Appendix 2 of Attachment 8 of the Response to Submissions.
11.	P&W	The three proposed 'optimal' translocation sites appear to have different soil profiles / characteristics to those supporting the natural populations of *Atriplex* sp. Yeelirrie Station. The upper clay horizon appears to be an important factor with regard to potential habitat for *Atriplex* sp. Yeelirrie Station and it is therefore unclear how Lake Mason site 4 was identified as 'optimal' habitat. Sites 5 and 6 differ from the majority of upper soil profiles associated with *Atriplex* sp. Yeelirrie Station natural populations. Both sites 5 and 6 also appear to have salinities higher than the average salinity of the areas where *Atriplex* sp. Yeelirrie Station plants were healthy and a lower kaolinite content. Site 5 additionally contained a higher calcite and bassanite content that the other sites.	As above.
12.	P&W	In the report on the Soil Water Group investigation (Appendix E5), data for both the western and eastern populations, as well as some data with respect to the potential translocation sites, is provided but with insufficient analysis and discussion	The data set was preliminary and not of sufficient detail to warrant detailed statistical analysis. As a result, Cameco has engaged Soil Water Group to undertake further test work and sampling. The additional work has allowed the use of more

No.	Submitter	Submission and/or issue	Response
		comparing the soil profiles of *Atriplex* sp. Yeelirrie sites with those of the potential Lake Mason translocation sites.	sophisticated analytical techniques (e.g. ordination / multivariate analysis). The results of this additional work is presented in Appendix 2 of Attachment 8 of the Response to Submissions.
13.	P&W	In view of the apparent difficulties in identifying a suitable natural translocation site for *Atriplex* sp. Yeelirrie Station with similar soil profiles and materials to the natural populations, there would appear to be value in further consideration of utilising soil from the pit areas to construct a suitable 'translocation soil profile' near the mine. The aim of this approach would be to establish an upper soil profile at the new translocation site with similar materials and depths of materials to the current soil profile underlying the western population. An assessment of potential impacts on conservation values at the translocation site (vegetation, flora and fauna) would need to be undertaken prior to a final decision on the translocation site.	Agreed. These options have been presented in the new Proposal (Attachment 8). Cameco proposes to re-establish habitat within a specifically designed and environmentally engineered mine void early in the mine development program. This will involve transferring the soil supporting the community from the existing location within the mine path to an early mine void generated in the first year of mining. Subsoil and surface soil characteristics and the sub-surface surface hydrology will be carefully reinstated to match the natural condition to maximise the performance in rehabilitation of the component species of the community.
14.	P&W	The proposal within the PER, to protect the site of the eastern genotype population as a conservation area, requires clarification in relation to scope, mechanism and timeframe for protection, and identifies and discusses the potential obligations and practicality for Government of such a proposal. Although the proposed conservation measures with regard to the eastern population are supported on face value (if they can be implemented appropriately and in a timely fashion), these measures would not directly offset or compensate for the total loss of the only natural population of the western genotype.	Cameco understands there are a number of options for the protection of the eastern population, ranging from vesting the whole of the pastoral lease to a conservation agency, to establishing a "reserve" over the population area within the pastoral lease. Should the Project be approved, Cameco commits to engaging Government to investigate and determine the best option to ensure the long term conservation of the eastern genotype. Cameco understands that conservation of the eastern genotype will not directly offset for the loss of the western population and has therefore proposed the range of other management measures including the research proposal, translocation and seed banking for the western genotype.
15.	P&W	The proponent should clarify whether the increasing salinity at the eastern population may pose a threat to the conservation of the eastern population, what the potential causes of increasing salinity are and (if required) what possible mitigation measures could be employed to address the threat.	There is no evidence available to suggest that the salinity levels at the eastern population are increasing or will increase. Cameco is unsure what evidence the Department of Parks and Wildlife are referring to with this comment. It is apparent that the eastern population is subject to the range of natural stressors, including flooding and drought that may result in changing population densities and dynamics, but Cameco is unable to say whether the changes are as a result of increasing salinity and if it is the case what is causing that increase. As discussed in response to Comment 2 above, the majority of area of occupancy of *A. yeelirrie* within the eastern population is in good to excellent condition. Further there was no detected difference between the western and eastern populations of *A. yeelirrie* for any of the measured variables and no difference in plant density once the outlier sites were accounted for. The western and eastern populations of *A. yeelirrie* can be considered equivalent in adult plant

No.	Submitter	Submission and/or issue	Response
			characteristics (PER, page 141 and Western Botanical 2015, pages 17 – 19). While some parts of the eastern population are acknowledged as being in poor condition, the processes involved are not well understood and not fully quantified.
16.	P&W	The PER states that the residual risk of the proposal to conservation of *Atriplex* sp. Yeelirrie Station is Medium to Low with the comment that "*Sufficient work has been completed to indicate, with a reasonable level of confidence, that sustainable replacement populations can be established to maintain long term genetic diversity"* (PER, page 118). Based on the information available from the PER and other sources, Parks and Wildlife does not agree with this conclusion and considers that the proposed impacts on this taxon are unprecedented and that the proposed translocation is a high risk strategy with a low likelihood of success.	Cameco has considered the concerns raised by the Department of Parks and Wildlife and has now prepared a new Proposal including increased management and mitigation measures (Attachment 8). Cameco believes the new proposals decrease the risk and increase the likelihood of success of translocation. In summary, the measures include: • Conservation and reservation of the eastern population. • Implementation of a targeted research and trials program on ecophysiology, seed biology and translocation. • Reintroduction of the western genotype within a specifically designed and engineered mine void early in the mine development program. • Seed collection of the western genotype. Seed collection has already commenced and will be continued to ensure (i) adequate seed resources from the western population is retained in long-term ex-situ seed storage and (ii) is available for translocation and rehabilitation programs. • Seed collection from the eastern genotype of *A. yeelirrie* will be implemented for ex-situ storage at the DPaW Threatened Flora Seed Centre. • Translocation trials and implementation of translocation of the western genotype to suitable areas on Lake Mason within the southern Yeelirrie palaeochannel on Yakabindie Station, commensurate with negotiations on developing security of conservation tenure over the translocated population.
17.	P&W; DotE; Wildflower Society	The PER (page 137) states that no flora species of conservation significance listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) have been recorded in the local or regional study areas. This statement was correct at the time of publication, however, it should be noted *Atriplex* sp. Yeelirrie Station was recently listed as endangered under the EPBC Act. Whilst this listing does not have implications under the Threatened Species trigger, the species and its relative importance will need to be considered under the nuclear action 'whole of environment' assessment. The EPBC listing of the *Atriplex* sp. Yeelirrie Station included Conservation Advice which requires addressing. Please provide an assessment of the proposal against the approved Conservation Advice for *Atriplex* sp. Yeelirrie Station.	*A. yeelirrie* is specifically assessed in the PER in accordance with the requirements of the *Environmental Protection Act 1986*. Accordingly, no particular significance attaches to the change in threatened species listing under the EPBC Act. However, Cameco acknowledges that *A. yeelirrie* was listed as Endangered under the EPBC Act 1999 (Cth) and published on 14/10/2015, after the PER was drafted and approved for release for review. (*Amendment to the lists of threatened species, threatened ecological communities and key threatening processes under Sections 178, 181 and 183 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (182) (14/10/2015)).* Even though the Conservation Advice is not a mandatory consideration under the EPBC Act, the threats identified in the Conservation Advice for *A. yeelirrie* are noted and addressed below. **Grazing by stock** Yeelirrie Station is destocked and has been for at least the past 15 years (Doug & Lucy Brownlie, previous manager of Yeelirrie Station, pers. comm.). The eastern population of *A. yeelirrie* is currently subject to occasional grazing by vagrant livestock from adjacent pastoral stations. Cameco has commenced discussions with the owners of the neighbouring pastoral leases to fence the eastern population of *A. yeelirrie* to exclude stock. The fencing will be undertaken when an agreement is reached and will be maintained throughout the life of mine and beyond during the period for which Cameco maintains responsibility for the site. *A. yeelirrie* plants have been observed in August 2014 and March 2015 recovering from grazing and associated trampling by vagrant stock (G Cockerton pers. obs). A minor proportion of *A. yeelirrie* plants within the eastern population were observed suffering direct grazing in August 2014 and March 2015 (G Cockerton pers. obs.). Based on these observations, it can be confidently stated that grazing by cattle does not at present impact major proportions of the eastern genotype population. No grazing of the western genotype population has been observed. **Weeds** *Acetosa vesicaria* is a weed known from the Yeelirrie Station where it is most commonly found in the revegetated

No.	Submitter	Submission and/or issue	Response
			rehabilitated stockpile areas and on the margins of tracks (Landcare Services 2011). *Acetosa vesicaria* is not a major competitor with *A. yeelirrie* in its natural habitat on the red clay flat and records of this species are restricted to a few scattered individuals in this habitat (Landcare Services 2011). Cameco commits to monitoring and managing *Acetosa vesicaria* throughout the life of mine and during establishment of revegetation. **Mining Exploration** Mining of the Yeelirrie orebody will involve taking the total western genotype population. Cameco has committed to a range of mitigation measures to address this level of impact on the species, inclusive of the aspects discussed in other responses.
18.	P&W	If the proposal is considered for approval, a condition of approval is applied that: • ensures that the proposal does not have a direct impact on the Priority 1 *Rhagodia* sp. Yeelirrie Station individuals or habitat; • ensures that the potential indirect impacts of the proposal on *Rhagodia* sp. Yeelirrie Station individuals and habitat are monitored and managed, with the monitoring and management to be developed in consultation with Parks and Wildlife.	Cameco has taken measures to ensure that there are no direct impacts on the P1 species *Rhagodia* sp. Yeelirrie Station. The populations of *Rhagodia* sp. Yeelirrie Station closest to proposed mine infrastructure will be bunded off from the ensuing development and no direct impacts will influence the site. However, it is acknowledged that bunding of the minesite infrastructure may alter the surface hydrology of the playa supporting *Rhagodia* sp. Yeelirrie Station at this site. The ingress and egress points as well as the levels of water within the clay pan and associated resident flooding timeframe will be carefully managed so that there are no adverse indirect impacts to the species from this activity. Monitoring and management of the population of *Rhagodia* sp. Yeelirrie Station will be implemented, in consultation with DPaW, to ensure that there are no indirect impacts to the population at this site. Following approval of the Project, Cameco will undertake a regional survey for *Rhagodia* sp. Yeelirrie Station to (i) confirm numbers of the species at known populations which have not as yet been quantified and (ii) to search for further populations in the region.
19.	P&W	The local population of Priority 3 *Eremophila arachnoides* subsp. *arachnoides* at Yeelirrie is the largest recorded population of this species. The potential for 26.5 per cent combined direct and indirect impact (risk largely from flooding) may potentially be significant at the local and regional scale. However, it should be noted that impacts at regional scale are difficult to determine due to the lack of reliable data. The potential impact of the proposal on the Priority 3 *E. arachnoides* subsp. *arachnoides* in a local and regional context should be clarified by the proponent as far as is possible using available data sources.	*Eremophila arachnoides* subsp. *arachnoides* is known from the following seven palaeochannel systems within an area that spans 200 km east-west and 420 km north-south. • Yeelirrie Station. Population of 43,255 plants over an area of approximately 2,688 ha estimated within and adjacent to the Yeelirrie development envelope (Study Area 1), not fully defined in the south-eastern extent of the Yeelirrie palaeochannel (Study Area 3) and absent from Lake Miranda. See Attachment 9, Figures 1, 2 and 3. Population numbers have been estimated and mapped (Western Botanical 2010) and is represented at the WA Herbarium (WAHERB) by one specimen. • Lake Mason palaeochannel, approximately 60 km south of Yeelirrie. Population not quantified or mapped in detail, however, scattered plants and groups of plants were observed in April 2015 by Western Botanical during a survey of the Lake Mason System. *E. arachnoides* was growing with *Eremophila pantonii* in open shrublands on calcrete platforms with Eragrostis sp. Yeelirrie calcrete (S Regan LCH26770) perennial grass cover, or as a component of the midstorey shrubs either with *Eucalyptus gypsophila* on Calcrete or with Casuarina pauper on calcrete. Represented by 12 records by Western Botanical and one specimen vouchered at the WA Herbarium. • Lake Noondie palaeochannel, approximately 120 km south of Yeelirrie. Though not quantified, qualitative notes taken during regional surveys indicated that the largest populations of *Eremophila arachnoides* subsp. *arachnoides* recorded during the Western Botanical Regional Surveys for BHP Billiton were seen on Pinnacles

No.	Submitter	Submission and/or issue	Response
			Station, Lake Noondie, Attachment 9, Figure 4. Represented by 13 records by Western Botanical and three specimens vouchered at the WA Herbarium. • Lake Way palaeochannel, approximately 55 km north-east of Yeelirrie. Toro Energy reported 23,440 plants of *Eremophila arachnoides* subsp. *arachnoides* occurring on calcrete expressions on the margins of Lake Way in their ERMP document (Toro Energy, July 2011), Attachment 9, Figure 5. Of these, only 344 individuals were to be directly impacted by that development. Represented by 12 records made by Western Botanical, however, no vouchered specimens from this region appear on the WA Herbarium's database. • South of the Lake Nabberu Palaeochannel system, 183 km north of Yeelirrie. Toro Energy reported up to 18,000 individuals of *Eremophila arachnoides* subsp. *arachnoides*, the numbers being extrapolated from in two transects in the Lake King area, a sub-set of the Lake Nabberu system (Toro Energy, July 2011), Attachment 9, Figure 6. One vouchered specimen from this region appears on the WA Herbarium's database and Western Botanical has made one record at this site. • Little Sandy Desert, on an isolated small calcrete outcrop some 100 km NNE of Lake Nabberu, Attachment 9, Figure 6. Represented by one vouchered specimen at WA Herbarium. Population not quantified, however, noted growing with other *Eremophila* species including *E. pantonii*. • Lake Yarrabubba palaeochannel, approximately 100 km west of Yeelirrie, represented by one specimen vouchered at WAHERB and a further two specimens at the Adelaide Herbarium (ADHERB), Attachment 9, Figure 7. Population not quantified or mapped and no vegetation associations noted. An analysis of the estimated population numbers of *Eremophila arachnoides* subsp. *arachnoides* shows that overall, around 85,015 individuals are known (Attachment 9, Table 1). The population numbers at Yeelirrie Study Areas 1, 2 and 3; at Lake Way and south of Lake King (part of the Lake Nabberu Palaeochannel) have been estimated using transects and extrapolation of numbers based on densities and area of occupancy (Western Botanical 2010, Niche Environmental 2011, 2014). In addition to these reasonably accurate estimates, a number of records using GPS were made during regional surveys conducted by Western Botanical for BHP Billiton and ten records are available on the WA Herbarium's FloraBase website. A review of the DPaW Threatened and Priority Flora File conducted on 1st February 2016 for *Eremophila arachnoides* subsp. *arachnoides* showed there were six records of the species. However, of these, five were found to be erroneous or highly likely to be erroneous and all were lacking any vouchered specimens at the WA Herbarium. Only the correspondence dealing with the populations reported by Toro Energy at their Lake Way and the regional Lake King (Lake Nabberu) populations being verifiable based on suitable habitat and corroborated evidence collected by Western Botanical or other sources. Reports of the species north of Jaurdi Station, at Wiluna West and near Sandstone were all considered, upon analysis of the habitats in which they were reported and in consultation with one of the individuals involved in said surveys and reports, as most likely being of *Eremophila pantonii* or of other species as yet unknown. *Eremophila arachnoides* subsp. *arachnoides* is a calcrete endemic species of the north-eastern Goldfields of Western Australia. It is always associated with the alkaline soils of the Cosmo, Cunyu, Mileura and occasionally the Melaleuca Land Systems (Pringle et. al. 1994) of the region. Using this as a basis for determining potential suitable habitat for the species, but restricting this analysis to Palaeochannels from where there are positive records of the species, it is estimated the area of habitat which could possibly support the species may be in the order of 45,958 ha. Where *Eremophila arachnoides* subsp. *arachnoides* is present, it is usually represented by large, old, multi-stemmed plants. Seedlings or juvenile plants are infrequently encountered. *Eremophila* seed in general has numerous built-in dormancy mechanisms through having an impervious hard woody seed coat and chemical based endogenous dormancy

No.	Submitter	Submission and/or issue	Response
			mechanisms. Seeds are stored in the soil and may be long lived, however, infrequently are exposed to the appropriate dormancy breaking mechanisms coinciding with suitable climatic conditions for establishment. Further, the sites supporting *Eremophila arachnoides* subsp. *arachnoides* are largely not impacted by soil disturbing activities and the soil surface is lightly impacted by grazing cattle. The numbers representing the species at areas of occurrence are therefore largely old plants. Seedlings of the species have been noted at Yeelirrie where tracks have been created within the calcrete landforms in the past. Seeds can therefore germinate following ground disturbing activities. The populations of *Eremophila arachnoides* subsp. *arachnoides* at Yeelirrie (Study areas 1, 2 and 3), Lake Way and Lake Nabberu have been assessed in some detail. Other sites of known occurrence are represented only either by GPS records of occurrence or by specimens lodged at the WA (8 specimens) or Adelaide (2 specimens) Herbaria. The Yeelirrie, Lake Way and Lake Nabberu populations occupy around 16,530 ha (of the potential habitat that could support the species in the region, representing 36% of the total area of potential occupancy. The density of populations of live plants within populations can vary significantly and it would be imprecise to extrapolate total numbers of plants likely based solely on an analysis of the area of suitable habitat - calcrete landforms in the region. However, as only 3 of the 7 extensive palaeochannel systems supporting the species have been surveyed in detail, it would likely follow that further survey of these sites would elucidate significant further numbers of the species. The Yeelirrie Project will directly impact 5,120 individuals of *Eremophila arachnoides* subsp. *arachnoides* (11.84% of the local population within the western Yeelirrie palaeochannel) and a further 6,350 individuals (14.68% of the local population) lie within an area of potential indirect impact. The total potential impact is therefore 11,470 plants representing 26.52% of the local Yeelirrie palaeochannel population. On a regional scale, however, these values only represent 6.02% directly impacted and 7.47% indirectly impacted by the Yeelirrie proposal, a total of 13.49% of the enumerated overall population. Given that only 3 of the 7 palaeochannels supporting the species have been assessed in any detail, it is surmised as likely that the overall extant population of this species is significantly greater than the available data suggests and that the proportional impact on the species by the Yeelirrie development would represent significantly less than the value of 13.49%.
20.	P&W	Of the vegetation units identified as having conservation significance (i.e. identified as restricted as per page 131 of the PER, or habitat for conservation significant flora), there are five vegetation units which are predicted to be impacted by more than 30 per cent, four of which are located on calcrete habitat ('C' is the first letter in the vegetation unit code) and (other than CLaS) are expected to have a limited distribution (PER, page 131). These include: • CEgW (restricted, phreatophytic, contains *E. arachanoides* subsp. *arachanoides* as a dominant species) – 46.4 per cent impact. • CCpW (restricted, phreatophytic) – 42.7 per cent impact.	The vegetation communities of the Yeelirrie Project area were mapped at NVIS 'Level V' Association where the dominant growth forms, height, cover and dominant species for each of the strata present were described. These were then linked to soil and landscape characteristics and the resulting vegetation – soil – landscape information was used to discriminate the vegetation associations mapped. The most recent and detailed publicly available regional-scale data on vegetation of the area encompassing the Yeelirrie Project is that by Pringle *et. al.* (1994) where land systems of the north-eastern Goldfields were mapped and their vegetation condition rated. Land systems are a very useful management tool for pastoral management and broader scale assessments over an extensive area. Each land system may contain many component vegetation associations as defined and mapped at Yeelirrie (Western Botanical 2010). However the available data sets are not suitable to map the finer level vegetation associations of the region. It is therefore not possible, prior to implementation of the Project, to determine the regional area of occupancy of each of these component vegetation associations definitively.

No.	Submitter	Submission and/or issue	Response
		• CApS (restricted, contains *Atriplex* sp. Yeelirrie Station as a dominant species) – 36.9 per cent impact. • CLaS (occasionally contains *Atriplex* sp. Yeelirrie Station, not as a dominant species) – 67.4 per cent impact. • SASP (contains Priority 3 *Euromyrtus inflata* as a dominant species) – 37.4 per cent impact. These impacts are significant, and measures should be put in place to minimise, monitor, manage and mitigate impacts on these restricted vegetation units; for example through the conditioning and implementation of the proposed flora and vegetation management plan.	**CEgW and CCpW communities** Both *Casuarina pauper* and *Eucalyptus gypsophila* are known to be common components of the calcrete platforms and gypsum lunettes fringing the saline palaeochannels in the Murchison biogeographic region. For example, extensive areas of both species are known by Western Botanical at Lake Way, Lake Miranda, Lake Mason and Lake Noondie although their areas of occupancy have not been mapped at this stage. While these communities are restricted to palaeochannels, the areas of the Cosmo, Mileura, Carnegie and Melaleuca Land Systems supporting them are extensive in comparison to the areas planned to be directly impacted at Yeelirrie (Cameco 2015). It is therefore unlikely that the CEgW and CCpW communities are as restricted as the current data indicates and rather the appearance of being restricted reflects a lack of data on distribution of these in the broader region. Cameco will minimise direct impacts to CEgW *Eucalyptus gypsophila* woodland and CCpW *Casuarina pauper* woodland communities within the Calcrete soil landscape system, through management of clearing during Project development. Cameco has an established internal procedure for obtaining permission for clearing and this will be utilised to manage clearing during the Yeelirrie Project. **CApS community** The western area of the CApS *A. yeelirrie* Shrubland community occupies 76 ha inclusive of a 10 m buffer around four sub-populations (71 ha excluding buffer). It lies within the orebody area and cannot be avoided in development of the Project. The eastern area of the CApS *A. yeelirrie* Shrubland community occupies 130 ha inclusive of a 10 m buffer around nine sub-populations (120.7 ha excluding buffer) and will not be impacted by the development. Mitigation actions for the proposed disturbance of this vegetation unit has been presented previously. **CLaS community** The *Lycium australe* community is closely associated with the margins of saline playa lakes and calcrete or gypseous platforms and dunes. It forms a highly variable playa lake fringing community and incorporates components of adjacent vegetation units within its often indistinct boundaries. *Lycium australe* has a wide distribution in Australia (Attachment 9, Figure 9) and is often a co-dominant to dominant species in communities where it occurs. It appears to be somewhat tolerant of waterlogging and inundation and is also moderately salt tolerant. It is rarely grazed. Extensive areas of *Lycium australe* shrubland were observed at Lake Mason during surveys for potential translocation sites for *A. yeelirrie* (Western Botanical 2015), however, these were not mapped at that time. *Lycium australe* shrublands are also known at Lake Miranda and Lake Way and similarly have not been mapped. While the values presented in the Cameco per (Cameco 2015) do not indicate significant area of Lycium australe shrublands outside the Yeelirrie Project's study areas 1, 2 and 3, it is anticipated that significant areas of this community, dominated by *L. australe*, are present in the north-eastern Goldfields and the eastern Murchison biogeographic region. It is unlikely that the CLaS community is as restricted as the current data indicates and rather the appearance of being restricted reflects a lack of data on distribution in the broader region. **SASP community** The SASP community is a very widespread and commonly encountered community of the north-eastern Goldfields within the Bullimore Land System (Pringle *et. al*. 1994). The characteristic low hummocked grasslands dominated by *Triodia*

No.	Submitter	Submission and/or issue	Response
			basedowii and largely missing co-dominant perennial shrubs dominant are relatively large in area and widespread in the region. Further, the SASP community can include emergent trees or shrubs and has been mapped as SASH community where it contains a significant Myrtaceous heath component (often long unburnt); SAGS where it contains emergent *Eucalyptus gongylocarpa* (Marble Gum) tree stratum; SAMA community where there are significant numbers of emergent mallees (usually *Eucalyptus kingsmillii, E. trivalva*); SAMU where it supports a significant Mulga (*Acacia aneura* sens. lat.) overstorey (usually long unburnt and on more silty-sand soils); and SAWS community where the upper stratum is dominated by *Acacia* species other than Mulga. The SASP community (lacking significant overstorey) was mapped within the Yeelirrie Study Areas with a cumulative 1,057 ha noted in Study Area 1. *Euryomyrtus inflata* P3 is associated with the SASP community in the region south—west of Wiluna and extends to south-east of Leinster. It is represented by 10 specimens at the WA Herbarium, an artefact of low levels of collection and vouchering of specimens in the sandplain landforms of this region. It is relatively abundant where it is found and was recorded at densities of between 40 to 350 plants per ha, equating to a total population of 134,520 plants within Study Area 1. The species is widespread and abundant on the sandplain landforms around the Yeelirrie Project area (Western Botanical 2010, page 104; Cameco 2015 page 136). The Yeelirrie Project has minor impacts to the southern edge of one population which lies on the northern boundary of the development envelope. Impacts to *Euryomyrtus inflata* and the SASP community are considered minor in both cases. Cameco will plan and implement a comprehensive vegetation monitoring program which will encompass regular monitoring of the condition of vegetation and component species on the perimeter of the development envelope and report this to regulators as required. This will include representative sites of all fringing vegetation communities and dominant component flora as well as any conservation significant flora supported. If concerns remain over the regional distribution of these communities, Cameco could commit to undertaking further surveys of regions away from the Project area to confirm the comments presented here.
21.	P&W	The location of groundwater bores and access corridors have not yet been finalised, and additional surveys and impact assessment will be required. Whilst the PER indicates on page 126 that only flora and vegetation surveys will be required, the implications of the bore field footprint, once determined, on flora, vegetation and fauna may need to be considered and approved by the OEPA, and possibly also under the WC Act if threatened species (e.g. *I. nigrum*) are present, prior to ground disturbance. The impacts on flora, vegetation and fauna (particularly those species or communities of conservation significance) should be assessed and approved by the OEPA (and Parks and Wildlife for species specially protected under the WC Act) when the information on bore field footprint (direct clearing and any changes to groundwater drawdown) on conservation values has been provided.	Cameco will implement a suite of flora, vegetation and fauna surveys encompassing the proposed borefields and associated transmission lines and infrastructure when the alignment and extent of the borefield is being developed. This will involve an assessment of impacts on flora, fauna and vegetation communities and will be provided to support clearing proposals.

No.	Submitter	Submission and/or issue	Response
22.	P&W	It is noted that in the PER Section on Other Approvals, approvals under the WC Act are described in Table 3-1 (page 28) as "…*if required"*. Taking of any threatened flora (i.e. *Atriplex* sp. Yeelirrie Station) or fauna (i.e. *I. nigrum*) would require approvals by the Minister for Environment (or delegate) under the provisions of the WC Act.	Comment noted.
23.	P&W	It is noted on page 137 in the PER that Priority flora are described as being listed under the WC Act. This is incorrect. Priority flora are not listed under the WC Act. The Priority flora list is maintained by Parks and Wildlife with a view to species being nominated for declaration as rare flora under the WC Act if and when sufficient information is available to support this.	Comment noted.
24.	DotE	Please provide further information on the potential impacts of altered fire patterns, including whether any of the species are used to fire, how the fire ban will be monitored on site and the measures which will be put in place if a fire starts.	The vegetation and flora of the sandplain communities are well adapted to occasional fire events, displaying natural recovery following a fire. There are no concerns for component species or their supporting communities. The vegetation communities of the Playa and Calcrete landscape systems within the palaeochannel would infrequently have been exposed to fire in the past. Fire could only have been carried in some of these communities following exceptionally wet summer periods when grasses are abundant and ignition sources such as lightning may have triggered small, localised fire events. While the majority of component species of vegetation in the Yeelirrie area do recover from fire, there are few that are dependent on frequent fires for survival. Most species which respond immediately post-fire are relatively short lived with life cycles from 1 to 10 years post fire) and once they have played their role in the post fire recovery period, return the normal situation of storing their seeds in the soil, awaiting the next opportunity for germination and growth. Seeds of these species are characteristically very long lived in the soil seed bank and may have multiple germination inhibition mechanisms as insurance against loss of viability. The major point of concern in management of vegetation and fire regimes is the potential for frequent fires with insufficient time between fire events for natural processes of recovery and replenishment of the seed bank, impacting on obligate seeder species. During life of mine, Cameco will manage on-site fire regimes by (i) not allowing burning of vegetation, and (ii) minimising and controlling fires near infrastructure areas. While the occurrence of fires within and near mine infrastructure will mean a nil fire regime in an ideal situation, this is not expected to adversely affect any species in a local sense. Species such as *A. yeelirrie* grow in open low shrubland communities within the palaeochannel claypans and clay flats. Groups such as Atriplex, Tecticornia and Maireana are inherently not flammable due to their succulent foliage and high salt content within tissues, making the foliage hydroscopic. Fire is not possible in the majority of chenopod shrublands and therefore is not considered a problem for conservation or management of these communities.
25.	DotE	It is unclear whether the percentage loss of *Atriplex* sp. Yeelirrie Station has been calculated using the rehabilitation population	No. The rehabilitation population of *A. yeelirrie* was not included in the percentage loss calculations. The small numbers in rehabilitation (109 plants as at 2014) contrast with the overall numbers of 84,510 plants in the western

No.	Submitter	Submission and/or issue	Response
		as well or not. Please provide clarification as to how the percentage loss has been determined.	population and 190,656 plants in the eastern population and make no material difference to the calculation of impacts on the species.
26.	DotE	It is not clear whether studies have been undertaken to determine the origin of the sub-populations of *Atriplex* sp. Yeelirrie Station, and the relative importance of each genotype. Please provide further discussion on whether studies have been undertaken to ascertain the importance of each genotype and the likely origin of the sub-populations, or whether such studies are proposed in the future.	While it may not specifically answer the question, a paper by Kelly A. Shepherd, Kevin. R. Thiele, Jane Sampson, David Coates and Margaret Byrne, titled, 'Recognition of a rare, new species of Atriplex (Chenopodiaceae) comprising two genetically distinct populations in arid Western Australia: implications for taxonomy and conservation', provides some discussion. The paper was published online on the 23rd December 2015 in the journal Australian Systematic Botany and can be downloaded from the journal website. Genetic structure in plant populations is influenced by a range of factors, including population size and distribution, historical range expansions and contractions, bottlenecks, mating systems and pollination mechanisms. *A. yeelirrie* is naturally rare, with a restricted distribution in a relatively rare habitat. Like other species in the genus, it is predominantly dioecious with small, wind-pollinated flowers, features that are expected to promote outcrossing. Unusually for the genus, fruits of *A. yeelirrie* are retained on branches for several years and appear to remain attached even at branch death. This is likely to significantly restrict the dispersal distance of seeds from maternal plants, and may contribute to the observed genetic distinctness of the two populations. The observed genetic divergence between populations of *A. yeelirrie* is considered to be moderate (assuming F_{PT} is an estimator of F_{ST}; Hartl and Clarke 1997), although it is significant and noteworthy given the small geographic separation between the known populations and the wind pollination of the species. The paper suggests the diversity has resulted from isolation and divergence over a time scale of greater than 2 million years. The importance of each genotype was not specifically considered in the paper, although it does state that they should be managed as separate units for conservation purposes. At this time, Cameco is not aware of any further work planned to consider the importance or origin of each genotype.
27.	DotE	It is not clear why a trial has not yet been undertaken for translocation of *Atriplex* sp. Yeelirrie Station. It is stated that the optimal-suboptimal sites will be further explored to assess their suitability. Please provide further discussion on the timing for when trial translocation testing will occur, and when the optimal-suboptimal sites will be assessed for their suitability.	Cameco acquired the Yeelirrie Project in December 2012 and undertook a Project review in 2103 prior to re-commencing the environmental assessment process in 2014. In 2104/15, Cameco funded the Western Australian Herbarium to undertake a taxonomic resolution of *A. yeelirrie*. In 2014/15, Cameco also undertook the preliminary studies on the eco-physiology of the plant and its habitat. These are all necessary steps required to be undertaken before one would consider commencing translocation in the field. Translocation trials are scheduled to commence in 2016 *as* outlined in Attachment 8.
28.	DotE	It is stated that prior to commencing work on the ground to establish the new population, Cameco would initiate ongoing implementation of activities contributing to a research plan to further understand the species and to support potential translocation, including seed collection and propagation research and trials. It is important that the most up-to-date and comprehensive information is used for the assessment of impacts to the	Agreed. A preliminary translocation program is presented in Table 9-24 on page 170 of the PER. Implementation of the preliminary plan includes the preparation of a detailed Conservation Species Management Plan, which will include a review of the most current information to support translocation. A more detailed plan for implementation during the life of the Project will be discussed and agreed with the DPaW.

No.	Submitter	Submission and/or issue	Response
		species, with particular regards to its likely success for translocation including seed collection and propagation research. Please provide further details of what a research plan might entail.	
29.	DotE	Assessment of environmental water requirements of identified groundwater dependent vegetation, and impacts to this vegetation as a result of groundwater drawdown from the proposed Project. Techniques from the Australian GDE Toolbox (Richardson et al., 2011) should be applied to confirm groundwater use by vegetation.	Groundwater management at Yeelirrie will be driven by the minimisation of impact on groundwater dependant ecosystems, primarily subterranean fauna, and Cameco has made the following commitments which also reduces the potential for impact on other groundwater dependant ecosystems, including vegetation; • Develop and implement a Subterranean Fauna Management Plan, which will be closely integrated with the Groundwater Management Plan. The Subterranean Fauna Management Plan will include the following as a minimum: o Internal trigger levels (groundwater level and quality) o Monitoring locations and monitoring frequencies o Reporting requirements o Abstraction locations • Not exceeding drawdown 0.5m as mapped on Figure 9-17 of the PER • Undertaking further groundwater investigations of the wellfields during a Definitive Feasibility Study (DFS) to further refine the groundwater model and look for opportunities to relocate abstraction wells from the palaeochannel. Potential options include: o locating well fields in the alluvium/weathered bedrock aquifers in the areas north of the valley floor and north of the proposed pit; o Investigating additional water sources outside the palaeochannel and not in preferred stygofauna habitat, with the potentially of relocating entire well fields; and o Increase supply from areas outside the palaeochannel As presented above, the major objective is to limit abstraction from the palaeochannel and where that is necessary to reduce abstraction to achieve commitments to levels of drawdown and groundwater quality. These commitments are expected to significantly reduce the potential impacts of groundwater drawdown on vegetation and will be verified using the GDE Toolbox during the DFS.
30.	DotE	Please note that the Flora and Vegetation Management Plan should incorporate ongoing monitoring and mitigation measures that reflect the water requirements of any identified Groundwater Dependent Ecosystems.	Comment noted. The Flora and Vegetation Management Plan will include (with reference to the Groundwater Management Plan) monitoring of groundwater drawdown levels and water quality as well as condition monitoring of vegetation communities considered to be groundwater dependent. Mitigation measures will include managing groundwater abstraction in response to trigger levels for groundwater height and condition monitoring results.
31.	DotE	On page 221 under Hydroecology there are a lot of assumptions made in the paragraph starting “Based on the modelling, uranium concentrations …”. Please provide stronger support for these assumptions. What information will be collected and what will drive the implementation of the mitigation strategies?	The assumptions referred to are outlined above the paragraph in a series of dot points. These set out the outputs from the model affecting uranium concentrations, pH and salinity of water in the evaporation pond. The parameter most strongly affecting the potential for uptake of the pond water by birds is the level of TDS in the evaporation pond water. The model predicts up to 200mg/l TDS. At this level it is unlikely birds would consume pond water.

No.	Submitter	Submission and/or issue	Response
			Pond water monitoring would focus of salinity and uranium levels as well as bird visitation. If for example, uranium levels exceeded the NOAEL benchmark and the TDS was within a range where the water was suitable for consumption, mitigation measures including bird scares and other mitigation strategies would be employed. The trigger levels and mitigation measure will be set out in the Fauna Management Plan.
32.	DotE	It is unclear how the groundwater dependent vegetation (GDV) monitoring program will interact with groundwater monitoring programs. The groundwater monitoring program needs to complement the GDV condition monitoring program. The GDV program needs to have reference to modelling and conceptualisations.	Groundwater abstraction and management will be driven by a number of environmental considerations, including managing impact on subterranean fauna and potential groundwater dependent vegetation. For subterranean fauna, limits to drawdown and water quality will be developed and agreed for inclusion in the Management Plan. The groundwater monitoring programs will be implemented and if the limits are reached, abstraction from the particular borefield will be reduced or cease, to maintain groundwater levels and manage the impact of the environmental aspect. Similar management options will be developed for groundwater dependent vegetation and would likely include groundwater level monitoring and vegetation condition monitoring feeding into groundwater abstraction programs.
33.	CCWA	The public submitter considers that the overall risk to flora and vegetation includes water drawdown, reinjection of water, increased salinity, erosion, dust deposition, disruption to surface water flow and land clearing, and that Cameco has relied on uncertainty to make optimistic predictions about species existing elsewhere while downplaying the risks. The public submitter is concerned that Cameco has not addressed the risks from increased salinity, increased erosion and the stress on remnant vegetation with increased demands from fauna that have less habitat to share in the PER.	Cameco disagrees with the premise. Cameco has undertaken comprehensive flora and vegetation surveys and modelling to understand the potential impacts from various factors. The Project will not result in areas of increased salinity. The location of the reinjection point has deliberately been placed within the mining footprint so as not to contribute to additional impact and dust modelling has demonstrated that this factor is unlikely to cause an impact. Surface water flow and the diversions required for safe mining have also been modelled and the results also suggest the impact is low and manageable. Land clearing is necessary for the Project to proceed and will be managed to minimise overall clearing within the Project footprint.
34.	CCWA	There is concern about the extensive clearing of Mulga *Grevillea berryana* Shrubland. There are inconsistencies in the PER. In one Section of the PER it states that 70% of the Mulga *Acacia ayersiana, Grevillea berryana* Shrubland (CMGbS) *will be cleared, whereas* Table 9-11 states 90.4%. Cameco also say that 99% of this vegetation community occurs in the 1m drawdown contour. *Grevillea berryana* is known to be a groundwater dependent plant species so it is expected that drawdown will impact this species. This species and vegetation community will suffer heavy impacts from clearing and water drawdown. Cameco is optimistic and states *"The component species are widespread and abundant where they occur, however the regional representation of the community is not*	**Mulga - *Grevillea berryana* (CMGbS) shrubland** With respect to proposed impacts to Mulga - *Grevillea berryana* (CMGbS) shrubland, the PER states: • 90.4% (43.3 ha of the 47.9 ha mapped) of the *Mulga - Grevillea berryana* (CMGbS) shrubland is subject to direct clearing (page 148 of PER). • A further 4.5 ha lies within the 1m modelled drawdown area. Therefore the potential total impact to the *Mulga - Grevillea berryana* (CMGbS) shrubland is 99.79% (page 151 of PER). Western Botanical (2011) discusses the known regional distribution of vegetation communities and component species in the absence of regional data at the NVIS Level 5 level of detail based on extensive knowledge of the flora and vegetation of the north-eastern goldfields in general and the region between Wiluna and Leonora specifically. The CMGbS community occurs on the outwash zone below calcrete rises within the Calcrete System, which grades into the Playa System. The soil profile shows a layer of windblown fine sandy loam over weathered calcrete. Within these landforms the community occurs as a broad ecotone between Sandplains supporting Mulga and Spinifex (SAMU) and hardpan Mulga (HPMS) which occur adjacent to *Lycium austral* shrubland (CLaS), *Melaleuca xerophila* Shrubland

No.	Submitter	Submission and/or issue	Response
		known (most likely due to low intensity mapping outside local Study Area)." Without looking for evidence about the component species existing elsewhere Cameco just make the proposition that it is and make no further mention of it here or in any of the Appendices on vegetation and fauna. While it is quite possible that this species is widespread the proponent should provide that evidence. The public submitter urges the EPA to require the proponent to be thorough in their work and provide detailed information about the range of Mulga *Grevillea berryana* Shrubland *outside* the Project area, or any similar situation where the proponent relies on unfounded assumptions. It is unacceptable for the EPA to accept that 99% of a vegetation community on site will be impacted without any clear management or mitigation strategy or any assurance and evidence that this species is widespread in the region.	(CMxS) and the *Acacia burkittii* Shrublands (CAbS) which occur on calcrete. It is variable and has influences from adjacent habitats. These landforms occur from the upper reaches of the Yeelirrie palaeochannel upstream from the proposed Project to the eventual outfall at the northern edge of Lake Miranda, a distance of approximately 100 km. On this basis it is a reasonable assumption that the component species as well as the vegetation community CMGbS will be replicated within this region. Following the submission of the PER and further discussions with the OEPA, Cameco conducted a targeted regional assessment for the CMGbS Community. During three days of assessment, an area of approximately 357 ha of a mosaic of CAbS, PLAPoS and HPMS vegetation communities on the western fringe of Yakabindie Station were assessed (Attachment 9). It is estimated that approximately 20% of this mosaic would represent an ecotonal community with similar dominant species composition to that within the CMGbS community on Yeelirrie Station, meaning that around 82 ha of CMGbS community occurs outside of the areas impacted by the Yeelirrie Project. Given this finding, the impact on the CMGbS community by the development of the Yeelirrie Project is estimated to be approximately 36% of the total noted to date. A memo regarding the further assessment of CMGbS Community is provided as part of Attachment 9. On this basis, Cameco considers that the objectives of the EPA would be met in that the removal of this vegetation type on the Project Area does not take the area remaining to less than 30% of the pre-clearing extent, thus meeting the requirements of EPA position Statement No.2 (EPA, 2000). ***Grevillea berryana*** *Grevillea berryana* is widespread in Western Australia, (See Attachment 9, Figure 11). *Grevillea berryana*, while being a co-dominant in the CMGbS vegetation community in the Calcrete Soil Landscape System, is also present as a minor component in adjacent vegetation communities in neighbouring soil landscape systems. It occupies the taller shrub / small tree stratum within the local study area in the CAbS vegetation community in the Calcrete Soil Landscape System; within the HPMS and WABS vegetation communities in the Hardpan and Drainage Soil Landscape System; and within the PLAET community in the Playa Soil Landscape System. ***Acacia ayersiana*** The Mulga component of the CMGbS, *Acacia ayersiana* is also widespread in Australia, Attachment 9, Figure 10. The Mulga is predominantly *Acacia ayersiana*, a form of Mulga that is associated with the palaeochannel valleys, calcrete soils and saline lake fringes of the north-eastern Goldfields. Minor occurrences of other component species in the Mulga complex, reported as *Acacia aneura* sens. lat in the baseline surveys at Yeelirrie (Western Botanical 2010). ***Eremophila arachnoides* subsp. *arachnoides* P3** The distribution of *Eremophila arachnoides* subsp. *arachnoides* P3 is discussed in detail in the response to comment 19 and within Attachment 9, Figures 1 to 8. The distributions of the other defining species of the CMGbS community are depicted in Attachment 9, Figure 9 and Attachment 9, Figures 10 to 16. On this basis, Cameco does not consider that the impact on this association within the mapped area is a critical impact.

No.	Submitter	Submission and/or issue	Response
35.	CCWA	*Rhagodia* sp. Yeelirrie Station (K.A. Shepherd et al. KS 1396) is a Priority 1 Species. Cameco make the optimistic statement that *"there will be no direct impacts on Priority 1 species Rhagodia sp. Yeelirrie Station, but indirect impacts may result from changes to surface water drainage patterns and affect a small proportion of the population within the Study Area (4.8%).'* Rhagodia is a high-risk species. Given that it has only been identified in the Project area the public submitter views the possible impacts as high impact. Cameco have not done an in depth study into the potential impacts of water drawdown or dust deposition, increased salinity or any other potential impact that may have dire consequences for this species.	Please refer to the response to Comment No. 18
36.	CCWA	The proponent has done a lot of work on the *Atriplex* sp. Yeelirrie Station. Despite this there is still concern about the ability for the survival of the Western population of this taxon and concern over Cameco's ability to re vegetate the pit area and re-establish the Western population. The current proposal is to clear the Western population present on the ore-body - this is around 37% of the total *Atriplex* sp. population on the site. There is concern about re-establishing the population because: 1. The pit area where the entire Western population is situated will remain affected by water drawdown for 50 years and up to 200 years; 2. The Atriplex Rehabilitation Site, to the west of the central part of the pit will also be affected by water drawdown; and 3. The tailings and backfilled pit post closure is expected to have a "salt enhanced crust" - pg. 95. There is concern that this salt crust will not support the revegetation of the Western Population of Atriplex. It is understood that Atriplex is sensitive to changes in salinity. The public submitter considers that Uranium mining and rehabilitation is complex, contaminating and costly and the Yeelirrie proposal threatens many endemic flora and fauna species.	The translocation program presented in the PER proposed to re-establish a population of *A. yeelirrie* (western genotype) at a location away from the minesite. Following further investigations since the PER was released, Cameco now proposes translocation across a number of additional sites. The new proposal is presented in Attachment 8.

No.	Submitter	Submission and/or issue	Response
37.	Wildflower Society	Translocation is a strong focus of the PER as a viable response to the loss of individuals through clearing. The proponent should provide evidence that translocated individuals have survived long term elsewhere.	Studies contributing to potential translocation of *A. yeelirrie* implemented to date revolve around (i) the availability, viability and germinability of seed of the western genotype of *A. yeelirrie* and (ii) local searches for potential translocation sites (Lake Mason, southern Yeelirrie Palaeochannel). Plants have not been grown in ex-situ cultivation nor have any trial translocations of the species been implemented. Important factors in determining whether translocation is feasible include (i) that genetically diverse seed is able to be collected from the target population, (ii) that seed is viable, (iii) that seed is germinable, (iv) that germination inhibition, if present, can be overcome, (v) that seed maintains its viability in ex-situ storage. Cameco has shown all these critical steps are readily achieved and has around 3.6 million seeds of *A. yeelirrie* Western genotype in ex-situ storage. Further seed collection is planned and can readily be implemented. Critical to the translocation process is the suitability of receptor sites. Factors such as soil type, soil texture, soil chemistry, salinity, topography and position in the landscape, edaphic features of adjoining habitats, potential for flooding and periodicity of inundation, potential impacts of drought, and potential groundwater contribution to the soil moisture in the vadose zone will need to be addressed in defining suitability of any site for potential translocation. Cameco has commenced the process of searching for and defining suitable translocation receptor sites. To date Cameco has assessed numerous sites at Lake Mason and some sites in the south-eastern portion of the Yeelirrie palaeochannel on Yakabindie Station. While many sites investigated were considered unlikely to be useful for translocation due to soil type and salinity issues, the preliminary results of some of these site investigations is encouraging. Areas of similar soil type and salinity levels to those areas supporting naturally occurring populations of *A. yeelirrie* have been located with up to 42 ha of similar soil type noted at “Lake Yakabindie” within the southern Yeelirrie palaeochannel and three sites at Lake Mason considered worthy of consideration of inclusion in a translocation trial (PER pp166-169). Sites at Lake Mason and at “Lake Yakabindie” that appear to be promising for translocation trials at this stage are presented in Attachment 9, Figure 19. Two locations within the mining open pit are considered to be potential translocation sites. These sites have been identified as they are located within parts of the open pit that will not be backfilled with tailings material and are also in areas where, because they are at the extremity of the pit will have more natural surface and groundwater hydrological conditions post mining (Re-creating a population above the tailings cells is considered possible however it will impact on the design of the tailings cap and may affect the performance of it). Mining of the ore body commences on the south-eastern end, and a site in the eastern mining cell would be established by the end of mining year 2. The cell would be backfilled with soils being mined from an adjacent cell area which hosts *A. yeelirrie*. The soil profile from the *A. yeelirrie* habitat would be removed as part of the direct handling of mined soil and placed into the adjacent mined out cell for rehabilitation. The area of this cell is approximately 36 ha. A second translocation site would be created in the north-western cell of the Pit. Again this cell is not required for tailings deposition and could be backfilled with surface and sub-surface soil from an area that hosted *A. yeelirrie*. In this instance suitable soils would be stockpiled for a period of time as the mining sequence does not allow direct handling. The construction of habitat at this location would not occur until the end of mining. The area identified is approximately 68 ha.

No.	Submitter	Submission and/or issue	Response
38.	Wildflower Society	Ecosystems function as a whole. Transplanting individuals from one ecosystem into another is compromising the integrity of the recipient ecosystem. This effectively increases the overall impact of the Project rather than lessening it. Efforts would be better spent protecting the remaining in-situ populations by exclusion, maintaining water regimes, seed banking and weed control.	Cameco understands the potential issues associated with translocation. To be considered, any recipient site will have similar soils and landscape and therefore similar suite of species. Preliminary investigations suggest that translocation would require limited or no physical disturbance to the landscape and the naturally occurring species. Cameco has committed to undertake an environmental impact assessment of any recipient site.
39.	Wildflower Society	No regional assessment of vegetation types present in the study area was demonstrated in the PER document. The only regional representation assessment was of Land Systems, which is too broad for EIA. Using Land Systems only is the equivalent of doing a conservation significance assessment of flora by identifying species to genus only. It is the equivalent in this case of saying, "*Atriplex* sp. Yeelirrie is not important because there are plenty of other Atriplex species out there".	The only publicly available and relatively detailed assessments of regional vegetation types pertinent to the Yeelirrie Project is that conducted by the Department of Agriculture (WA) at the Land System level (Pringle et. al. 1994, Payne et. al. 1998). Necessarily due to the vast areas covered in these works, the level of mapping undertaken was at a broad scale (1:100,000 capture scale) and is approximately equivalent to NVIS Level 1 Class or NVIS Level II Structural Formation. The use of Land Systems as a surrogate regional representation of vegetation at the higher level is commonly employed in Environmental Impact Assessment given the lack of a more detailed regional vegetation treatment. Cameco, through the prior baseline flora and vegetation works commissioned by BHP Billiton (Western Botanical 2010, WB653) and in subsequent updates to the flora and vegetation of the Local Study Area commissioned by Cameco (Western Botanical 2015, WB839) mapped and assessed 100,772 ha of the Local Study Area at a high level of detail (1:10,000 and 1:20,000 scale of capture) and to NVIS Level 5 Vegetation Association. The areas mapped included significant buffer around the proposed mine development area which is approximately 9 km long x 1.5 km wide and involves direct clearing of 2,422 ha within a development envelope of 4,874.6 ha (PER page xxii). Detailed vegetation maps are presented in Western Botanical 2011, Appendix E1 of the PER. The areas where vegetation was assessed and mapped were 15 km wide across the palaeochannel at the widest point in a north-south dimension and 60 km long within the alignment of the palaeochannel in an east-west dimension. Vegetation mapping and assessment involved the establishment of 182 quadrats and 180 relevés over this area. Regional surveys extended over an area of some 185,000 sq. km (18.5 million ha) and focussed on searching for conservation significant species of interest to the Yeelirrie Project and vegetation communities similar to those of the calcrete landforms of the Yeelirrie palaeochannel. By any measure, these represent an extensive coverage of (i) vegetation within and adjacent to a proposed disturbance footprint and (ii) targeted regional survey for flora and vegetation implemented by a proponent. Land Systems, and by inference the associated finer scale Vegetation Communities, of the majority of the areas assessed (inclusive of sandplains of the Bullimore Land System, hardpan landforms of the Yanganoo Land System and vegetation communities of the breakaways and granitoid landforms of the Sherwood Land System) were considered to be regionally common, widespread and well represented (Western Botanical 2011). However, it was acknowledged that the Cunyu, Cosmo, Melaleuca and Mileura Land Systems and their associated vegetation communities which are associated with calcrete expressions of the Yeelirrie palaeochannel were regarded as limited in area and disjunct in distribution within the eastern Murchison biogeographic region (Adapted from Western Botanical 2011, page iv). For this reason, the occurrence of these landforms and associated vegetation communities were targeted within the regional surveys conducted and reported in Western Botanical 2011. However, the focus of the regional surveys was to target the occurrence and numbers of individuals of species with conservation significance to the Yeelirrie Project, not to map

No.	Submitter	Submission and/or issue	Response
			or quantify the area of each vegetation association at the regional sites investigated. Therefore, while calcrete landforms were specifically targeted across the 16 regional lake systems and records of vegetation associations present and numerous conservation-significant species were made and reported (Western Botanical 653, Appendices 15, 17), no areas of occupancy calculations or mapping of vegetation communities at these regional sites was conducted or reported. The regional locations of vegetation associations similar to those at Yeelirrie that were noted in the regional surveys (Western Botanical 2011, Appendix E1 of the PER) is presented in Attachment 9, Figure 18. While these records are limited to Lake Way, the south-eastern Yeelirrie palaeochannel, Lake Miranda, Lake Mason and Lake Noondie, they may not represent all the occurrences of these vegetation communities at these lake systems.
40.	Wildflower Society	There was only a local conservation significance assessment done of 'vegetation communities' within the footprint, which is virtually meaningless. Some of the data appears to have been collected and presented in the appendices, which is to be commended, but the distillation and structure of it is poor and difficult to interpret in any meaningful way.	See the response to comment 39 above.
41.	Wildflower Society	DAFWA Land System mapping provides more information for regional assessments than just the land area of each Land System remaining. Cunyu LS for instance was described by DAFWA as 50% of it in Good to Fair condition and 50% in Poor condition. Does the Project impact on vegetation in Good to Fair condition? If so, the conservation implications are greater than indicated. Another example is that 'Drainage Foci' with Mulga on Red Clay in Cunyu LS represents less than 1% of the total Cunyu LS area. Is this ecosystem potentially within the Project footprint? These are only selected examples of what could have been looked at. A response from the proponent is required on this. The regional conservation significance assessment of the 'vegetation communities' present has not been distilled and presented effectively to enable informed decision making. This needs to be remedied by the proponent.	Western Botanical suggests that the Cunyu and Land System and associated Mileura, Melaleuca and Cosmo Land Systems within Study Area 1 and 3 on Yeelirrie Station are in Good to Excellent condition due to (i) nil pastoral activity and minimal grazing over the past 15 years (D. Brownlie, pers. comm.) and (ii) minimal other disturbance to the calcrete landforms in the Study Area on Yeelirrie Station other than in recent exploration activities. The soil surfaces are intact, the vegetation is in good condition for the prevailing seasonal climatic conditions, there is ample recruitment of annuals and juvenile perennial species following high rainfall events, there is excellent annual and perennial grass cover following high rainfall events.
42.	Wildflower Society	Ruby Dock is an aggressive coloniser of disturbed ground in the arid areas of WA. Without effective weed control, Ruby Dock will inevitably colonise these areas also and spread outwards, effectively increasing the impact area of the Project. Vague management commitments have been made regards weed control e.g. in Section 12; Management Framework PER pg. 430 describes commitments to develop "weed management practices". This species warrants special mention. Strong and	Weed management will be a focus aspect of overall flora and vegetation management throughout the life of the Yeelirrie Project. Weed hygiene and management protocols will be developed by Cameco on Project Approval. Ruby Dock occurs primarily within former areas of rehabilitation conducted by WMC Resources in 2006, both within the calcrete landforms near the orebody and in rehabilitated areas used for stockpiling of ore during test mining by WMC Resources and on a large laydown area near the North Gate to the Project. It is present in only low numbers outside of these areas, specifically on the margins of tracks for a short distance from the rehabilitated areas.

No.	Submitter	Submission and/or issue	Response
		specific commitments to control the spread of this species should be made.	Weeds of the Yeelirrie State Agreement Act area were mapped or reported in 2010 (Landcare Services 2011, LCS691; Western Botanical Sept 2010). Two episodes of weed management were conducted on site in 2010 and 2011 (Landcare Services 2011, LCS691, LCS 708) under the then Draft Ruby Dock Weed Management Plan (Landcare Services 2010, LCS676). The foci of this management plan were to identify, map and reduce the extent of occurrence of Ruby Dock within the Project Area while implementing Best Practice weed hygiene for the Project. Future mapping and control of Ruby Dock and other weed species will be implemented throughout the life of the Yeelirrie Project. If the Project was to proceed, weed control measures will be coupled with weed hygiene protocols to prevent the inadvertent introduction to, and spread within, the Yeelirrie Project area. Weed control is being implemented on an annual basis.
43.	Wildflower Society	Cameco Australia Pty Ltd holds the Yeelirrie Pastoral Station lease. Because of the extra pressures placed on a significant part of the landscape as a result of this Project, and the likely conservation significance of some of the flora species and vegetation types in the local area, it is recommended that if possible, the pastoral station remain destocked for the life of the Project.	The Yeelirrie Pastoral lease is destocked (as mentioned in the PER on page xxiv) and Cameco has no plans to restock it.
44.	PS46	The Department of Environment Conservation report Taxonomic Resolution of *Atriplex* sp. Yeelirrie Station (PER Appendix E4) concludes that "The two populations of *Atriplex* sp. Yeelirrie Station are genetically very distinct, despite their close proximity. It is critically important to assess whether the two populations are best regarded as separate taxa (species, subspecies, or varieties) or as belonging to a single taxon." Has Cameco completed any additional studies to determine if the two Atriplex populations should be regarded as separate species or subspecies? The PER lists the protection of the eastern *Atriplex* sp. Yeelirrie Station population as management for reducing the projects impact on the species, however if they are separate species protection of the eastern *Atriplex* sp. Yeelirrie Station is not a sufficient approach. The management measure of implementing a research plan and translocation program for the reestablishment of the western population is not a sufficient measure to protect the species. I would recommend that Cameco be given a condition to demonstrate successful reestablishment of the western population/subspecies (through seed collection, germination, and planting of new individuals outside the Project area) prior to removal of the western population. There is a real risk that	A paper by Kelly A. Shepherd, Kevin. R. Thiele, Jane Sampson, David Coates and Margaret Byrne, titled, 'Recognition of a rare, new species of Atriplex (Chenopodiaceae) comprising two genetically distinct populations in arid Western Australia: implications for taxonomy and conservation', published in 2015, has concluded that the two populations can be described as one species. Cameco has proposed a package of management measures for the translocation of the Western genotype at a number of sites. Translocation is planned to occur at least 5 years before the commencement of mining and at least 12 years before the last populations of the Western genotype would be removed from the mine area. Translocation will be supported by a research Project looking at aspects of eco-physiology to assist in understanding the habitat needs of the species. An extensive seed collection program will also be undertaken with seed being stored in the Seed Bank. A revised proposal for the protection of *A. yeelirrie* is provided in Attachment 8.

No.	Submitter	Submission and/or issue	Response
		this Project could lead to the extinction of a potential species/subspecies which is only known from this location.	
45.	PS151	The contaminated dust from the mine will impact the vegetation. For example, after the trucks go down the haul road, the vegetation would be covered in thick dust. It was noted that the vegetation receded from the road.	Dust control is very important on a uranium minesite because of the occupational health requirements to limit potentially radioactive dust. Traffic dust is most easily managed using water carts and dust suppressants. In preparing the PER Cameco has calculated the requirements for water use and has included this quantity in the water balance. Cameco will also investigate the use of road surface binding agents to manage dust and reduce water use.

4. Terrestrial Fauna

No.	Submitter	Submission and/or issue	Response
1.	P&W	It appears that indirect and secondary impacts on the threatened shield-backed trapdoor spider (*Idiosoma nigrum*), in particular from changed hydrology and vibrations, have not been fully addressed in the PER and an assessment of the proportion of local habitat for this species that may be impacted by the proposal has not been undertaken. Populations / individuals of *I. nigrum* nearest to the mine development envelope are likely to be impacted by changed hydrology (PER, Figure 9-19, page 212). If there are significant impacts on the local populations of this species, it may be appropriate to require the development of a management plan to ensure impacts on local populations are managed to acceptable levels to ensure these populations remain viable.	**Proportion of local distribution of species:** *Idiosoma nigrum* is associated with three Vegetation and Substrate Associations (VSAs or 'habitat types'): Spinifex Sandplain, Acacia Woodland over Sparse Spinifex and Mulga over Spinifex Sandplain. These VSAs are combined as 'Acacia Sandplain' in some instances in the PER. In combination, these have a total area of about 69,800ha across the c. 100,000ha study area (Table 9-32). Only 821ha (1.2% of the area that supports them or 0.82% of the total study area) will be directly impacted. A slightly larger area of these VSAs will be affected by hydrological change (drawdown of >1m or flooding after a major rainfall event): 1434.6ha (Table 9-32). This gives a total of 2256ha of the estimated distribution of the species in the study area being either directly or indirectly impacted (3.2% of the area that supports them or 2.26% of the total study area). Note that the impact of such hydrological changes upon the trapdoor spider is uncertain and the figure of 1434.6ha affected by hydrological change is a maximum. Impacts from dust are mentioned in the PER but the extent of dust deposition is largely restricted to the pit area (Figure 9-19) and barely reaches areas occupied by the spider. However, there may be some dust along roads. Bancroft and Bamford (2014) found no conclusive evidence for adverse effects of dust on the Shield-backed Trapdoor Spider, although it did appear that more burrows were temporarily sealed at a site within 200m of an active pit and where dust was conspicuous (M. Bamford pers. obs.). **Effect of vibration:** Mine areas are located approximately 3km from known locations of trapdoor spiders. Studies elsewhere in the species' range (Bancroft and Bamford 2014, in the Karara region) found no significant effect of vibration or dust from an active mine within 200m. **Management plan:** Bancroft and Bamford (2014) have established a protocol for marking and monitoring the species in a BACI designed experiment at the KML mine (Karara). This targets animals adjacent to (and distant from) areas of direct impact. However, the very low density of the species at Yeelirrie makes it very difficult to monitor sufficiently large sample sizes. Given this and the fact the Project will have a minor impact on the local population Cameco considers that a specific management plan is not required to ensure that the populations remain viable.

No.	Submitter	Submission and/or issue	Response
2.	P&W	The threatened black-flanked rock-wallaby (*Petrogale lateralis lateralis)* has been reported in the PER as being a 'resident' species from breakaways and the Barr Smith Range near Yeelirrie. Further investigation is needed to determine whether a resident population of *P. lateralis* exists at Yeelirrie. Without confirmation of a resident population, and as there is no information on the species in this area, it is not possible to determine what impacts of the proposal may have on the species at a local or regional scale. More information, potentially including targeted surveys for *P. lateralis*[2], is required to provide information on distribution and abundance, including use of the landscape in the vicinity of the proposal. If there is a resident population of *P. lateralis* at Yeelirrie, this would be significant for the species as the nearest record is more than 300km away and the species has just had a change in conservation status from vulnerable to endangered in the Specially Protected Fauna Notice published in the Government Gazette 3 November 2015. Any resident population would be considered a separate conservation unit until genetic studies were conducted to determine relatedness to other known subpopulations of the threatened species.	In general, confirmation of a resident population is not needed to predict the potential for impacts in fauna investigations for Environmental Impact Assessment (EIA). The nature of fauna populations is that they may vary seasonally and annually, so it is quite possible for field investigations to conclude that a species may be present and resident at least some of the time even if it is not found. It is also the nature of fauna populations that they don't need to be resident to be impacted. For example, a Project area might provide 'landscape permeability' for dispersing animals of a species even when that area does not support a resident population. It is thus the ecological function of the site for that species that is being impacted. The potential for a species to recolonise an area also needs to be considered in EIA. In the case of the Black-flanked Rock-Wallaby in the Barr Smith Range near Yeelirrie, an enormous effort could go into searching for the species, it might not be found, but one could still not conclude that it is absent. As an example, the same species was 'rediscovered' in Kalbarri National Park as a result of a chance encounter by hikers; and this despite a number of previous targeted surveys in the area. For the purpose of EIA, it is best to take the precautionary approach, assume a species is present if there is a reasonable amount of evidence to suggest this is the case, and assess the likely impact based upon this assumption. Impacts from a development Project also need to be considered in the context of other threatening processes. For example, many threatened mammals in Western Australia are under pressure from landscape scale processes (fire, livestock grazing, and feral predators). A development proposal may interact favourably or unfavourably with such processes; or may be relatively insignificant but provide an opportunity to manage these. This is the approach that has been taken with possible impacts of the Yeelirrie Project upon the Black-flanked Rock-Wallaby in the Barr Smith Range. The risk to a population, should it be present, is considered to be very low because most development is well away from the area where the species may occur, except for a very small (compared with total suitable habitat) quarry. There may be an increase in the risk of roadkill due to increased traffic, but the major roads directly associated with the Project are also well away from the Barr Smith Range. The closest point of the access road from the east is about 3km from where old scats were found, with most of the Barr Smith Range over 10km north of the development areas. As identified in the PER, roadkill of even one animal might be important as any population is likely to be very small, but the greatest risk to the Black-flanked Rock-Wallaby from the Yeelirrie Project lies with any interaction with the landscape scale threatening processes that are primarily responsible for its decline. The station has largely been de-stocked and the risk of fire is low, but feral predators are present. Of particular importance is ensuring that the dynamics between Dingoes, Foxes and Cats is maintained so that the most significant predator of the species, which is almost certainly the Fox, is kept at very low numbers.
3.	P&W	The proponent has committed to developing and implementing a number of strategies and plans to manage, monitor and mitigate the proposal's impacts on fauna (for example, page 234 of the PER commits to the development of a Fauna Management Plan). Whilst the strategies and plans are yet to be developed, it is uncertain if they will encompass the recommendations within Appendices G1 and G2. Development	Cameco values the input from our consultants and the recommendations made in the two Bamford reports have been developed in discussion with Cameco and will be incorporated into the Fauna Management Plans. Cameco would be happy to consult with DPaW over fauna management strategies and plans.

No.	Submitter	Submission and/or issue	Response
		and review of these strategies and plans should include consultation with Parks and Wildlife.	
4.	P&W	There are a number of known (three taxa) and potential (13 taxa) SRE invertebrate taxa that are proposed to be impacted by the proposal, some of which are currently only known from (and therefore apparently restricted to) the proposal area. It is difficult to assess the risks posed by the proposal to potential or known SRE fauna taxa or their conservation significance. For example: • For some taxa, there are differences in the potential impact of the proposal between the PER (page 228-229) and the specialist report (Appendix G2, page 21). For example, the tiger beetle *Pseuditetracha helmsi* is a confirmed SRE species and has a "*Negligible*" predicted impact in the PER and an "*Insufficient data – potentially Moderate*" category of predicted impact in Appendix G2. Conversely, the mygalomorph *Aname* 'MY212' is a potential SRE taxon and has a "*Moderate*" predicted impact in the PER and a "*Minor*" category of predicted impact in Appendix G2. The difference(s) are not explained in the PER. • Conclusions on potential impact for at least five taxa are based on "*Insufficient data*" (even for apparently restricted species). • Comments on habitat for some taxa being present outside the footprint do not appear to be based on a fine scale understanding of apparently restricted taxa habitat, but rather on broader scale habitat types. Further information for all the new and undescribed species (in particular those that were only found within the footprint) to determine if they occur elsewhere in the region or are restricted to the substrate of or above the orebody should be conducted. This could be either through targeted surveys or investigations to provide evidence to support comments in the PER that taxon habitat, as defined at a finer scale, is present outside the footprint.	A conservative approach was used, in that anything that may be restricted to the calcrete and claypan areas was likely to suffer a moderate impact, with some uncertainty, and anything found in other VSAs would be Minor or Negligible. The Tiger Beetle is one of the few species to be known from other locations, so that may have influenced the change in the PER. The following approach was utilised by to assign impacts in Appendix G2 of the PER (based upon records and likely restriction of species to the calcrete, calcrete outwash and claypan areas that are heavily impacted, but still represented outside): • Recorded only outside calcrete, calcrete outwash and claypan: Negligible; • Recorded in VSAs outside the calcrete, calcrete outwash and claypan (but also in these): Minor; • Recorded only in calcrete, calcrete outwash and claypan: Moderate. Insufficient data was used where there were few collections, however in retrospect this could be considered to apply to almost all the significant invertebrates. Cameco has partly identified which SRE species will be directly and potentially indirectly impacted in Tables 9-31 and 9-32 in the PER (pages 215 and 218 respectively). Tables 9-31 and 9-32 detail whether or not species were collected inside or outside the footprint and the percentage impact for each associated VSA(s). An updated Figure 9-19 from the PER has been included as Attachment 4. This figure now distinguishes between all species of the same genus and identifies those species which will be directly impacted by the mine pit or infrastructure, or indirectly impacted (e.g. from hydrological changes). The associated area of VSA(s) that will potentially be impacted as a result of indirect impacts is partially quantified in Table 9-32 of the PER (page 218). Cameco has provided an updated impact table in Attachment 4 that considers all direct and indirect impacts to SRE species, the table within the attachment presents the preferred VSA(s) of each species, the area of these VSAs within the Project/Study Area and the area (and percent) of a species' VSAs, which will or potentially will be impacted. Impact significance has been reassigned based on these percentages. The reassigned impact significance levels are generally the same as previously stated (Table 9-34 of the PER) with the following differences: • Impact previously thought to be Moderate, however now considered to be Minor to Moderate – the Isopod Platyarthridae/Bathytropidae; • Impact previously thought to be potentially Moderate, however now considered to be Moderate – the barychelid mygalomorph spider and the cheiridiid pseudoscorpion. • Impact previously thought to be Negligible, however now considered to be Minor - the isopod *Cubaris* sp. 2, the mygalomorph spider *Kwonkan* MYG210 and the mygalomorph spider *Kwonkan* MYG211 (but minor in PER). • Impact previously listed as either Negligible (in PER Table 9-34) or potentially Moderate (PER Appendix G2), however now considered to be Moderate – the Tiger Beetle *Pseudotetracha helmsi*. • Impact previously listed as either Minor (in PER Table 9-34) or potentially Moderate (PER Appendix G2), however now considered to be Moderate - the mygalomorph spider *Kwonkan* MYG172. • Impact previously listed as either Minor (in PER Table 9-34) or potentially Moderate (PER Appendix G2), however now considered to be Moderate – the isopod *Cubaris* sp. 1.

No.	Submitter	Submission and/or issue	Response
			• Note that three species, the Tiger Beetle *Pseudotetracha helmsi*, the mygalomorph spider *Kwonkan* MYG172 and the isopod *Cubaris* sp. 1, had different listings between the PER Table 9-34 and the PER Appendix G2, but the predicted impact upon all of these is now considered Moderate. It should be noted that a comprehensive collection of SRE invertebrates to the point where precise patterns of distribution on the local scale in relation to the environment can be strictly defined is almost impossible. Therefore, the exact impact to SRE species cannot be determined. All SRE invertebrate species are likely to experience some direct impact (habitat loss) and some indirect impact (e.g. dust, hydrological change). As previously discussed, Cameco commits to undertaking an SRE survey prior to the commencement of ground disturbance activities in order to confirm the presence of the SRE species outside of the Project Area. Avoidance of SRE species has been applied in that Cameco has endeavoured to reduce the size of the Project footprint where possible. In addition to this, impacts to SRE species have been avoided by planning to construct all unnecessary infrastructure away from the calcrete, calcrete outwash and playa areas, where several of the SRE invertebrate species are recorded.
5.	DotE	Please note that the Malleefowl is no longer listed as a migratory species, and the Northern Marsupial Mole has been delisted under the EPBC Act.	Comment noted.
6.	DotE	It is unclear which version of the ERICA Tool was used to make the assessment for non-human biota. The current version is 1.2. This is the version that should be used as it contains the most up to date parameter databases. A clear statement on which version of the ERICA Tool was used to make the non-human biota assessment should be provided.	The latest version of ERICA, Version 1.2, was used for the assessment.
7.	DotE	It is unclear exactly which radionuclides were included in the ERICA assessment. Table 42 suggests that potentially only 238U, 230Th, 226Ra, 210Pb and 210Po were included. The radionuclides 234U and 234Th should have also been included, were they? A clear statement of all radionuclides included in the ERICA assessment should be provided.	U234 was included in the assessment, but Th234 was not. Th234 has been covered in the ERICA re-assessment (see comment 25 and Attachment 10).
8.	DotE	The concentration ratios given in Table 42 for Kangaroo "ARPANSA 2014- maximum of reported arithmetic means" appear to be incorrect. Table 42 gives the concentration ratio for 238U as 0.007. The maximum of reported arithmetic means given in the ARPANSA 2014 report for uranium is 0.0212 for Red-kangaroo (arid).	Correct. There are two errors in Table 42 affecting the concentration ratio figures for uranium and radium. There is also potential for confusion in the text, where "maximum" levels are referred to. To provide clarification the ERICA assessment has been redone and is reported in Attachment 10.

No.	Submitter	Submission and/or issue	Response
		Table 42 gives the concentration ratio for 226Ra as 0.041. The maximum of reported arithmetic means given in the ARPANSA 2014 report for radium is 0.76 for Red-kangaroo (arid). Table 42 gives the concentration ratio for 210Po as 0.55. The maximum of reported arithmetic means given in the ARPANSA 2014 report for polonium is 1.06 for Red-kangaroo (arid). Please confirm what concentration ratio values were used in the ERICA assessment for kangaroo.	
9.	DotE	The ERICA assessment only considers potential impacts during the operational phase of the mine. No assessment is made for potential post-rehabilitation exposures. Depending on the above-background radionuclide activity concentrations in the cover material, post-rehabilitation exposures to burrowing animals (e.g. reptiles and small mammals) from radon and progeny could be significant. ERICA assessment of potential post-rehabilitation exposures of non-human biota will be required as part of rehabilitation planning.	A qualitative statement was made in the PER which noted that the impacts to non-human biota following closure would be negligible. The logic was that during peak operations, the quantitative assessment determined that no exposures would exceed the trigger level. (Note that this is apart from lichen and bryophytes, which is explained in the PER text). Therefore, once operations cease and the area is rehabilitated, then it can be reasonably assumed that the impacts would be less than they would be for a full operations. Radon progeny exposure to burrowing animals is not expected to be significant given that the cover material is waste from the pit covered by a layer of topsoil. The difficulty with post closure ERICA assessments is to identify credible potential exposure situations without being extreme or alarmist. An additional ERICA assessment has been conducted which includes a post closure assessment. See Attachment 10.
10.	DotE	The PER states that, “Impacts to habitat from ground disturbance, stockpiling and surface contamination and backfilling with tailings…”. These impacts are not quantified. The proponent should provide further clarification to quantify these impacts.	The quotation is taken from page xxix of the Executive Summary - and is simply a summary. These impacts arise from clearing, development of the open pit and backfilling the pit with tailings. Quantification of these impacts is provided in Section 9.3.5 of the PER, which includes 725.9 ha of clearing for the development of the open pit. The impacts of clearing are discussed in more detail in the relevant flora and fauna Sections of the PER.
11.	CCWA	The public submitter considers that there would be clear impacts on terrestrial fauna through loss of habitat, introduction of weeds, the risk of radiation uptake in the food chain, the bioaccumulation of radiation and heavy metals and subsequent health problems, and that here is the risk of population fragmentation through habitat loss and breaking up fauna corridors. While Cameco have an overarching principle to avoid and minimise ground disturbance and clearing, they have not identified or specified any habitat areas that will be protected or any offsets for those areas.	Cameco would like to refer the CCWA to Section 9.3.5 of the PER which details the potential impacts to terrestrial fauna and the proposed management and mitigation measures. In addition to this further commitments are discussed within this document. As presented in Table 9-32 of the PER, Cameco agrees that some fauna habitat will be directly impacted by clearing and that there is the potential for some habitat to be affected by groundwater drawdown, surface water alterations and dust deposition, however the risk of these combined impacts causing population fragmentation or breaking up fauna corridors is extremely low. As discussed in Section 9.3.5.4 of the PER, the risk of radiation uptake and bioaccumulation within the food chain is very low.

No.	Submitter	Submission and/or issue	Response
		After numerous studies it is possible that Cameco have simply deferred this issue to future Management Plans to avoid public criticism as opposed to dealing with this matter through the PER.	
12.	CCWA	Cameco offer broad-brush solutions to potential problems. For example Cameco has stated: *"If populations of significant species are identified within the Project boundary and disturbance to those areas cannot be avoided, a specialist zoologist will be consulted prior to ground disturbing activities."* This is an example of many similar weak statements about how the proponent intends to manage significant species. This is a problem for the following reasons: 1. This statement offers no commitment to protect species, or the habitat for the species. 2. The only commitment made here is to consult a specialist - not to follow specialist advice. 3. There is no other comment made in this Section that provides any clear commitment to protect habitat of significant fauna species - if the clearing is 'unavoidable'. 4. Significant flora and fauna species are likely to become collateral damage without any clear commitments to protect, preserve, offset, relocate or any other possible management options. 5. There is no clear definition or regulatory guidance for what constitutes as unavoidable - this ambiguity offers the proponent a free range to clear any area no matter how significant as long as they can argue the case that it was 'unavoidable'. Cameco should have identified whether or not there is a significant species within the Project boundary and have a detailed management plan for how they will ensure the protection of that species.	As discussed in Section 9.3.3 numerous fauna surveys have been undertaken over the Project area, which have identified the current locations of significant species. The comment *"if populations of significant species are identified within Project boundary and disturbance to those areas cannot be avoided, a specialist zoologist will be consulted prior to ground disturbance"* is in reference to future fauna management and the potential for significant species to colonise within the Project envelope prior to direct ground disturbing activities. As discussed above, additional commitments for management of Terrestrial Fauna include: • Pre-clearance surveys for Malleefowl and Brush-tailed Mulgara will be undertaken prior to commencement of ground disturbing activities. • Where confirmed during pre-clearance surveys, significant populations of Brush-tailed Mulgara and Malleefowl will be avoided where possible. If disturbance of significant populations are unavoidable then Cameco will seek approval from the Chief Executive Officer of the Environmental Protection Authority prior to commencing ground disturbing activities. If pre-clearance surveys identify active Malleefowl mounds, then clearing will be delayed until the completion of the annual breeding cycle (February to May). The mound would then be removed during the non-breeding period. • Installation of suitable fauna egress in all stormwater and surface water diversion channels. • Undertaking regular inspections of water management areas (evaporation pond, tailings ponds, stormwater infrastructure and the surface water diversion channel) for potentially trapped wildlife. The frequency of inspections will be outlined within the Fauna Management Plan. Cameco will report all confirmed wildlife deaths discovered during these inspections.
13.	CCWA	The PER document outlines some of the key risks for each threatened species. For each description Cameco downplay the	Cameco disagrees with this comment and would like to refer the CCWA to Section 9.3.5 of the PER which details the potential impacts to terrestrial fauna and the proposed management and mitigation measures. In particular the submitter should refer to Table 9-33. An example from Table 9-33 (Bilby) is given below. The conclusion of a Minor impact, even though this easily-detected species was not recorded, seems consistent with the information provided. For example, the

No.	Submitter	Submission and/or issue	Response
		risks stating in every case that *"impacts of the Project on this species are expected to be negligible or minor."* These overly optimistic statements are not supported with any evidence or explanation. There is no rationale for why impacts such as road kill, loss of habitat, fire, feral animals would be 'minor' or 'negligible'. There is no explanation or description of how the Cameco intend to manage these risks and *impacts*. The proponent refers to a Fauna Management Plan that is yet to be developed. There is no evidence to suggest *that* these risks and impacts to endangered species can and will be adequately managed.	absence of the species (which really is easy to detect if present) suggests that a Minor impact may in fact overstate the risk. In addition, there is extensive available habitat outside the development area, which explains why habitat loss and roadkill would be expected to have only Minor impacts. It is thus incorrect to claim that there is no rationale given for the conclusion of a Minor impact. The greatest threat to Bilby populations is from landscape-scale processes such as feral predators and altered fire regimes. Fire and feral species are discussed as threatening processes with respect to the proposed development and there is potential for the Project to affect these processes in ways that could be either beneficial or adverse to the Bilby. The relationship between the proposed development and such threatening processes could have been extended and more clearly stated, but standard practices around a Project such as this should ensure there would be no change in the abundance of feral species or in the fire regime. This could perhaps have been more clearly stated and Cameco does need to clearly recognise a responsibility to manage, or at least avoid altering, landscape-scale processes. While the fauna management plan is yet to be developed, components of it are clearly identified in Table 9-33.
14.	CCWA	To Cameco's credit they offered CCWA a one on one lesson on the ERICA tool to explain how the ERICA model works. This session was appreciated and interesting, but not all together convincing. The public submitter remains critical about the use of Northern Hemisphere studies as the basis for the ERICA model. The ERICA tool is a tiered assessment. The initial inputs to ERICA for the 70 animals were less that 10uGy/hr so no further assessment was conducted. This type of assessment rules out any clear assessment around different scenarios where the risk to health is increased under certain conditions that are unique to that environment and species. There are many possible factors that influence radiological uptake in animals that go beyond animal size and diet. Without proper scientific studies on the radiological uptake of Australian animals in different Australian environments i.e. Arid, wet tropics under different conditions (cyclones, high winds, high rainfall events, in fire) the public submitter considers that there are serious limitations in the ERICA model. This tool cannot replace on the ground testing and assessments of individual species and individual pathways that are more or less significant for different species. The public submitter is unclear on the details of the ARPANSA 2014 kangaroo model and how it was used or implemented to identify the risks to kangaroos in the PER. Cameco stated that they created a kangaroo model using the ERICA tool, but then	**ERICA** Cameco was required to assess the potential radiological impacts to non-human biota using the ERICA method as outlined in the Terms of Reference *"Assessment of potential radiation impacts on flora and vegetation using the Environmental Risk from Ionising Contaminants: Assessment and Management (ERICA) tool. Australian specific data should be used where available."* The National authority on radiation matters in Australia is the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). ARPANSA considered ERICA to be an appropriate assessment tool for undertaking an assessment of radiological impacts to the environment and this is outlined in the recent publication "Guide for Radiation Protection of the Environment Guide G-1 November 2015". ARPANSA has also published Australian species specific data that can be used in the ERICA assessment. Cameco understands the limitations in the assessment tool but recognises the value the tool provides in giving a broad risk based assessment of the potential impacts. In all cases the assessed levels were well below the threshold level of 10uGy/hr that no further work is necessary. The ERICA assessment undertaken by Cameco demonstrated that the radiological impacts to generic species types (referred to as reference plants and animals) was negligible. **Application of the Kangaroo Model** The ERICA software is versatile and allows users to create their own reference species. This involves two main steps. The first step is to define a geometry for species of interest. The second step is to utilise specific data on concentration ratios (where a concentration ratio is a measure of the concentration of a radionuclide in the exposure media (for example soils) and the species itself). To take advantage of this versatility and to use the system for a local species, Cameco developed a geometry model for a kangaroo and applied the ARPANSA published concentration ratios for the radionuclides. ARPANSA published concentration ratio data for uranium, radium, lead and polonium, but not thorium. Therefore, for thorium, Cameco used the default thorium concentration ratio for the reference species "large herbivore" from the ERICA system.

No.	Submitter	Submission and/or issue	Response
		stated that they did not use it because ARPANSA 2014 did not provide concentration ratio values for thorium so *"the default ERICA value for large mammals is used in the assessment."* So the ARPANSA kangaroo model appears to be irrelevant in this scenario.	
15.	CCWA	There is a story in the region about a kangaroo with black lungs - this has almost become folklore, you can ask almost anyone in the area and mention the kangaroo with the black lungs and most people will know what you are talking about. In fact there were two kangaroos that were shot just south of the Magellan lead mine, when they were cut open the lungs and organs were dark red, almost black. In 2011 when BHP Billiton was involved at Yeelirrie some of the Traditional Owners living in Leonora made inquiries to BHP Billiton about kangaroos with black lungs. In response BHP Billiton agreed to send some samples off for testing. In late 2014 Traditional Owners from Leonora asked Mia Pepper from CCWA to find out what happened to those samples – they specifically mentioned samples that BHP Billiton took including a kangaroo, a goanna and the root of a kurrajong tree. A CCWA representative spoke to Cameco and asked if he could follow up on what happened to the samples taken for testing and advised that the community were still concerned about this matter. After some months Cameco wrote back saying that they did not intend to do any further sampling and that they had not received or found any data on this from BHP Billiton but that they were working to locate and verify the data which he hoped would be included in the PER. The public submitter has not been able to find any record of this in the PER. It is disappointing that the proponent had an opportunity to engage with the community over a clear concern and example of impact from mining on the environment and has not addressed it informally or in the PER. This shows a lack of commitment to evidence and addressing community concern through evidence. The ERICA tool is no replacement for testing on local animals that could provide new data and evidence.	It is difficult to comment on something that has been described by the submitter as folklore. Firstly, the animals were not taken near the Yeelirrie Project. Secondly they were taken before Cameco acquired the Yeelirrie Project. Cameco did make a request to BHP Billiton for data, however by the time the request was made of Cameco none of the people previously involved in the Project were still employed by BHP Billiton, and the fate of the samples and results could not be determined. The sweeping statements made by the submitter regarding a lack of commitment to engagement is incorrect and does not represent Cameco's approach to the local community.
16.	CCWA	The public submitter acknowledges that there are significantly different views about the impacts of low levels of radiation. As	The effect of the low level of radiation arising as a result of implementing the Project has been assessed using the approved ERICA model. ERICA modelling indicated the expected dose rate for all plant groups is expected to be less

No.	Submitter	Submission and/or issue	Response
		identified by Cameco there are a number of pathways for radiological uptake in animals. These include birds drinking contaminated water, kangaroos eating grass which has dust on it containing radionuclides or heavy metals from the mine, or animals inhaling radon gas. The public submitter expects that this Project is likely to have a radiological impact but has no clear detail to reference in relation to the adequacy of the mitigating strategies that the proponent intends to use to protect fauna from the numerous pathways of radionuclide uptake or heavy metal uptake because there is no Fauna Management Plan. This process is flawed as it lacks transparency. The public submitter urges that any future Fauna Management Plan be made available for public comment before any Departmental or Ministerial approval.	than the screening level of 10 µGy/h, with the exception of lichen and bryophytes. These organisms derive most of their nutrients from dust falling on them. However, lichen and bryophytes are known to be particularly radio-resistant and a threshold no-effect dose rate has been estimated to be 125,000 µGy/h, with some diversity reduction observed at 1.1 Gy/h (UNSCEAR 1996). Consequently no effect is expected on plants from dust emissions from the Project. ERICA modelling also indicated the expected dose rate for all groups of fauna as a result of the Project was below the screening level of 10 µGy/h. Therefore no significant radiation impacts on terrestrial fauna are expected to occur as a result of the Project. The primary pathway is via dust and Cameco has committed to manage dust emissions from the Project to minimise impacts. Based on the modelled dust emissions and application of the ERICA model, flora and fauna are not at risk from radiation.
17.	PS27, PS35	Local fauna could become extinct due to this mine. Avoidance of radioactive contamination is superficially dealt with in the PER, for example excluding birds from contaminated ponds in this semi desert environment will be particularly challenging.	This statement is not supported by the surveys completed.
18.	PS151	Contaminated dust also has an impact on wildlife. Four to six years ago some Aboriginals were saying that they opened up a Kangaroo and the heart, liver and kidneys were a darker red. These were tested and confirmed to have lead. The submitter also experienced the darker red, which is not right, when they shot and opened up a Kangaroo near the Wiluna-Meekatharra Road. A complaint was made to the mines department and the submitters were told that they would sort it out.	Comment noted. See response to comment No 15.

5. Human Health

No.	Submitter	Submission and/or issue	Response
1.	DotE	Page 307 - The only pathway considered here is inhalation of radon progeny. Possible contributions from inhalation of radon and dust are not included. Please demonstrate that the dose	Cameco assumes that this comment refers specifically to the Section titled “Other Workgroups” on page 307 of the PER (as the other Sections on this page which refer to Processing Plant Workers, considers other radiation pathways and doses).

No.	Submitter	Submission and/or issue	Response
		contributions from exposure pathways other than inhalation of radon progeny are negligible.	Appendix J1 of the PER provides some additional detail. The Section notes that gamma radiation exposure is expected to be negligible because the administration area is not close to any sources of gamma radiation. The potential doses from the inhalation of dust from Project emissions were not originally calculated. However, the air quality modelling predicts that maximum ground level concentrations of approximately 0.1mg/m^3 may occur in the administration area. Using the methods for dust dose assessment outlined in Appendix J1, and assuming an average uranium concentration in the dust, the estimated dose is approximately 0.05 mSv/y. Therefore, the conclusion in the PER remains valid. Note that the potential dose from inhalation of radon (as a gas alone) is not generally considered to be a major exposure pathway (ARPANSA 2005).
2.	DotE	The overall approach towards the management of radiation exposure is consistent with recommendations of best international practice (International Commission on Radiological Protection), in particular the proposed application of the principle of optimisation. However there is no commitment to establish dose constraints for different worker groups and members of the public, and reference levels for non-human biota. There also needs to a demonstrated understanding of the principle of limitation of exposure. The proponent needs to define and develop appropriate dose constraints and reference levels.	In the PER Cameco has used the term “Action Levels”. In practise the term means the same as “Reference Level”. Action levels are internally set levels or limits that if exceeded prompt a specific response of remedial action. They are not a regulated limit. They are typically developed by reference to standard doses from common tasks, comparison of doses for various facilities or perhaps set as a percentile of the regulatory level and work by improving management of radiation exposure and keeping doses down. Similar meaning is given to other terms including “Investigation Levels”. Therefore the use of the term Action Level should be read to be the same as Reference Levels. The definition of dose constraints has changed since it was originally introduced. Dose constraints were defined in the Mining Code 2005 as: • a prospective restriction on anticipated dose, primarily intended to be used to discard undesirable options in an optimisation calculation; • in occupational exposure, a dose constraint may be used to restrict the options considered in the design of the working environment for a particular category of employee; and • in public exposure, a dose constraint may be used to restrict the exposure of the critical group from a particular source of radiation. The definition of dose constraints has been the subject of recent change due to the 2007 recommendations of the ICRP. The historic definition was to prevent workers and the public exposed to several sources receiving doses approaching the limit whereas now the dose constraint is for the most exposed individual from a particular source. The definition of a dose constraint in ICRP103 (2007) is: • ‘A prospective and source-related restriction on the individual dose from a source, which provides a basic level of protection for the most highly exposed individuals from a source, and serves as an upper bound on the dose in optimisation of protection for that source. For occupational exposures, the dose constraint is a value of individual dose used to limit the range of options considered in the process of optimisation. For public exposure, the dose constraint is an upper bound on the annual doses that members of the public should receive from the planned operation of any controlled source.’ In practice, the dose constraint represents the upper bound of exposure above which positive action will be taken to immediately reduce exposure and below which further optimisation occurs as per ALARA. In the PER, Cameco has presented preliminary Action Levels and foreshadows the development and use of Dose Constraints. Cameco commits to developing Dose Constraints with the State based regulator and to document these in

No.	Submitter	Submission and/or issue	Response
			the operational Radiation Management Plan. Dose Constraints are not limits and therefore Cameco considers that these should not be captured in Licence conditions which has the effect of establishing the prescribed Doses as limits. In the same manner, reference levels would be established for minimising the radiological impacts to non human biota. For the impact assessment a reference level of 10uGy/h was used and it is likely that a level less than this would be used as a reference level during operations.
3.	DotE	Page 317 - In many cases problems show up after operations start. Assuming that all problems can be controlled or eliminated by good design is not good practice. Feedback loops in processing facilities are known to lead to elevated radionuclide concentrations, but are very difficult to predict. Monitoring and checking is always required to verify that the assumptions incorporated in the design remain valid. The proponent needs to develop appropriate Plans to implement these checks.	Section 9.6.6.2 notes that radiation, along with most other hazards and risks, are most effectively controlled in the design stage of a Project. Section 9.6.6.2 also notes that radiation monitoring results would be used to optimize radiation exposures and doses. Section 9.6.6.5 also notes that a regular and ongoing review of the adequacy and effectiveness of engineering and management controls would occur. Section 9.6 notes that details of specific measures would be outlined in the Project Radiation Management Plan which will be developed for the Project as part of the approval process. Monitoring and checking is achieved through the "Plan Do Check Act" model for the development and review of Management Plans.
4.	DotE	Page 318 - "Continuous RnDP monitors will be installed in the pit at times when stable atmospheric conditions are likely to occur". This is self-contradicting. In addition, so elevated radon concentrations in the pit may occur during non-inversion conditions (day-time, cool, low winds…). Please give this issue more consideration.	Cameco is committed to using continuous RnDP monitors. The operational Radiation Management Plan will specify the times and locations for using real time monitoring devices. While used during night times in the cooler months of the year, Cameco accepts that stable atmospheric conditions may occur on other occasions and the monitoring equipment (such as a Rad7) would be fitted to some mining vehicles or located with stationary workers (such as maintenance crews) during those periods.
5.	DotE	Page 320 - This statement "Worker radiation monitoring records would be made available to the CEO of ARPANSA via the Australian National Radiation Dose Register (ANRDR), in accordance with confidentiality requirements." Submission of personal radiation dose records to the ANRDR should be made a licence condition, to overcome privacy legislation.	Comment noted. Cameco would not object to a licence condition that covers this requirement.
6.	Rad Council	The proponent has identified the key factors which need to be included with respect to radiation. The risks associated with radiation are expected to be addressed in the Radiation Management Plan and can be adequately monitored and managed under this plan. This will be regulated by the Radiological Council under the *Radiation Safety Act 1975*, and the Department of Mines and Petroleum under the *Mines Safety and Inspection Act 1994*.	Comments noted.

No.	Submitter	Submission and/or issue	Response
7.	DotE	Page 379 – There is a detailed discussion of flood levels, etc., but no mention of radiation doses or the effects of possible erosion of the cover material by surface flooding. Please provide a discussion on how these events can affect the predicted radiological impact on humans, and the environment.	Section 9.6.6.6 of the PER describes the potential impacts of erosion of the TSF cover on radon emissions (see Section called Assessment of radon exhalation from the TSF post closure). Two scenarios were modelled. The first was a total loss of cover of approximately 0.5m, based on 10,000 year estimates as seen in Appendix O1 of the PER. The second scenario accounted for gullying across 20% of the cover (to a depth of 1.5m). In both scenarios, the overall change in attenuation by the cover material resulted in exhalation levels that were consistent with natural background levels. See Attachment 10 for more information.
8.	DotE	While it is reasonable to assume that the Ra-226 will go to the tailings, the volume of tailings is much less than the volume of the original ore, so the Ra-226 activity concentration in tailings could be considerably higher than in the original ore. In addition, crushing and grinding will reduce the grain size and increase the probability that the radon atom produced by the alpha decay of Ra-226 will be able to escape from the grains. Thus one would expect a higher radon emanation (exhalation) rate from the tailings when they dry out following disposal. Please check the validity of the assumptions used in the radon emission calculations.	It is incorrect to say that the volume of tailings is much less than the volume of the original ore. The volume of tailings is almost exactly the same as the volume of mined ore. The Yeelirrie ore contains on average 0.16% uranium, therefore, over 99% of the ore goes to tailings. Therefore in practice, the Ra-226 concentration in ore is very similar to that of tailings. There is published evidence that indicates that the radon emission rates from tailings are in fact less than that for ore. This is because the crushing and grinding of the ore, followed by processing results in a very fine slurry that settles to form a concrete like layer. The dried compacted tailings is generally very competent. In BHP Billiton 2009 (Olympic Dam Expansion Draft Environmental Impact Statement (DEIS) 2009, Supplementary Environmental Impact Statement (SEIS) 2011), radon exhalation rates of 2.5Bq/m^2/s for ore and 0.5Bq/m^2/s from tailings are reported, based on actual measurements. The exhalation rates from consolidated tailings are lower than the rates for unbroken ore. From a theoretical perspective, the Olympic Dam results are reasonable. Evidence for this is in IAEA 2013 (Measurement & Calculation of Radon Releases from NORM Residues (TRS #474)) which notes that radon exhalation is proportional to the diffusion coefficient of the material as follows; Exhalation $\propto$ (Diffusion coefficient)^{½} Diffusion coefficients for soils are generally of the order of 10^{-6} while rock (non-porous) is of the order of 10^{-7}. Concrete can be of the order of 10^{-9}, while saturated mud can be of the order 10^{-10} (Leach et al. 1980). Therefore, consolidated tailings which is more likely to be closer to concrete than rock, will have a lower diffusion coefficient. The intuitive situation, which suggests that crushing and grinding of ore leads to increased surface area and therefore higher probability of radon escaping, is not seen in the Olympic Dam measurements. One suggestion is that at an atomic level, the effect of particle size is not particularly relevant – at such a small scale, there is no significant difference between a crushed or uncrushed sample. An additional factor is the moisture content of the ore and tailings. The tailings retains some moisture which reduces exhalation rates. Reference: Leach 1980 - Leach, V.A., Lokan, K.H. Martin, L.J. – A Study of Radiation Parameters at Nabarlek Uranium Mine, N.T. Australian Radiation Laboratory 1980 As part of final closure design, Cameco would undertake radon emission testwork on the final compacted and consolidated tailings to provide input data for optimising the final closure cover depth.
9.	DotE	It is unclear why radon emanation at Yeelirrie will not be similar to that at the Wiluna Uranium Project. At Wiluna, proponents	Comparisons between Lake Way and Yeelirrie are not relevant. These are two different deposits under different conditions.

No.	Submitter	Submission and/or issue	Response
		have designed the TSF cover to include a 0.6 m thick radiation control layer. Other operations (Wiluna uranium Project) have committed to using a radiation control barrier as part of their closure designs. It should be shown why this is not considered necessary in this case. For example, radiation risk assessment may show that the radon leakage from the TSF is minimal, given the nature of the materials creating a highly convoluted pathway for radon diffusion, and thus the proposed design has been shown to be adequate in models. The proponent could assist in the understanding of likely outcomes through additional discussion of the proposed tailings cover method and the likely exposure levels.	While Cameco may not have labelled a layer of material above the tailings a "radiation control layer" the proposed tailings cover has been designed for its capacity to attenuate radon and is as effective. Radon exhalation through a cover or a "radiation control barrier" is generally governed by the permeability and depth of the cover material or barrier. Therefore, the same attenuation outcomes can be achieved by using different materials with different permeability's and different depths. A thinner layer of material can be used if it has a lower permeability. When making a decision on the final cover design, an important factor is the economic availability of suitable materials for cover purposes and at Yeelirrie this will include waste rock. The final depth of cover at Yeelirrie was driven by a range of reasons including: • Corporate standards; • Availability of materials; • Radon attenuation; • The fact that the ore body is within a flow channel and potentially subject to erosion; and • There are larger volume of tailings to store. Cameco has optimised the design based on these factors. The Yeelirrie cover gives a high level of attenuation in regards to radon exhalation and also is an effective barrier for gamma radiation directly from the tailings itself. The closure cover for the TSF has been designed to limit radon gas from exiting the tailings. In designing the thickness of the tailings cover for the Kintyre Project (Kintyre ERMP, p. 242), the movement of radon gas through the closure cover was modelled using RADON computer software, (U.S. Nuclear Regulatory Commission [USNRC], 1989). In applying this model, Cameco has used the NRC Regulatory Guide 3.64 (NUREG 3.64) (USNRC, 1989) to define an emission limit (known as an 'exit flux') of less than 0.74 $Bq/m^2/s$. While Cameco is aware that NRC has no regulatory role in Australia it does provide a useful guidance document on Radon attenuation figures that could easily be used in Australian conditions. Based on this limit, the model was used to determine the thinnest cover required to achieve this result. RADON code modelling determined that a 1.6 m thick layer of salvaged topsoil is sufficient to limit radon attenuation to less than 0.74 $Bq/m^2/s$ when combined with a 1 m layer of waste rock. As discussed in the Yeelirrie PER, Section 9.12.3.2, the planned cover will generally exceed 3 m in thickness.
10.	DotE	U-series disequilibrium is not adequately covered. In determining radiation dose from exposure to dust produced by mining it is assumed that all produced dust contains radionuclides in secular equilibrium with 238U. However, geochemical characterisation of tailings indicated that the ore may be below secular equilibrium for the 238U decay chain, and 238U may have been preferentially leached. If this is true the secular equilibrium assumption will provide an under estimate of radiation exposure from dust produced at the mine. Discussion of the implications for disequilibrium conditions on the assessment of radiation exposure via the dust should be included.	It is correct to say that the tailings will not be in secular equilibrium, however, it is incorrect to say that this results in an underestimate of the modelled potential doses from the inhalation of airborne dust pathway. Assuming secular equilibrium is maintained has the effect of producing an overestimate of the potential doses from inhalation of dust. It assumes that all radionuclides are present in the dust, even though in practice the uranium radionuclides from any dust from tailings will be at a far lower concentration. Therefore it assumes that a dose is being delivered by all the radionuclides. The radiation assessment in the PER assumed that all radionuclides were present in the dust, which produces an overestimate of the potential doses. Dust modelling has been completed, including consideration of maximum wind speeds and dust storms in the region and the radionuclide concentrations in air and RnDP concentrations were used as the basis for the calculation of the public dose using the dose factors and methods recommended by the IAEA and ARPANSA (PER, p. 312 -315). This includes the dose from inhalation and ingestion of dust borne radionuclides (including an estimate of the consumption of cultivated foods and bush tucker grown within a region that would receive

No.	Submitter	Submission and/or issue	Response
			dust from the Project). Based on a conservative estimate of 100% occupancy, the estimated total public dose contributed by the Project at Ululla Homestead is 0.028 mSv/yr, or less than 3% of the allowable dose over and above background.
11.	DotE	Wash-downs needed careful enforcement. Estimated radiation doses are under the 1mSv/y (+background), and the proponent says (pp xiii Exec. Sum.) The workforce exposures are expected to "easily comply with the guideline dose limits" and that "no significant radiation impacts on terrestrial fauna are expected to occur" represent a high level of confidence (which could potentially in time lead to complacency). Vehicle wash-downs and other procedures need to be enforced to ensure compliance. Clarification of wash-down enforcement considerations.	This query relates to comments in Table E-3 in the Executive Summary of the PER. Cameco recognises that radiation protection is a fundamental task and takes its commitment to radiation protection seriously and is confident that doses to workers, the public and the environment will be low and well controlled. The statement "*easily comply*" is used in the environmental assessment context and not the management context (within which the concern of complacency is understood to arise). Management actions will be separately regulated by the Radiological Council under the *Radiation Safety Act 1975* and the Department of Mines and Petroleum under the *Mines Safety and Inspection Act 1994*. Further, Cameco currently successfully operates a number of uranium mining and processing facilities in Canada and has demonstrated that radiation, like all hazards and risks, can be properly controlled through vigilance, effective management systems, design controls and a trained workforce. As part of operational management, Cameco will implement a Radiation Management Plan to ensure that radiation impacts remain well controlled. Cameco has also undertaken extensive modelling of potential doses, as outlined in Section 9.6 and Appendix J1 and J2 of the PER, which provides the basis for the comments made in relation to compliance with dose limits. Operational management requirements, including the need to wash down vehicles and ensure that all equipment is cleared before leaving the operational area, will be part of the management plan. An overview of the operational management measure is provided in Section 9.6.6.7 of the PER.
12.	DotE	Based on gamma surveys at waste rock piles and stockpiles for mining trials, it is concluded that radionuclides were not released from either stockpiles or waste rock. There is no discussion of the possibility that radionuclides were released and transported some distance from the stockpiles. Provide reasons or evidence for the statement that no radionuclides were released, explaining why they could not have been transported (e.g. in runoff or through percolation) away from stockpiles in the 20-30 years between stockpiling and rehabilitation. Particular attention should be given to radium which is relatively mobile.	It is noted that this comment refers to a sentence in the introduction and in Section 2.2 of Appendix M3 of the PER – Geochemical Assessment of Tailings and Mine Waste. However, Section 4.5 of Appendix M3 describes the testwork on radionuclides in material from the Yeelirrie region, including material that would make up waste rock. The testwork indicates that all radionuclides are barely soluble, apart from radium 226, which could not be detected in leach liquor. The reason given for radium being detected is that the analytical technique had a much lower level of detection. The evidence for the statement that radionuclides were not released through transport mechanisms (such as in run off or through percolation) is the gamma monitoring results which were conducted by an aerial gamma survey and referenced in the appendix. Another justification for the very limited potential for transport of radionuclides is that run off from stockpiles is generally actively managed as part of routine operations. Run off is usually collected in sedimentation ponds and contained.
13.	CCWA	Ore stockpiles with uranium are likely to release Radon gas. Radon gas poses a serious health risk and is the primary cause of lung cancer. This gas also gets trapped between layers of hot and cold air. The proponent has discussed in the PER that radon will only come from the ground and the pit. There is no discussion on	Cameco notes that there are a number of issues here and will address each of them below, Firstly however it is important to understand how the air quality assessment model and the radon dose assessment interacts to provide Cameco with the data to calculate the radon dose for the Project, including under various atmospheric conditions. Cameco has completed an assessment of Project air quality. The study report is provided as Appendix L1 of the PER.

No.	Submitter	Submission and/or issue	Response
		radon gas coming from stockpiles. There is no assessment of this health risk in the assessment. In the avoid and minimise Section relating to ore stockpiles there are no proposed management strategies to avoid, minimise or manage the risks of inversions and radon build up. Cameco does provide some measurements and analysis of the risk of radon from the pit and has acknowledged the risk of radon gas build up during an inversion. However they do not provide any clear management strategy for work conditions during an inversion event. They state they will have real time radon monitors in the pit and minimize workers exposure. Real time radon monitors should also be placed in other areas of the mine to test and track how radon might move or build up on site during inversions. These tests should be conducted around ore stockpiles where there is also potential for radon. The assessment of radiation doses from inhalation of radon decay products has been modelled with consideration to inversions. *"Modelling of radon gas in the open pit under stable atmospheric conditions (as would occur under an inversion) was conducted under worst case conditions (maximum hours in the pit under the worst case inversion) and showed that the maximum worker dose from Radon gas would be 4mSv/yr. Real time radon monitors would be established to confirm radon gas levels in the open pit and workers rotated or removed as required to minimise dose,* "(pg. 119). However the assertions made here are not supported with evidence or any further description on the assumptions or the data used for this modelling. It is not clear how Cameco arrived at this conclusion. The description on changes to operational activity during inversions to limit exposure to workers is minimal. There is no description of trigger levels of radon for rotating workers. There is no indication that workers will be supplied with equipment to monitor radon doses. Will dose rates for workers be based on modelling and assumptions or on real data or evidence about exposure? This is particularly concerning when considering the Yeelirrie State Agreement Act which give Cameco an exemption from meeting labour conditions.	The air quality assessment investigates the potential for air quality impacts to occur due to mining operations for a scenario representing a stage in the development that is likely to result in the highest ground-level concentrations at the closest sensitive receptors. The assessment used meteorological and dispersion models to assess the potential impact associated with dust emissions (TSP, PM10, PM2.5 and dust deposition) from the proposed Yeelirrie Uranium Project in isolation (operationally contributed) and with the inclusion of ambient background levels of dust representative of the region. The meteorological and dispersion models are also used to model radon build up and dispersion under various meteorological conditions to enable an assessment of the potential for radon impacts to occur due to mining operations thus providing the information for Cameco to understand the potential risks and dose from radon emissions. The radon assessment is outlined in Appendix J2 of the PER and predicts the ground level radon concentrations due to the Project, including at each of the nearest sensitive premises. **Radiation emissions from stockpiles** The potential dust emissions and radon emissions from stockpiles have been included in the impact assessment for the Project. Table B1 of Appendix B of the Appendix L1 of the PER (Air Quality Report) shows the estimated volumes and surface areas of stockpiles. The air quality assessment also includes the impacts of very stable atmospheric conditions (inversions) modelled outputs. This is outlined in Section 6.2 of Appendix L1. **Control of radon decay product exposure during temperature inversions** Section 9.6.6.3 of the PER provides an outline of the operational control measures for elevated levels of radon and radon decay products in the mine pit during stable atmospheric conditions. Further details will be provided in the Radiation Management Plan (as noted in Section 9.6.6.7 of the PER) as required for operational approval. The Radiation Management Plan is assessed by the Radiological Council under the *Radiation Safety Act 1975* and the Department of Mines and Petroleum under the *Mines Safety and Inspection Act 1994*. Cameco notes the Radiological Council's submission that "*The proponent has identified the key factors which need to be included with respect to radiation. The risks associated with radiation are expected to be addressed in the Radiation Management Plan and can be adequately monitored and managed under this plan*". **Provide supporting evidence for radon decay product exposure to mine workers** Please refer to Sections 9.1, 9.3, 9.6 and 9.8 of the PER. Please also refer to appendix J1 (Radiation technical Report) of the PER. **Provide action levels for mine radon and radon decay product concentrations** Please refer to Table 9-62 which provides the proposed radiation action levels and required action that would be implemented as part of a radiation management plan. The potential dose from inhalation of pure radon is very low compared to the dose from the decay products. This is why controls are based on the levels of radon decay products in the air. **Monitoring of workers and dose assessment methods** There are standard methods for the calculation of doses to workers and these are described in ARPANSA 2005 and in detail in the Western Australian NORM Guidelines. Cameco also has extensive experience in managing uranium mines

No.	Submitter	Submission and/or issue	Response
		Cameco has failed to effectively describe the risks associated with inversions on air quality or provide evidence to support claims about inversions and radon build up. In this Section the public submitter could not identify what Cameco meant by 'sensitive receptor' or establish what Cameco consider to be 'acceptable levels' of air pollution. The public submitter is not satisfied or confident Cameco can and will adequately minimise, avoid or monitor the risks associated with elevated levels of radiation or heavy metals in the environment that are dispersed through dust and accumulated during inversions.	and maintaining high standards. Cameco maintains a corporate Radiation Protection Programme which will be used to set minimum requirements for radiation protection at Yeelirrie. As part of the approval and authorisation process, Cameco is required to submit a detailed Radiation Management Plan. This plan will outline, in detail, the monitoring and methods for radiation exposure and dose assessment. **Cameco has failed to effectively describe the risks associated with inversions** This is incorrect. Cameco understands that very stable atmospheric conditions (also called inversions) occur in the region and have included this fact in all impact assessments. The air quality impact assessment includes the modelling of very stable atmospheric condition and this is outlined in Section 6.2 of Appendix L1 of the PER. The occupational radiation impact assessment is outlined in Section 9.6 of the PER and is based on outcomes of the air quality modelling. The assessment also considers the impacts of very stable atmospheric conditions on the potential doses from inhalation of radon decay product doses to mine pit workers. Even though the stable conditions are taken into account in the air quality modelling, as a precautionary measure, an additional dose factor was applied for when assessing the potential doses for mine workers. **'Sensitive receptor' is not defined neither is what Cameco considers to be 'acceptable levels' of air pollution** The sensitive receptor locations are described in Section 3.1 of Appendix J1 of the PER. The locations of the receptors are also noted in Table 9-54 of the PER. The 'acceptable levels' of air pollution, from a radiological perspective, are based on the potential exposures and doses that might be received by people or the environment. These levels have been established at an international level and are propagated into national and state legislation. Cameco complies with all of the applicable statutory radiation limits as they apply. **Submitter is not satisfied or confident Cameco can and will adequately minimise, avoid or monitor the risks associated with elevated levels of radiation** As noted, Cameco has extensive worldwide experience in operating uranium mines in a productive and safe manner. Radiation is only one of a number of risks and hazards that Cameco successfully manages. Cameco maintains formal safety and environmental management systems and engages qualified practitioners who provide operational and strategic advice on radiation management and the system of dose limitation. Further, as previously noted, radiation exposure to human receptors is regulated by the Radiation Management Plan which is assessed by the Radiological Council under the *Radiation Safety Act 1975* and the Department of Mines and Petroleum under the *Mines Safety and Inspection Act 1994*. The submission implies that Cameco's management is voluntary and may be discontinued. This is incorrect.
14.	Denmark Env. Centre; PND(WA)	A 9 km stretch of open pit mining of a radioactive mineral in a highly mobile calcrete form in a region with high winds and the frequent occurrence of dust storms means significant public health risks and a high level of public interest. Beyond the workforce is a sparse but important Aboriginal and pastoralist community also risk from mining disturbance, wind dispersal, and transporting of this radioactive mineral.	Cameco recognises all of the issues outlined in the submission and had quantified the actual impacts of the proposed operation. Reference to the specific issues are as follows; • Radiation impact – Section 9.6 of the PER • Impacts of winds – Section 9.8 of the PER • Impacts of groundwater – Section 9.5 of the PER • Impacts on flora and fauna – Sections 9.1 and 9.2 of the PER

No.	Submitter	Submission and/or issue	Response
			It should also be noted that each of the assessments is supported by detailed technical reports that are provided publicly as appendices to the main PER. In all assessments, it has been shown that there is little to no impact on people or the environment outside of the mine lease area. The air quality assessment for the Project (Appendix L1; Katestone 2014a) was based on hourly meteorological data for one year to account for typical meteorological conditions likely to be experienced in the region. The meteorological data generated was evaluated against observational data recorded at five automatic weather stations and at Yeelirrie and Wiluna. The meteorological data accurately represented the type, magnitude and frequency of meteorological conditions that are likely to occur, including consideration of maximum wind speeds and dust storms in the region. The approach that was adopted is consistent with standard practice. Estimates of the public dose from airborne radionuclides inhaled or ingested was also modelled and show a very small dose and no risk to the public from the development of the Project. See also the response to Comment 10 under the heading Air Quality and Atmospheric Gases for additional discussion on the Air Quality modelling, wind speeds and dust generation.
15.	Denmark Env. Centre	Long haul transport of yellowcake (to a port) always carries the risk of accidents	Cameco recognises that there are risks associated with all road, traffic and transport situations and aims to minimise the risks from its activities through the development of a transport management plan. This plan requires the approval of the Radiological Council under the *Radiation Safety Act 1975*. Notably the EPA stated in EPA Report 1522 (Kintyre proposal) at p.19 that "*The Radiological Council also advised that the transport of uranium oxide concentrate can be adequately managed under the Radiation Strategy (Transport of Radioactive Substances) Regulations 2002*". In countries where the company operate, Cameco regularly undertakes desktop exercises and at least one annual full-scale exercise of our transport emergency response. Cameco involves their trucking contractors and regularly works with different local emergency responders to achieve the maximum learnings from these events and Cameco Australia will implement similar training measures and other transport related practices and procedures in place at other operations. While it might be new to Western Australia, it is important to understand that uranium is moved safely all over the world every day of the year. In fact, the IAEA reports that since 1963 when transport standards for these goods were set, there has not been a transport accident involving Class 7 (radioactive goods) where there has been significant radiological results.
16.	Kalgoorlie – Boulder Chamber of Commerce & Industry	Regional Communities – Assurance that regional communities on the transport route are taken into consideration in the event of unforeseen circumstances.	Comment noted. Cameco has consulted and will continue to consult with local communities and committees including the State and Regional Emergencies Services Network over the development of the transport management plan and provide information sessions and updates to all communities along the proposed transport route.

No.	Submitter	Submission and/or issue	Response
17.	Uniting Church	While the proponent proposes to ensure radiation measurements will remain within the required thresholds, the level of negative impact involved from any unforeseen mistakes, equipment or design failure, or external disturbance, presents a risk that we consider too great to subject the local community to.	The potential for natural hazards to affect the Project are considered in Section 7.7 of the PER. A number of other risks including those associated with impact of dust and radiation on occupational and public health and the environment and the transport of uranium oxide final products are also considered in the PER. The assessment indicates that for the whole Project, all hazards and risks are manageable. The potential radiation risk is shown to be low and well within internationally recommended guidelines. Other hazard identification and assessment processes considering the risks associated with the operation of plant and equipment and handling of process chemicals are assessed outside of the PER process. These occur as part of the Project pre-feasibility studies and are then further refined during definitive feasibility studies and again during the design and engineering phase. The risk and hazard management plans are assessed by the Department of Mines and Petroleum during the approval of the Mining Proposal prior to the construction of the Project. It should be noted that management of unforeseen events is not unique to Yeelirrie and can occur for any Project and for any situation. Predicting what may go wrong is part of a risk assessment which identifies potential events, the potential consequences and the likelihood of such an event. An integral part is to ensure that systems exist to manage and minimise the impacts of failures. To this end, Cameco maintains an emergency response plan and contingencies.
18.	PS1, PS3, PS10, PS49	Uranium mining poses a significant risk to workers and other persons exposed to uranium mining activities. There are links between radiation and solid cancers. As more information becomes available the limit of exposure decreases, for example, the allowed dose in 1934 was 500 millisieverts, now it is 1 millisievert. Many studies provided which show the relationships between radiation and cancer. Studies show that radiation in the embryo causes and increase of future cancer or leukaemia by 50 times more, plus more chances of deformities, therefore why are women of child bearing age allowed to be associated with the nuclear power industry or other activities where the chance of radiation exposure is high. Will you be employing women of child bearing age? Small amounts of by-products have been used for construction of equipment in the US. Troops in war situations have shown long term negative impacts on health. How can you ensure this won't happen in WA? All known uses of uranium involve long term danger to humanity, except nuclear medicine.	Cameco clearly recognises that exposure to higher levels of radiation can result in the development of cancers and therefore maintains a companywide radiation management system. The company approach is based on the international framework known as the "system of dose limitation", which is recommended by the International Commission on Radiological Protection (ICRP) and requires projects to be justified, the doses optimised (i.e. keeping exposures as low as reasonable achievable (ALARA) taking into account social and economic factors) and limits not to be exceeded. The ICRP-based approach is adopted in legislation around the world. Under their employment conditions, pregnant workers are requested to declare their pregnancy in order to ensure that the dose to the unborn foetus remains below the member of the public dose limit of 1mSv/y (factored for time). In practice, this is generally handled sensitively with workers moving to lower or no dose positions. There is some evidence to suggest that exposures to higher levels of depleted uranium in particulate or vapour form, may occur in a war zone with the explosion of shells with armour piercing depleted uranium tips. However, comparing mining conditions with war conditions is misleading. Radiation worker dose records demonstrate that radiation doses in a minesite can be managed to levels well below the safe working limit.

No.	Submitter	Submission and/or issue	Response
19.	PS3	How much lead will remain after mining and what will be its health implications. Who pays sickness benefits to those affected with cancer, leukaemia or genetic disease? Who pays carers benefits, What about the pain and suffering of victims and compensation for families who have lost loved ones?	Just to clarify any misunderstanding, Cameco is not mining or producing lead at Yeelirrie. Uranium is a naturally occurring element that is radioactive. It decays, and gives off energy in the form of radiation and effectively turns into a different element or different isotope of the same element. For uranium, the main isotope is known as Uranium-238. This element decays and forms an isotope of thorium known as Thorium-234. This isotope is also radioactive and turns into another isotope of uranium called Uranium-234. The decay chain continues for another 11 elements, until stable lead is reached (also known as lead 206). A proportion of all lead found in nature comes from the decay of uranium, with some also coming from other naturally occurring radioactive decays. However, the majority of stable lead comes from supernovae during the formation of planets. Cameco maintains insurance for compensation for work related injuries and illnesses.
20.	PS35	The concerns of dust containing radioactive particles are not adequately addressed in the PER. Effective dust suppression would require large quantities of water, adding to already large water extraction rates. Measures to manage radon emissions appear inadequate.	This statement is incorrect. Cameco has conducted an extensive assessment of dusts and the radiological impacts of dust emissions. The impacts have been assessed for workers (see Section 9.6.5.1 of the PER), the public (see Section 9.6.5.2 of the PER) and to the environment (see Section 9.6.5.2). The assessments are based on a detailed quantification of the potential emissions from the operations and workplace conditions and in most cases are conservative (that is, they do not assume best conditions). This is also the case for radon. The requirements for water for dust suppression is discussed in Section 6.6 of the PER. In Figure 6-14 there is an allocation within the Project water supply of 71m^3/hr for dust suppression. The discussion in Section 6.6 also notes that water of a lower quality will be used for dust suppression.
21.	PS147	Uranium mining would expose workers to radiation at elevated levels from background radiation. Significant breaches of risk and safety controls occur in Western Australia. In particular, mining is a high risk occupation and accidents do occur.	The PER, Section 9.6 and Appendix J1, provide a comprehensive overview of radiation, including a description of the natural background radiation. The assessment of potential doses to workers and the public has been based on conservative conclusions, and therefore the theoretical predicted doses are more than likely to be higher than those that will be received. Radiation is highly regulated in Australia (as it is elsewhere in the world). Companies are required to not only keep worker and public exposures beneath recommended limits, but they are also required to ensure that doses have been optimised. This means that companies must demonstrate that they are keeping exposures as low as reasonable achievable (ALARA) taking into account social and economic factors. This is usually achieved through management systems which aim to continually improve workplace conditions and reduce potential emissions. Workplace health and safety is also well regulated in Western Australia.
22.	PS151	Uranium is the most controversial commodity in the world. The submitters are frightened of radiation and its health effects. It brings thoughts of atomic testing in Maralinga. The submitters parents passed away from cancer after the blasts in 1957.	The submitter should note that uranium is classified as a low level radioactive product and the radiation associated with mining and milling should not be compared with the radiation associated with atomic testing. Cameco recognises that uranium is controversial, but also acknowledges that state, national and international controls and regulations are in place to ensure the safe production of uranium and the safeguarding of the use of uranium. An operating licence condition

No.	Submitter	Submission and/or issue	Response
			which is monitored at a national and international level ensures that Australian uranium cannot be used for any military purposes.

6. Hydrological processes

No.	Submitter	Submission and/or issue	Response to comment
1.	P&W	The groundwater model provided with the PER is in Appendix I1 (Cameco, 2015) which supersedes the results and predictive simulations by URS for the original BHP proposal. It should be noted that the URS report was not provided with the PER, but some of the modelling results are cited in Appendix F2.	Comment noted. The superseded URS model is available if required.
2.	P&W	The modelling undertaken for Cameco appears to be based on a "…*relatively simple hydrological regime*…" (Appendix I3, page 1). However, *URS (2011)* indicated a complex hydrological system, with variable salinity in lateral, longitudinal and vertical scales, particularly in the central calcrete.	The model was peer reviewed for the OEPA and that review is included as PER Appendix I3. The model is conceptually simple but highly detailed in structure including 9 layers 905 columns and 332 rows, or up to 2.7 million cells (some inactive). This can be compared to the PRAMS model, used for water management in the Perth region, which includes 12 layers, 214 columns and 454 rows or 1.2 million cells. Development and calibration of the Yeelirrie model was very well supported by regional and local data sets. In particular the local calcrete aquifer hydraulic properties are well defined by extensive dewatering trials undertaken in the 1970's. The history of the Yeelirrie and other nearby projects and operations means that the groundwater aspects of the proposal is uniquely well informed by WA resource industry standards.
3.	P&W	Further the model relies on two key datasets, one from the operation at the adjacent Albion Downs Borefield. It is understood from the interagency briefing on 2 December 2015 that the Albion Downs Borefield abstracts from sand and alluvium. The relatability of that dataset to predicting the effects of abstraction from the calcrete and alluvium aquifers at Yeelirrie that will be required for this proposal is uncertain and should be confirmed.	While wellfield data from Nickel West Mt Keith operations was used in the development of the groundwater flow model, these data were not considered as a "key dataset" in the development of the model. More critical datasets include the results from test pumping the mining slots and monitoring observation wells in 1972 and 1973, and the field investigations conducted during 2009 and 2010 which included the drilling in excess of 150 production and monitoring wells and a series of pumping tests. The work undertaken and the results used in the groundwater model is described in Appendix I1 of the PER.
4.	P&W	The selection of water source for the proposal should be based on consideration of sourcing water from areas with the lowest potential environmental impact. The philosophy for water use for the Project is described in the PER on page 44: "…*utilise poorer quality (higher salinity)*	Agreed. Subterranean fauna is one of the significant aspects of the Project and the focus has changed to managing groundwater abstraction to minimise drawdown in areas of key habitat rather than the more general goal of utilising poorer quality water first.

No.	Submitter	Submission and/or issue	Response to comment
		groundwater where possible…potentially minimises the impact…on groundwater dependent ecosystems". This implies that the best quality water (lowest salinity) is expected to be the most environmentally important, although this has not been confirmed. Selection of water sources should include consideration of sourcing water (regardless of 'quality') from areas with the lowest potential environmental impact on the high value conservation assets at risk from the development of this proposal. The PER does not separate the impact of dewatering for access to the orebody for dry mining and the impact of water abstraction for use. The impact from water abstraction for use should be minimised as far as possible, and alternatives that will not impact on significant conservation values investigated in order to minimise the impact on the subterranean fauna community and component taxa. There is the potential to reduce the impact of the proposal presented in the PER to the subterranean fauna community and component taxa if the proposal is refined to remove the impacts of water abstraction for consumptive use.	While there are no management options available to Cameco to reduce the take of water or the modelled impact from dewatering the open pit, there are however management options available to limit the impact from production borefields including managing abstraction to meet maximum drawdown targets though to foregoing a supply altogether. In order to minimise the impact on subterranean fauna, Cameco has made the following amendments to the Project. • Amended the borefield design to remove abstraction for the palaeochannel to the north of the open pit to preserve the central and northern calcrete habitat • Commit to maintaining the 0.5 m drawdown as shown in the PER and Attachment 3 to preserve habitat in the northern and central calcrete by maintaining groundwater levels and water quality of the palaeochannel to the north west of the open pit • Commitment to not locating any production bores in the palaeochannel to the south east of the open pit unless an alternative water source cannot be located. • In the event that a borefield is operated in the palaeochannel south east of the open pit, commitment to manage the borefield to reduce impact on the habitat of species only know from the habitat south east of the open pit. The impact of dewatering only was presented in the PER Appendix I1 (Figure 5.11a).
5.	DotE	There is inconsistent application of PMP and ARI design events. These have implications on the facility design. Please clarify the relationship between PMP and ARI events and which the TSF is designed to accommodate. This can also include discussion of potential short-range climate variability on the design.	The freeboard includes an allowance of a 1m clearance between the highest tailings level and the top of the embankment. It also includes the volume below the beach to the decant pond level. According to calculations provided in Appendix H1 (Table 5-4) of the PER, a 72-hour PMP event would result in a depth of water of 1.0m. The TSF design includes an allowance for an event of this magnitude and also provides for additional storage from the basin area in the TSF below the beach. Based on the above, this design is considered to be adequately robust to cater for any short-range climate variability. Such variability is expected to be extremely small in relation to a 72-hour PMP event.
6.	DotE	Comprehensive work has been done on water balance and sensitivity analysis. However, the site water balance and the Goldsim model do not account for potential changes in rainfall resulting from forecast climate change. Subsequently, the design specifications are based on an assumption of stationarity in modelling the water balance. A discussion of the potential issues in the assumption of stationarity, and potential mitigation and management options to account for changes in rainfall, and how this would affect the Yeelirrie Project water balance, should be provided.	Water balance calculations included in Appendix H2 of the PER, Section 4.2.1 and Section 5.1 addressed climate variability as part of a sensitivity analysis. That analysis considered the driest, wettest and medium rainfall patterns over a 31-year period from the 120-year dataset. From this analysis, it was concluded in Section 5.7.1 that the water balance may experience some impact from a drier or wetter climate, but overall, it is not significantly affected by climatic variability. Such variability is able to be made-up by changing the rates of groundwater abstraction from the water supply borefields. The site water balance and Goldsim model use the historic 120 year rainfall record for the Monte Carlo simulations. Therefore the climate variability within this period has been taken into account. The rainfall record shows a significant variability in annual rainfall within the 120 year record. The forecast climate change for this region, falls well within the statistical variability of the record used.

No.	Submitter	Submission and/or issue	Response to comment
			At this preliminary (conceptual) stage the design specifications are based on the statistical mean over a 120 year period with provisions being made for variability and uncertainties in the lower confidence limits. The current water balance therefore provides an appropriate level of variability for this stage of the Project. The potential mitigation and management options for seasonal variability are described in the surface water and groundwater management plans. These indicate the management of excess water during wet periods and the supply of additional water during dry periods.
7.	DotE	It is unclear how pit dewatering volumes evolve. A wide range of different volumes is presented, possibly to show that there is variation over the life of the Project. These include figures of 4 ML/d, 7.5 ML/d and 13.5 ML/d. While this represents the heterogeneous nature of dewatering requirements, it may confuse assessments of the water balance. Please clarify the volumetric withdrawal rate for pit dewatering. This could take the form of a line or bar chart, showing predicted dewatering over the life of the operation. In addition to the simulated water demand and supply (i.e. figure 9-37) it would be beneficial to understand the transient discharge to evaporation for the TSF and evaporation ponds (i.e. in water balance 9-36) over the operational life of the mine.	Dewatering volumes that are expected to be abstracted are represented in Figure 9-37. This shows the expected changes throughout the mine life due to the progress of mining within the superficial aquifer. This presentation shows the dewatering rates (blue line) in context with the other supply and demand aspects of the site's water balance. It also shows the periods when excess groundwater from mine dewatering is required to be re-injected to preserve the resource, avoid the need for off-site discharge, and minimise impacts. The water balance is inherently complex to meet the needs of dewatering-driven supply, and process-driven volumetric and quality demands. All of these variables and expected supply and demand outcomes are described in detail in Appendix H2. All discharges through evaporation are detailed in the water balance report presented as Appendix H2 (See Section 3.1.7 with regards to the evaporation pond losses). TSF evaporation losses are detailed in Section 2.5.4 of that report. Evaporation from the TSF is calculated as follows: • Evaporation from beach areas is assumed to be 1.6 mm/day. The beach area is calculated daily based on the daily water balance in the TSF. • Evaporation of the ponded area of the TSF is calculated with reference to the daily water balance in the TSF. The ponded area is subject to evaporation which is in turn subject to estimated salinity levels. The water balance simulates evaporation from the Evaporation pond by simulating the daily water and salt balance in the pond to work out evaporations rates and volumes on a daily bases over the operational life of the mine. The Project water balance (Figure 9-36) shows the combined nett evaporation losses (hourly and annually) from the TSF and Evaporation pond. The water balance for both these facilities include the variability in rainfall input each receive. A graph showing the transient discharge from the TSF to the evaporation pond has not been included in Appendix H2 (Water Balance) as this was deemed not critical to the level of detail presented in the report.
8.	DotE	It is unclear how the surface water and groundwater management plans relate. Surface water and groundwater connectivity needs to be defined to address potential creek/calcrete hydrological impacts from abstraction and reinjections. This includes both baseflow and stream recharge considerations. That is, will mounding of groundwater upstream as a result of reinjection influence the baseflow contribution and increase recharge downstream due to a steeper groundwater gradient?	The surface water management plan focusses on issues associated with runoff collection, or diversion to achieve volumetric and quality objectives relating to fauna and groundwater recharge. The groundwater plan focusses on issues associated with abstraction and associated drawdowns at the water table. Volumetric aspects of the two are linked in the water balance (Appendix H2), while ecological aspects (water availability, recharge and resultant quality are linked through the fauna and vegetation management plan. Groundwater-surface water connectivity is described in Appendix H1, Section 8. This Section details the reliance of groundwater levels and quality on recharge that is driven by large storm events that initiate ponding of surface water in low-lying areas. In this setting, groundwater does not discharge to the surface, hence there are no baseflows within the mine site. Channelled flows across the valley flanks deliver runoff to the valley bottoms, where it accumulates, often in a clay pan. Based on flood modelling (Section 8.2), changes to flood depth (water availability) that drives groundwater

No.	Submitter	Submission and/or issue	Response to comment
			recharge, and water table quality in potential GDE areas downstream of the mine are not expected to be significant. Changes to groundwater quality from stormwater releases are discussed in Appendix H1, Section 8.3. Drawdown and mounding issues associated with groundwater abstraction and re-injection are assessed in Appendix I1. As discussed in Section 5.6.2 of that report, at no time is mounding expected to approach the surface, or lead to ecological impacts due to the concurrently operating mine dewatering activities. During the initial four years of operation, re-injection will establish a slightly steeper hydraulic gradient towards the dewatered open pit, but it will remain low due to the presence of transmissive and porous calcrete. Upstream mounding is not expected to impact undisturbed areas upstream due to the high degree of aquifer storage and transmissivity.
9.	DotE	It is unclear if the groundwater operating and management strategies will be subject to review and optimisation. Regular reviews of monitoring programs and modelling are necessary to inform an optimised groundwater operations strategy and management plan.	It is standard practice in WA to manage abstraction-related impacts via a groundwater operating strategy in line with Department of Water guidelines. These as well as non-abstraction-related impacts are managed through a water management plan, These strategies and plans are reviewed annually and updated if there have been significant changes to either the take or use of groundwater, or management approaches that have been changed to adapt to unforeseen aquifer responses. Groundwater monitoring data is reviewed annually according to established State-based guidelines and conditions that are typically placed on a groundwater well licence. This process requires a review of long and short-term impacts (annual and triennial reviews) as well as the monitoring programme and its effectiveness. A commitment is already in place in the PER to implement this process in Section 9.5.6.
10.	DotE	"However, depending on the development stage of the mine, there will be operational requirements to manage and discharge excess water." (p. 255) It is unclear which development stages are referred to and under which scenarios and operational requirements discharge of excess water will be required. Clarification would enable better assessment of the performance of hydrological changes within the surface water diversion bund during operations.	During normal operations, stormwater is collected from disturbed areas in stormwater ponds, completed mine voids and following extreme events, active mine voids. The operational requirements associated with this include the transfer and potential discharge of excess water from active mine areas in order to allow mining to continue. In all cases, this water would be stored on site and tested to determine if it was suitable for discharge. If it is suitable, it would be discharged. If not, it would either be treated and discharged, or sent to the processing plant depending on the volumes and quality of the excess water involved.
11.	DotE	The groundwater flow model has been identified as conservative. What other scenarios were also modelled? E.g. • Reduced water supply demand from Project whilst maintaining pit dewatering. • Average recovery of water from tailing and processing, requiring adequate disposal/reuse of excess water. • Impacts of drawdown resulting from above average abstraction from wellfield. • Excess water resulting from rainfall and run off. This represents a potentially worst-case scenario, as it appears to be biased toward the use of pit dewatering water and negates	In relation to the specific suggested additional scenarios: • "Reduced demand" The Project water demand is expected to be lower than the scenario that is modelled. Simulation of lesser (more realistic) borefield abstraction rates would produce a lesser impact. If Project water demand was lees that the supply generated by dewatering, the excess would be reinjected. • "Average recovery" As a subset of the above, the assumed recovery rates are relatively low and hence conservative from a water supply perspective. Greater recovery of water from tails would mean less demand for groundwater and would be achieved by lowering rates of groundwater abstraction and result in potentially less impact. • The simulated wellfield abstraction is considerably greater than the water balance requirement defined by conservative assumptions, hence the scenario is unlikely. In any case the proposed Wellfield abstraction rates are very low by regional standards. This low intensity of abstraction will allow adjustment of the geometry of abstraction if necessary.

No.	Submitter	Submission and/or issue	Response to comment
		scenarios of disposal. This may also induce preferential flow gradients towards the pit. Other scenarios should be investigated by the proponent as part of their potential management/mitigation plans. In addition, the likelihood of the modelled scenario should be addressed, including the key differences between this scenario and the most likely operational scenario.	• If rainfall and runoff capture resulted in "excess water', use of this water would be prioritised and wellfield supply would be reduced.
12.	DotE	"Regional water level shows fluctuations are less than 0.2m with no evidence of seasonal fluctuations." (p. 268) A discussion of evidence against seasonal fluctuations of the water table is required. Information provided during the site visit indicated a muted seasonal response may in fact exist across the site. Hydrographs for a representative suite of bores should demonstrate the presence or absence of any seasonality.	In context "seasonal fluctuations" referred to the fluctuations experienced from year to year. The groundwater-surface water interaction assessment in Appendix H1 (Appendix H6) of the PER detailed that groundwater has been observed to rise by up to 0.16m from 1:1 year events, which would approximate a seasonal response. However, groundwater has been observed to rise by up to 0.86m in alluvium formations at the water table following a 1:20 year event (~50mm).
13.	DotE	It is unclear how the modelled water balance compares to the conservative scenario utilised in groundwater flow modelling. From the information in Table 9-44, it could be interpreted that the water balance is derived from the groundwater model, or vice versa. The note to Table 9-44, and Section 9.5.5.2 implies that the model informed the groundwater abstraction component of the water balance, thereby inducing a 26% oversupply of groundwater in the balance. Other factors incorporated in the water balance model are: • Assuming a low (10%) recovery of water from tailings and processing • Using low abstraction intensity from the well field • Making no allowance for harvesting of rainfall and runoff Providing a concise summary of the derivation of the groundwater components of the water balance model, including description of whether the modelled water balance is a potential development scenario, or if it represents something else, would assist in assessing the water balance.	**Models used** Predictions for mine dewatering, reinjection and water supply were made in the Cameco Groundwater Model as presented in Appendix I1 of the PER. Water balance modelling was undertaken using calculations performed in spreadsheets. Goldsim was used to refine these calculations, primarily to examine sensitivities associated with climatic variability. **Exchange of information between models** The groundwater model was informed by calculated excess that needed to be re-injected using the spreadsheet models. The water balance calculations also informed the projected make-up water supply used in the groundwater model by determining shortfalls in the mine dewatering supply. Both sets of water balance calculations were informed by the predicted mine dewatering rates using the groundwater model. This approach ensured that reliance of models on each other would not lead to additional uncertainties. The 26% oversupply used in the groundwater model was not derived from, or used by the water balance calculations. It was only utilised in the groundwater model to conservatively assess drawdowns from the water supply abstraction.
14.	DotE	The conceptual water balance does not include predicted annualised input from rainfall directly into the TSF, however, it does include space for this to be considered as an input. It is understood that site storm water has been accounted for	Considering the semi-arid environment, stormwater generally constituents a minor component of the tailings decant. Borefield water demand is based on a notional "steady-state" operational condition where the stormwater contribution is not considered and hence is zero in Figure 9-36.

No.	Submitter	Submission and/or issue	Response to comment
		separately (as described in appendix H2). If available, this figure should be incorporated in Figure 9-36.	For purposes of the design of the capacity of storage, stormwater runoff is a critical component and a full statistical consideration of rainfall has been included in the determination of requirements for peak water storage capacity.
15.	DotE	It is unclear which post-closure landform DEM is used. It is also not apparent whether the DEM was included as a potential variable in any sensitivity analysis. Clarification of the DEM used in surface water modelling and whether it is incorporated in sensitivity analysis would address this issue.	The DEM that was used for post-closure modelling is described in Appendix H1, and shown in Figure 7.3b. This DEM was the only one used for all post-closure surface water modelling and there was no sensitivity analyses undertaken using different DEMs.
16.	DotE	While 100 scenarios were tested, it is unclear if this is representative of the number of plausible combinations of varying input values. This could be addressed by commentary around the representative nature of the tested scenarios (including risk weighting or probability).	The sensitivity values are not theoretical maxima or worst case. The modelled outliers could be considered to encompass nominally 90% probability of all cases. The impacts from low probability outcomes beyond the sensitivity range can be assessed based on the difference between the base case and the sensitivity evaluation.
17.	DotE	The "Verification Tools" for all groundwater-related matters should include monitoring of groundwater levels and heads. In addition, the criteria should include a demonstration that groundwater level and head monitoring results are consistent with modelled predictions.	Agreed. Abstraction/injection rates, groundwater levels and quality should be monitored and used to verify model predictions. Model calibration was undertaken in the development of the model and is reported in the report "Final Report. Groundwater Study. Proposed Yeelirrie Development" (URS, 2011) which includes a thorough description of model calibration statistics.
18.	DotE	Given the potential for the fixed head boundary at Lake Miranda to influence the outcomes of the model, discussion on the sensitivity to model boundary conditions is warranted. This may be included in URS 2011, but this is not readily available. Discussion of the boundary conditions and other aspects of model setup would be helpful in comparing the Cameco 2015 groundwater model with previous models and understanding potential sensitivities. This would benefit from evidence for the appropriateness of model boundary conditions, such as conceptualisations or measured heads in these locations.	Lake Miranda is unlikely to affect the predictions at Yeelirrie because: 1) it is a very long way away and 2) has an operating borefield (Albion Downs) with its own impact footprint between the two. The model boundary conditions for the Cameco and URS models are the same with the exception of the configuration of recharge for the TSF cells. The two models share the same calibration specifications and sensitivities. Conceptualisation of the hydrogeology including the spatial distribution of the field data is provided in Sections 2, 3 and 4 of Appendix I1 and applicable figures in Appendix I1d. This presentation provides a summary of maps and cross-Sections from the 2011 URS report showing field measurements, unit identification and discretisation within the domain. The model domain was extended to the catchment boundaries purposefully to avoid boundary effects from any abstraction or solute prediction scenarios. The model grid was aligned to the Yeelirrie Palaeochannel, and sized and layered to provide a high degree of resolution for three-dimensional flow and solute movements. Behaviours of recharge, discharge and salt accumulation were each tested to ensure that steady-state simulations of groundwater levels based on data collected since the early-1970s. Transient calibrations were undertaken to understand its ability to represent aquifer hydraulics, recharge/discharge water balances and salt accumulation characteristics. The catchment-wide domain and transient calibration was based on examinations of groundwater stresses such as the Slot 1 dewatering trial, pumping tests on 58 bores, and long-term (20-years) Albion Downs Borefield abstraction. Few models have benefited from this amount of baseline information to support the calibration.

No.	Submitter	Submission and/or issue	Response to comment
			Calibration and appropriateness aspects were examined during various peer reviews during and after the model's construction. The latest review that examined issues associated with boundary conditions and sensitivities was included in the PER as Appendix I3.
19.	Denmark Env. Centre	The requirement to use over 8 million litres of water per day is of great concern – in a region of poor water supply and poor water security, in a region that is facing both a reduction in average rainfall and increased rainfall variability due to climate change. Water use is expected to affect pastoral leases in the area. Food security is a critical issue – protection of water assets is much more important than short-term mining royalties.	Discussions on groundwater availability is presented in Section 9.5 of the PER. It documents studies and investigations that have been conducted since 1972. These studies provide a high level of confidence that there is sufficient water for the Project and that the proposed abstraction is conservative compared to groundwater availability. Water use is unlikely to impact any third parties as the main groundwater borefield is situated within Yeelirrie Station which is owned by Cameco. Significant drawdown from the main borefield is not expected to extend beyond the boundary of the pastoral lease. A small borefield to the north of the project area is located on Ululla Station. Drawdown levels up to 0.5 m are predicted to occur in the vicinity of pastoral bores and are not expected to restrict the ability of the bores to continue to supply stock water. The current conceptual borefield is not expected to impact Youno Downs Station as the 0.5 m drawdown does not extend into that property. The Project will not impact on ground water quality within the Pastoral Leases to the north of the Project as the movement of groundwater is to the south of the Project. The modelled extent of the groundwater drawdown on Pastoral Leases is shown on the Figure in Attachment 5.
20.	PS3, PS9, PS20, PS30, PS32, PS34, PS35, PS38, PS39, PS42, PS43, PS44, PS45, PS50; PS52; PS112	Where is water going to come from for the Yeelirrie mine? Is it going to be depleted or from renewable sources? Concerns about the long term effects on surface and groundwater and the quantity of water which will be used. Undue disturbance of underground water resources would have severe ecological and polluting consequences in this region. Where replenishment of water is low, and likely declining rainfall. The complex consequences on local and adjacent hydrology are only superficially dealt with. Such huge water usage has the potential to impact the levels at Youno Downs Station. The PER states that there is sufficient water for the proposal, but refers only to modelling of availability and presumes that the Department of Water (DoW) will approve the abstraction of water and reinjection of contaminated water. The proponent cannot then say with certainty that sufficient water is available, therefore the PER is misleading. Uranium causes environmental dangers to water sources. Food is more important to the future of WA, than uranium mining.	See the response to Comment 19 above. <u>Water Usage for the Project and Impacts on Adjacent Pastoral Stations</u> Water for the Project will come from pit dewatering and a water supply borefield on the Yeelirrie Pastoral lease. The conceptual borefield is shown on Figure 9-35 of the PER. The figure shows a cluster of bores labelled the Western Brackish Borefield within the current tenure and Agreements Area. The figure also shows the borefield infrastructure extending beyond the bores and into Youno Downs Station. The 0.5 m drawdown contour does not extend the full extent of the line because the bores in the conceptual groundwater model do not extend all the way to the end of the conceptual infrastructure. The Project is therefore not expected to water levels at Youno Downs Station. Further information on the potential impacts on neighbouring stations is provided in Attachment 5. Long term impacts of groundwater abstraction and water table recovery are discussed in Section 9.5.5.2 on pg 283 of the PER. <u>Transport of Contaminants in Groundwater and Impacts on Adjacent Pastoral Stations</u> Long term impacts of solute transport from the in-pit TSF and stockpiled materials are discussed in Section 9.5.5.3 of the PER. Contaminants of concern (other than chloride, which was included as a non-retarding conservative tracer) are expected to travel only up to 600 m and remain within the Development Envelope. There is therefore considered to be no risk of these contaminants reaching downstream pastoral bores, and consequently no risk to stock from consumption of groundwater in downstream pastoral bores.

No.	Submitter	Submission and/or issue	Response to comment
		Youno Downs is near the proposed mine site and access the same groundwater for food production. Food production should have a higher ranking in WA than uranium. How will the eater use affect pastoralists in the areas?	Reinjection will only be used to manage natural groundwater (not process water) that is pumped out during pit dewatering in years 1-4 prior to operation of the mill. Excess water will be reinjected within the pit extent, where groundwater will subsequently be lowered by future dewatering and groundwater abstraction.
21.	CCWA	Yeelirrie is in an arid area, with low groundwater recharge - the study estimates a recharge rate of approximately 2.6 GL/year; in addition natural ET consumes about 89% of this recharge, leaving approximately 0.4GL/year in net recharge. The extraction rate due to dewatering of the deposit and other milling, tailings and processing needs is estimated to be approximately 53.4GI, over the Project life of 20 years, that is approximately 2.5GL/year, 6 times more that the net recharge. The additional water extracted by mining (water that is not met by the net recharge) will be derived from two possible sources: • Storage depletion - loss of groundwater in storage from around the deposit. • Capture of discharge - loss of groundwater inflow to Lake Miranda. When groundwater is extracted above the recharge rate, some combination of these two sources always occurs (e.g. Konikow and Leake, 2015). During groundwater modelling, Lake Miranda was assigned the property of having a constant head. This essentially supplies the lake with an infinite source of water, and prevents impacts on lake levels from mining being accurately quantified. Given the high permeability of the aquifers, there is likely to be a strong connection between these and the lake, and given the high extraction volumes from de-watering, a large amount of water that would otherwise discharge to the lake would be captured by the de-watering. This runs the risk of drying out the lake. In terms of the water derived from storage in the aquifers, the aim of the mining is to reduce water in storage and lower the water table in the deposit. However, the extent of the impact on groundwater levels is something that could be variable - e.g. the	See the response to Comment 18 above.

No.	Submitter	Submission and/or issue	Response to comment
		loss of storage may be highly localised, or it may extend into the surrounding region (where it could impact other users). This variability also poses a significant additional risk to subterranean fauna and groundwater dependent ecosystems. Having accurate values of transmissivity and storativity is critical to predicting the extent of the drawdown. It appears there is some field data to provide estimates of these values, but the heterogeneity and complex geology may be an issue and increase the uncertainty of this impact. The public submitter considers that a more detailed study is needed in order to verify the proponent's claims.	
22.	CCWA	It is noted that in the table of aquifer properties (table 4.3) that the vertical hydraulic conductivities are estimated as being constant fractions of the horizontal hydraulic conductivities. In some cases the horizontal and vertical conductivities are estimated to be the same (in the calcrete) while in the other units the ratio is 10:1. The use of a constant value for all units implies that this parameter (the vertical anisotropy) is not well known. The result of this is that the level of cross-connectivity between different layers is probably still quite uncertain. The interception of this much water will starve any existing features that depend on groundwater discharge (such as Lake Miranda) of their current water. Impacts of cumulative drawdown from BHP's Albion well-field (to the east) and the Yeelirrie Project may also be an issue, although the model appears to predict fairly minimal interaction between the two. Water table drawdown estimates in groundwater modelling are always highly dependent on the model parameters used to simulate the future scenarios, which can be quite uncertain. The model parameters were unidentifiable in the Groundwater modelling study (Appendix 11), making it difficult to comment on the accuracy of the future scenarios presented in the PER. The public submitter is very concerned that the dewatering and water drawdown from mining activity at Yeelirrie will have severe consequences on the subterranean fauna and they again urge the EPA to reject the proposal.	See response to Comments 2, 3, 4, 17 and 18 above.

No.	Submitter	Submission and/or issue	Response to comment
23.	CCWA; PS151	Youno Downs is the neighbouring cattle station. The station has a number of watering points for cattle some of which have not been identified by Cameco and others that are likely to be impacted on by water drawdown. In the PER Cameco have not identified Youno Downs station as a water user (271 & 283). Of particular concern in Cameco's proposed Northern borefield that is quite close to Youno Downs southern bore known as Dempsey. The drawdown from the Northern borefield is expected to be 5m - pg. xxxiii. Dempsey is a watering point for Youno Downs cattle - the drawdown from the borefield may have a material impact on the ability to use Dempsey as a watering point for the cattle at Youno Downs station. The Dempsey bore is operated by a windmill and seems that the water level has stayed about the same over the 25-30 years that cattle have been run on Youno Down station. This indicates that there is water flowing and that there is some recharge. Any future changes to this are likely to be a direct result of Cameco's extraction of water. The cattle are attracted to water and it is believed that cattle from Youno Downs sometimes cross the station boundary and visit the Eastern Mile Bore which is just 2km from the proposed open pit. If the bore were running the cattle are more likely to take the journey to the Eastern Mile Bore. There is no description of this in the PER. The public submitter would like to know if Cameco will fence the area. A rockhole is situated about 8km east of the mine. The public submitter would like to know if Cameco plans to monitor this rockhole to ensure that water being taken from the Eastern bore doesn't reduce flows to it. This rockhole is a unique watering point for native animals in the area.	Operational areas of the minesite will be fenced to exclude stray livestock and wildlife, however neighbouring pastoralists also have a responsibility to maintain their boundary fences to ensure their livestock does not stray onto neighbouring stations. In addition to this, Yeelirrie and Youno Downs station do not share a boundary and the Youno Downs boundary is 6 km from Yeelirrie's north western boundary. Current groundwater modelling for the conceptual borefield is presented on Figure 9-41 of the PER and shows no drawdown encroachment to the Youno Downs pastoral lease. As shown in Attachment 5 to this document the modelled 0.5m drawdown is well away from the Youno Downs boundary and Dempsey Bore. Cameco is aware that further groundwater investigations are required during the DFS to confirm the final location of the borefield. Should the final borefield be different from the conceptual model presented or should Cameco wish to obtain permission to explore for water on Youno Downs then Cameco would consult with the owners for access to the Lease area for drilling. The Yeelirrie Station is destocked and all pastoral bores have been decommissioned, including Eastern Mile Bore. The rock hole that is referred to is filled from runoff and is not an expression of groundwater and in a normal season the pool is dry for up to 6 months of the year.
24.	CCWA	Cameco describe in detail the rainfall events in the past, noting that there is a combination of high rainfall events, increased rain but variable rain over summer and less rain over winter etc. Cameco also explains predictions from the Bureau of Meteorology (BoM) and CSIRO in 2007 about more increased intensity of extreme rainfall events. The public submitter notes that similar observations and predications are made in the 2014 State of the Climate report produced by the BoM and the CSIRO which state that *"the*	No specific climate change sensitivity runs were undertaken as part of the Cameco Groundwater Model, however URS did consider a number of low and high recharge scenarios (URS 2011, Section 7.7.1). It should be noted that there are uncertainties in both the recharge distribution and evaporation (ET) (including ET extinction depth). Calibrated recharge and ET rates were used in the models. The recovery modelling used the same rates (over the length of the recovery), except for the TSF area. The reference to page 143 of the PER refers to the soils of the *A. yeelirrie* population and has potentially been taken out of context.

No.	Submitter	Submission and/or issue	Response to comment
		frequency and intensity of extreme daily rainfall is projected to increase" and *"tropical cyclones are projected to decrease in number but increase in intensity."* Cameco make an important observation that less frequent more intense rainfall events will impact on groundwater recharge rates, as more rainwater will be lost to evapotranspiration. This is supported by evidence on page 143 of the PER which shows after rainfall event soils beneath the surface are still dry. In this arid area absorption rates of water are relatively low and water tends to pool on the surface. While this has been acknowledged by the proponent in the Section on climate change (Section 7.4.1 page 128) the public submitter has not seen how this evidence has been incorporated into future predictions about the recovery of groundwater over time (page 283 & figures 9.44, 9.45 & 9.46). The public submitter has calculated net recharge rates of 0.4GL/year based on the information provided by Cameco. The public submitter would hope to see more details on expected recharge rates over time and how this impacts on the rehabilitation of subterranean fauna habitat and groundwater dependent ecosystems.	
25.	CCWA	There are predictions from BoM and CSIRO, acknowledged by Cameco, that rainfall events are likely to become more infrequent and more intense. This change will affect the impacts during mining and post closure. Cameco refer to ARI event as a 1:100 year event or a 1:1000 year event and suggest they have modelled for those scenarios and are confident the integrity of the infrastructure and design will withstand these events. The public submitter would like to know what the exact worst-case scenario is that infrastructure has been design to withstand and whether or not the infrastructure or design features will remain intact for 50, 100, 1,000 or even 10,000 years, and what data was used and what assumptions were made in modelling the scenarios.	As discussed in Section 9.1.3 of the PER (page 238) the surface water diversion bund is designed to protect against a 1,000 year ARI flood event. Cameco would like to refer the submitter to Section 9.12.4 and Appendix O1 of the PER that provide detail regarding how the mine will be decommissioned and rehabilitated.
26.	PS151	The submitter is highly concerned that their bores will be impacted. The submitter has previously experienced this and the replacement bore is now un-consumable, even as stock water.	See the response to comment 23 above. Further information is provided in Attachment 5.

No.	Submitter	Submission and/or issue	Response to comment
27.	PS151	The bore near the No-Ibla Homestead will be impacted by the proposed 11 bores and are within 3km. The water at No-Ibla is also pure and therefore there are concerns that this clean water will be lost.	See the response to comment 23 above and Attachment 5. No-Ibla will not be impacted by the current conceptual borefield. Any changes to the borefield design in the future will take the submitters concerns into account.

7. Inland waters environmental quality

No.	Submitter	Submission and/or issue	Response to comment
1.	DotE	The proponent has described a scenario whereby dewatering using trenches is unsuccessful. If this is a possibility, the downstream impacts of having pits which are not dewatered should be considered for activities such as tailings deposition. How does this impact on the proposed schedule for tailings deposition and management?	Dewatering using trenches proved successful during trial mining at several different sites in the 1970's and are expected to generally provide effective dewatering. The contingency measures described in Section 6.3.2.1 potentially relate to limited duration periods of unfavourable weather conditions – i.e. sustained wet periods and/or locally abnormal ground conditions. Since the elevated water table condition will be limited in extent and duration it will not directly affect tailings management.
2.	DotE	It is unclear what dam consequence category has been applied to this Project's TSF particularly from an environmental spill consequence consideration. The Dam consequence category is required to determine what design consideration should be included for consideration including freeboard levels. It is recommended that as a minimum a High consequence category be assigned to this TSF in accordance with the ANCOLD guidelines on Tailings Dams based upon environmental spill consequences.	Section 7.3 of Appendix D – Yeelirrie Tailings Storage Facility Design and Management discusses ANCOLD design standards and guidelines. Section 7.3.2 states that the Yeelirrie TSF's are rated high hazard category dams and are designed on this basis. The facilities are in-ground rather than above ground and the hazard is therefore substantially less, however, for design purposes the "high" consequence category has been applied.
3.	DotE	What is the calculated maximum PMP event that has been considered and in consideration of the ANCOLD consequence category applied to this TSF, what is the minimum freeboard that will be applied to the deposition of tailings?	The characterisation of the PMP is provided in Appendix F in Appendix H1 of the PER. The PMP as it relates to different durations is defined in Table 5-4 in Appendix H1. These calculations indicate that to contain water from a 24-hour PMP would need a freeboard in excess of 0.65m, plus sufficient height to maintain structural integrity of the embankment. If a smaller freeboard was adopted and was present near the completion of a cell, this would then rely on the overflow to be safely captured by the perimeter drains. The critical period is therefore, when the tailings cell is virtually full and not yet capped.
4.	DotE	It is stated in the Surface Water Assessment (p56) that stormwater may need to be released from the site during the operational phase. While it is acknowledged within the report that any such water would need to be of appropriate quality for	The reference to stormwater release on page 56 is a global statement, whereas on page 63 (not 68) it refers to volumetric movements of stormwater for different ARI events. The option for discharge is intended for post-event periods when rainwater that has been collected in the pit or stormwater ponds, and after it has been tested to determine if it is suitable

No.	Submitter	Submission and/or issue	Response to comment
		release, it is unclear whether any plans or facility has been made for treatment of this water prior to release. This seems somewhat inconsistent with the statement on p68 that additional stormwater would be diverted into the inactive pits. The proposed handling of stormwater should be clarified. A discussion should be provided of the expected quality of stormwater under conditions where release may be required, together with an assessment of the impact of such releases. If necessary, consideration should be given to treatment options.	for release. For smaller events, it is possible that the stormwater may contain higher solute concentrations than for larger events. If the water is not of suitable quality for discharge, it will be utilised for ore processing. Various treatment technologies are available to remove solutes. Options for treatment will be considered based on the volume of water to be treated and cost of treating for specific solutes. A concept diagram explaining stormwater movements and discharge decision making concepts presented as Figure 1 in Attachment 7.
5.	DotE	What happens after closure, when groundwater removal by pumping will no longer be applied? If the groundwater flows back into the tailings, how will leaching be minimised?	In a post-closure environment, it is expected that pre-mining groundwater levels will recover within about 50 to 150 years resulting in mixing of groundwater with tailings porewater. Eventually the deeper tailings would exist in a predominantly groundwater chemical regime, similar to the current state of the orebody. The primary geochemical gradient introduced during this process is a decrease in the tailings pH (~9.5) to the groundwater pH (~7). The decrease in pH is a very effective process of controlling the mobility of a number of constituents of concern. Geochemical models predict a decrease in soluble uranium, vanadium, arsenic, molybdenum, selenium chromium and copper due to the formation of secondary minerals. A large factor in the formation of some of these secondary minerals after groundwater recovery was the availability of calcium and magnesium which have higher concentrations in the groundwater. The sensitivity of the tailings source terms to changes in oxidation reduction potential (Eh) was explored (Section 3.4, Appendix I2). Conditions that decreased the Eh to -150 mV were modelled (representative of in-situ groundwater conditions) and slight increases in solute concentrations in tailings porewaters were observed in the model however these were generally offset by decreases in other elements (calcium, silicon, sodium, magnesium, aluminium, iron, nickel, strontium and uranium). An evaporative gradient will exist in the post-closure tailings as is present in the current environment. It is anticipated that with the construction of the proposed cover and the depth to the water table, this gradient will be relatively small. The net effect of the evaporative gradient will be to cause the accumulation of secondary precipitates at the interface of the proposed capillary break in the cover system of the TSF. Some of these secondary precipitates would likely redissolve as a result of rainfall recharge but the net effect would be removal of some primarily sodium precipitates. Current maps of the area indicate that calcrete extends around the proposed in-pit tailings facility. After closure this calcrete network will provide a continuous preferred high transmissivity groundwater flow path around the tailings from west to east. This flow path will help to minimise exchange between water in transit around the tailings and resident groundwater.
6.	DotE	Grinding the ore to aid in leaching out the uranium also makes the uranium decay products (e.g. Th-230, Ra-226) more susceptible to leaching when the tailings are returned to the	Section 6.5 of the PER provides a more detailed description of the tailings properties. Table 9-64 of the PER also provides an assessment of the radiological properties of the tailings. The results are based on testwork undertaken by Cameco. The results show that the majority of the non-uranium radionuclides remain bound in solids portion of the tailings and therefore unavailable for seepage.

No.	Submitter	Submission and/or issue	Response to comment
		mined out pit. Has this been taken into account in the assessment?	When accounting for the mass balance, 99.5% of all non-uranium radionuclides remain in the solids phase and approximately 75% of uranium radionuclides remain in solids.
7.	DotE	The amount of Low- level Radioactive Waste should include the tailings and waste rock (approximately 30 Mt). Please provide further clarification of what the understanding is on the amount of LLRW that will be produced by this proposed action.	Note that this Section refers to non-process wastes (as described in Section 6.10.1). Therefore the radioactive waste referred to here is specifically waste generated in the laboratory or as a result of used personnel protective equipment. It is estimated in the PER, Section 6.10.1.3, that approximately 20 m^3/annum of low level radioactive waste (LLRW) would be produced. Tailings, as a process waste, is described in detail in Section 6.5 of the PER. The classification of LLRW is used to define a broad range of material types. ANSTO defines low level waste as containing 'limited amounts of long-lived radionuclides' and that the classification covers a very wide range of radioactive waste, from waste that does not require shielding for handling and transportation up to activity levels that require more robust containment. As such the classification is not helpful in managing radioactive issues arising from waste rock material. Section 9.6.5 discusses the potential impacts of radioactivity on the health of workers and provides context for discussion of waste rock. At closure waste rock material will contain an average of 100 ppm U. This equates to an expected dose rate from standing directly on waste rock material of 0.65 µS/hr. This dose rate does not take into account the shielding applied from radiation by the cover materials which will be in place at closure over waste rock materials (at least 3 m of rock and soil) In comparison the total dose rate from natural background sources is typically between 0.3 and 1.5 µS/hr.
8.	DotE	Under the listed aspect "Radiation contamination of soils, surface water and groundwater" of Table 8.2, the management column makes no reference to controls or mitigations in relation to groundwater. It states "Implementation of radiation, dust and surface water management measures." Please demonstrate how groundwater contamination will be addressed or managed, particularly with respect to subterranean fauna.	Please refer to Attachment 3 that outlines updated management and mitigation measures and commitments for subterranean fauna.
9.	DotE	The quoted porosity of 0.48 to 0.56 is similar to or higher than that for typical soils. This would suggest that the potential for leaching radionuclides from the tailings into groundwater could be quite high. In other Sections of the PER, it was stated that the tailings would be compacted and that the potential for leaching would be low. Please provide further clarification on the potential for leaching.	Tailings will be discharged as thin layers on a sloping beach surface. Evaporation and decant of free drainage will provide consolidation but not compaction. This is normal practise in the minerals industry and the consolidated tailings porosity is not unusually high. High porosity is not uncommon for clayey materials. This characteristic does not mean that the material is permeable, or leachable. The contrast in these properties is shown in Table 9-80 in the PER. Very low rates of pore water movements are expected because of this low permeability and low hydraulic gradients.
10.	DotE	The standards against which radiological characteristics of groundwater will be assessed is unclear.	The National Water Quality Management Strategy (NWQMS) references the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ARMCANZ/ANZECC 2000). Radionuclides in groundwater are discussed in Section 9.6.4.6 of the PER. As expected, groundwater from within the orebody exceeds the radionuclide trigger values

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<tr><th>No.</th><th>Submitter</th><th>Submission and/or issue</th><th>Response to comment</th></tr>
<tr><td></td><td></td><td>Discussion of appropriate NWQMS radiological guidelines should be considered.</td><td>for livestock water quality (and irrigation water quality), but is below the trigger values outside of the orebody. However, regardless of this, the groundwater within the Project area is not suitable for pastoral purposes due to elevated dissolved solids.

Average total dissolved solids (TDS) of the natural groundwater generally increases from west to east of the deposit (down gradient) with shallow groundwater TDS in the eastern part of the deposit (32,700 ± 14,900 mg/L) and average palaeochannel aquifer increasing to 87,400 mg/L towards the Albion Downs well field (PER Section 9.5.4.4). This compares with guidelines for stock water TDS levels given by ANZECC of:

<table><tr><td></td><td>No adverse effect on animals expected</td><td>Animals may have initial reluctance to drink or there may be some scouring, but stock should adapt without loss of production</td><td>Loss of production and a decline in animal condition and health would be expected. Stock may tolerate these levels for short periods if introduced gradually</td></tr><tr><td>Beef cattle</td><td>0–4,000 mg/L (TDS)</td><td>4,000-5,000 mg/L (TDS)</td><td>5,000-10,000 mg/L (TDS)</td></tr><tr><td>Sheep</td><td>0-2,400 mg/L (TDS)</td><td>2,400-4,000 mg/L (TDS)</td><td>4,000-7,000 mg/L (TDS)</td></tr><tr><td>Horses</td><td>0-4,000 mg/L (TDS)</td><td>4,000-10,000 mg/L (TDS)</td><td>10,000-13,000 mg/L (TDS)</td></tr></table>
These levels exceed the guidelines for both drinking and livestock water quality and render the groundwater unfit for human or stock consumption.</td></tr>
<tr><td>11.</td><td>DotE</td><td>Whilst clays and carbonates are the dominant sorption receptors, there is no discussion of the potential for iron oxides to act in a similar fashion, which would contribute to the potential dispersion of various chemical constituents in groundwater.

Include summary of the role of iron oxides (partly contained in various appendices) to more fully characterise the geochemistry and mineralogy pertinent to potential chemical dispersion.</td><td>Cameco agrees that there are significant iron oxides in the subsurface in the Yeelirrie region and that iron oxides play an important role in the retardation of contaminants. Cameco did not have accurate mapping of iron oxides in terms of amounts (or type goethite or hematite) and extent in the region and so conservatively did not assume any sorption by iron oxides for any tailings constituents.

Iron oxides would be expected to significantly attenuate the concentration of many tailings constituents such as uranium, arsenic, and molybdenum.</td></tr>
<tr><td>12.</td><td>DotE</td><td>It is not clear why some chemical constituents identified in tailings material geochemical testing (pp358) are not considered in the seepage models, such as barium, boron, strontium, thallium, radium or SO_4. It is recognised that Cl is more transportable via groundwater than SO_4, and thus would be expected to travel further. However, information relating to barium, boron, strontium, thallium and radium has not been included.

Discussion of reasons for not including these constituents should be provided in closure planning. These constituents are</td><td>Appendix I1 and I2 (Table 3.8) list site-specific Kd values appropriate for various lithographic units at Yeelirrie. The chemical constituents mentioned by the reviewer (strontium, barium, boron, sulphate and radium-226) all have very low retention in the solid phase based on Kd values. The recommended sorption coefficients for Yeelirrie materials are zero for all units for thallium, barium and strontium (Appendix M3, Table 4.14). Radium-226 and boron have some attenuation but it is relatively small. Kd values are the only attenuating factors that were included in the groundwater modelling. Proportional to their initial concentration, all the constituents discussed will (based on conservative groundwater modelling) travel very similarly to chloride in the environment around Yeelirrie.</td></tr>
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No.	Submitter	Submission and/or issue	Response to comment
		also discussed in Appendix I2 and Appendix M3; however, the reasons behind their exclusion are not readily apparent.	
13.	DotE	Solubility limits and transport of U and V from the TSF are not discussed. Carnotite saturation is expected to be an upper limit for U and V concentrations in solution, despite 'a significant number' of solutions in leach tests being oversaturated with respect to carnotite. While this means that carnotite is likely to precipitate in the system, depending on the kinetics of precipitation, U and V could be transported in groundwater before being removed by mineral formation. Additionally, samples from the Kalgoorlie storage facility used as an analogue for Yeelirrie showed U concentrations approaching schoepite saturation (significantly higher than carnotite saturation). It is unclear if there is any evidence to suggest schoepite solubility will not control U concentrations if K and CO_3 are removed from pore water by groundwater flow or carbonate precipitation.	Solubility and transport of uranium and vanadium are discussed in the source term document (Appendix I2) and the solute transport model (Appendix I1). Based on the geochemical speciation modelling performed in conjunction with the source term determination three potential solubility controls on uranium were identified carnotite (K2(UO2)2(VO4)2•3H2O), (meta)tyuyamunite (Ca(UO2)2(VO4)2•(3-8)H2O) and uranophane (Ca(UO2)2(HSiO4)2•5H2O). As the reviewer notes, schoepite also acts as a likely solubility control on uranium concentrations but at a higher concentration of uranium. It is likely that the aqueous speciation of uranium in carbonate rich environments, while not inhibiting carnotite precipitation, may increase the solubility to some extent. Another possibility raised during the initial work was that potassium concentrations may have remained below a threshold needed to exceed carnotite solubility. The solubility of carnotite and (meta) tyuyamunite is still an area of active investigation in the scientific literature but both have their solubility minima between pH 6-7, which suggests increased solubility control as they mix with groundwater and the pH is buffered towards background levels. This is also the case with schoepite, which also has a solubility minimum just over pH 7. The Kalgoorlie samples displayed a large range in uranium concentrations which were consistent with schoepite saturation but also with other uranium-containing species of lower solubility. The data suggest that no single phase was controlling uranium in the tailings.
14.	DotE	Further details are required to establish the appropriateness of surface area and cation exchange capacity used in solute transport modelling through the tailings. Surface area and cation exchange capacity were analysed on a single sample of tailings material (YC3). It is not clear how representative this sample is, or the sample preparation method. Further information is necessary to determine if this material is representative.	Surface area and cation exchange capacity were not used in solute transport modelling (Appendix I1). The updated solute transport modelling utilised Kd values (Appendix I1 and I2) and modelled uranium, vanadium, arsenic, molybdenum and chloride. The Kd values were site specific, determined from experiments conducted on Yeelirrie soils and sediments (Appendix M2 and M3).
15.	DotE	Based on climate data, the maximum period over which solute accumulates at the surface of waste and stockpiles is 120 days. It is unclear which climate data was used to derive this flushing period. A significant assumption in solute release modelling is that new piles will be flushed a minimum of twice per year, which limits the total solute release that may occur at any one time. The possibility that piles may not be flushed at this frequency during operation could result in the surface area available to leach solutes being greater, due to an increased amount of material available to flush than anticipated by this modelling.	There is no evaporation data recorded for the Yeelirrie weather station. The closest weather station with evaporation records is the Wiluna weather station approximately 70 kilometres away from Yeelirrie. Mean annual pan evaporation at Wiluna is extremely high at 2400 mm per year. Climate data was taken from Appendix M3 and originated from URS. SRK Consulting conducted an analysis of the potential for solute release from incident rainfall and runoff (Appendix M3, Chapter 3). Rainfall intensity values as a function of storm duration and the recurrence interval. The tests showed a rapid decrease in solute concentrations for consecutive leach steps indicating a finite capacity of the materials to release solutes. Most of the solutes were removed after the first leach event and by the third event in excess of 87.5% of the solutes had been removed. The climate data imply that surfaces could be flushed two or three times a year (using a maximum observed dry period of 120 days) indicating that most of the solutes would be removed within one year of placement. Therefore it was assumed that any given surface was active only in the year in which it was placed on the stockpile.

No.	Submitter	Submission and/or issue	Response to comment
			The plan for the Yeelirrie Project is to have nine ore stockpiles separated based on uranium and smectite grades. In addition there will be three categories of waste, mineralised waste, clean waste, and top soil. Each waste category is planned to be placed in 12 separate piles spread across the south side of the pit. The solute loadings values are relevant only during operations as the stockpiles will be processed as ore or put into the pit by the end of the mine life (19 years). During operations stockpile runoff will be collected in ditches around the various stockpiles and directed towards the pit
16.	DotE	Clarification is required as to why it is assumed that 50% or more of total available solutes will be removed from storage piles by each flushing event.	Experimental test results showed that solute release occurs rapidly and that solutes are generally removed during the first flush (Appendix M2). The base case scenario assumes that placed surfaces remain active for one calendar year. Recognising that runoff typically represents in excess of 50% of total rainfall, more than 50% of the solutes would be removed in the first rainfall event that generates runoff. In the second event in excess of 50% of the remaining load would be removed.
17.	DotE	Further information is needed to establish the potential for solute transport from the TSF through vertical groundwater flow. Groundwater is expected to enter the TSF through upward vertical flow driven by evaporation, then exit during periods of high recharge. There may be the potential then for solute transport in this water through equilibration with the solid tailings. What is the residence time expected for water entering the base of TSF cells before outflow is driven by recharge?	As described in Appendix I2 (Appendix B, Page 27), solute movements due to advective flow are expected to be inward into the TSFs during operations but close to nil after closure and recovery. Because of this, an assessment of porewater displacement due to lateral flow under high and low recharge conditions was made. Accounting for groundwater fluxes and solute loadings, the time required to displace the porewater solute loadings in the tailings (solute residence times) ranged from 3,000 years for some cells to nearly 3,000,000 years for others.
18.	DotE	Solutes are expected to be trapped in the vadose zone by evaporation of water from over the TSF. It is unclear how close to the surface solutes may get before precipitating. This has implications for the design of the TSF cover. The conclusion that solutes will remain in the vadose zone is also inconsistent with the assumption that recharge can drive outflow from the base of the TSF cells, which implies that it will also be flushing solutes accumulated in the vadose zone back down into the TSF.	Solutes naturally accumulate in the vadose zone across the Yeelirrie Catchment as evidenced by the extensive hardpans present beneath the valley floor and valley flank areas. Over a very long time, hardpan layers are expected to form within the cover materials placed over the TSFs as a result of infiltration and evaporative losses within the unsaturated zone. These movements will be separated from porewater in the tailings due to the presence of a capillary break. This break will prevent vertical (upward) fluxing of porewater, while laterally, it will divert infiltration (that exceeds the storage capacity of the cover) towards transmissive aquifers along the sides of the TSF landform. Very small amounts of porewater solutes from the tailings may participate in this flow system through diffusion (concentration gradient-driven movements) while rainfall-infiltrated water is present in the capillary break. Advective movement of solutes is not expected due to the fact that the tailings will have a hydraulic conductivity that is many order of magnitude lower than the capillary break materials. Progressive rehabilitation of tailings cells will commence approximately 8 to 10 years after the initial tailings deposition in tailings pond 1. Progressive rehabilitation of the tailings cells allows for the trialling of several cover system alternatives. It is proposed that the first tailings cells be covered and instrumented to allow for cover performance evaluations and modelling. This will allow the most appropriate cover system to be utilised in the closure of subsequent tailings cells. Some key design features of the TSF closure would include (Appendix D, Section 8.9): • Covering the tailings with at least 2 m of benign overburden designed to limit radioactive emissions to levels equivalent to those found prior to mining activity, and to limit the depth of infiltration of rainfall into the cover, and

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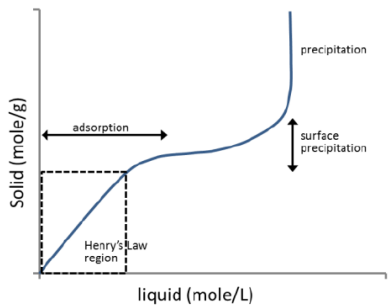
			effectively prevent surface water from driving the migration of contaminants from the buried TSF into the surrounding groundwater. • Contour the cover to create a water shedding profile where incident rainfall is transported laterally to the cell perimeters and shed into the surrounding natural environment without significant erosion or entrainment of the cover. • Provide a cover that can be revegetated, which may require the inclusion of a capillary break layer over the tailings mass. The statement that solutes will remain in the vadose zone is not inconsistent with the occurrence of recharge. The most severe storm events drive recharge while the overall net evaporative environment would drive solute deposition at the proposed capillary break.
19.	DotE	In solute transport modelling, clarification is needed on how the potential downstream U concentration of 1500 mg/L was determined, and why it was assumed all other solutes would increase in concentration proportional to U. Geochemical modelling indicates that carnotite will precipitate from pore water in the TSF, limiting U and V mobility. It is unclear how the concentrations for U and V used in this modelling were arrived at. Additionally, concentrations for all other solutes were scaled up proportionally to U. It is unclear if this is the approach used to model dilution.	The stated uranium concentration (1500 mg/L or more) does not relate to a downstream position – rather being an in-cell hypothetical maximum considering only a first step, that being evaporative concentration. Considering that step alone, the removal of H_2O only from solution results in equal enrichment of dissolved constituents The outputs from the particular assessment method were from the PHREEQC model. No dilution was modelled in this process. The model uses the groundwater flow and geology in the vicinity of Yeelirrie, the source terms determined for tailings constituents and the site specific distribution coefficients (K_d) for the tailings constituents (Appendix I1). Using these parameters it predicts where the tailings constituents will be as a function of time, it does not explicitly include any other chemistry in the determination. Time zero is essentially at the end of mining/rehabilitation. It does not account for the chemical reactions that will occur as the groundwater water recovers to its pre-mining levels. The SRK documentation in Appendix I2 was included because data from this study was used in the current update of source terms and solute transport modelling. The reviewer should refer to Appendix I1 for solute transport modelling performed by Cameco. It should also be pointed out that the SRK document was not discussing downstream concentrations but uranium concentrations in several hundred years within one of the tailings cells in the TSF.
20.	DER	Although the tests used would give a useful indication of the extent to which chemical constituents are leached under surface conditions, it is considered that the testing procedures used are of questionable value in assessing the leaching potential within a TSF where there are likely to be very high solid to liquid ratios, where the ionic strength and alkalinity of pore-water is many orders of magnitude higher than in many of the test solutions used, and where the partial pressure of carbon dioxide (a major control on the solubility of uranyl complexes) is likely to be at least an order of magnitude higher than atmospheric levels (probably on the order of 10^{-2} atm. within the TSF rather than the atmospheric level of $10^{-3.5}$ atm.). These same factors are also likely to limit the value of the sorption tests that were undertaken to determine the potential for aquifer sediments to attenuate concentrations of chemical constituents (particularly of uranium and vanadium) that might	The reviewer questions the use of column and bottle roll tests in providing realistic adsorption potentials for constituents within the TSF. Several specific issues that are mentioned include the very high solid to liquid ratios in the TSF system and the many orders of magnitude higher ionic strength, alkalinity and PCO2 of pore-water compared to the test systems. There are a number of assumptions implicit with the Kd concept: (i) the system is at equilibrium, (ii) only trace amounts of contaminant exist in the aqueous and solid phases, (iii) there is a linear relationship between the amount of contaminant in the solid and aqueous phases, (iv) fast reversible kinetics, (v) all adsorption sites are accessible and have equivalent adsorption binding energies, and (vi) the contaminant (or sorbate) exists as a single species. It is readily apparent that in most groundwater/soil environments many of these assumptions are not met leading to large variations in Kd (over many orders of magnitude). This is true even if Kd values are determined using site specific measurements. In addition to noting that Kd is not applicable to precipitation/dissolution reactions, Kd values are valid only for adsorption and ion exchange under limiting and unchanging conditions (Figure 1 below). In addition to the inherent theoretical assumptions present in the Kd approach, there are different methods of measuring Kd values each of which has its own set of assumptions for calculating Kd values from experimental data. In general, there are five methods used to determine Kd values: (i) laboratory batch method, (ii) in-situ batch method, (iii)

No.	Submitter	Submission and/or issue	Response to comment
		be discharged from the TSF. It is likely that the proponents have greatly over-estimated the potential for uranium (VI) to be adsorbed onto iron oxyhydroxide mineral surfaces under the geochemical conditions present in the calcrete aquifer because most of the uranium is probably present at calcium- and magnesium-uranyl-carbonate complexes under these conditions. These complexes have been demonstrated to have a very limited capacity to be adsorbed by iron oxyhydroxide minerals under the pH conditions present in the calcrete aquifer (Fox *et al.,* 2006).	laboratory column method, (iv) Kow method, and (v) the field modelling method. Generally, Kd values that were measured by different methods for the same system have values that may range over an order of magnitude (Gee and Campbell, 1980). The approach used in this submission combined column tests with batch studies using site specific solid materials. SRK Consulting conducted analyses using de-ionised water and barren process liquor in order to determine sorption coefficients on Yeelirrie materials including loam, clay-quartz and palaeochannel sands. Some samples used a mixture of 10% CO_2/90% air occupying the headspace of the bottle in addition to just air in order to account for higher CO_2 concentrations. SRK used site specific materials but some site specific conditions were not as close to field conditions as they could have been, such as ionic strength and alkalinity. Differences in the soil to water ratio in the subsurface versus in batch experiments would be expected to be conservative in this situation as Kd values would be expected to increase as the solid to solution ratio increases.  **Figure 1.** Schematic of an equilibrium contaminant partitioning curve for a contaminant. It is apparent that Kd is linear only in the Henry's Law region of low aqueous concentrations. At higher concentrations precipitation dominates. A summary of the solute transport results, submitted in support of the proposed Yeelirrie Project, as a function of Kd value used for the modelling is provided in Table 1 below.

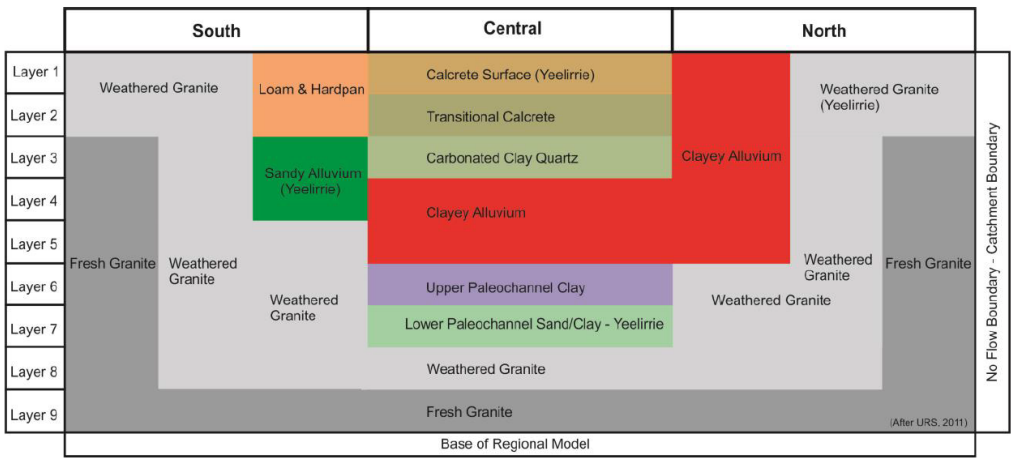
No.	Submitter	Submission and/or issue	Response to comment
			Table 1. Solute Transport Results as a function of K_d Sensitivity

COC	Plume conc.	Base Case (extent of plume)			Sensitivity Case (0.1*Kd)		
	(mg/L)	east-west	north-south	Vertical	east-west	north-south	vertical
U	0.2	eastward to 300 m	northward to 500 m	layer 8 (weathered granite)	eastward to 1100 m	northward to 500 m	layer 8 (weathered granite)
V	0.01	eastward to 200 m	northward to 200 m	layer 8 (weathered granite	similar to U		
As	0.01	eastward to 200 m	northward to 600 m	layer 8 (weathered granite	similar to U		
Mo	0.01	eastward to 300 m	northward to 500 m	layer 6 (weathered granite	similar to U		

Table 1 shows that uranium is modelled to extend almost four times farther to the east in the reduced Kd case (0.1*Kd) compared to the base case. Similar results are modelled for vanadium, arsenic and molybdenum.

Table 2. Kd values used in Solute Transport Modelling

Constituent	**Distribution coefficient, K_d (mL g^{-1})**	
	loams	**clay-quartz**
As	350	1.3
B	51	3
Cr	4	10
Cu	0.93	1.1
Mo	47	0.67
Ni	0	0
Se	50	0.83
Sr	0	0
U	420	1.1
V	480	2.7
Zn	0	0
Ra-226	0	2.8

No.	Submitter	Submission and/or issue	Response to comment
			Figure 2. Schematic of Lithological zones of the Yeelirrie Region  Table 2 lists Kd values for some COCs (constituents of concern) in two different Yeelirrie lithologies. For solute transport modelling purposes the Kd for clay-quartz (Kd(U) = 1.1 in clay- quartz) was used for the clay-quartz, carbonated clay-quartz, calcrete and transitional calcrete systems while the Kd for loam (Kd(U) = 420 in loam) was used for the carbonated quartz-rich loam, carbonated loam and loam systems. A schematic of the lithological type of different horizons at Yeelirrie is shown above (Figure 2). A conservative Kd of zero (no retention) was used for weathered granite and any descriptor including sand. SRK had inferred Kd values for the palaeochannel sands that were much greater than values for the loam systems. A Kd of zero for the palaeochannel sand systems was used in the solute transport modelling conducted as part of this analysis. It is well known that published values for the distribution coefficient, Kd, can vary greatly depending on factors such as the material type and properties, pH and the speciation of the contaminant. The sensitivity analysis of the solute transport model with respect to the Kd values (Table 1) indicate differences in the extent of travel of uranium between the base case and a case using 0.1*Kd values. The Kd values used were determined on site specific materials from a large number of studies (115 total) and applied conservatively to suitable lithologic layers in the Yeelirrie region. There are a number of important points to consider when interpreting these results: • The thermodynamic definition of the Kd term assumes that the system is reversible but in very saline environments the dominant sorption mechanism would likely be inner-sphere adsorption because sodium and calcium cannot

No.	Submitter	Submission and/or issue	Response to comment
			compete effectively for ions that are involved in this type of bonding arrangement. Uranium forms very strong inner-sphere surface complexes that are unlikely to be affected by high salinity; • In 2004, a number of trial sites that included ore stockpiles and other waste were rehabilitated after 31 years in place. It was noteworthy that tailings solids from the stockpile remained within meters of the stockpile toe.
21.	DER	The proponents have used the geochemical model PHREEQC to predict the concentration of uranium in solution that will be in equilibrium with pore-water within the TSF. It is likely that this concentration has been greatly underestimated because the standard geochemical databases used with PHREEQC do not include data for calcium- and magnesium-uranylcarbonate complexes (Fox *et al.*, 2006; Nair and Merkel, 2011; Drage and Kennedy, 2013). These complexes are highly soluble and stable in solution at pH values above 7 and greatly increase the solubility of uranium under geochemical conditions that are present at the Yeelirrie mine site. It is also likely that most of the uranium in groundwater in calcrete aquifers near Yeelirrie will be bound up calcium- and magnesium-uranyl-carbonate complexes. Thermodynamic data for these complexes have to be manually entered within existing geochemical databases to ensure that they are considered in solubility and chemical speciation calculations undertaken within PHREEQC. A second potential problem with using PHREEQC to simulate geochemical conditions within the TSF is associated with the very high salinity and alkalinity of the pore-water that will be present in the structure. PHREEQC uses the Pitzer approach to simulate geochemical speciation in highly saline solutions, but this must be specified when the program is used. Additionally, the default Pitzer dataset only contains limited geochemical data for red oxsensitive chemical species such as uranium compounds which means that this dataset cannot be relied on to provide meaningful results without extensive modification. These factors mean that there is likely to be a large degree of uncertainty associated with the concentrations of uranium (and, to a lesser extent, vanadium) that have been predicted to occur in pore-water in the TSF and that have been used as source concentrations for further solute-transport modelling.	Cameco agrees with the reviewer that it is important to include calcium uranyl carbonate species in thermodynamic databases used to predict tailings porewater concentrations of uranium. Included in the PER submission is Appendix I2 titled “Development of Tailings and Mine Waste Source Terms for the Proposed Yeelirrie Mine”. In Appendix I2, tailings source terms are updated from the previous SRK study (submitted as Appendix A in the PER document). The updated source term study used the Geochemist’s Workbench software to model uranium concentrations and other constituents of concern in the TSF. An updated HATCHES NEA v20 database was used that included the following uranyl calcium carbonate and uranyl carbonate species, $CaUO_2(CO_3)2$-, $Ca_2UO_2(CO_3)0$ and UO_2CO_30 (Table 3.1, Development of Tailings and Mine Waste Source Terms for the Proposed Yeelirrie Mine). Only the calcium uranyl carbonates were included in the database as these were judged the most important species as reported by Drage and Kennedy (2013). Several mineral species were also updated in the thermodynamic database for the model as detailed in the report. Uranium processing of the ore requires leaching the ore with sodium bicarbonate/carbonate, which would result in as-discharged tailings with a pH between 9.5 and 10.0 with high alkalinity. The pH in Yeelirrie tailings porewater is significantly above the point at which calcium would precipitate as calcite in the tailings (pH ~> 8). The presence U(VI) in calcite systems under alkaline conditions have been previously studied. Elzinga and co-authors (2004) produced research, over a uranium concentration range applicable to Yeelirrie tailings, suggesting that uranyl triscarbonate ($UO_2(CO_3)34$) complexes formed on the surface of calcite. The inner-sphere adsorption mechanism confirmed results from other researchers (Rihs et al., 2004). The uranyl triscarbonate species was also the species predicted to be in highest concentration in the geochemical modelling of the Yeelirrie tailings. The concentrations exceeded that of the modelled calcium uranyl carbonates in geochemical models of Yeelirrie tailings. Several studies investigating interactions in the uranyl calcite system and using luminescence and synchrotron techniques have suggested that uranyl can also coprecipitate with calcite forming undetermined uranyl carbonate species (Reeder et al., 2000). In addition to surface complexation and coprecipitation, several studies have been published that show that calcite may promote the formation of U(VI) precipitates, such as schoepite ($((UO_2)8O_2(OH)_{12}.12H_2O$) (Carroll et al., 1992; Geipel et al., 1997; Elzinga et al., 2004). In summary, the calcium uranyl carbonates were considered in geochemical models in the source term update document. Their inclusion in the calcite system present at Yeelirrie showed that while they are an important aqueous species, they are limited by the overall availability of calcium. The source term developed for the Yeelirrie tailings conservatively did not take into consideration any adsorption processes for uranium on calcite. Cameco also agrees with the reviewer that in the high saline environment of Yeelirrie it is important to explore the use of the Pitzer equations for modelling the geochemistry of the proposed Yeelirrie TSF. As mentioned by the reviewer, the Pitzer equations are not ideal because of the limited availability of thermodynamic data for many species. Other approaches used to model the behaviour of ions in concentrated solutions are equally limited in terms of the availability

No.	Submitter	Submission and/or issue	Response to comment
			of datasets (virial techniques). Appendix I2 provides tailings source terms, which have been updated from the previous SRK study (submitted as Appendix A of I2 in the PER document). The geochemical model used in the source term update utilises the B-dot equation to determine activity coefficients. The approach used in the update was to validate the B-dot equations by comparing the results from a limited dataset (basically only alkali and alkali earth cations) with both the B-dot equations and the Pitzer equations. The primary difference between the approaches was that the Pitzer model predicted more carbonate mineral precipitation which reduced the alkalinity in the remaining water that much faster. The reduction in alkalinity would have the effect of reducing the solubility of elements such as arsenic, uranium and vanadium. The use of the standard B-dot equations therefore appeared to be a conservative option to model the geochemistry. Cameco agrees that there are some uncertainties regarding the long term behaviour of wastes and plans to address these by undertaking the following tests during the early years of mining: • sorption tests at various pH levels and long term kinetic column tests to determine speciation mobility and further calibrate existing geochemical modelling data. • the development of a site-specific surface complexation model to replace the default Dzonbak and Morel used by PHREEQC and other geochemical speciation models; • long term flow through column experiments with sediments from the site; and • the use of that obtained from field and laboratory testing to develop two- and three-dimensional reactive transport models for the site.
22.	DER	There are a number of potential problems with how the release of solutes from the TSF has been simulated. 1 *Poorly characterised source concentrations and aquifer dispersion and retardation coefficients in the solute transport model* - In this modelling approach, a source concentration and release-rate for the contaminant is assumed, and concentrations of the contaminant in groundwater are reduced by the effects of hydrodynamic dispersion and retardation by adsorption by minerals in aquifer sediments. Small changes in any of these parameters can lead to significant changes in the extent to which groundwater may be contaminated by a point-source release of contaminants. The sensitivity analysis that was undertaken as part of the solute transport modelling exercise has indicated that the model output is particularly sensitive to small changes in the adsorption coefficients for sediments. Given that the measured adsorption coefficients may not be indicative of actual values in the calcrete aquifer, the predicted mobility of uranium and other contaminants in groundwater at the site may also not be correct.	The reviewer questions the adsorption coefficients used in the solute transport modelling. Adsorption coefficients and their use in the solute transport modelling are discussed in the response to comment 20. Cameco agree that it is important to consider potential chemical reactions between the TSF porewaters and groundwater surrounding the TSF. The source terms capture the solute release within the TSF but do not capture solute release from residual mineral bearing materials in the immediate vicinity of the TSF so that locally certain parameters could increase above the levels seen in the TSF source term but as the transport modelling shows, as the plume moves away the solutes would be removed. The net effect might be that the distance over which increased concentrations are observed would be greater than those predicted but in the far field there would be no difference. Also included in the PER submission is Appendix I2, titled “Development of Tailings and Mine Waste Source Terms for the Proposed Yeelirrie Mine”. In this Appendix chemical reactions between TSF porewater and groundwater were considered in a sensitivity type analysis. No reactive transport modelling was preformed but mixing of the TSF porewater with groundwater was simulated in a geochemical model by mixing progressively higher ratios of groundwater with tailings porewater (1:1, 10:1, 25:1 and 100:1). Consistent trends were observed as the ratio of groundwater to tailings porewater increased. The primary geochemical gradient that was introduced was a decrease of the pH value towards neutral values. At a ratio of 10:1 the pH is predicted to be about 9.6 but at a ratio of 25:1 the pH has reduced to 7.1. There was also predicted to be significant decreases in uranium, vanadium, arsenic, molybdenum, selenium, chromium, and copper as groundwater mixes with the tailings porewater. The reduction of solute concentrations results from buffering the pH towards neutral and the resulting precipitation of secondary minerals. This analysis did not impact the source term development or the solute transport model but suggests that there is additional conservatism in the results of both.

No.	Submitter	Submission and/or issue	Response to comment
		2 *Lack of consideration of chemical reactions between TSF leachate and the aquifer* matrix – The solute transport modelling that was undertaken has not considered the possibility that some chemical constituents in material that could leach from the TSF (particularly the very high carbonate and bicarbonate ion concentrations that will be present in pore-water in the TSF) could react with minerals in the aquifer matrix near the TSF and release additional contaminants such as uranium and vanadium into solution. Reactive transport models such as PHAST or PHT3D would need to be used to determine the importance of aquifer matrix - leachate interactions in a situation like a release from the TSF at the Yeelirrie mine site. 3 *Lack of consideration of density-coupled groundwater flow near the TSF* – the salinity of pore-water within the TSF is likely to be more than a factor of ten times higher than in groundwater in the immediate vicinity of the structure. This large difference in salinity would probably have significant effects on the characteristics of groundwater flow near the TSF if there was a significant leak from the structure. Under these circumstances, density-coupled groundwater flow modelling techniques would probably be required to determine groundwater flow behaviour.	It is agreed that density effects have an impact on groundwater flow and solute transport simulation. For this specific case, however, it is conservative to neglect the density effect. The explanation is as follows. Darcy's law is as follows: $$\vec{q} = -K\nabla h \quad (1)$$ Where $\vec{q}$ is specific discharge, K is the hydraulic conductivity tensor, and h is hydraulic head. ∇h is the driving force of groundwater flow. For density coupled flow, the three flow components are as follows (Post et al. (2007)): $$q_x = -K_{xf}\frac{\partial h_f}{\partial x} \quad (2)$$ $$q_y = -K_{yf}\frac{\partial h_f}{\partial y} \quad (3)$$ $$q_z = -K_{zf}\left[\frac{\partial h_f}{\partial z} + \frac{\rho-\rho_f}{\rho_f}\right] \quad (4)$$ $$K_f = \frac{k\rho_f g}{\mu_f}\frac{\mu_f}{\mu} \quad (5)$$ Where Kf is the fresh water hydraulic conductivity, hf is the equivalent fresh water hydraulic head, ρf is the fresh water density, ρ is the density of water in the formation at the point of velocity calculation, μ is the dynamic viscosity of water in the formation, and μf is the equivalent fresh water dynamic viscosity. The term represent the relative density contrast, and accounts for the buoyancy effect on the vertical flow. Assuming all other factors remain the same, it can be deduced from equations (2), (3) and (4) that increases in groundwater density due to increasing salinity will result in a much higher impact on the vertical flow component than on the horizontal flow component. This has been demonstrated in Post et al., 2007. For the specific case of the proposed Yeelirrie Project, the mine pit is located within calcrete and sandy alluvium. Underlying these layers is clayey alluvium and paleo-channel clay, which overlies paleo-channel sand (see Figure 6-18, URS, 2011). Two cases are considered here for explanation: Case 1: Without considering the density effect (i.e., higher density due to higher salinity near the mine pit), the horizontal flow components are much higher than the vertical flow components (in a slightly upward direction, see Figure 6-2, URS, 2011) since the horizontal hydraulic conductivities are much higher than the vertical ones (Kh vs Kv is assumed to be 10:1 in the model). Case 2: If taking the density effect into account, the vertical (downward) flow components in Case 2 would be much higher than those in Case 1. A higher downward vertical flow component in Case 2 would lead to a longer travel distance for the solute in the vicinity of the TSF. When the groundwater moves downward in the sandy alluvium and encounters the clayey units, most of it would preferentially flow within the sandy alluvium (due to its higher hydraulic conductivity) towards the east (downstream direction). When the groundwater flows eastward and encounters clayey

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<tr><td></td><td></td><td></td><td>materials intruding into the sandy alluvium from below, it would flow upward. This would result in a longer travel path for the solute entrained in the groundwater. A higher vertical downward flow component could also result in more water flowing downward further into the clayey alluvium and paleo-channel clay, thus leading to longer residence time. All these factors lead to a longer residence time of solute in the groundwater in the vicinity of the TSF for Case 2 over Case 1. Therefore, within the same time, solute would travel less distance from the TSF in Case 2.

In summary, it is conservative not to take the density effect into account near the mine pit.</td></tr>
<tr><td>23.</td><td>DMP</td><td>The solute transport modelling for the TSF was undertaken under a range of recharge rates of water through the tailings cover, however only the "base case" (infiltration of 0.24 mm/year) was presented in this Section of the PER. The proposed TSF cover design is predicted to allow 1.2 mm/year seepage into the TSF, which is in between the modelled "base case" (infiltration of 0.24 mm/year) and "worst case" (infiltration of 6 mm/year) scenarios used in the solute transport modelling. Given the "worst case" scenario predicts the transport of uranium, vanadium and molybdenum to travel much further than the "base case", this Section of the PER should discuss further the implications of the TSF solute transport modelling results and whether the proposed management of tailings is likely to result in significant impacts on local or regional groundwater quality. This would also need to take into account any comments provided by the Department of Environmental Regulation (DER) in relation to the solute transport modelling.</td><td>Both sets of results (0.24 mm/year base case and 6.0 mm/yr High infiltration model) are included and discussed within the Mine Closure Plan (MCP) (Section 7.6.12) and discussion is provided within the PER in Section 9.12.3.4 (Post-closure groundwater modelling - groundwater quality). Comparison between base case and high infiltration model shows:

• The maximum eastward extent of the chloride plume front (0.01 mg/L) did not change significantly, but the width of the plume was shown to increase.
• While the extent of the Chloride plume was not significantly affected, Chloride concentrations in groundwater increased significantly.
• The maximum extent of the predicted Uranium, Vanadium, Arsenic, and Molybdenum plumes increased significantly. The Uranium plume (using a concentration value of 0.2 mg/L above background levels) was predicted to extend approximately 6 km to the east; compared to the several hundred metres predicted by the base case model.
• Downward transport of contaminants to the deeper model layers (e.g. Layer 8: weathered granite) also increased.

Modelled infiltration of 1.2 mm/yr is 5 times higher than base case but 5 times lower than high infiltration rate. Therefore it is considered that the modelling conducted thus far has adequately captured the expected ranges of infiltration which may occur.

Average dissolved Uranium concentrations within the deposit are between 0.29 mg/L and 0.74 mg/L within the palaeochannel sediments. Average TDS generally increases from west to east of the deposit (down gradient) with shallow groundwater TDS in the eastern part of the deposit (32,700 ± 14,900 mg/L) and average palaeochannel aquifer increasing to 87,400 mg/L towards the Albion Downs well field (PER Section 9.5.4.4). This compares with guidelines for stock water TDS levels given by ANZECC of:

<table>
<tr><td></td><td>No adverse effect on animals expected</td><td>Animals may have initial reluctance to drink or there may be some scouring, but stock should adapt without loss of production</td><td>Loss of production and a decline in animal condition and health would be expected. Stock may tolerate these levels for short periods if introduced gradually</td></tr>
<tr><td>Beef cattle</td><td>0–4,000 mg/L (TDS)</td><td>4,000-5,000 mg/L (TDS)</td><td>5,000-10,000 mg/L (TDS)</td></tr>
<tr><td>Sheep</td><td>0-2,400 mg/L (TDS)</td><td>2,400-4,000 mg/L (TDS)</td><td>4,000-7,000 mg/L (TDS)</td></tr>
<tr><td>Horses</td><td>0-4,000 mg/L (TDS)</td><td>4,000-10,000 mg/L (TDS)</td><td>10,000-13,000 mg/L (TDS)</td></tr>
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No.	Submitter	Submission and/or issue	Response to comment
24.	DoW	Groundwater abstraction and mine pit dewatering could potentially impact groundwater availability to groundwater dependent ecosystems and other groundwater users. The predicted water level drawdown in the palaeochannel shows that there is no notable interference between the proposed abstraction at Yeelirrie and the Albion Downs palaeochannel wellfield. No discernible change in groundwater flow is expected at the catchment scale. Please note that the DoW has not comprehensively assessed the dewatering model and the modelled drawdowns. This would be undertaken as part of the licensing process required under the RIWI Act. However, the modelling appears sufficient and accurate to determine groundwater drawdowns and impacts.	Comment noted. Cameco has made a number of commitments about managing groundwater abstraction in the palaeochannel to manage and minimise the impact on groundwater dependent ecosystems. (see response to comment 4 in Section 6, Hydrological processes)
25.	DoW	The internal geometry and stratigraphy of the aquifer system at the Yeelirrie Project sire is consistent with well-known regional hydrogeology. The conceptual hydrogeological model is also consistent with several large scale quantitative hydrogeological evaluations in the region.	Comment noted.
26.	DoW	The DoW also is satisfied with the proposed dewatering methodology and notes that there is still sufficient scope in the PER to allow further investigation into additional methodologies such as a groundwater barrier wall.	Comment noted.
27.	DoW	The DoW notes that the exact locations and combinations of supply borefields have not been finally resolved. Cameco has committed to undertaking further testing of the wellfields during a Definitive Feasibility Study. This information will allow Cameco to further refine the groundwater model and look for opportunities to relocate abstraction wells from the palaeochannel.	Comment noted.
28.	DoW	The hydrogeological studies provide sufficient rigour and accuracy to enable an adequate assessment of impacts on the environment, other users and the aquifer system.	Comment noted.

No.	Submitter	Submission and/or issue	Response to comment
29.	CCWA	It is acknowledged that more intense rainfall is likely to intensify the risks of erosion. This may pose a significant risk to ore stockpiles and runoff. On page 251 Cameco state that erosion Is likely to *"dropout downstream of the Project"* There is however no further description about the risk and impact of erosion. Presumably the erosion will carry particles with it that will *"dropout downstream of the Project."* The public submitter would like to know what exactly will drop out, what is the likelihood of radioactive particles or heavy metals to be transported through erosion and what is the cumulative impact over the life of the mine on the receiving environment?	During operation, rain falling on site will be captured and held on site by flood retention bunds and water storage facilities as presented on page 255 of the PER. The submitter appears to have misread the discussion on page 251 as it is not considering runoff from the site. It is discussing the change to stream flow, erosion and sedimentation characteristics for locations downstream and upstream from the site as a result of the construction of the diversion bund to divert water around the site. In this instance the runoff is from undisturbed areas and would not be contaminated from activities on the mine site therefore the likelihood of radioactive particles or heavy metals to be transported through erosion and the cumulative impact over the life of the mine on the receiving environment is very low.
30.	CCWA	In Section 9.10.5.3 Cameco claim that in ARI flood event - any release of water from the site would have to be of a sufficient quality. The public submitter would like to know what the parameters are for 'sufficient quality' how many ppm of arsenic, mercury, lead, acid, uranium, radium etc. constitutes as sufficient quality? In these conditions the public submitter is concerned that frequency and intensity of rainfall events, dust storms, cyclones could exceed expectations and have a detrimental impact on: • Drainage systems capacity (Section 9.4.5); • Tailings; • Inundation of backfilled areas; and • Metalliferous drainage from ore stockpiles.	Project elements have been designed to store storm water rather than for release of water. Design elements include the following, • Section 9.10.5.3 states that the proposed design of the flood retention bund is expected to be sufficient to retain a 1:1,000 year ARI flood event. • The TSF design criteria includes the requirements for freeboard. The 1,000 year ARI 72 hour has been used as the design event for the preliminary freeboard analyses and the facility design criteria requires a 0.5m freeboard in the event of a 1:1000 year ARA 72 hr event. • Ore stockpile pads will also be engineered (compacted and sloped) to minimise seepage and to collect runoff. Flood release criteria have not been developed and would be considered in the preparation of a surface water management plan with advice from the relevant agency.
31.	CCWA	The risks associated with runoff and seepage are downplayed, as follows: a. there is a surface water diversion bund, b. the stockpiles will be in the same area where there is water drawdown and c. solute release will only be significant in the first rain fall event. These explanations do not address continuing concerns about drainage from ore stockpiles: • The surface water diversion bund will mitigate some impact of surface water but will not keep water out of the stockpile	The surface water diversion bund will redirect the minor drainage line that naturally flows through the Project area. Within the Project area, stockpile areas and other laydown areas would be compacted and engineered to direct local rainfall and runoff to water storage ponds as shown (conceptually) in Figure 6-3 of the PER. This water will be used on site or sent to the evaporation pond. With the stockpiles being within the dewatering drawdown any leachate will be captured by dewatering pumping and used on site. With respect to Appendix M2, yes it is acknowledged that it was commissioned by BHP for a lower rate of mining than proposed by Cameco, however, the processes of solute release are the same as is the protective measures proposed continue to apply, including the placement of stockpiles within the drawdown zone and to that extent, the timing or duration of storage of stockpiles does not impact the outcome.

No.	Submitter	Submission and/or issue	Response to comment
		as there will be some flow of water within the bund and water will fall directly on the stockpile. • The stockpiles will be above the water drawdown area and leaching will stay inside the affected footprint - this will not stop leaching from the stockpile into the ground water and over time potentially build up and flow outside the footprint or mix with water that is being dewatered and then used for some other onsite process - for example dust suppression. • In the third point it seems as though Cameco are saying that the most risk of solute release from rain on stockpiled ore is from the first rain and risks are reduced with subsequent rainfall events. This logic falters when you consider that the high grade ore stockpiled is likely to be processed at some point and new ore will be stockpiled to replace it. At least Cameco have suggested that high grade ore will be stockpiled for a maximum of 32 months. At the very least every 32 months there will be different ore stockpiled and at risk of 'solute release' from the next rainfall event. Appendix M2 shows a balance sheet of how much ore, of which grade ore will be stored in each year of the Project. However this balance sheet has scant relevance for Cameco's Project as it was developed for BHP Billiton's proposal which was to mine at a rate of 1.2Mtpa unlike this proposal which is to double the rate of mining - up to 3Mtpa. Appendix M2 suggests the stockpiles will remain for 32 years and at the end of 32 years there are still stockpiles of low grade waste, waste and topsoil. This report was prepared for BHP Billiton in 2011 and, as noted, the Cameco proposal is significantly different to BHP Billiton's. The public submitter expects these changes to have a significant impact on the volume of stockpiled material and the length of time that ore is stockpiled and these require dedicated attention and assessment. The measurement and assumptions in Appendix M2 are not applicable to Cameco's proposal for mining Yeelirrie. Cameco have not provided any updates to the report, they have not demonstrated a clear proposal for stockpiling or managing the risk of metalliferous drainage from the stockpile.	

No.	Submitter	Submission and/or issue	Response to comment
		The lack of detail and evidence specific to the Cameco proposal and to the ore stockpiles is of great concern. It is recommended that the EPA should require that the proponent provide detailed reports on the current proposal incorporating a detailed discussion on all the risks and mitigating strategies. It is noted that Cameco has relied heavily on an out of date report that was written for the BHP Billiton proposal for Yeelirrie, and that the BHP Billiton proposal was significantly different particularly in relation to the frequency of mining.	
32.	PS76; PS126;	Uranium tailings would pollute and impact on rivers.	The tailings form the Yeelirrie Project will be stored below ground surface in an engineered storage facility which is considered best practice for the storage of mine waste. Modelling undertaken confirms the tails will be secure for the modelled period of 10,000 years and does not support the claim by the submitter.

8. Air quality and atmospheric gases

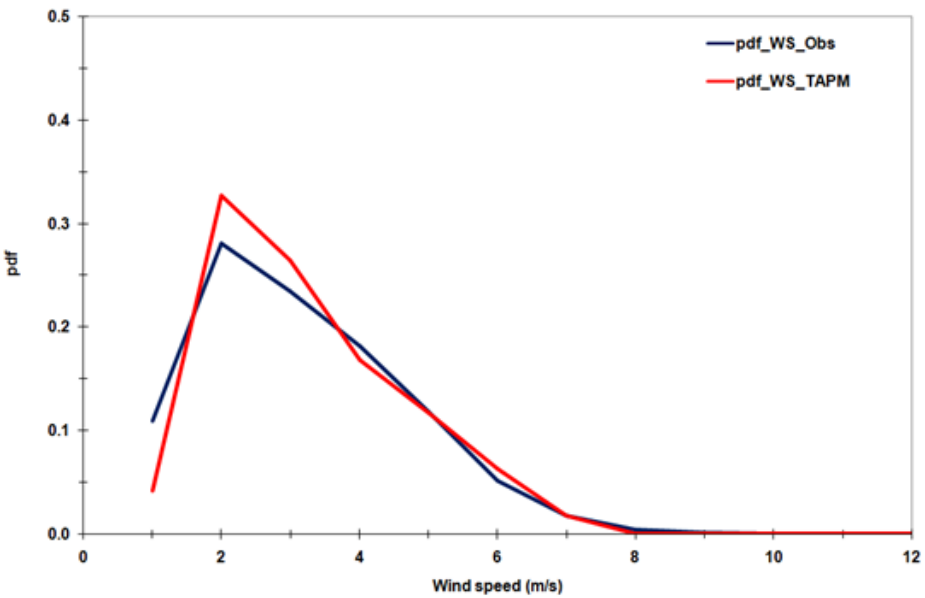
No.	Submitter	Submission and/or issue	Response to comment
1.	DotE	The Goldfields Natural Gas pipeline is 50 km from Yeelirrie. The substitution of natural gas (or renewable energy options) for a proportion of the proposed diesel consumption, such as power generation and heat production, could potentially yield economic, environmental and infrastructure development benefits, such as increased availability of energy options which could in turn help provide impetus for additional infrastructure investment in the area. Recognising that the choice of fuel is a commercial decision for the proponent, factors such as gas availability and easement acquisition may preclude the use of this preferred energy source. The proponent may benefit by exploring with the Commonwealth Clean Energy Regulator (http://www.cleanenergyregulator.gov.au/) whether options could be available through the $2.55 billion Emissions Reduction Fund to provide incentives for emissions abatement activities, or whether renewable energy credits could assist in improving the commercial viability of the Project. Progress	Cameco is aware of the environmental benefits of using gas instead of diesel fuel for power generation at Yeelirrie and has undertaken preliminary investigations for the potential availability of natural gas from the Goldfields gas pipeline. As stated on page 46 of the PER, the option of powering generators with gas is being investigated during additional PFS level work, which will be completed in 2016. The gas option is Cameco's preferred option if it is available. Cameco would welcome the support of the Commonwealth Clean Energy Regulator in potentially making this opportunity more viable.

No.	Submitter	Submission and/or issue	Response to comment
		reports with securing gas supply for Yeelirrie could be factored into future Project assessment.	
2.	DER	The proponent compared model results for the 6th highest PM10 and 2nd highest NO_2 against criteria from the national Environment (Ambient Air Quality) Measure (NEPM). The comparison could also have included the maximum PM_{-10} and NO_2 concentrations, To emphasise that the contribution from the proposal is insignificant in comparison to background, a more appropriate technique would be to include results from the proposal in isolation to background contribution.	Cameco notes that the emission concentrations assessed for NO_2 are conservative in that it is assumed that there will be no capture of generator emission. Background measurements of particulates, were taken from industrialised/urbanised areas to also "provide conservative estimates" (Katestone p.24, PER Appendix L1). The maximum 24-hour PM_{10} is predicted at Yeelirrie Pool. The maximum concentration is 13.4 µg/m^3 due to the Project in isolation and 38.4 µg/m^3 for the Project including background. The maximum 1-hour NO_2 was presented for all receptors with the exception of Yeelirrie Pool. The maximum is 384.4 µg/m^3. Section 9.8.5 Table 9-68 of the PER document presents the predicted ground-level concentrations due to the Project in isolation and for the Project including background, from which it is clear that the Project has a small contribution to overall concentrations. Section 9.8.5 Table 9-69 of the PER document presents the predicted ground-level concentrations due to the Project in isolation only.
3.	DER	Modelling results indicate that particulate matter and nitrogen dioxide are the two major pollutants emitted from the Project with the most significant ground level concentrations. Dust generation from fugitive dust emissions and its dispersion is usually the major concern for ambient air quality around open cut mines. The modelling of fugitive particulate emissions is complex and there are a number of factors which result in uncertainty in the modelled concentrations, however in this case the modelling is appropriate to show that the dust contribution is not significant at larger distances.	Comment noted.
4.	DER	The air dispersion model, Calpuff, used for airshed modelling of NO_2 emissions from the Project, is an appropriate model in this case. The configuration of the air dispersion modelling appears reasonable. However, the predicted highest 1- hour NO_2 concentration at the nearest sensitive receptor (Yeelirrie Pool) exceeds NEPM criteria. The predicted 2nd highest NO_2 concentration is 64% of the NO_2 NEPM criteria. The air quality assessment of power generators was conducted based on using rich-burn engines with no emission control in place. Generally, rich-burn engines generate more emissions than lean-burn engines, however rich-burn engines can achieve very low emissions levels if paired with after-treatment systems (such as three-way catalysts). Whilst the predicted highest 1-hour NO_2 level exceeds NEPM criteria, it was unclear from the	Comment noted. Emission rates of NOx have been based on rich-burn engines with no emission controls. The predicted ground-level concentrations were based on the assumption that no emission controls would be applied. The generation of 15MW of diesel generated power will require a Part V licence (Prescribed Premises category 52). Cameco will address the need or otherwise for low emissions controls with the DER through the works approval and licensing process.

No.	Submitter	Submission and/or issue	Response to comment
		report whether after treatment systems are proposed to be used to reduce NO_2 exhaust emissions. This information should be provided.	
5.	DER	An assessment of incremental deposited dust against the standard of 2g/m^2/month was undertaken and it is noted that predicted incremental dust levels at sensitive receptors (Table 9.6.8) are expected to be very low, at a maximum of 0.013g/m^2/month. However, an assessment of total deposited dust against the standard of 4g/m^2/month has not been carried out. The proponent has advised that this was due to lack of background data. An assessment of the impacts of heavy metals has not been conducted. It is noted that there are plans to assess heavy metals from deposited dust samples. This is not a standard method. It is not a possible to determine heavy metal concentrations in ambient air using deposited dust samples. When will this information be available?	The current NSW EPA (2005) impact assessment criteria for deposited dust has been applied to assess the impact of predicted dust deposition rates for the Project, as described in Section 9.8.5 of the PER. The NSW assessment criteria set a maximum allowable increase in the deposition rate of 2 g/m^2/month and a maximum annual dust deposition rate of 4 g/m^2/month. These criteria are based on studies undertaken on coal dust deposition in the Hunter Valley in NSW by the National Energy Research and Demonstration Council (NERDC, 1988) and have been set to protect against potential amenity impacts. The 2 g/m^2/month criterion is intended to be used to assess the total acceptable increase in dust deposition over existing background deposition levels, while the 4 g/m^2/month criterion is used to assess the total dust deposition (from all regional dust sources). In the absence of baseline data on deposited dust levels, it is not possible to determine a total dust deposition rate for comparison against the maximum annual deposition rate of 4 g/m^2/month. However, comparison of the model results against the 2 g/m^2/month criterion indicates that the incremental dust deposition rates associated with Project are predicted to comfortably comply with the maximum allowable increase in deposition rates at the nearest sensitive receptors. Dust deposition criteria involves an amenity assessment. The proposed development is located in a remote part of Western Australia, with low levels of residential development. Given the low levels of heavy metals recorded in our geochemical datasets from exploration activities (i.e., Arsenic and Lead < 100 ppm, Thallium < 1 ppm and Cadmium < 0.1 ppm), low predicted incremental levels and limited regional dust sources other than natural background levels, there is not likely to be a significant environmental impact. However, an assessment of heavy metals in ambient air could be conducted as part of the licencing process under Part V of EP Act. The Environmental Scoping Document (ESD) prepared by the Office of the EPA did not require Cameco to assess the impacts of heavy metals as part of the PER. Further, Cameco considers that the potential impacts associated with heavy metal concentrations within ambient air are likely to be negligible considering the low levels of heavy metals recorded in Cameco's geochemical datasets, and do not represent a key factor for the proposal. The production of dust containing radioactive material is addressed in Sections 9.6 and 9.8 of the PER.
6.	CCWA	In Section 6.3.2.2 Cameco state that high grade ore would be stockpiled for no more than 32 months and medium grade for no more than 12 years. The only safeguard or management strategy discussed by Cameco is this very simple statement *"A dust suppressing material such as hydromulch may be applied to stockpiles to reduce the potential for wind erosion and reduce the demand for dust suppression water."*	The air quality assessment for the Project (Appendix L1 of the PER) details the proposed controls to be used for stockpiles (e.g. watering and the use of a sealing product) and quantifies their effectiveness (Section 5.3 of Appendix L1). Section 9.8.6 of the PER document provides details of management measures that will be applied to avoid and/or minimise emissions. These are reproduced below. ***General - Avoid and Minimise***

No.	Submitter	Submission and/or issue	Response to comment
		The proponent has not described the risks or potential impacts of the various ore types or given a balance sheet of how more ore, of what grades, will be stockpiled for how long. The proponent suggest hydromulch 'may' be used, indicating they are not entirely sure if hydromulch could be used or would be effective and provide no discussion on the merits of hydromulch or any alternative options for dust and leach suppression. Bringing this radioactive material to the surface will make radioactive materials bioavailable. The material will be left on the surface for periods of between 32 to 144 months depending on the grade of the ore. A clear management strategy has not been provided and a clear understanding of the risks have not been demonstrated. This aspect of the proposal represents a significant risk to the environment and public and workers health. In relation to the management of dust and ore stockpiles Cameco state they will use *"conventional dust management techniques, including the use of water sprays, dust suppressants and progressive rehabilitation, will be used to manage dust emissions."* We must await a future Dust Management Plan for any real detail or understanding on what actions will be taken to actually manage this risk – this approach is deeply deficient.	The Project has been designed to minimise atmospheric emissions as a result of its operations and comply with all relevant air quality standards and guidelines. A Dust Management Plan will be prepared for the Project. The plan will include ambient monitoring of PM_{10} concentrations and dust deposition rates. The results will be used to develop management targets for PM_{10} concentrations to allow adequate response time to reduce the risk of exceeding the NEPM standard. The Dust Management Plan will include limits and management targets for the Project by using the Ambient Air Quality NEPM. Within the mining and stockpile areas conventional dust management techniques, including the use of water sprays, dust suppressants and progressive rehabilitation, will be used to manage dust emissions. The process plant uses wet processing and the plant has been designed to minimise particulate emissions. Tailings will be deposited to the in-pit TSF as a slurry and kept moist throughout operations to prevent dust generation at the surface. The power station will be maintained to operate efficiently. The proposed approach to managing dust confirms with industry best practice. The production of dust containing radioactive material is addressed in Sections 9.6 and 9.8 of the PER.
7.	CCWA	The increased risk of mining up to 3Mtpa poses additional risks for managing dust and air quality through the increased rate of land clearing, area to be mined at a given time and the increased volume of ore being stockpiled. In Section 9.8 on air quality, the proponent acknowledges the two greatest risks to air quality are stockpiling of ore and inversions, however no detailed information is provided about stockpile structure and content, nor is there any clear description of risks for above average dust events or regular inversion events. There are also no management strategies. The key threats from ore stockpiles and the impact of ore stockpiles on the environment, public and workers health, flora and fauna have not been adequately addressed. Nor are there	Details regarding the tonnes of ore stockpiled, area of stockpiles and emissions of dust from the stockpiles is provided for each ore type in Appendix L1 of the PER. Management practices are also presented in Table 15 in Appendix L1. The management practices included in the air quality assessment are provided in Attachment 6, which has been reproduced from the PER Appendix L1. The air quality assessment was based on meteorological data for one year. One of the most important aspects of local meteorology around the Yeelirrie region is the frequency and intensity of nocturnal inversions. The modelling effectively simulated these conditions as discussed in Section 3 of Appendix L1 of the PER. A general description of meteorological conditions included in the modelling is provided in Section 6 of Appendix L1. The PER (Section 9.8 and Appendix L1) assessed the potential impact due to the Project (including stockpiles) based on the actual proposed rate of mining. The assessment showed that predicted ground-level concentrations were well below the relevant air quality criteria at sensitive receptors. The assessments of workers' health, flora and fauna were presented in Sections 9.1 – 9.6 and 9.10 of the PER.

No.	Submitter	Submission and/or issue	Response to comment
		sufficient management protocols to manage or mitigate the risks - particularly concerning inversions and dust.	
8.	Denmark Env. Centre	The Project will release significant CO_2 emissions (126,000 tonnes per year) at a time when we need to be looking at reductions in emissions. The Company can hardly argue that nuclear power plants are 'climate-friendly'.	Section 9.9.5.1 presents a discussion of the nuclear fuel cycle GHG emissions which suggests that the nuclear fuel cycle is indeed cleaner compared to the use of fossil fuels to generate power. The PER presents a likely "worst case" emissions for the operation of the Project in that it does not take into account the potential for the reduction of emissions if the move was made to a gas fired power station. Nor does it take into account the CO_2 gas capture from the power station for use in the mineral processing circuit. Implementation of both of these options would make a significant reduction to the CO_2 emissions of the mine. The Project complies with the EPA's guiding principle for this factor of "*encouraging best practice to minimise greenhouse gas emissions as low as reasonably practicable*" (Environmental Protection Bulletin No.24). Further, the Project does not meet the EPA's significance threshold for this factor, which is "*the potential to significantly increase the State's greenhouse gas emissions*": Environmental Protection Bulletin No. 24; Appendix L2 (URS) Table 4-1.
9.	PS3, PS50	Where will the electricity come from, how will it be generated and how much CO_2 will it generate? The proponent does not present a plan of how it will control dust and emissions in the event of not having enough water. The proponent states (Section 2.8.3) that the only emissions to air will be CO_2 and dust. This is misleading as the nature of the dust has not been is outlined and no reference is made to the known increased radiation emissions from the mine area.	The PER (Section 6.8) states that power will be generated on site from a diesel fired power station. It goes on to say that a gas fired option is also under consideration and would be pursued if the gas pipeline has the capacity to supply gas at the time of the development. The PER assessed the availability of water for the Project and demonstrated that there is sufficient water to be used for dust suppression and all other purposes. Section 9.6 of the PER discusses the radiological environment of the Project and considers natural levels of background radiation and the potential impacts that emissions of radioactive material from the Project could have on human health. The PER demonstrated that such emissions would meet regulatory criteria. The radiation technical report is provided in the PER at Appendix J1 (JRHC Enterprises Pty. Ltd, 2015) and the air quality assessment of radon emissions is provided in the PER at Appendix J2 (Katestone, 2014a).
10.	PS151	The submitter is concerned with the contaminated (radioactive) dust and the health impacts it will have on themselves and the people that work with them. The submitter has outback legionnaires disease and is concerned with the cumulative impact from the ingestion of contaminated dust. All the workers on the mine will have protection, which is concerning in itself. However the people outside the mine will have nothing and will have to breathe the contaminated dust. In 2004, there was a horrific dust storm that caused dust to pile up 3-8 inches deep on the Yeelirrie-Meekatharra Road and the topsoil was gone making the roots of the spinifex visible. Have these storms been considered?	The PER included an air quality assessment (Appendix L1) that quantified potential ground-level concentrations of dust (TSP, PM10, PM2.5 and dust deposition) due to the Project. The assessment showed that ground-level concentrations of the key mining related pollutants will be below the relevant health criteria at all sensitive receptors. The potential air quality impact associated with diesel generators was also assessed. The assessment showed that ground-level concentrations were predicted to be below the relevant health criteria at all sensitive receptors. The BoM states that a dust storm is an area of raised dust that moves with the prevailing wind system. The minimum wind speed required to generate dust depends on the size of the dust particles, with larger particles needing higher wind speeds to become airborne. In Australia, the minimum wind speed required is about 30km/hr (8.3m/s). Once airborne, to lift the dust to high levels, the atmosphere must be unstable. This instability can often be created by intense surface heating or the passage of a trough or cold front across the region. The purpose of the model is to determine impact of the proposed mine, not dust storms and to represent typical conditions / emissions not to model an "event".

No.	Submitter	Submission and/or issue	Response to comment
		If the mine was to go ahead, Cameco should be made to monitor at its neighbours to ensure people outside the mine are not being impacted. The monitoring needs to be robust (PM2.5) and the samples should be independently tested. The submitters believe that there should be guarantees that people outside the mine are safe and that at no stage they will come in contact with the contaminated dust. Is it unsatisfactory that a Dust Management Plan was included in the PER document.	The measured wind speed at Yeelirrie for 8 Feb 2010 to 19 January 2011 had a maximum 1-hour wind speed of 11.74 m/s. There were 10 hours above 8.3 m/s (0.1%) of measurements. The modelled wind speed at Yeelirrie for 1 Feb 2010 to 31 January 2011 had a maximum 1-hour wind speed of 7.54 m/s. The Figure below illustrates the frequency distribution of wind speeds for modelled data versus observational data. It demonstrates little variability between the modelled and observational data above 4 m/s.  Wind erosion from the site accounts for 40% of total dust from the project. The wind erosion emissions were based on the NPI mining version 3 (2012) constant emission factor and therefore total emissions do not vary based on the wind speed. Within the mining and stockpile areas conventional dust management techniques including the use of water sprays, dust suppressants and progressive rehabilitation will be used to manage dust. A dust management plan will be produced following Project approval. Also see the response provided to Comment No. 24 (Section “The proposal – General”), which confirms that Cameco is happy to work with the submitter to install dust and radiation monitors at an appropriate location. See also the response to Comment 14 under the heading Human Health.

No.	Submitter	Submission and/or issue	Response to comment
11.	PS151	There is no consideration of No-Ibla in regards to dust impacts which is only 38 km from the centre of the mine. The submitters regularly camp here i.e. during mustering.	The PER did not provide predictions at No-Ibla nor at Youno Downs. However, it is possible to use the data developed for the PER to estimate the potential impact of the Project at these locations. No-Ibla and Youno Downs are outside of the modelling domain that was used in the air quality assessment. Table B2 (Attachment 6) presents the predicted ground-level concentrations (µg/m³) of TSP, PM10 and PM2.5 and dust deposition rate (g/m²/month) due to the Yeelirrie Uranium Project at No-Ibla and Youno Downs, based on the predicted ground-level concentrations at the northwest and west-north-west extent of the modelling domain, respectively. Table B3 (Attachment 6) presents the predicted ground-level concentrations due to the diesel generators with no emissions control at No-Ibla and Youno Downs. Ground-level concentrations of all pollutants are well below the relevant air quality criteria.
12.	PS151	The submitters consider they have contaminated air to the north (lead mine) and to the east is where the uranium mine will be. In cyclone seasons we get the North Westerlies and the weather comes from the north west. During summer time and leading up to summer we get strong winds from the east. The easterlies are the prevailing winds. We are going to get hammered from those two boundaries with contaminated dust.	The air quality assessment was based on a representative year of meteorological conditions. The PER (Section 6 and Appendix L1) summarises the meteorological data within the model. The PER includes wind roses that represent the frequency of wind speeds and wind directions that occur in the region. Wind roses are presented for the complete year, for each season and for four periods of the day. The wind roses indicate that strong winds occur from the east, particularly in summer and spring. The air quality assessment demonstrated that predicted ground-level concentrations would be below the relevant air quality criteria at all receptors. Further, radiation associated with dust deposition has been evaluated. At the Project boundary after 15 years of operation the increase in soil radiation concentration from dust deposition is less than the existing naturally occurring levels: Appendix J1 p.45.This results in radiation impacts from dust deposition complying with the public exposure guidelines.

9. Terrestrial environmental quality

No.	Submitter	Submission and/or issue	Response to comment
1.	DotE	An additional waste management facility is to be established on the mine lease 4 km south-east of the metallurgical plant for general wastes. Low level radioactive wastes would be disposed of in the TSF on a campaign basis. Mixing of waste streams is indicated on pp79 Figure 6-14 with Sewage being sent to the TSF. This conflicts with pp86 (The Project) which states that sewage will be treated and used for irrigation and dust suppression. Clarification on the additional facility to provide separation of disposal for non-radioactive material separate to radioactive material.	Figure 6-14 is conceptual and sewage would not be sent to the TSF and will be treated prior to irrigation. The purpose of the waste management facility is to provide a staging point for the collection, treatment and re-cycling of all site wastes as discussed in Section 6.10.1.4 of the PER. As discussed in Section 6.10.1.3, small quantities of low-level radioactive wastes (LLRW) would be comprised of laboratory wastes (about 4 to 6 m^3/annum) and used personal protective equipment produced by the Project. Items of plant and equipment that were found not to meet the radiation activity criteria for off-site disposal would be stored within the waste management facility before disposal. LLRW material that is not able to be sent offsite would ultimately be disposed of within the TSF cells in discrete campaigns. This will typically occur in excavated trenches which would be immediately backfilled.

No.	Submitter	Submission and/or issue	Response to comment
2.	PND(WA)	Yeelirrie occasionally experiences major rainfall events. At such times, the mine's overburden and tailings storage could be flooded, spreading their toxic waste over a large area.	Calculations were undertaken to determine the height of freeboard required to ensure the containment of tailings and rainfall in the event of a major rainfall event. According to calculations provided in Appendix H1 (Table 5-4), a 72-hour PMP event would result in a depth of water of 1.0m. The TSF design includes an allowance for an event of this magnitude and also provides for additional storage from the basin area in the TSF below the beach. Based on the above, this design is considered to be adequately robust to cater for any short-range climate variability. Such variability is expected to be extremely small in relation to a 72-hour PMP event.
3.	PS50	The proponent states that they are unsure if the site has been contaminated by previous activities. This is misleading and the answer is yes.	Cameco is not aware of having made the comment attributed to us by the submitter. Cameco is aware of the trial mining activities conducted on the Project are in the 1970's and 1980'sand the rehabilitation activities of the 1990's and early 2000's.

10. Heritage

No.	Submitter	Submission and/or issue	Response to comment
1.	DotE	Evidence of cultural and archaeological studies undertaken within the Project area as well as the wider region has been provided. However while the proponent has indicated that the majority of the Project area has been surveyed and assessed there are still parts of the Project area that have not been surveyed. The unassessed area forms a buffer zone to the mine site where there is still the potential for impact from development. Completion of cultural mapping of the development envelope and any other areas that may be indirectly impacted to identify sites of significance to Aboriginal people, including its relevance within a wider regional context should be undertaken.	Agreed. Cameco is aware of our obligations the *Aboriginal Heritage Act 1972* (WA) including the need to undertake heritage surveys of areas not yet surveyed before ground disturbing activities. Cameco requires s. 18 consent to undertake the Project, and those surveys will be completed as part of that process. This is acknowledged in Section 9.11.6 of the PER, where a number of commitments are set out in relation to future surveys. Notably prior studies identify that there is a low likelihood of significant archaeological sites within those parts of the project area that have not been previously surveys (Waru Consulting report, Appendix N).
2.	DotE	The proponent has assessed the impact on Aboriginal sites of significance including four sites that it considers will have significance within the disturbance footprint: "Yeelirrie_061", "Yeelirrie_139", "Yeelirrie_179" and "Yeelirrie_198")	Cameco undertook an assessment of the area not surveyed, and as reported on page 367 of the PER, concluded there is a very low likelihood of archaeological sites occurring on the unsurveyed land. As noted the policy position in Guidance Statement 41 supports Aboriginal sites in the present context being assessed under the *Aboriginal Heritage Act 1972*. As noted in the Waru Consulting report (Appendix N of the PER), the unsurveyed area (if it contains archaeological sites) are likely to be "*very small artefact scatters* [which] *are typical for the region, and most are affected to some degree of disturbance and erosion because of the general proximity to watercourses. These*

No.	Submitter	Submission and/or issue	Response to comment
		In addition the proponent has indicated that while the entire Project footprint has not been assessed for indigenous heritage sites the area assessed aligns with areas likely to be disturbed as part of the Project. The unassessed area forms a buffer zone. The proponent has indicated that based on previous studies that they do not expect to find significant sites in the unassessed areas. Assessment of impacts on any Aboriginal sites of significance in accordance with EPA Guidance Statement 41, including a description on heritage sites and/or cultural associations associated with the implementation of the proposal should be undertaken.	*very small and ubiquitous scatters are in marked contracts to the far less common and very much bigger artefact scatters that represent major campsites*" (p. 16). See also p. 17, 18 and 21. Cameco has committed to a number of management measures including a survey of the land not already surveyed prior to the commencement of ground disturbing activity. There are, as noted in Section 9.11 and Figure 9-66 of the PER, a number of sites to the north of the Development Envelope. These are registered and significant ethnographic sites first recorded by Liberman in the 1970's. These site will not be disturbed by development of the Project.
3.	DotE	Outcomes and objectives for the Project have been provided however monitoring; trigger and contingency actions have not been detailed. It is noted that a Cultural Heritage Management Plan will need to be developed prior to commencement.	The Cultural Heritage Management Plan will include a series of actions and commitments to ensure that sites are protected. These include: • Implementation of a Ground Disturbance Permit Form: The proposed action of ground clearing is a trigger for the completion of the Ground Disturbance Permit Form. This form requires the actioner to seek approval from environmental and heritage managers. This ensures that the appropriate clearances and approvals are in place before any ground disturbance takes place and if an area has not been surveyed, the process would trigger a heritage survey. • No Go Areas: Another management tool included in the Management Plan is the mapping and communication of No Go Areas. These areas might be areas where sites are known to occur or where surveys have not been completed to an appropriate level. These areas and processes are communicated during induction and at toolbox meetings. These two procedures limit the potential for unauthorised disturbance of sites. If sites are required to be disturbed, the Management Plan would set out the required procedure for consulting the appropriate indigenous people or group to arrange a clearance survey as required under Section 18 of the Aboriginal Heritage Act of Western Australia. Contingency measure would be established to manage unauthorised disturbance. The Management Plan would also set out requirements for consultation over management of sites and regions as discussed in Section 9.11.6 of the PER.
4.	DAA	DAA can confirm that there are currently two identified Aboriginal heritage places as being located either wholly or partially within the Project area. These places are both identified as archaeological places. It is understood more contemporary heritage surveys have been undertaken and	Appendix N of the PER consisted of a comprehensive review and assessment of the heritage surveys conducted over the Yeelirrie area. The following information is extracted from that report and further information can be obtained from the report.

No.	Submitter	Submission and/or issue	Response to comment
		these Aboriginal heritage places have been identified and may be avoided. A number of other heritage surveys occurred between 1997 and 2011 which have included portions of the Proposal areas. It is understood that as a result of these surveys a number of archaeological places, mainly stone tool artefacts scatters and culturally modified trees, have been identified within the Proposal area. It is understood the Proponent considers that the Proposal will not have an impact on any currently registered Aboriginal sites, however, archaeological places identified that have not yet been reported to the DAA may not be able to be avoided. Please confirm what and how many archaeological sites are to be impacted (directly and indirectly) as a result of the proposal.	An extensive archaeological survey was commissioned by BHP Billiton in 2010. The survey was conducted by heritage consultants Ironbark Heritage and Environment Pty Ltd during the period 8 December 2010 and 2 April 2011 and the final report titled "Archaeological Assessment: Yeelirrie" is dated May 2013. The survey covered an area of approximately 40 km^2 and included the main Project area, the northern quarry and infrastructure corridors. Figure 9-65 in the PER shows the extent of the survey area and Cameco's Development Envelope and indicates that not all of the Development Envelope has been surveyed. A total of 166 places with archaeological material were identified and recorded by Ironbark during their surveys, along with 2933 isolated artefacts. All of the 35 heritage areas previously recorded by other consultants were re-recorded and are included in these totals. One of the archaeological sites (DAA #11526 "Yeelirrie 03"), which was recorded in 1976 by the WA Museum near the Northern Quarry, was also re-recorded. Not all of these 166 places were considered significant or important by Ironbark and not all of them are within the Development Envelope. In particular, the archaeological places that contained rock shelters and quarries were all situated outside the Development Envelope, and were north and/or east of the Northern Quarry, close to the breakaways and granite outcrops where the WA Museum recorded numerous ethnographic, archaeological and ethno-archaeological sites. A number of marked trees, considered to be culturally marked trees were found in the area to be disturbed by mining. Scatters of artefacts were found principally on low-lying land also to be disturbed by mining. Only 63 of the recorded 166 places of archaeological material were judged by Ironbark to meet or possibly meet the criteria of s.5 of the AHA, as understood in 2011, and were considered possible Aboriginal sites under the AHA (IHE 2013: Appendix A). These were chiefly (but not always) the artefact scatters with more than 70 artefacts. In addition, all 20 culturally modified trees that Ironbark judged not to be natural scars were considered to meet s.5 criteria and be possible Aboriginal sites under the AHA. That was also the case for the six rock shelters and the single quarry. The remaining 103 'archaeological sites' were assessed to not meet the AHA criteria and were thought likely to have the status of Stored Data (IHE 2013: Appendix B). All of these likely Stored Data places were artefact scatters with less than 70 artefacts (or artefactual pieces). Although it is not explained or made clear in the report, the negative status assessment was clearly based on their very small size, with most containing less than 20 pieces. Cameco will apply for s. 18 consent for the Project, thereby enabling a formal decision to be made by the Aboriginal Cultural Materials Committee on whether any Aboriginal Site meeting the AHA criteria occurs within the Project area.
5.	PND(WA)	Yeelirrie is a special place for its Traditional Owners. It encompasses stories and cultural sites important to them. Ngalia spokesman Kado Muir said "We are concerned about the plants which would have medicinal value, food value, and also provide an ecosystem for animals that we rely on; from honey ants to fauna like kangaroo and other animals". Indigenous ecological knowledge should be incorporated into any future land clearing at Yeelirrie.	As stated above, in response to Comment No. 4, development of the Project will not impact on the sites that have been recorded as those most significant to Aboriginal people. Cameco acknowledges that the Project will have an impact, clearing land and disturbing plants and animals and is committed to minimising the Project footprint. The impacts of vegetation clearing and how this will affect fauna habitats are discussed in Sections 9.1.5 and 9.3.5 of the PER respectively. The assessment completed demonstrates the impact of the Project will not extend significantly beyond the Development Envelope described in the PER and will not result in the loss of values or knowledge expressed by the submitter. Consideration of bush tucker, including the protection of species and the rehabilitation with bush tucker plants will be discussed during the engagement over the Aboriginal Heritage Management Plan.

No.	Submitter	Submission and/or issue	Response to comment
6.	R Chapple; Proforma 2	Yeelirrie is a significant place and mining at Yeelirrie would destroy a number of heritage sites. The original on ground assessment carried out in 1978 identified 42 registered sites of which 35 contained evidence of Aboriginal habitation. These 35 sites should have been identified in the PER and they still fall within the classifications contained within the *Aboriginal Heritage Act 1972*. A full reassessment of the sites in the area should be provided.	The assessment carried out in the 1970's was based on the mining proposal by the then proponent, WMC Resources Ltd. The proposal included the construction of a town in the Barr Smith Range north of the minesite. The heritage surveys conducted at the time identified a number of sites in the vicinity of the proposed town but away from the minesite and these sites were subsequently registered. Cameco does not propose to undertake any ground disturbing activity in the vicinity of these sites or places. These sites are discussed in Sections 9.11.3.1 and 9.11.3.2 of the PER and some of the sites are shown on Figure 9-66. Reassessment of these sites is not required because the Project will not impact upon them and there is a significant buffer between the Project and these sites. Archaeological material located within the Project area will be formally determined and classified through a S.18 application under the *Aboriginal Heritage Act 1972*.
7.	CCWA	The public submitter considers that this Project will destroy Aboriginal heritage. Aboriginal heritage is the longest surviving culture in the world. It is strongly believed that Aboriginal heritage which is hundreds of thousands of years old should be treated it the same regard as European heritage. The destruction of Aboriginal heritage is a loss forever, all for the sake of a short term mine. It is poor policy and poor trade that would see the Government place the value of a short term mine over Aboriginal heritage that has existed for centuries. The Conservation Council of WA and the community consider that these sites should not be destroyed. Avoid where possible is not sufficient. The Conservation Council of WA and the Anti Nuclear Alliance of WA have been engaged with and are supportive of the newly formed group Aboriginal Heritage Action Alliance – a group of lawyers, academics, organisations and Aboriginal people. The public submitter does not support the proposed changes to the Aboriginal Heritage Act and would be concerned about any impacts the changes might have on the protection of the sites at Yeelirrie. The proposed changes will make it easier for sites to be deregistered and/or destroyed with less consultation with Aboriginal people. At the Yule River annual meeting with Aboriginal representatives from across WA, Representative bodies from the Kimberley and Pilbara and members of Parliament, a resolution was passed demanding that... *"procedural fairness is in the Aboriginal Heritage Act 1972 (WA) for decisions affecting*	The greater Yeelirrie area has been the subject of surveys for Aboriginal heritage since the 1970's. Extensive consultation was carried out in the 1970's and in 1997 (Wanmulla Social History Project, a survey carried out for the purposes of supporting a Native Title claim), and since then during implementation of small scale exploration projects within the Yeelirrie Project footprint. This collection of work is very extensive and the evidence is that the heritage landscape is well mapped and well understood. Based on a review of the historical and recent record of surveys, Cameco is confident the Project will not have an impact on significant heritage sites. The Project area has been surveyed and found not to contain any ethnographic sites. Archaeological sites found within the Project area consist of scatters and marked trees. Notably, the Project area does not contain landscape features which would be associated with camping grounds or petroglyphs. Cameco is aware of it obligations under the Aboriginal Heritage Act and will comply with all aspects of the Act should the Project proceed. Arguments regarding proposed amendments of the *Aboriginal Heritage Act 1972* are beyond the scope of this environmental assessment. This proposal does not involve Aboriginal Heritage significance in the sense identified in EPA Guidance 41 or listed MNES under the EPBC Act. Given the low likelihood that the Project area comprises unidentified archaeological material and the precautionary principle will be satisfied through a requirement for a Cultural Heritage Management Plan (including a requirement for archaeological surveying of presenting unsurveyed areas).

No.	Submitter	Submission and/or issue	Response to comment
		the heritage of Traditional Owners, and that other legal challenges available to protect threatened heritage sites be investigated." The public submitter supports this sentiment and effective action for the better protection of Aboriginal Heritage sites.	
8.	Uniting Church	In all matters relating to this proposal, nothing can proceed without the 'free, prior and informed consent' of the indigenous people affected. The full list of rights of the Indigenous people should be upheld for the Yeelirrie Traditional Owner in relation to this proposal.	Aboriginal people have been extensively consulted since the 1970's in relation to Aboriginal heritage in the wider Yeelirrie region and Cameco continues to consult with local Aboriginal people about the implementation of the Project. The project area is the subject of a native title claim and the claimant group will continue to be consulted. Further, p. 27 of Waru Report states: "*Management of the Aboriginal heritage places within the Development Envelope will need to be considered, with the aim of avoiding unnecessary damage or disturbance, irrespective of their status under the Aboriginal Heritage Act 1972. The involvement of local Aboriginal groups and the Native Title Claimant group is recommended in developing a Cultural Heritage Management Plan for these heritage places and archaeological remains*". Cameco is committed to preparing such a management plan, which will include a requirement for consultation with relevant Aboriginal people. The Waru report also makes a number of other recommendations about heritage management and consultation and Cameco is committed to implementing all of the recommendations made. Cameco has met with the relevant aboriginal people through its engagement with CDNTS and the Tjiwarl native title claimant group and discussions about the management of heritage values will continue with this group through the development of the Project. The significant heritage sites in the vicinity of the Project area are those situated to the north of the Project. These places were first described by Liberman in the 1970's and include sites of mythological significance, art sites and natural features such as pools in gorges and gnamma holes. These places were placed on the register of heritage sites as a result of those early surveys. When the Yeelirrie Project was first proposed in the 1970s, it included a plan to construct a town and the proposed location for the town was near to these sites. Cameco's proposal does not include a town and the Project layout including the location of the proposed accommodation village has been planned to avoid the significant sites. In summary, the Project will not directly or indirectly impact these significant places.
9.	PS15; PS21; PS32; Proforma 2	Total disregard for aboriginal heritage – Yeelirrie is a very significant site for Aboriginal Heritage with over 42 aboriginal sites in the Project area. The proposal includes no reassessment of these sites. There is no mention in the PER of how aboriginal heritage sites will be protected and how concerns and opposition of traditional owners will be handled. Cameco has not proposed to reduce access or block traditional owners from the mine and surrounds for fear of contamination.	Cameco is aware of its obligations from both a regulatory and social licence perspective. We understand the heritage landscape and have determined, in consultation with a heritage consultant that development of the Project will not disturb the sites referred to by the submitter. Cameco continues to discuss the Project with Aboriginal people. If the Project is approved, exclusions zones may be established for safety and health matters, however, these are unlikely to present significant restrictions on the movement of people for traditional activities.

11. Rehabilitation and decommissioning

No.	Submitter	Submission and/or issue	Response to comment
1.	DotE	Given the mining will occur to a depth of no greater than 15m (and an average depth of 10m from Table 6-3) and the need for an adequate cover for capping/revegetation this could result in larger items of potentially contaminated processing facilities lying relatively close to the surface. Further information regarding onsite disposal management is required including how the relatively shallow depth of mining and its impact on on-site disposal will be managed.	An estimated 58,000 tonnes of ore will be produced from the open pit. As stated in the PER, during mining and at closure, low-level radioactive materials will be disposed of into the pit. During operation up to 26m^3 (approximately 20 m^3 of used PPE and 4-6 m^3 of laboratory waste) will be disposed of per annum (Section 6.10.1.3). At closure, contaminated plant and equipment would also be disposed of in the pit. The closure plan provides for up to a 3m deep cover above the tailings, consisting of 1m thick capillary break overlain by at least 2 m cover of soil (Section 9.2.3 of Appendix O1). It is planned that contaminated material would be broken down, concrete crushed and plant and equipment broken down into smaller items, placed on the consolidated tailings and covered by the 3m cover to be placed on top of the waste material.
2.	DotE	Table 6-18 states where required, provide appropriate sediment containment features to minimise sediment carry on to other areas. The use of sediment capture features will require some form of active management to ensure they do not rapidly fill and become ineffective. Please provide details on how proposed erosion control methodology will be self-sustaining following closure.	Based on surface modelling of the post closure landform including reinstatement of drainage channels, and the modelling flow rates and sediment loading sediment capture features will not be required post closure and will not be retained. That Section does not link self-sustaining criteria to erosion control. The self-sustaining link is for ecosystem performance. It is expected that sediment would be controlled, at and shortly after closure, by the low gradients incorporated into the closure landform design. Sediment will re-deposit in the valleys alongside the final landform. Surface water modelling (Appendix H1, Section 7.2.2) indicates that flow velocities are expected to be very small and well below erosive thresholds.
3.	DotE	Information on topographical and surface drainage surveys and criteria for determining a return to 'as close to pre-mining conditions as practicable' should be provided.	The preliminary landscape profile before and after mining is presented in Figure 9-69 and 9-70 on page 381 and 382. The objective of the post mining landform is to achieve functioning surface water flow that achieves acceptable outcomes for stream flow velocity and sediment erosion and disposition. The key features of pre-mining conditions include the presence of drainage flow paths to the north and south of the orebody that will only flow following very large rainfall events (between a 1:20 and 1:100 Year ARI). The closure landform as described in Section 7 of Appendix H1 incorporates the re-establishment of these drainage features. Prior to the commencement of Project design and construction a detailed LIDAR survey will be completed which will provide a base topography for the detailed design for construction and closure.
4.	DotE	Modelled erosion rates from the WEPP model are proposed to be used to calibrate the SIBERIA model. A model is being used to calibrate another model without reference to any field or measured data – this is considered inappropriate.	The WEPP model is based on actual measurement taken using rainfall simulator calibrated to Yeelirrie storm events and utilising soil material taken from Yeelirrie. This has been used to calibrate the SIBERIA model and is discussed in Section 9.12.3.1. Therefore the landform modelling has not been entirely a desktop exercise and field measurements have been collected to calibrate the model. Cameco agrees that a field calibration using field scale rainfall simulator would be beneficial to further test the cover system and calibrate the model. It is suggested that this could be undertaken as part of the Definitive Feasibility Study.

No.	Submitter	Submission and/or issue	Response to comment
		Landform modelling should not be an entirely desktop exercise – there should be some proposed activities to collect field measurements to assist with the calibration of models. Please describe the activities which may occur to collect field data which could be used to calibrate the erosion models.	It should also be noted that it is very difficult to field validate a 10,000 year model.
5.	DotE	A DEM with a horizontal resolution of 100 metres is proposed to be used for landform modelling. There is no information on the vertical resolution of the DEM. 2 key points: (1) A DEM with a 100m resolution would be considered very coarse / low resolution. While the landscape in question is understood to have limited relief (~15 metres), at this resolution it would be very difficult to accurately / reliably show any change in elevation which may result from erosion / deposition down to 0.5 metre level, which the results purport to indicate. (2) The use of such a coarse DEM is not recommended and is not best practice for landform modelling. The proponent should be aware that there are publicly available DEMs (e.g. 1" SRTM data = 30 metre resolution) that cover the whole of Australia. A 10 metre (or finer) resolution would be more appropriate for the extent of the model area. What is the vertical resolution of the existing DEM? Finer resolution DEMs do exist for the area, so why are they not being used, given the importance of being able to demonstrate changes in elevation / landform shape?	Cameco agree to a certain extent in that a finer resolution would have some benefit, however we are unsure if the finer scale would have had any real effect on outcomes. During the time of modelling it was considered important to use the same model which was used to model surface water so the URS model was adhered to.
6.	DotE	A draft Safety Case should be included in the document. This should include all the draft plans. Some of the plans mentioned in Table E3 in the Executive Summary are already developed in draft form, but in most cases the information relating to a particular plan is scattered throughout the document, and needs to be consolidated. For example, the Mine Closure Plan described in Section 9 should be part of the Safety Case.	A requirement to prepare a Safety Case was not set out in the Environmental Scoping Document and therefore has not been prepared at this time. Cameco agrees that it may be beneficial to develop such a Plan and agrees it would be a living document. Cameco suggests that it would be appropriate to develop the document alongside and perhaps as an overarching document for the various management plans that Cameco is committed to developing and refining as the Project proceeds. Cameco would be happy to discuss where a Safety Case fits within EHS management systems.
7.	DotE	A post closure plan should include a sensitivity analysis of the assumptions used in the post-closure impact assessment.	The Mine Closure Plan presented in Appendix O1 is preliminary in nature. Under the guidelines, the Plan will be reviewed and resubmitted for assessment as the Project develops. Sensitivity analysis of assumptions will be made as the Project and the Plan develops.

No.	Submitter	Submission and/or issue	Response to comment
		Estimates of post-closure doses should include a discussion of the peak doses that are likely to occur over the long-term for the different radionuclide transport pathways. The effects of barrier degradation also need to be discussed.	Post closure doses are estimated to be similar to existing doses in the region. In the Closure Plan, Cameco commits to controlling radiation levels at the surface of the rehabilitated landforms and across the Project area to levels that are below accepted health guidelines. Cameco also notes post closure radiation doses to human receptors following will be similar to the pre-mine environment. Cameco has committed to monitoring to confirm this. The Radiation Appendix (Appendix J1) also notes that the facilities will be closed to ensure that radiation exposures are low and consistent with natural background levels. Section 9.6.6.6 of the PER describes the potential impacts of erosion of the TSF cover on radon emissions (see Section called Assessment of radon exhalation from the TSF post closure). Two scenarios were modelled. The first was a total loss of cover of approximately 0.5m, based on 10,000 year estimates as seen in Appendix O1. The second scenario accounted for gullying across 20% of the cover (to a depth of 1.5m). In both scenarios, the overall change in attenuation by the cover material resulted in exhalation levels that were consisted with natural background levels.
8.	DotE	"The proposed Project would recover uranium…..... 5 m below the natural ground surface." If the pre-mining water table level is restored after closure much of the deposited tailings (and other back-filled material) will be below the water table. Treatment processes such as extraction, crushing and grinding) will change the physical characteristics of this back-filled material and may increase the potential for leaching of radionuclides from this material into groundwater. Please provide further discussion on this issue.	In a post-closure environment, it is expected that pre-mining groundwater levels will recover within about 50 to 150 years resulting in mixing of groundwater with tailings porewater. Some effects of this mixing are discussed in the response to a previous comment (please see response to comment 5 in Inland Waters Environmental Quality). The metallurgical process extracts uranium leaving the other radionuclides in the tailings which represents approximately 85% of the initial radioactivity. Analysis of tailings porewater and solids shows that to a large extent that radionuclides other than uranium tend to remain bound with the tailings solids. This is supported through various published studies [1, 2] and by the rehabilitation activities carried out on stockpiled materials during the previous mining trials at Yeelirrie. Before closure, readings of up to 45 µS/hr were obtained for stockpiled material. Surveys taken after stockpile removal typically gave readings of less than 1.5 µS/hr (WMC, 2004). The low readings documented after removal of the stockpile suggests that there was limited or no release of radionuclides from the stockpiles during their lifetime (20 to 30 years).
9.	DotE	It is assumed that lining the tailings disposal cells with clay where they contact the pit wall will prevent groundwater from infiltrating into the tailings. Please demonstrate that this assumption will remain valid for very long timeframes (post-closure). This demonstration also needs to take into account that the physical characteristics of the tailings are very different from those of the original ore, as a result of processing. This could be addressed in the Mine Closure Plan.	Note that the assumption is that of the reviewer and is not stated in the PER. The compacted clay embankments separating tailings from pit walls will reduce outward lateral seepage during the operational phase and early post-closure, rather than to prevent groundwater flow into the tailings. Over the later part of each cell's nominal 7 year life, water levels in the cells will rise above external groundwater levels. Immediately after closure, the clay embankments will be effective in minimising outward lateral seepage. Monitoring and management of lateral seepage from tailings dams during the operational phase is a routine element of mine site compliance. The proposed operating system ensures that lateral flux from the operating dam will be low compared to other alternative arrangements and compared to other mine tailings repositories. Outward gradients are expected since the net percolation rate through the cover implies an effective 1.2mm/year discharge rate. This rate is low because the cover will limit the volume of rainfall recharge reaching the saturated tailings, and the capillary break will divert excess infiltration away from the tailings as depicted in the concept drawing (Figure 2) in Attachment 7. Although there will be an outward hydraulic gradient, the gradient is small. Combined with

No.	Submitter	Submission and/or issue	Response to comment
			the low hydraulic conductivity of the consolidated tailings, the clay embankments and floor, very small seepage rates are expected.
10.	DotE	It is stated that the tailings will partly resaturate after dewatering from adjacent mine blocks is discontinued. This resaturation may mobilise the radionuclides in the tailings at a rate considerably higher than in the original ore because of the fine grain size of the tailings. This appears to contradict the statement made that little or no seepage is expected. Please provide clarification on this point.	It is expected that in the post-closure environment, the bottom part of the tailings will re-saturate as the groundwater recovers to its pre-mining level. Refer to the response to Comment 5 under Inland Waters Environmental Quality, for the discussion on groundwater recovery impacts. The mobilisation of radionuclides are addressed in the response to comment 8.
11.	DotE	The dewatering drains shown in Figure 2.1 will not be effective once they are below the water table. In addition, if the clay underneath the tailings is low permeability material, how will the drains remove water from the tailings?	Cameco agrees with the reviewer in that the dewatering drains will not be effective post-closure when dewatering has ceased. The primary purpose of the dewatering drains are to dewater the mining blocks prior to mining. The secondary purpose is to aid in consolidation for the first few layers of tailings. It is expected that after several layers of tailings are deposited the drains will not be effective in dewatering the tailings, rather evaporation will be relied upon to dewater further lifts. Post-closure the dewatering drains are not expected to play a role.
12.	DotE	It has not been demonstrated that the proposed TSF will comply with current legislative and regulatory requirements over long periods (see earlier comments on changes in material characteristics and Control by Design). The Mine Closure Plan will need to demonstrate that the long-term impacts will be in compliance with current requirements. This would be facilitated by a sensitivity analysis on some of the important environmental transport parameters, such as Kd. In particular, Kd can vary with particle size, pH, the chemical properties of the material containing the radionuclides, etc.	A sensitivity analysis on Kd values was performed in Appendix I1 (Section 7.6.1). It is well known that published values for the distribution coefficient, Kd, can vary greatly depending on factors such as the material type and properties, pH and the speciation of the contaminant. The sensitivity analysis of the solute transport model with respect to the Kd values (Table 1) indicate differences in the extent of travel of uranium between the base case and a case using 0.1*Kd values. The Kd values used were determined on site specific materials from a large number of studies (115 total) and applied conservatively to suitable lithologic layers in the Yeelirrie region. There are a number of important points to consider when interpreting these results, ▪ The thermodynamic definition of the Kd term assumes that the system is reversible but in very saline environments the dominant sorption mechanism would likely be inner-sphere adsorption because sodium and calcium cannot compete effectively for ions that are involved in this type of bonding arrangement. Uranium forms very strong inner-sphere surface complexes that are unlikely to be affected by high salinity; ▪ In 2004, a number of trial sites that included ore stockpiles and other waste were rehabilitated after 31 years in place. It was noteworthy that tailings solids from the stockpile remained within tens of meters of the stockpile toe. The seepage modelling detailed in Appendix I1 was subjected to an independent peer review according to the Australian Modelling Guidelines in Appendix I3. The design concepts detailed in Appendix D incorporate seepage mitigation features that while not unique in the industry, are combined into a unique arrangement to maximise benefits and minimise disturbance and long term seepage impacts. As part of a normal design process, the concepts will be refined and optimised in such a way to maximise performance. These aspects will be aimed at maximising

No.	Submitter	Submission and/or issue	Response to comment
			consolidation and minimising seepage to meet operational and closure outcomes. The performance of these measures will be adaptively managed to ensure they continue to meet best practice standards. With respect to the comment on compliance, there are several steps yet for the approval of the TSF design, construction and operational management. These include: ▪ When a TSF is proposed, the proponent must provide information consistent with DMP's guidelines on tailings storage design and operation, available at http://www.dmp.wa.gov.au/834.aspx ▪ If the geotechnical design is approved by Resources Safety, the operator will be required to submit an operating manual for the tailings storage to Resources Safety, available at http://www.dmp.wa.gov.au/6713.aspx ▪ A works approval and licence to operate a tailings facility is also required by the WA Department of Environmental Regulation.
13.	DotE	"Tailings from the Yeelirrie processing facility would be placed back into pit voids and covered. This disposal method is both safe and secure for uranium mining tailings." This assumes that nothing will change with time, i.e. that all barriers will retain their integrity, that pre-mining conditions will apply post-closure, etc. The Mine Closure Plan will need to demonstrate the validity of these assumptions and that the modelling considers the effects of break-down of these assumptions.	The statement should be read for what it is - an overarching introductory comment which is then backed up by a chapter of detail discussing radiological considerations that guide design and controls. The Technical appendices and the PER address a range of scenarios to demonstrate that the proposed option is indeed a safe and secure storage facility. Cameco considers the return of tailings to an in-pit facility to be a best practice approach to mining the Yeelirrie orebody. In support of this disposal scenario Cameco has constructed a number of models and performed a variety of sensitivity analyses. The location where the Yeelirrie tailings will be stored is a stable, ancient and non-erosive environment. By using suitably engineered materials that have been derived from the pit, they are not going to be subjected to any foreseeable changes that might disrupt their emplacement characteristics or physical properties. It has not been assumed that pre-mining conditions will prevail after closure. As described in Section 9.12.3.3, the TSFs will change the way groundwater flows along the valley bottom. Preferential pathways for groundwater through flow are expected to remain in undisturbed areas outside of the TSFs. The effects of this have been incorporated into the seepage modelling. The cover materials will also be locally derived and placed back in a similar setting from which they came. The cover will alter slightly the movement of runoff, but the existing bi-modal movement beside the orebody will be maintained. While the materials in the cover may settle as the tailings consolidate, they are not expected to break down or lose functionality in terms of minimising infiltration to the tailings and maintain adequate physical separation for radiological aspects.
14.	DotE	Relying on sorption controls to immobilise constituents of concern may not be useful in the long term. Sorption is a dynamic process, and slows down movement, but does not stop it, as an equilibrium state will eventually be reached, when adsorption balances desorption. At this point a concentration gradient (for the contaminants) may still exist, so there may still be a net flow of contaminants. The Mine Closure Plan will need to describe the situation that will result once the cover material is eroded away, and once the sorption processes come into equilibrium.	Cameco has not relied on sorption controls in the development of its closure plan. Cameco has only introduced sorption controls through the inclusion of site-specific distribution coefficients for a few constituents of concern in relevant geologic media. The primary control mechanism being relied upon are solubility controls for most constituents. Cameco agrees that sorption is a dynamic process and that equilibrium may be reached, but not all sorption occurs in the same manner. Ion exchange is a type of adsorption that relies on reversible electrostatic associations. This type of adsorption mainly applies to alkaline and alkaline earth metals and is short term phenomena. For the metals that Cameco has modelled in its solute transport model, specific adsorption is the retardation mechanism. Specific adsorption is an inner-sphere process that results in a more stable bond with the constituent of concern. This enhanced stability makes the COC less prone to desorption during changes in chemical conditions.

No.	Submitter	Submission and/or issue	Response to comment
			The cover will not be eroded away. Landform evolution modelling has characterised how it is expected to change in the long term in response to prevailing climatic conditions. (see response to comment 18 and Section 9.12.3.1 of the PER) The entire Yeelirrie Uranium Deposit is also in a natural state of flux. There are naturally occurring concentration gradients for all solutes. The migration and accumulation of uraniferous groundwater and carbonate deposits have evolved across a geological timescale to yield an orebody in the mine site and naturally elevated concentrations at accumulation points along the valley floor. While this evolution will be accelerated at the mine site, it will reach a new equilibrium based on prevailing conditions. These conditions have been investigated, described and assessed in various documents in Appendix I of the PER.
15.	DotE	Is there any plan in place to deal with the possibility that the assumptions on which the post-closure impacts have been developed might change? Adequate information to address this comment has not been provided and will need to be included in the Mine Closure Plan.	The Mine Closure Plan is a working document that will be reviewed through the EPA process under the requirements of the State Agreement. This process provides for a review of initial assumptions and a revision of the Plan to reflect new conditions or circumstances.
16.	DotE	Provide context for the time scale of long-term, for which the TSF is designed to be erosion-resistant and non-polluting. Later in the document (e.g. Section 9.5.5.3) 15,000 years is mentioned. Is this the sort of timescale?	Yes. The reference presented on Section 9.12.3.1 of the PER says that the modelling was conducted for a time period of 10,000 years.
17.	DotE	No discussion of use of a radiation control layer is provided. Other operations (Wiluna uranium Project) have committed to using a radiation control barrier as part of their closure designs. It should be shown why this is not considered necessary in this case. For example, radiation risk assessment may show that the radon leakage from the TSF is minimal, given the nature of the materials creating a highly convoluted pathway for radon to diffuse, and thus the proposed design has been shown to be adequate in models. The proponent could assist in the understanding of likely outcomes through additional discussion of the proposed tailings cover method and the likely exposure levels.	Refer to response to comment 9 under 'Human Health'. While Cameco may not have labelled a layer of material above the tailings a "radiation control layer" the proposed tailings cover has been designed for its capacity to attenuate radon and is as effective. The primary purposes of a TSF cover layer are to provide structural stability and containment of the tailings. By fulfilling these criteria, radiological aspects are well controlled and this has been described in Sections 9.6.6.6 and 9.12.3.6 of the PER, which describe the radon attenuation properties of the proposed TSF cover.
18.	DotE	A risk of erosion channelling and gully development from significant rainfall events does exist and modelling shows that this could be as deep as 1.5 m in limited locations. Furthermore, there is documented potential for plant root penetration and the subsequent development of infiltration pathways at Rum Jungle in the NT. As the mine development progresses the locations where this risk is highest should become apparent with more clarity. The proponent could consider reducing the risk of deep	It should be noted that the climatic conditions at Rum Jungle are significantly different to Yeelirrie. Significant rainfall, subtropical vegetation means that little can be gained from comparing the two projects. The results of the laboratory testing were used to conduct landform evolution modelling using the SIBERIA model over a 10,000 year climate scenario and two model scenarios were developed for each of the two soil materials. See Section 9.12.3.1 of the PER. The base case model, where soil erodibility values were kept constant throughout the entire 10,000 year modelling period resulted in the modelled output of erosion up to 1.5m. This is considered a "worst case" model scenario, as it

No.	Submitter	Submission and/or issue	Response to comment
		channelling cutting through tailings cap material by including rock armour in the higher risk locations. Further detail on scour prevention, armouring in limited higher risk locations and root infiltration consideration would assist in providing a better assessment of the potential surface water impacts and post-closure landform.	assumed that no surface-stabilising vegetation or soil cover (e.g. cryptogam or plant material) will develop, and the soil will remain in a similar condition as it was shortly after completion of the backfilling process. The "time-varying erodibility" model scenarios were considered to be the more realistic of the two models, as they include a degree of soil stabilisation, resulting from factors such as plant or cryptogam growth or litter cover that is expected to increase with time after rehabilitation. The erosion potential used is still highly conservative due to the following assumptions: • zero initial surface cover (e.g. no woody debris or plant litter, no contour ripping etc.); and • no vegetation for the first 100yr of modelling. Results from the model scenarios show that whilst the majority of the TSF cover system is expected to remain intact some gully formation of <0.5 m of erosion over 10,000 years was predicted in isolated locations. The hydrology modelling supports the less erosion model and indicates that flow velocities will be very small due to the low surface gradients. Details over how excessive velocities can be managed at a local scale would require further assessment of various landform shapes and soil properties. In this setting, these issues are typically not difficult to resolve. This is something that would normally be done during operations and refined during regular closure planning updates. A commitment would be made to include this in the closure planning process.
19.	DotE	It is unclear if various climate change scenarios are included in the HYDRUS model. In the event that there is an increase in cyclone activity, or higher intensity rainfall events, this may have implications on the performance of the cover. This should be discussed.	The parameters used in the model are discussed on page 376. It states that a 1:100 yr ARI storm event (equating to 158 mm in 24 hrs) was inserted into the climate record to simulate high rainfall and ensure the model included the expected range of rainfall ARIs. A rainfall event of this magnitude provides a simulation of the level of rainfall event described by the submitter.
20.	DotE	Discussion is required to show why the hydraulic parameters of the TSF and tailings materials are considered low, in relation to other materials in similar settings (e.g. from Mt Keith, or TSFs in the region). Currently, the assessment shows that they are low only in comparison to the calcrete in the area. Discussion is needed to show the rationale for considering the TSF materials to represent low permeability materials in comparison to other operations.	Yeelirrie tailings differ from typical tailings due to parent rock differences and processing differences. Regionally typical tails derive from hard metamorphic rock ores subject to crushing, grinding and flotation. The Yeelirrie parent material is a variably cemented clay which is subject to chemical digestion. The resulting Yeelirrie tailings contain a comparatively high clay content (typically >12% <2 micron) which is the primary control on in-situ permeability. Qualitatively stated the Yeelirrie tailings can be described as a clayey- silt compared to typical tailings which are silty-sand. Tailings and engineered embankments of low hydraulic conductivity are the result of high clay contents. Such clay contents are the result of the alluvial deposits from which they came. In contrast, other TSFs in the region are based on orebodies and construction materials that have been derived from weathered bedrock. Tailings from mines such as Mt Keith are the product of grinding fresh to weathered bedrock that as a result, has high sand and silt contents compared to the alluvial clay-based ore and substrate materials at Yeelirrie. This relationship equally applies to the alluvial materials planned to be used to construct the TSF embankment at Yeelirrie. Such low hydraulic conductivities are based on extensive field and laboratory testing as described in Appendix D, I1 and I2 of the PER. The discussion on the contrast between the calcrete and clay is intended to show that groundwater flow around the completed TSFs will be unconstrained in comparison to the tailings. For calcrete, even low hydraulic gradients can

No.	Submitter	Submission and/or issue	Response to comment
			transmit considerable volumes of groundwater. In contrast, such low gradients, according to Darcy's Law, mean that flow rates will be orders of magnitude slower.
21.	DotE	It is unclear why the particular range of recharge values used in the sensitivity assessment of the geochemical model was chosen. It is not apparent if these represent reasonable values, or are intended to be highly conservative. It is also unclear if non-TSF sourced recharge is included in the geochemical model. The rationale for the selected range needs to be provided, as well as a clarification around the use of non-TSF sourced recharge. This is particularly important given recharge is one of the parameters to which the geochemical system is most sensitive.	The range of recharge values used in the sensitivity analyses was adopted from both model calibration and field observations. While the model-calibrated (catchment-scaled and annualised) recharge rates appear low, an assessment into the interaction between groundwater and surface water (Appendix H1, Section 8) estimated recharge rates for individual events suggests that locally, they may be higher, especially when rainfall exceeds about 50mm per event, or after a series of smaller ones. The observations were derived from automatic data loggers measuring at a high frequency, and rainfall data derived from Yeelirrie Homestead. The range of recharge rates chosen for sensitivity spans this range. Non-TSF sourced recharge is an integral part of the numerical groundwater flow model. Recharge is applied at different rates across the model domain to replicate the presence and availability of surface water to initiate the recharge event. All TSF-related simulations include this recharge. Given the long timeframes simulated in the numerical model, all recharge was annualised in order to achieve calibrated baseline groundwater levels and solute distributions. Movements of groundwater around the TSF are driven by this recharge and the hydrogeology of the undisturbed materials (depth, thickness, hydraulic conductivity and evapotranspiration-driven discharges). The interaction between this flow system and the TSFs have been subjected to a high degree of focus to understand drivers and uncertainties such as those included in the sensitivity analyses.
22.	DotE	Section 5.8, Appendix A or Appendix I2 – Reporting of data quality control in laboratory results is not covered. Analyses for samples from the 8th month of tailings ageing tests were undertaken by a different laboratory to the 1, 2, and 4 month samples. It is unclear why this occurred. Additionally, there is no discussion of quality control or data standards used to compare results from these two laboratories and ensure consistent data quality. There is mention that charge balance for results from the second laboratory was 'poor' but a value is not given. The results of the 8 month tailings ageing test are significant to the assumption that pore water in the TSF will rapidly attain equilibrium with the solid tailings; if these results are unreliable the tailings source terms for the model may not be appropriate for modelling and management of the system.	From our communications with the author of the report presented in Appendix I2, it appears that there was limited or insufficient sample volume for the original laboratory to undertake analysis. Therefore samples were sent to another laboratory. Only a limited number of analytes are in question (alkalinity, TOC). The remainder of analytes were based on testing at the original laboratory. The assessment of the author is that the overall assessment the majority of parameters would not be impacted. For the samples that were sent out, no QA/QC data were reported by the laboratory hence the author undertook a check on the ion balances and considers that the results would not materially impact the analysis.
23.	DotE	It is unclear what volume of tailings will be disposed as a proportion of the volume available in the void. Provide assurance that the amount of tailings to be deposited will allow enough void space for cover materials and final landform.	Cameco contracted Runge Pincock Minarco (RPM) to do a pre-feasibility mining study. A component of that work was to perform a material balance on the pit resources and tailings. The expected consolidated tailings volume per ore tonne is 0.8 m^3. This leaves sufficient room in the pit after tailings are deposited. The closure plan for the pit currently requires 2 m of benign overburden for capping material. The final landform is expected to be mounded above the natural ground level and to provide a surface for revegetation.

No.	Submitter	Submission and/or issue	Response to comment
24.	DotE	Inconsistency between solids concentration in table (40%) and in text (30-55%). Include range in solids concentration for context.	There is no inconsistency. When discussing milling, in Section 6.4.2.1, the PER states that a slurry of around 30 to 55% solids density would be created, while in Table 6-5, the figure 40% is presented as an average value in a table titled Indicative Features. 40% is within the range of 30 to 55%.
25.	DotE	How does the design avoid groundwater flow through the TSF? Outline the reason that backfilling will allow preferential flow post-closure. E.g. is the fill design such that higher transmissivity zones are located to direct flow around/away from the TSF?	There will be a large difference in hydraulic conductivity (and transmissivity) of the TSF embankments (0.00014 m/d), the mine backfill (0.04 m/d) and the undisturbed superficial aquifer (4 to 700 m/d – sandy alluvium to calcrete). In all cases, hydraulic gradients that drive flow will be low to very low. Groundwater flow will always be greater where there is higher transmissivity, and in this case, subjected to recharge events that will continue to occur across low-lying areas after closure. Even if the mine backfill was not present, or did not have low hydraulic conductivity as assumed, the large contrast (many orders of magnitude) in transmissivity between the undisturbed superficial aquifer and the back filled pit means that the preferential flow path within the undisturbed aquifer around and away from the backfilled pit will remain.
26.	DotE	Previous tailings characterisation is not summarised. Briefly summarise Golder (1982) findings, and comment on additional testing, or direct reader to summary in appendices.	Golder Associates conducted laboratory and field testing of tailings from the experimental ore treatment plant at Kalgoorlie. The purpose of the testing was to evaluate geotechnical aspects of tailings deposition. They determined mechanical properties of the tailings with specific attention to determining the best method of tailings disposal among these options: • Filling one tailings cell completely before starting to fill the next and, • Filling the cells in thin layers with each layer being allowed to dry by evaporation before filling the succeeding layer requiring a number of ponds in rotation. The overall testing program also included an evaluation of two tailings tanks at the Kalgoorlie research station which were initially filled with tailings on January 15, 1982. Laboratory tests indicated that the tailings, in general, behave similar to those of natural soils of similar composition. The results of the analyses suggest that if the final volume of the tailings were deposited simultaneously in an impermeable pond primary consolidation would be complete in about 3.5 years. If the base was sufficiently permeable to permit base drainage consolidation could be complete within 1 year. The study could not determine how long it would take to form a surface crust or the eventual depth of the crust but estimated that with an annual evaporation of 2.3 m, a crust of 1.5 m could be formed in less than a year.
27.	DotE	The low-permeability nature of the TSF floor material is not explicitly defined. The materials making up the cell floor and embankments need to have a design specification that requires suitably low permeability material, and this needs to be provided in context. This is vital in assessing the capability of the TSF floor to impede seepage. This information is provided in Appendix D, and should be included in discussion of the TSF design.	It is stated in Section 6.5.4.4 that "The permeability of the pit floor and the TSF cell embankments would be very low, with an estimated permeability of 1 x 10^{-9} m/sec, similar to the permeability of a geosynthetic liner." Section 6.6 in appendix D explicitly defines the permeability of the cell floor and embankments. It is agreed that it would be easier to follow if reference to appendix D is cited in the discussion of this Section.

No.	Submitter	Submission and/or issue	Response to comment
28.	DotE	Not enough evidence is summarised to show that a 1 year drying cycle is sufficient. For example, it does not appear that the possibility of a wet year, or a significant rainfall event occurring immediately prior to TSF covering, has been considered. Provide evidence to suggest a 1 year tailings drying cycle prior to capping is sufficient. Provide some examples of management measures that can be undertaken in the event that this period is insufficient, such as installation of wicks or similar things. Describe the material that will be used to cap the TSF, and summarise its hydraulic properties.	Cameco has considered a number of mitigation actions to ensure effective fluids and tailings management. If observations in the first years indicate that additional evaporation capacity is required, the mining schedule leads the tailings schedule by two to four years (i.e. there is additional pit void area available for constructing additional cells). The construction of additional cells could be brought forward permitting deposition at an even slower rate of rise to achieve the final state required. Other possible contingencies include underdrains that could aid in producing negative pore pressures resulting in deep vertical cracking of the clay-rich tailings thereby enhancing evaporation. It is possible that underdrains may not be effective due to the low conductivity of the tailings. If this proves to be true then vertical wick drains could be installed to produce ponding on the surface thereby enhancing evaporation. This approach has been highly successful at other facilities. Removing additional available tailings decant could also aid the rate of evaporative drying from the surface. An evaporation pond is planned to add additional contingency for evaporation capacity. Cameco plans to use the thin layer deposition method for tailings deposition with a 1 month drying cycle. It is anticipated that at the end of tailings deposition, the final landform could be established almost immediately depending on other scheduled activities. See also the response to comment 26 for further details.
29.	DotE	The potential that erosion-induced sediment loss from the final landform will be deposited “nearby” is mentioned, but it is not clear over what spatial extent this will occur. This could be addressed by a map showing areas of erosion and areas of deposition predicted from the modelling.	Change to erosion and sedimentation characteristics for the post closure environment are discussed fully in Section 9.4 and Appendix H1 of the PER. For the smaller events, up to and including the 1:20 year ARI, the changes in flow velocities are insignificant from baseline. As a result the change to baseline erosion and sedimentation characteristics are insignificant. • For extreme events up to 1:100 year ARI. (Figure 7-11of Appendix H1) there would be small and localised decreases in flood water flow velocities around the post-closure minesite of less than 0.2 m/s. This relatively small change in velocities is not increasing the erosion characteristics as the flow velocities are still well below the 2/ms threshold for erosion. • For the very extreme events to 1:1,000 year ARI (Figure 7-12 of Appendix H1) the changes in flow velocities across the valley water course both upstream and downstream of the after closure minesite are less significant than for the 1:100 year ARI event. Therefore no changes to the erosion and sediment characteristics are expected. • For ultra-extreme PMP event (Figure 7-12) the changes in flow velocities across the valley water course both upstream and downstream of the after-closure minesite are less significant than for the 1:100 year ARI event. Therefore no changes to the erosion and sediment characteristics are expected. For the smaller events, up to and including the 1:20 year ARI, the changes in flow velocities are insignificant from baseline. As a result the change to baseline erosion and sedimentation characteristics are insignificant. • For extreme events up to 1:100 year ARI. (Figure 7-11) there would be small and localised decreases in flood water flow velocities around the post-closure minesite of less than 0.2 m/s. This relatively small change in velocities is not increasing the erosion characteristics as the flow velocities are still well below the 2/ms threshold for erosion. • For the very extreme events to 1:1,000 year ARI (Figure 7-12) the changes in flow velocities across the valley water course both upstream and downstream of the after closure minesite are less significant than for the 1:100 year ARI event. Therefore no changes to the erosion and sediment characteristics are expected. • For ultra-extreme PMP event (Figure 7-12) the changes in flow velocities across the valley water course both upstream and downstream of the after-closure minesite are less significant than for the 1:100 year ARI event. Therefore no changes to the erosion and sediment characteristics are expected.

No.	Submitter	Submission and/or issue	Response to comment
30.	DotE	The final paragraph notes that the final landform isolates the backfilled pit from certain design events, however does not mention contingency measures should the design event be exceeded.	The paragraph describes a range of events and the likelihood that the cover and backfilled pits beneath would be inundated. The purpose of this discussion was to characterise the likelihood of flood-driven erosion by checking the velocities of the flood water. That discussion is provided in Section 7.2.2 and Section 7.3 in Appendix H1. There are no design events or exceedance criteria associated with this discussion, or the performance of the described landform, hence, there are no contingency measures required.
31.	DotE	There is no mention of modifying/updating the Landform Evolution modelling as more information becomes available during the operating life of the mine. Model predictions should be regularly updated as more information becomes available. This applies to all modelling and predictive work and needs to be captured in appropriate Plans.	Comment noted and agreed. The requirement for a regular update is met through the "Plan Do Check Act" model for the development and review of Management Plans.
32.	DotE	Final landform modelling identifies the potential for gullies to develop up to 1.5 m deep over the TSF through the proposed cover materials. It is unclear how this would affect the integrity of the final landform design. It is also unclear if plant root penetration and subsequent infiltration pathways have been considered in the TSF design. Lessons from the Rum Jungle rehabilitation experience show this is a valid consideration. Information provided by the Proponent during the site visit indicated that landform stabilisation by armouring and other means is being considered as part of the proposal.	Armouring and landform stabilisation needs to be assessed as part of a detailed design as part of normal closure planning processes. These means of controlling erosion are well established, but require site-specific details including materials characterisation testing and mapping. Field trials of cover systems planned to allow monitoring and calibration of current landform erosion modelling will be combined with vegetation establishment trials to identify suitable shallow rooted species for use in revegetation. Successful shallow rooting species will be chosen to both aid erosion control and not provide deeper root pathways (i.e. >2m) for increased infiltration to TSF cells.
33.	DotE	Further information related to the expected range in tailings compositions due to blending different ores during production is necessary to assess whether the mean tailings composition used in determining source terms is appropriate. Based on known composition and chemistry of different ore types in the deposit and the desired U concentration of the ore for processing, it should be possible to provide an estimate of the variability there may be in tailings composition.	Cameco has categorised the ore into five main uranium categories, ultra-high grade, very high grade, high grade, medium grade and low grade. The ore has been further classified into high smectite and low smectite for all grades except the low grade category. Tailings will typically be deposited in a group of five tailings cells in rotation such that tails will be mixed during mining and relatively homogeneous. While data likely does exist on elemental distributions from diamond drill cores, it is not clear how that could be used to better understand the tailings composition given the significant mixing that occurs mining and during deposition.
34.	DotE	Table 2.2 of Appendix I2 – Clarification is required as to why several analytes have a reported median (or average) concentration of 0.00 mg/L. This could be due to all samples being below detection limit, or rounding to 0.00. In addition, information on the number of samples used in determining average regional groundwater geochemistry values	The zero values occurred as a result of a rounding error. An erratum op of the table is attached – the number of samples on which the statistical analysis has been carried out is included in the table for each parameter.

No.	Submitter	Submission and/or issue	Response to comment
		is not provided. This is required to determine the robustness of the baseline dataset.	**Table 2.2: Groundwater Chemistry - Summary Statistics**

Parameter	Units	N	Minimum	Maximum	Median	Average
pH (field)		44	6.0	7.8	7.0	7.0
Eh (field)	(mV)	44	18	701	340	328
Alkalinity	mgCaCO3/L	42	41	946	205	226
Al	mg/L	44	0.01	2.42	0.02	0.22
Ca	mg/L	44	27	1020	273	361
K	mg/L	44	10	2100	207	460
Mg	mg/L	44	16	3500	434	737
Na	mg/L	44	113	23600	2845	5035
SiO2	mg/L	44	0.1	112	55	58
Br	mg/L	44	0.1	169	11	34
Cl	mg/L	44	81	43900	4985	9115
F	mg/L	44	0.3	3.8	1.5	1.6
N	mg/L	44	0.01	56.5	15.8	19.9
P	mg/L	44	0.01	2.7	0.1	0.2
SO4	mg/L	44	57	13700	1945	3155
Ag	mg/L	44	0.001	0.04	0.001	0.005
As	mg/L	44	0.001	0.05	0.003	0.019
B	mg/L	44	0.38	47.80	5.23	11.04
Ba	mg/L	44	0.01	0.53	0.05	0.07
Be	mg/L	44	0.001	0.05	0.001	0.003
Bi	mg/L	44	0.001	0.01	0.001	0.003
Cd	mg/L	44	0.0001	0.01	0.0002	0.0004
Ce	mg/L	44	0.001	0.01	0.001	0.003
Co	mg/L	44	0.001	0.18	0.01	0.01
Cr	mg/L	44	0.001	0.04	0.004	0.01
Cu	mg/L	44	0.001	0.08	0.01	0.02
Fe	mg/L	44	0.05	5.06	0.25	0.51
Hg	mg/L	44	0.0001	0.0001	0.0001	0.0001

No.	Submitter	Submission and/or issue	Response to comment

Li	mg/L	44	0.001	0.18	0.02	0.04
Mn	mg/L	44	0.001	21.5	0.17	0.77
Mo	mg/L	44	0.002	0.62	0.06	0.11
Ni	mg/L	44	0.001	0.17	0.02	0.03
Pb	mg/L	44	0.001	0.15	0.003	0.01
Re	mg/L	44	0.001	0.01	0.001	0.003
Sb	mg/L	44	0.001	0.01	0.001	0.003
Se	mg/L	44	0.01	0.23	0.03	0.05
Sn	mg/L	44	0.001	0.01	0.001	0.003
Sr	mg/L	44	0.30	25.90	5.36	8.31
Th	mg/L	44	0.001	0.01	0.001	0.003
Tl	mg/L	44	0.001	0.01	0.001	0.003
U	mg/L	44	0.001	2.36	0.16	0.31
V	mg/L	44	0.01	0.13	0.01	0.03
W	mg/L	44	0.001	0.20	0.01	0.01
Y	mg/L	44	0.001	0.01	0.001	0.003
Zn	mg/L	44	0.01	1.89	0.03	0.09

35.	DER	A potential problem is the extent to which drying of the tailings will take given the extreme salinity of the pore-water that will be present in the tailings. Under these extreme salinity values, the actual evaporation of water from brine is only a very small fraction of the potential evaporation rate of fresh water measured using standard evaporation pan techniques. Additionally, the brine will contain very high concentrations of sodium carbonate which is a deliquescent salt that resists drying. Although the proponent's intent is to deposit tailings in thin layers with a drainage system, it is likely that a significant amount of pore-water will remain within the tailings with the deposition of successive layers in the TSF. A potential problem with the proposed method of tailings disposal is that the salinity of the pore-water in the tailings is likely to be a factor of ten times higher than the salinity or pore-water in clayey sediments that will surround the TSF. This means that there is likely to be a significant osmotic pressure gradient between the tailings and the surrounding sediments	The primary disposal concept is that the tailings would be deposited sub-aerially directly into beached (1% slope) TSF cells located in the mined-out pit. The mine plan includes a dewatering schedule, mining and milling and progressive rehabilitation of the tailings disposal. Internal berms would be constructed of compacted tailings (if the material proves suitable and if it is available), or other appropriate fill material. Embankments contacting the pit wall would be constructed of silty-clay, which are abundantly available on site as the substrate of the mined ore. In order to promote consolidation of the tailings, several strategies are being proposed: • Sub-aerial deposition of nominal 40% solids content tailings slurry onto a series of 1% beached TSF cells; • Deposition will be cyclically rotated among 5 TSF cells at a time (3 cells in the first year of operation) over a 30 day period. The average size of the tailings cells is over 300,000m^2; • A 1.5 million cubic meter evaporation pond will be used to remove excess water; • Approximately 10% of the TSF decant water is planned to be returned to the mill; • Deposition will occur in thin layers to achieve an approximate 100 mm (consolidated) increase in consolidated depth per deposition period. This deposition height was determined through careful review of historical documents and a conservative estimation of the evaporation present at Yeelirrie. The evaporation rate at Yeelirrie greatly exceeds precipitation in every month of the year; • Use of the dewatering channels under the pit floor to aid in drainage;

No.	Submitter	Submission and/or issue	Response to comment
		(refer to Malusis et a/. 2003 for more information about this issue) which will push water into the TSF, further hindering the drying and consolidation of the tailings. These two factors could make it difficult to establish a stable cover on the TSF within a reasonable time-frame after mining has been completed.	• Instrumenting the initial tailings cells in order to measure water levels and pore pressures in the tailings mass in order to better understand and potentially adjust the tailings management. The consolidation of the tailings is critical to the progressive reclamation plan for Yeelirrie. In the water balance model proposed for Yeelirrie, the evaporation rates used were consistent with those used for highly saline waters in Australia and elsewhere. The first tailings cells constructed will be instrumented with vibrating wire piezometers in order to monitor pore pressures in the tailings. This data in addition to active management will be used to maximise the consolidation of the tailings. Consideration of other mitigation measures such as a supplementary evaporation pond is also possible. In relation to the concern that an osmotic pressure gradient between the tailings porewater and groundwater could draw water into the tailings further confounding attempts to consolidate the tailings, although the salinity of the tailings porewater will be significantly higher than that of the surrounding groundwater, during operations the contact between these fluids will be minimised by active dewatering. Dewatering of the pit area will occur through dewatering trenches placed 3 meters below the pit floor from prior to the start of mining until year 18, the final year of milling. The dewatering schedule would promote unsaturated conditions underneath the tailings thereby inhibiting any osmotic counter flow. The low permeability of the clay floors would further restrict the flux of water thus allowing the tailings to consolidate under dewatered conditions. In addition Malusis et al (2003) did not consider density coupled groundwater flow arising from density differences between TSF porewater and groundwater, which would effectively act in opposition to the osmotic flow. In our judgement the net effect of these added factors would not further hinder consolidation of the tailings.
36.	DMP	The matters relating to this being a State Agreement Project are not consistently addressed in the PER and appendices. Section 3.1.4 of the PER states that environmental approvals are required under the Mining Act, including approval of a Mining Proposal. Appendix D (Tailings Storage Facility Design Report) also makes reference to approval of the tailings storage facility (TSF) design by DMP. However, Appendix O1 (Conceptual Mine Closure Plan) makes reference to the fact that the Project won't be directly regulated under the Mining Act as it is managed under a State Agreement Act.	The DMP will be aware of the informal arrangements between the DSD and the DMP for the environmental assessment and approval of State Agreement Act projects. Cameco has been advised by the DSD that they typically provide the detailed Project Proposals that are required to be produced under a State Agreement Act to the DMP for review. Cameco further understands that in the case of the Yeelirrie Project, the Project Proposals would be similar in scope to a Mining Proposal required under the Mining Act, providing the DMP with an opportunity for review and comment. In relation to the Mine Closure Plan, Cameco has recently received correspondence from the DSD (see Attachment 12) which requires State Agreement companies to prepare and submit Mine Closure Plans in accordance with the Guidelines. Further, the DSD has advised that these Plans would be provided to the DMP for review and advice.
37.	DMP	It should be made clear via the PER review process that the majority of the Project will not be subject to approval of a Mining Proposal and Mine Closure Plan.	See above. While a Mining Proposal and the Mine Closure Plan may not be required by the DMP, Cameco understands and expects the Project Proposals and the Mine Closure Plan would be prepared to meet the Guidelines and be assessed by the DMP as part of DSD's approval process.
38.	DMP	It is noted that the progressive backfilling of mine pits with waste provides inherent closure benefits in terms of visual amenity, long-term geotechnical stability and the ability to undertake progressive rehabilitation.	The upper surface of the backfilled mine pit and the TSF cover material have been carefully designed to maximise surface stability and minimise excessive water infiltration below the upper profile. Revegetation candidate species will be selected to form a resilient, functional ecosystem whose growth requirements are able to be met by the surficial profile. Given that the revegetation species selection will include the criteria that reconstructed soil profiles are able to maintain vegetation requirements (e.g. shallow rooted species, plant available water, nutrient stores etc.), it is expected that with

No.	Submitter	Submission and/or issue	Response to comment
		The proposed TSF cover system design will consist of a one metre-thick layer of waste calcrete (clean and partially mineralised), placed directly above the consolidated tailings material to act as a capillary break. This will be overlain with at least two metres of the stockpiled surficial loam soil to act as a growth medium. The PER does not discuss how this cover system relates to the expected root depth of revegetation species. The PER should discuss the ramifications of this cover design on the revegetation of the covered TSF (i.e. is the cover design expected to restrict the range of species that are predicted to colonise the cover system? Will any deep rooted species be likely to intercept the tailings material and uptake soluble metals or radionuclides?).	the appropriate climatic conditions successful revegetation establishment and growth will occur, thereby meeting the specified completion criteria. Selection of appropriate species will minimise the potential for disruption of the capillary break.
39.	DMP	The closure objectives appear to be generally appropriate and, while the completion criteria are preliminary, they are considered adequate given the likely time until mining commences and the total life of the Project. The closure objective for radiation is: "Control radiation levels at the surface of the rehabilitated landforms and across the Project area to levels that are below accepted health guidelines." Consideration should also be given to post-closure radiation levels being equal or less than background to ensure ecological values are protected. The 'Financial Provisioning for Closure' Section should be updated prior to Project construction to include a more detailed analysis of the predicted closure costs. This update should be undertaken in accordance with Australia Accounting Standards Board 137: Provisions, Contingent Liabilities and Contingent Assets.	Comment noted and understood.
40.	CCWA	Cameco has demonstrated that *"under the 1:1000 year ARI scenario, the post-closure backfilled pit area would be subject to inundation for the duration of the event and surface water would potentially infiltrate the closed landform."* This is even more concerning given that post closure these backfilled areas will contain radioactive/ contaminated materials and soils. There may also be increased pressure on tailings inside the backfilled areas. There is no clear discussion about the impacts of this event and no scenarios provided. Should this event happen post closure,	An objective of the closure design is to ensure minimal disruption to catchment surface flow post closure. The key elements of this are to reinstate the natural water course channels and to maintain low flow velocities for regular events, i.e., up to 1:100 ARI. These have been achieved, but requires that the final closure height of the facility maintains pre-mining contours to the extent possible. Based on the design, modelling of a 1:1000 year event indicates the facility would be flooded. The model also predicts low stream flow rates and minimal erosion of the cover. Therefore, there would be no loss of tailings from the facility under these conditions.

No.	Submitter	Submission and/or issue	Response to comment
		for example 100 years after the mine has closed would the post mining design features be intact? The public submitter would like to know how water from the backfilled pit area will interact. Will it leach from the bottom or the sides, will radioactive material float to the surface and interact with surface water. Lake Miranda is downstream from Yeelirrie, Lake Way and Lake Maitland. There is no discussion on the cumulative impact of this type of event in the region and impacts on surrounding and downstream environments including Lake Miranda. The public submitter notes the motion passed in WA Parliament that indicates very clearly that some of the materials we are talking about in the post closure site will remain radioactive and volatile for no less than 10,000 years.	
41.	CCWA	Uranium mining gets its greatest opposition due to there being no example of a uranium mine that has been rehabilitated successfully. Each former uranium mine has had legacy issues from salinity and erosion to acid and metalliferous drainage or increased levels of radiation in the environment. In the conceptual Mine Closure Plan Cameco outline all of the relevant legislation but fail to provide a detailed description of what those obligations are in relation to the Yeelirrie proposal and how they intend to meet them. The public submitter expects this to come in the future Mine Closure Management Plan and urge the EPA and the Minister to require that the proponent have a public consultation period before approval of any future Mine Closure Management Plan.	Refer to the response to Comment 36. Cameco will be submitting future Mine Closure Plans in accordance with the DMP Guidelines.
42.	CCWA	In the conceptual mine closure plan - Appendix O1 Section 3.1.4 outlines what a State Agreement is and why they are created but fails to describe the mine closure obligations under the Yeelirrie State Agreement. From reading the Yeelirrie State Agreement Act itself we cannot identify any clear obligations for mine closure and are unsure if this Act gives any exemptions to Cameco on rehabilitation requirements. We raise this here as a question for direct consideration and response from both the EPA and proponent.	Refer to the response to Comment 36.
43.	CCWA	Consultant Nick Tsurikov has raised concerns about regulations and standards of radiation in rehabilitation and public access to closed sites:	The standard discussed here does not apply to mine rehabilitation. Cameco understands that the levels applied to individual drill sites which are not relevant to mine closure and that the guidelines quoted are now superseded.

No.	Submitter	Submission and/or issue	Response to comment
		"The grantee party undertakes to return any site of ground disturbance to a condition prescribed by relevant regulatory guidelines for environmental rehabilitation to its original state or so that it poses no radiation threat to the public. *a) Unfortunately, the earlier DoCEP guideline contained the suggestion that "drill sites must be cleaned to 1 microSievert per hour at a height of 1 meter (excluding any natural mineralized outcrops in the area)" that was in direct contradiction with the requirement of the return of the site to its original state.* *b) The use of the clean up criterion of "less than 1 microSievert per hour" would result in an unacceptable radiation exposure to members of the general public. Even when only the exposure to external gamma radiation is considered in a dose assessment (not taking into account any other exposure, such as inhalation of dust and ingestion of soil and flora/fauna), the dose constraint of 0.3 mSv/year that is used for classification of contaminated sites (part 6) will be reached in less than two weeks (300 hours or twelve and a half days) of the permanent occupation of the site.* *The possibility of Aboriginal people camping on the particular former drilling site for about two weeks or more cannot be ruled out. Therefore, the criterion mentioned above is unacceptable and emphasises the requirement for all radiation management plans approved prior to 2008 to be re-assessed and amended where necessary, as soon as possible."*	In the PER, Cameco commits to controlling radiation levels at the surface of the rehabilitated landforms and across the Project to levels that are below accepted health guidelines. Cameco also notes in Appendix O1 that ambient radiation doses to human receptors following closure will be similar to the pre-mine environment. Cameco has committed to monitoring to confirm this. Appendix J1 also notes that the facilities will be closed to ensure that radiation exposures are low and consistent with natural background levels.
44.	CCWA	There is a cattle station to the north west of the mine site. Will the mine site be fenced during mining to stop the cattle wandering onto the mine site? If so will the fencing be maintained post closure? This would assist in the safety of the cattle and revegetation during rehabilitation. It is noted that a number of former mines in the area were not fenced and this led to cattle death due to them being attracted to water. The public submitter welcomes the target radiation levels being "below accepted health guidelines". The public submitter would welcome conditions that would reflect this standard, so that if	It should be noted that the mine site is on Yeelirrie Station which is owned by Cameco. The owner of the pastoral lease to the north west of the mine site has an obligation to himself and his neighbours to maintain his boundary fencing to retain his cattle on his property. His cattle should not be straying onto Yeelirrie Station. The mine site (mine, waste rock dumps and processing and infrastructure areas) will be fenced to exclude livestock. It is likely that the fencing would remain in place for some time after closure to allow revegetation to advance without the pressures of grazing from wildlife or kangaroos. It is unlikely the site would remained fenced permanently. It should be noted there will be no artificial open water bodies left after mine closure. The open pit will be backfilled and the evaporation dam and other storage dams will be closed and rehabilitated.

No.	Submitter	Submission and/or issue	Response to comment
		levels are above health guidelines the company will be held accountable for any remedial work to reduce levels.	
45.	CCWA	In the Section on Tailings Storage Facility - Pg. 95 - Cameco describe the capping of tailings and the closure of mine cells. It is suggested capping of the tailings will be done using lower permeability soils. For the rest of the pit they suggest using higher permeability soils over the clay embankment and open pit. The idea being that the pit which surrounds the tailings cells will act as a diversion channel, diverting water away from the tailings cells and into the pit. Also on Pg. 95 under 'General Infrastructure' the proponent describes all the other materials that will be disposed of inside the pit surrounding the tailings cells. This would include the disposal of contaminated pipes, soils and all other contaminated materials. If these contaminated materials are placed in the pit areas, and a key design feature is to divert water into this area then what mechanisms are in place to stop these contaminated materials leaching from the pit during rainfall events post closure? There is no further discussion in the PER about this potential impact or design feature. There is no clear balance sheet on the volumes or types of radiation of those materials and soils to be disposed of in the pit or analysis of the risks of those materials. In other Sections of the PER the proponent gives an estimate of 1.2mm/yr of seepage from the tailings. It is not clear what the volume of this seepage is. Nor is it clear if this seepage includes seepage from the pit as well as the tailings or if there is further seepage from the pit post closure.	Comment noted. The higher permeability materials are proposed to be placed outside of the tailings storage embankments to form a groundwater channel. The contaminated materials proposed to be disposed of, would be placed within the tailings storage embankments along with tailings and are then capped with the closure cap, therefore any leachate would be contained within the tailings storage facility. The figure of 1.2 mm/yr is the estimate of seepage through the tailings storage cover into the tailings and is discussed in full on page 376 of the PER.
46.	CCWA	Cameco have not provided a Tailings Management Plan but have given some idea of the overall tailings proposal. The public submitter has a number of unanswered questions, many specifically relate to Diagram 6-13 and Figure 9.67: • What is the balance (total volume) of tailings production by operational year i.e. Tonnes in year 1, tonnes in year 2, tonnes in year 3 etc.? • What is the total capacity of tailings storage by year? • How will tailings from the processing facility be transported to each of the 22 cells?	Appendix D of the PER presents a report that summarises the design and management of the proposed tailings storage facility and along with the PER is the source for the information presented below. While the report is quite detailed for this phase of planning, It should be understood that further work is required before the final design and operations manual could be prepared to meet the requirements under State legislation before mining can commence. • Cameco proposes to produce approximately 2.4 Mtpa of tailings material for the life of the mine. A schedule for tailings deposition volumes is outlined in Appendix D Section 8.5 (Table 8.1). The capacity of tailings cells have been designed as part of the Pre-Feasibility Study in order to allow for sufficient volume. • Over the life of the Project, approximately 10 cells would be built within the pit void allowing for the permanent storage of around 2.4 Mtpa of tailings material. The cells in the first tailings pond would have an average area of about 309,000 square metres (31 hectares). It is anticipated that three to five cells would be operated simultaneously

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Which ingoing and outgoing pipes to the tailings will be permanent and which will be temporary?
How will these pipes be managed?
Where does the "internal drain" drain to?
Has there been consideration of applying an artificial clay liner or any other technology to prevent seepage?
What is the maximum seepage rate from the tailings (noting minimal seepage of 1.2mm/yr)?
Is 1.2mm/yr the distance tailings will seep per year - how will these changes overtime - e.g. increase, reduce?
What are the impacts of seepage of 1.2mm/yr?
What is the volume of tailings that will seep per year?
What is the impact of that volume of seepage?
What is the expected radiological content of tailings?
What is the expected heavy metal content of tailings?
What is the expected acidity of tailings?
What detection system is there to identify is seepage has gone beyond 1.2mm/yr?
What is acceptable seepage and why?
What are "deposition spigots"?
Where is the "pit dewatering system" in the diagrams?
Is the "Internal Drain" the same as the "central decant system"- If not what is the difference? If so why do they have different names and could that not cause confusion and potential risk?

</td><td>
at any given time during the Project life, using their combined area to maximise the speed of drying of newly deposited tailings.

Tailings would be piped to each cell.
Incoming pipes deliver tailings and outgoing pipes remove the liquid (decant) from the pond. Some of the decant would be recycled through the mill and the remainder would go to the evaporation pond. Some piping, for example the main line to the TMF and the main return line might be permanent for the life of the mine. Piping to each cell would be temporary and removed once the cell is full. All piping would be removed from the surface of the ground at mine closure.
Flow sensors would be installed to monitor flow and identify leakages.
Tailings pipelines will be inspected on a regular basis to check integrity.
The internal drain drains to the central decant system.
The natural clay soil underlying the ore body has been assessed and is considered to be of low permeability of <1 x 10^{-9} (m/s) vertical hydraulic conductivity. This clay soil has been drilled to a depth of 30 m and determined to provide an effective clay liner for the TMF. The embankments would be constructed from this material and have similar levels of permeability. Therefore an artificial liner will not be required.
The seepage rate from the tailings will vary through time,

Section 5.5.2 of App I1 states “In summary, the recharge rates within TSF cells are assumed to vary through time as follows:
Before tailings deposition – recharge rates (i.e., 0.40 mm/year) estimated through calibration process are used;
During tailings deposition – a uniform recharge rate 0.08 kL/day (equivalent to 11.68 mm/year) is applied; and
After tailings deposition, with the cover in place, recharge is assumed to be 0.002 kL/day (equivalent to 0.24 mm/year, or 0.00065 mm/day, which is 0.1% of annual average rainfall)

The figure of 1.2 mm/yr seepage is the average estimated seepage or recharge of solute (rainfall) through the cover and into the tails.
Transport of tailings contaminants and impacts on groundwater is discussed in Section 9.5.5.
The metallurgical process extracts uranium leaving the other radionuclides in the tailings. As a consequence, approximately 85% of the radioactive material associated with the original ore is left in tailings. The majority of the radionuclides in the ore is from the U-238 decay series.
The activity of the radionuclides in the tailings solids are; (from table 7.4 of Appendix D)

<table>
<tr><th>Radionuclide</th><th>Activity</th></tr>
<tr><td>Thorium-230</td><td>9,540-17,800</td></tr>
<tr><td>Radium-226</td><td>9,220-14,300</td></tr>
<tr><td>Lead-210</td><td>10,200-15,700</td></tr>
<tr><td>Polonium-210</td><td>Not analysed</td></tr>
<tr><td>Actinium-227</td><td>390-610</td></tr>
<tr><td>Thorium-232</td><td>n/a</td></tr>
<tr><td>Radium-228</td><td>47-120</td></tr>
<tr><td>Thorium-228</td><td>47-79</td></tr>
<tr><td>Potassium-40</td><td>290-470</td></tr>
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The concentrations of the metal and other constituents are (from table 7.3 of Appendix D)

<table>
<tr><th>Constituent</th><th>Units</th><th>Concentration</th></tr>
<tr><td>Aluminium</td><td>wt%</td><td>3.8</td></tr>
<tr><td>Antimony</td><td>ppm</td><td><0.5</td></tr>
<tr><td>Arsenic</td><td>ppm</td><td>14</td></tr>
<tr><td>Calcium</td><td>wt%</td><td>10.6</td></tr>
<tr><td>Carbon</td><td>wt%</td><td>5.6</td></tr>
<tr><td>Copper</td><td>ppm</td><td>18</td></tr>
<tr><td>Iron</td><td>wt%</td><td>1.8</td></tr>
<tr><td>Lead</td><td>ppm</td><td>130</td></tr>
<tr><td>Magnesium</td><td>wt%</td><td>4.2</td></tr>
<tr><td>Molybdenum</td><td>ppm</td><td>27</td></tr>
<tr><td>Potassium</td><td>ppm</td><td>7,480</td></tr>
<tr><td>Selenium</td><td>ppm</td><td>0.2</td></tr>
<tr><td>Silicon</td><td>wt%</td><td>20.9</td></tr>
<tr><td>Sodium</td><td>ppm</td><td>40</td></tr>
<tr><td>Uranium</td><td>ppm</td><td>150</td></tr>
<tr><td>Vanadium</td><td>ppm</td><td>260</td></tr>
</table>

The expected pH of the tailings at the point of discharge is 9.5 (p. 2 of Appendix D)
The significance of seepage through the cover system is the effect recharge has on groundwater transport modelling (discussed in Section 9.5.5).
Deposition spigots are a ring of pipe outlets established around the perimeter of a tailings cell. They discharge tailings into the cell and can be regulated (turned on and off to achieve the required discharge rate and thickness of the deposited layer.
The pit dewatering system consists of a series of drains dug into the floor of the pit to dewater the ore. The drain is shown in Figure 6-10 as the toe drain on page 66 of the PER.
The word decant is used to describe the tailings liquor taken from off the tailings. In Figure 6-13 the tailings liquor recovery system is labelled as the “Internal Drain” while in the text it is described as the central decant system.

</td></tr>
<tr><td>47.</td><td>CCWA</td><td>Having spoken to Cameco during the PER process to try and gain a better understanding it is clear that a lot of operational details remain uncertain, including in relation to the piping and drainage system. The system seems complex - with room for error, which should be considered and mitigated. This has not been demonstrated in the PER and unfortunately has been exempt from this process and public scrutiny.

The public submitter considers there an issue with this process and transparency, but also the lack of understanding or planning around certain aspects of the Project - like tailings management - adds uncertainty about the ability to manage the risks. Tailings for example pose a significant risk and pathway for radionuclides</td><td>The piping and drainage system for the tailings system – discharge to the TMF via pipes and a discharge spigots and the reclamation of liquor back to the mill or the evaporation pond is very simple and no different to any other mineral tailings management system.

The other drainage system described is the pit dewatering system which consists of a system of drains dug into the ore body and floor of the pit to dewater the pit. This system is also quite straightforward and well understood by Cameco.

The storage of tailings in-ground rather than in an on-ground facility is considered best practise for the storage of uranium tailings.</td></tr>
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No.	Submitter	Submission and/or issue	Response to comment
		into the environment. Claims about a seepage rate of 1.2mm/yr seems arbitrary given that so much of the design is yet to be defined. The public submitter would like to again draw your attention to Appendix 2 which outlines the number of incidents and accidents at Cameco's facilities in the US, Canada and Kazakhstan.	
48.	CCWA	The reality is that industrial accidents happen. Designs are only as good as the operational and safety measures built in to protect against accidents and mistakes. At this stage the public submitter has no assurances that these mitigating and operational strategies are either in place or adequate. There is no real detail or schedule of the balance of mining, stockpiling or processing ore and the production of tailings. This kind of balance sheet - matching up with the capacity balance of tailings storage would be useful to better understand how all of this material at different stages of mining and processing is proposed to be managed.	The detailed design and the operating strategy of the tailings storage facility will be submitted for assessment following the definitive feasibility study and detailed design phase and before commencement of construction.
49.	CCWA	In previous submissions the public submitter has made to the EPA about uranium mining they have raised the issue of tailings management and noted a motion passed in WA Parliament on Wednesday, 23 May 2012. The motion reads: *That this house recommends, should the government proceed with its intention to license uranium mining in Western Australia, the government adopt the equivalent or better environmental management regulatory requirements for any future uranium mine in Western Australia as exists under commonwealth and Northern Territory legislation for the operation of the Ranger uranium mine in the Northern Territory with regard to the disposal of radioactive tailings, including the requirements that -* *a) the tailings are physically isolated from the environment for at least 10,000 years; and* *b) any contaminants arising from the tailings do not result in any detrimental environmental impacts for at least 10 000 years.* This motion is significant in many ways. • It acknowledges the very long timeframe that radioactive tailings need to be managed for.	Comment noted. To inform the design criteria, Cameco has undertaken modelling of a period of 15,000 years to predict solute transport (see pages 289 and 378) and 10,000 years for landform evolution modelling for tailings storage facility integrity (see Section 9.12.3).

No.	Submitter	Submission and/or issue	Response to comment
		• It gives a clear expectation on environmental protection from this waste. • It presumes that tailings can and should be physically isolated from the environment (Cameco's proposal explicitly states that tailings will leak). This standard is similar to the standard enshrined in the regulatory framework governing operations at the Ranger uranium mine in Kakadu. This standard should ensure physical chemical and biological isolation from the surrounding ecosystems for at least 10,000 years. The reality is that no uranium mine has been able to achieve chemical and biological isolation of radioactive materials even during operation of uranium mining. For example two operating uranium mines in Australia with similar processing and tailings storage as proposed by Cameco at the Yeelirrie site have both been unable to contain tailings during operation.	
50.	CCWA; Proforma 1	The public submitter expects both a commitment and the demonstrated financial and technical capacity from Cameco to undertake ongoing monitoring until the tailings have reached long term physical, chemical, biological and radiological stability and pose absolutely no risk to the environment for a period of no less than 10,000 years. This is in line with the precautionary principle and intergenerational equity, principles Cameco claims to adopt as underlying environmental principles. The public submitter expects that this is done in compliance with the 10,000 year standard for isolation of tailings from the environment. The public submitter recommend that conditions be applied to ensure corporate responsibility over the site is not relinquished until tailings can be robustly demonstrated to present no risk.	As discussed in Section 9.12 of the PER, Cameco will close and rehabilitate the Project in accordance with an approved Mine Closure Plan. This will ensure the construction of a safe, stable, non-polluting post-mine landform that is capable of sustaining agreed post-operational land use, and does not impact on surrounding environmental values or uses.
51.	CCWA; Proforma 1	Having read the Yeelirrie State Agreement Act and the Yeelirrie PER there is no clarity, commitment or acknowledgement of any requirements to hold bonds or securities for the rehabilitation of the proposed Yeelirrie mine. There are clear state requirements for all tenement holders operating under the *Mining Act 1978* to pay a 1% levy under the MRF except for tenements covered by State Agreements.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. However, it should be noted that Part VA of the *Environmental Protection Act 1986* allows for financial assurances to be imposed should the Minister for Environment deem it to be necessary.

No.	Submitter	Submission and/or issue	Response to comment
		Bond requirements are now a discretionary power for the Minister to apply a bond or not. There is concern that the political desire of the Government to approve and establish a uranium mine may cause a Minister to be lenient on bonds to show support and good will to the company and the industry. Despite the current situation the discretion of the Minister is often open to lobbying and the politicising of an issue. Bonding for the proper and long-term management of uranium mine tailings should not be politicised. It should be enshrined in law to ensure rehabilitation, the ongoing protection of the environment and effective long-term management of tailings. The public submitter considers that Cameco should not be exempt from the MRF and in addition to the 1% levy Cameco should be required to provide a bond that equates to 100% of the expected cost of rehabilitation and that this bond be reviewed and adjusted annually. The public submitter recommends this for all mines but emphasise the need on this arrangement for uranium mining given the unique risks, complexity and costs associated with rehabilitating uranium mines. The core reasons why mine securities for uranium mines should be applied are as follows: 1. The uranium market is particularly volatile; it has been dominated by low prices. The industry has presented overly optimistic forward projections that may be quite out of touch with reality. The public submitter has seen a number of uranium projects in Australia close, downsize and sell off assets indicating that optimism around long term projections is not warranted. This can be currently seen in Rio Tinto's decision not to support an extension to mining at the Ranger operation in Kakadu. In the case of any new proposals there is a real risk that they will open and close prematurely without rehabilitation, leaving a burden on the tax-payer and the MRF to rehabilitate and secure the site. *2.* There is no incentive for companies to rehabilitate. An article by the Charmian Barton from Norton Rose Fulbright LLP summarised the problem with removing bonds in this way *"The requirement for a performance bond creates the main incentive for meeting closure and rehabilitation obligations. Payment of an annual levy under the new*	

No.	Submitter	Submission and/or issue	Response to comment
		Fund may not create the same incentive. In transitioning to the Fund, comparable incentives and enforceability will need to be provided through DMP's environmental compliance regime. Failure to do so presents a significant risk to the state. It is currently unclear how DMP will treat performance bonds in the future or how the existing performance bond regime will transition to the Fund." Again please note that the under the *Mining Act 1978* the DMP does not have powers to enforce environmental conditions. 3. There is no example in Australia of a uranium mine site that has been successfully rehabilitated. The world's best practice for uranium rehabilitation was carried out at Wismut in Eastern Germany at a cost of US $9.3 billion. Please note the West Australian Government made a promise to deliver world's best practice uranium mining - and currently the world's best practice uranium rehabilitation costs approximately $9.3 billion. 4. Rehabilitation of uranium mines is disproportionately high, even below world's best practice standard rehabilitation is likely to cost hundreds of millions. For example the projected costs of the rehabilitation of the Ranger uranium mine in the Northern Territory is upwards of AUD $512 million. *5.* Uranium tailings are different to other mine wastes and pose a long term risk to the environment and public health. The unique problems of uranium mine tailings are noted in the Management of Radioactive Waste from the Mining and Milling of Ores (IAEA, 2002a) it states *"Of the different waste streams produced by mining and milling operations, tailings represent the greatest challenge, particularly in terms of long-term management, because of the large volumes produced and their content of very long lived radionuclides and heavy metals".* *6.* The DMP engaged the UAG to benchmark WA regulations for uranium. In the final report to the DMP in relation to bonds they said this *"Bonds should reflect the maximum, full third party costs of closure and rehabilitation. While this requirement may not be that onerous for true ISR operations, when applied to conventional mining operations (where TSFs and waste rock dumps have to be*	

No.	Submitter	Submission and/or issue	Response to comment
		rehabilitated), the costs could be extremely high. Nevertheless, this requirement is entirely appropriate and should be retained." 7. The proponent Cameco has a record of poor environmental management and financial compliance. It is based overseas and operates only as a subsidiary in Australia, a status subject to change in the future. Bonds may be the only protection the State has against any premature closure and possible abandonment. The public submitter urges the EPA to recommend a 100% bond, annually reviewed and adjusted, be applied to any approval for uranium mining at Yeelirrie.	
52.	CCWA	In the conceptual mine closure plan - Appendix O1 - Cameco outline that there is likely to be metalliferous drainage from the ore stockpile. This would include: boron, barium, molybdenum, strontium, thallium, uranium, vanadium and zinc. As the first pit is mined and tailings cells constructed it is assumed that large volumes of ore - of varying grades - will be stockpiled. During these first few years of mining the public submitter expects the ore stockpile to be a major liability for dispersal of radioactive particles be it from rain and uncontrolled drainage or from wind. There is no clear balance sheet of ore stockpiling through the life of the mine and there is no accounting of how much ore will be stockpiled.	The main pathway for loss from stockpiles is via seepage. Modelled plumes for Chlorine and Uranium are presented and discussed in Section 9.5.5.3 of the PER. In summary: **Uranium** In the east-west direction, the likely resultant uranium plume front (threshold of 0.2 mg/L) is predicted to remain within the mine-waste backfill (i.e. stay within the mine pit). In the north-south direction, the plume front (0.2 mg/L) could travel northward in the calcrete by as much as approximately 500 m. In the vertical direction, the predicted uranium plume could reach the weathered granite. **Vanadium** In the east-west direction, the likely resultant vanadium plume front (0.01 mg/L) is predicted to remain within the mine-waste backfill (i.e. stay within the mine pit). In the north-south direction, the plume front (0.01 mg/L) could travel northward approximately 600 m, and southward approximately 200 m. In the vertical direction, the plume front could reach the weathered granite in a limited area. **Arsenic** In the east-west direction, the likely resultant arsenic plume front (0.01 mg/L) is predicted to remain within the mine-waste backfill (i.e. stay within the mine pit). In the north-south direction, the plume front (0.01 mg/L) could travel northward in the calcrete by approximately 600 m. In the vertical direction, the plume front could reach the sand/clay lower palaeochannel formation and the weathered granite in a limited area. **Molybdenum** In the east-west direction, the likely resultant molybdenum plume front (0.01 mg/L) is predicted to remain within the mine-waste backfill (i.e. stay within the mine pit). In the north-south direction, the plume front (0.01 mg/L) could travel northward in the calcrete by approximately 500 m. In the vertical direction, the plume front could reach the sand/clay lower paleo-channel formation and the weathered granite in a limited area. **Sensitivity analysis** The sensitivity analyses undertaken indicate that COC transport is more sensitive to the diffusion coefficient (Kd), infiltration through tailings and backfill cover, and the extinction depth, rather than the source concentration in the respective simulated range of these parameters. This, along with the uncertainty in characterising Kd, infiltration

No.	Submitter	Submission and/or issue	Response to comment
			through tailings cover, extinction depth and source concentration, has been taken into account in considering the transport simulation results presented in the PER. High site-specific Kd values are supported by field evidence, gamma radiation surveys obtained after the removal of stockpiled materials during rehabilitation activities in 2004 at the Yeelirrie site showed very low readings after removal of the stockpile indicating a very limited release during the stockpiles lifetime (20 to 30 years).
53.	PND(WA); R Chapple; PS3; PS5; PS8; PS9; PS13; PS14; PS21; PS24; PS26; PS27; PS28; PS29; PS30; PS32; PS33; PS35; PS36; PS38; PS39; PS42; PS43; PS45; PS49; PS59; PS66; PS73; PS81; PS89; PS96; PS98; PS100; PS104; PS123; PS124; PS126; PS127; PS129;	Concerns that rehabilitation is unlikely to adequately re-establish flora and fauna in the region into the future. There are unique risks and extremely high costs associated with rehabilitating uranium mines; no effective long-term remediation of tailings in Australia and the material stored in tailings storages will remain and risk forever. As such, Australia has no example of a successfully rehabilitated uranium mine. There should be zero public and taxpayer exposure, which implies a 100% cost recovery for the agreed mine closure outcomes. Cameco should be legally bound to isolate its mine waste from harming life for 10,000 years. The longevity of nuclear waste generated by this generation will leave an intractable perpetual storage problem for generations to come. It is blatant abuse if the principle of intergenerational equity. There is no evidence that Cameco has funding to rehabilitate the mine, the aquifer and the food sources. Full costings should be provided by Cameco to demonstrate that the mine is viable. Uranium and its tailings present an environmental risk and would have consequences for the world at large timescales, requiring action for tens of thousands of years. This puts a large burden on future generations who will have to safeguard these materials for time frames exceeding those of any culture known to earth. Tailings should be contained for at least 100,000 years given the half-lives and decay chains involved in uranium mining	Closure and rehabilitation of the mine would be undertaken in accordance with an approved Mine Closure Plan. Refer to response to comment 18 regarding closure design of the TSF and long term stability. Part VA of the *Environmental Protection Act 1986* allows for financial assurances to be imposed on a project should the Minister for Environment deem it to be necessary.

No.	Submitter	Submission and/or issue	Response to comment
	PS142; PS144; PS145; PS148; Proforma 1		
54.	R Chapple	The changes recommended from 2003 Senate Inquiry have not been noted by Cameco who have not presented a detailed Mine Rehabilitation Plan in the PER. This is of serious concern considering bond requirements (under the Mining Rehabilitation Fund) are now at the discretionary power of the Minister for Mines and Petroleum. In the event that the Yeelirrie mine is approved, the Minister for Mines and Petroleum should require unconditional performance bonds from Cameco.	The submitter raises issues that are not directed towards Cameco. If approved, the Project will report disturbances to the DMP and contribute to the Mining Rehabilitation Fund through a levy. Part VA of the *Environmental Protection Act 1986* allows for financial assurances to be imposed should the Minister for Environment deem it to be necessary.
55.	PS127	Current practice to leave mines in a safe condition does not mean that safe access is possible, rather that the affected area is not accessible for other use.	Cameco disagrees with this statement in relation to the Project and would like to refer the submitter to Section 9.12 of the PER which discuss how the Project will be rehabilitated and decommissioned.

12. Offsets

No.	Submitter	Submission and/or issue	Response to comment
1.	P&W	There is a high level of uncertainty as to: • The nature of the proposed offsets for this proposal. • What outcomes the proposed offsets would likely deliver. • Whether the outcomes are adequate to address residual impacts (if these impacts are found to be acceptable).	Cameco agrees that there was insufficient detail presented in relation to offsets. New management and mitigation measures have been presented in this response for both *A. yeelirrie* (Attachment 8) and subterranean fauna (Attachment 3) and these are supported by further discussion on offsets following review of the new proposals by OEPA and DPaW. While Cameco notes that "*the EPA's preference* [is] *to recommend specific offset conditions to the Minister, rather than identifying the need for an offset plan to be developed post-approval*" (Environmental Protection Bulletin No. 1), Cameco also notes that the Department of Parks and Wildlife is both a decision-making authority that will be consulted by the Minister as part of the condition setting process under s. 45 of the *Environmental Protection Act 1986* and a party that will be involved in the implementation of the offsets package for *Atriplex*. Accordingly, this is a case where offset proposal is more properly to be considered at the implementation condition stage.

No.	Submitter	Submission and/or issue	Response to comment
			Cameco also notes the Department of Parks and Wildlife submission 2 below.
2.	P&W	Due to the significance of the impacts and the uncertainty identified above, Parks and Wildlife is not currently in a position to indicate support or otherwise for the proposed offsets. However, the following are high level comments on the proposed offsets: • Offset 1: Comments on the proposed conservation of *Atriplex* sp. Yeelirrie Station's eastern conservation unit is provided under the Flora and Vegetation Section of this table. • Offset 2: The preparation of a formal species Recovery Plan by a development proponent for approval at the State or National level is not considered appropriate. Parks and Wildlife is normally responsible for recovery planning in accordance with its policies and process as this planning is expected to address measures that are beyond the capacity or ability for the proponent to implement (such as actions by government agencies). It may be appropriate for a proponent to prepare a research and conservation plan with defined objectives relating to the outcomes of prescribed measures to aid conservation of the species in geographic areas defined within the approval conditions. This type of plan would normally be prepared prior to consideration of the proposal for approval or prior to ground disturbance. Additional comments are provided on these matters in item 2 above. • Offset 3 and 4: No specific offset has been proposed for subterranean fauna, and the proponent indicates an intention to initiate further conversations with the OEPA and Parks and Wildlife to determine suitable offsets (PER, page 197). In relation to possible research into subterranean fauna habitat, it is noted in the PER that there are reported difficulties in identifying prospective microhabitats for the subterranean fauna taxa. In particular, the PER states "*… the fine-scale heterogeneity of salinity and other habitat characteristics of the subterranean environment at Yeelirrie make it difficult to design an appropriate sampling program. This was highlighted by the considerable mis-match between the modelled*	Comment noted. In relation to *A. yeelirrie*, some of the activities proposed by Cameco as management and mitigation measures, previously may have been considered as offsets. Therefore it will be necessary to have further discussions with both OEPA and DPaW to develop an offsets package as appropriate and Cameco commits to having these discussions. In relation to subterranean fauna, Cameco reviewed six Ministerial Statements of projects where stygofauna was a significant aspect. One of the six Statements included an offset "condition" which was to apply if the "CEO determines that risks to the long term viability of subterranean fauna species may be offset". The Condition required the proponent to "prepare a subterranean fauna research plan In consultation with the DPaW and the WA Museum" which is what Cameco has proposed in the PER. Cameco accepts there is more work to do to define what that research plan might look like, but is not able to do this in isolation from agencies. Cameco will be happy to work with agencies when it is determined that an offset is required and they are ready to discuss offsets.

No.	Submitter	Submission and/or issue	Response to comment
		salinity of bores used for targeted sampling in 2015 and the actual values recorded in those bores during when sampling "	
3.	DotE	The offsets table 12.1 should be populated with proposed offsets for residual impacts on subterranean fauna.	See below.
4.	DotE	The Department of the Environment released an *EPBC Environmental Offsets Policy* in October 2012, which outlines the Commonwealth approach to offsets. This policy does not appear to have been directly addressed. Please provide an assessment of the proposal against the EPBC Act Environmental Offsets Policy. A number of the measures proposed as an offset do not appear to adequately address the principles of the policy. The Policy is available at: https://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-policy_2.pdf	Cameco has provided a revised proposal for the protection of *Atriplex yeelirrie* as Attachment 8. Cameco proposes these measures as management and mitigation measures. However they all meet the requirements of the EPBC Offsets Policy and could otherwise be considered as offsets. Cameco will seek further advice from both agencies on potential offsets following the State and Federal agencies review of Attachment 8.
5.	DotE	The *EPBC Act Policy Statement on Translocation of Listed Threatened Species – Assessment under Chapter 4 of the EPBC Act does* not appear to have been directly addressed. Please provide a discussion of the proposal against the EPBC Act Policy Statement on translocation of listed threatened species, and reflect on the potential implications for the assessment of offsets under the EPBC Act Environmental Offsets Policy. The Policy is available at: https://www.environment.gov.au/system/files/resources/c0463a3b-cf06-44a7-a7c6-76b488321561/files/epbc-act-policy-translocation.pdf	Cameco was not aware of the EPBC Act Policy Statement on Translocation. At the time of preparing the PER *A. yeelirrie* was not a listed species under the EPBC Act. Having reviewed the Policy, Cameco considers the proposed translocation program could be considered a conservation translocation and the completed and proposed studies into the eco-physiology of the species and the translocation would be best described as mitigation measures. Cameco understand that an assessment of the impact of translocation would be required and have foreshadowed this action in the PER.
6.	Uniting Church	The estimated volume of greenhouse gas emissions over the life of this Project is a significant environmental impact that must be accompanied by effective and equivalent offsets.	Compared to many projects, the life of Project emissions is not significant. However, Cameco recognises there is potential for further reductions, including the switch to gas for power generation and the capture of power generation plant CO_2 emissions for use in processing. These will further significantly reduce the Project emissions.

13. Consultation

No.	Submitter	Submission and/or issue	Response to comment
1.	DotE	The proponent has identified that consultation has occurred with Traditional Owners, identified the broad outcomes of the consultation process as well as identifying key consultation outcomes against key environmental factors. However they have not provided evidence of this consultation at this stage. The impact of the mine on the collection on bush foods was raised as part of the consultation process with the proponent indicating that this was discussed as part of the consultation process. While information on water quality and availability have been provided in detail, the possible impact on bush foods that could be used by Indigenous people have not been addressed.	A record of consultation undertaken during the preparation of the PER is presented in Appendix C of the PER. In relation to fauna, Cameco has advised indigenous people that for other than the mine site area and an appropriate buffer, hunting will not be restricted. For flora, clearing for the mine may impacts some foods. For many reasons clearing will be minimised and this will also reduce the impact on bush plants. The other significant impact considered during the assessment is the effects of dust and radiation on plants including bush foods. The ERICA modelling presented on page 314 of the PER confirms the modelled emissions and doses will not impact bush foods and that they can be eaten without risk.
2.	DotE	Mitigation measures in relation to impacts on heritage have been identified within the PER and discussed. However there is no indication that these have been developed in consultation with relevant Indigenous groups. Please provide further evidence of consultation with Indigenous groups both past and proposed.	In the limited opportunities Cameco has had to meet and discuss Project related issues with CDNTS and the Tijwurl native title claimants, heritage has not been a topic of much discussion. However, in the many conversations Cameco has had with family groups who are part of the Tijwurl claim group, heritage has been discussed and there is a general recognition that the Project is some distance away from the important ethnographic sites in the region and that these won't be disturbed by the Project. The heritage landscape of the wider Project area is very well documented and the Project will not disturb any registered sites. There are a number of artefact scatters within the development envelop and relevant indigenous groups will be consulted at that time. It is also likely there will be more opportunity to consult once the Tijwarl native title claim is resolved.
3.	CCWA	In April 2015 Cameco hosted an open day and arranged buses from Wiluna, Leonora and Meekatharra. There were serious concerns about the uranium mine, the impact on the environment, the act of mining on a cultural site and impacts to cultural heritage. There were one or two people who indicated that they would be open to discussion on some benefits or community Project funding, but did not indicate that they were happy or would consent to the Project. Those who voiced that interest were in the minority. This limited interest expressed in holding conversations about community benefits has caused much conflict and division in the community.	Clearly, CCWA's record of the meeting differs from Cameco's. Cameco is always respectful towards people including opponents and would not have stated that the Project would go ahead anyway. Our experience is that not all people in the indigenous community oppose the Project. Cameco will continue to talk and listen to people and to take account of their concerns where possible.

No.	Submitter	Submission and/or issue	Response to comment
		Cameco indicated that this was the first of many meetings to come. They also mentioned that the mine would go ahead despite the concerns of the community. Cameco's attitude was viewed as imposing themselves on an unwilling community. For over 40 years family groups in the area have remained united in opposing the mine at Yeelirrie. Yeelirrie in the local language means place of death, and reflects dreamtime stories about that country.	
4.	CCWA	The sense of obligation to protect Yeelirrie was reflected in the 27th May 2010 media release from Central Desert Native Title Service on behalf of the traditional owners who instructed to strongly oppose the development and uranium mining at Yeelirrie. This view is still held and maintained except for the view of a few individuals who are opposed to the mine but feel they cannot stop it, so they may as well get some benefit from a Project that is inevitable. Active opposition from most of the community coupled with resignation from the rest does not constitute social licence. The proposal is likely to have impacts on the internal community relations. This is likely to be caused by proponents communicating with people who are willing to talk about benefits as they think the proposal will go ahead despite their objections and they have no other options. This tends to cause rifts between families and within families. This chain of events has been witnessed many times before over mining proposals. Erosion of family relations has occurred over the last two years since Cameco purchased and actively engaged in the Yeelirrie proposal. Any genuine Project assessment process should recognise and reflect Aboriginal aspirations and concerns. The EPA may not have the powers to change or influence the way this company behaves or an overall systematic problem but it is such a serious and direct impact of mining that it is important that it is raised.	Cameco has met with the CDNTS both separately and with Tijwarl Native Title Claimants on numerous occasions over the last three years and they have not put this position to the company. Cameco is aware there are individuals in the indigenous community who oppose mining, uranium mining and mining at Yeelirrie. Cameco accept their right to protest and if they are willing to discuss specific concerns either around environmental issues or anti-nuclear sentiment then the company will be happy to meet them and discuss their concerns. In some instances the parties will agree to disagree. Cameco can only meet those people who want to meet us and do not seek to divide the community. In Canada, and with our Kintyre project in Australia, Cameco works well with local indigenous groups to implement social change through, training employment, business and community development and would seek to apply the same approach at Yeelirrie. Many aboriginal people say they want change, they want the opportunity to continue to live in regional centres with an opportunity to have a job and a better community and they state they are prepared to leverage their native title interests to achieve this as long as heritage issues are addressed and important places are not disturbed.
5.	PS12; PS31;PS35	Cameco is well known for deception and a disregard for local communities and other stakeholders, present and future. The strong, united and adverse reaction of the traditional owners living in the region of the Yeelirrie mine clearly contradicts the proponent's claims of adequate consultation.	The heritage sites of the Yeelirrie area were first recorded in the 1970's by independent anthropologists working for the WA Museum with aboriginal people who lived on the land around Yeelirrie at that time. The important ethnographic sites were recorded and registered during this time. The location of these places was confirmed by a survey completed in the 1990's. These places do not occur within the Project Area and will not be impacted by the development of the Project.

No.	Submitter	Submission and/or issue	Response to comment
		The proponent downplays the significance of effects on the acknowledged heritage sites of the target region.	As indicated above, Cameco has endeavoured to consult with, and will continue to consult with local communities and other stakeholders. However, we can only meet those people who want to meet us.
6.	PS9; PS21	The mine is a threat to local pastoralists. How will environmental concerns and opposition of local pastoralists be handled?	Cameco is concerned that neighbouring pastoralists are worried about the impact of the Project on their health and lifestyle and have met with them to discuss their concerns. Cameco does not agree that the operation of the Project, located approximately 61 km east of their homestead will cause radiation or dust related health impacts. The results of modelling of environmental impacts including radiation and air quality supports this. Cameco is happy to continue to meet with the Project neighbours and has advised them of the offer to provide radiation and dust monitoring in order to establish baseline levels. Cameco has also suggested that the pastoralists, given they do not believe or trust Cameco seek independent qualified advice in relation to radiation health and dust modelling.
7.	PS151	The submitters consider that the meeting with Cameco didn't achieve anything as the concerns raised in relation to dust, water and health were not addressed. The submitters felt intimidated and rotten when Cameco advised that it would take the water that it required for the proposal. The submitters kept raising their concerns about dust, but the concerns were not addressed and were advised that they would be addressed in the next document, however the submitters did not consider this to be good enough. The submitters did not feel comfortable when Cameco questioned their concerns about uranium mining and the dust and asked … what about mineral sands, what about the transport of fuel, and aboriginal people sniffing fuel? They're more dangerous than uranium mining. Anyway, Yeelirrie is only a low level uranium mine. Cameco also said that there would be less health impacts from the radiation than there would be from breathing dust from cattle dung in the cattle yards. The submitters consider that the previous proponents were a pleasure to work with compared to Cameco as the previous proponent explained things better, and the submitters knew where they stood. This is not the case with Cameco.	Cameco has met with the submitters at their homestead. The meeting was cordial. However it is clear that the submitters are worried that the Project will generate dust and radiation that will impact their health and it is unlikely they will ever accept any assurances from Cameco in relation to either of these aspects. The submitters also concerned that the Project water supply will affect their pastoral water supply. At the meeting Cameco advised them that the groundwater borefield shown in the PER was conceptual, but that is was unlikely that the borefield would extend into their pastoral station and that the initial modelling showed no drawdown impact on their bores. The offer was made to continue to provide information to them as plans for the borefield developed if the Project was approved. In relation to water, Cameco advised that the modelling demonstrated that there was sufficient water for the Project. Cameco is very comfortable that the development of the water supply will not impact the pastoral supply and will commit to making good any supply should that not be the case. Cameco has advised the submitter that the company is willing to continue to meet with them in the future as the Project approval advances. Cameco also offered to host them at Yeelirrie to discuss radiation, however that offer was declined.

14. Other

No.	Submitter	Submission and/or issue	Response to comment
1.	DotE	Discussion of assessment methods does not clearly describe what accredited assessment process involves. Whilst it is stated that the Project will be assessed in a manner similar to that under the bilateral agreement, this process is not explained. Please provide a more detailed outline of the assessment process.	In June 2009, when the Project was first referred by the original proponent, BHP Billiton, it was assessed that it was a controlled action and was to be assessed under the assessment bilateral agreement between the Commonwealth and the State of Western Australia. Following the variation to the proposed action that was submitted by Cameco and approved in December 2014, the DotE reviewed the assessment process and determined that the proposed action could not be assessed under the current bilateral agreement as the agreement did not include transitional arrangements for projects that were being assessed under the pre-2012 assessment bilateral agreement. The DoTE then decided that the proposed action would be assessed through an accredited assessment by the WA Government of the proposed action under the EP Act 1986. This decision is covered in correspondence from the DotE to Cameco in a letter dated 12 March 2015.
2.	DotE	Please provide a summary of the potential economic benefits the Project is likely to generate, including the number of jobs to be created both during construction and on an ongoing basis.	The potential economic benefits were not stated in the PER as they are so dependent on the price of the product and are commercially sensitive. Approximately 106 Mlbs of packaged U_3O_8 equivalent will be produced across a 15 year period which would attract a WA State Royalty of (currently) 5%. As stated in the PER, key characteristics table (p. xxiv and 55), the peak and average construction workforce is 1200 and 500 respectively and the peak and average operational workforce is 300 and 225.
3.	DotE	Appendix I2 – Reporting of data quality control in laboratory results is not covered. Duplicate analyses were undertaken for bottle roll tests. The report states these showed similar trends, but does not quantify what the difference between duplicates was. Clarification on the differences between duplicates would be informative.	Section 4.4 of the report provided in the Appendix I2 describes the duplicate tests, “Four sets of column pairs were set up to operate in series. The first column in each pair was open to air and operated such that the solution drains down and the sample becomes unsaturated between flushing events. The second column was not open to air and was maintained under saturated conditions (filled with solution) at all times.”
4.	DotE	Unit given for radon emission rates are Mbq/s, should they be mbq/s?	No, the correct units are MBq/s (MegaBecquerels per second rather than milliBecquerels per second))
5.	Main Roads	If contacted Main Roads can provide technical advice, road asset data and other information that the proponent can use for transport planning, during the mine development, mine construction and production phases. We would encourage the proponent to continue to liaise with Main Roads on its transport planning.	Cameco has met with representatives of the Department of Main Roads in Kalgoorlie to discuss the Project plans and timelines. Cameco has committed to continue to consult with the Department. If the Project is approved Cameco will continue to work with the Department as Project planning progresses.
6.	Main Roads	Main Roads does understand from discussions held with the proponent that the concentrate product will be transported in	Cameco has met with representatives of the Department of Main Roads in Kalgoorlie to discuss the Project plans and timelines.

No.	Submitter	Submission and/or issue	Response to comment
		vehicles (road trains) that meet and operate under current licence and/or permit conditions related to size (length and/or mass). Main Roads, Heavy Vehicles Services directorate can provide operators with all essential information required including permits and notices.	Cameco has committed to continue to consult with the Department. If the Project is approved Cameco will continue to work with the Department as Project planning progresses.
7.	Main Roads	Main Roads plays a lead role in managing traffic on the State Road network in the event an emergency incident affects traffic operations. The proponent must as a part of its emergency management process develop suitable traffic management plans to operate under emergency response conditions. Main Roads can provide valuable input into the development of such plans and should be consulted during the plan preparation and review process.	Cameco has met with members of the Goldfields Regional emergency services network and commits to continue to consult with the network and the Department to develop plans to their satisfaction.
8.	Main Roads	Main Roads, does work in close collaboration with other organisations including local government, DFES and the Police in the event an incident, disrupts or stops traffic flow and operations along the road network. It is critical that the proponent's incident management plans, include appropriate risk planning to identify, assess and manage any risks that have the potential to disrupt or impact access any location, at any time along the state road network.	Cameco has met with members of the Goldfields Regional emergency services network and commits to continue to consult with the network and the MRD to develop plans to their satisfaction. In Canada, Cameco works closely with emergency response co-ordinating organisations in the preparation of incident management plans and the allocation of responsibilities during an incident. Cameco also works with these agencies in the design of training exercises for emergency responses and Cameco Australia plans to build a similar constructive relationship with response agencies to ensure plans are appropriate for our conditions and distances.
9.	CCWA	Cameco's transport of uranium has not been without incident. The public submitter notes that in 2013 a truck carrying uranium from Cameco's Ontario Port Hope refinery caught fire. The driver was quick to act and disconnected the load from the truck. This quick thinking of the driver was responsible for avoiding a major accident. Cameco denied any responsibility for the accident that was instead deflected to the trucking company. In 2010 a shipment of uranium from Vancouver to China was refused by China and sent back to Vancouver after a number of sea containers were damaged. In 2013 in Ontario, where Cameco have the Port Hope Refinery, it was reported that more than one truck in seven carrying radioactive material has been pulled off the road by Ontario ministry of transportation inspectors for failing safety or other requirements. A total of 16 out of 102 inspected trucks were placed *"out-of-service,"* which means the vehicle *"must be*	Cameco does not deny that transport related incidents occur. The important issue, is however, how the incidents were responded to and whether they resulted in any significant environmental impact. Cameco routinely transports uranium oxide and other forms of uranium without incident, moving approximately 1,400 to 1,600 truckloads annually company-wide. In all of our operations there has not an incident that has resulted in a significant loss of product from shipping containers. In countries where we have transport operations, we implement our Emergency Response Plans and routinely undertake desktop emergency response exercises and at least one annual full-scale exercise of our transport emergency response in accordance with the applicable Emergency Response Assistance Plan. The benefit of these exercises are evident in the way we respond to and manage real incidents. Our trucking agents and different local emergency responders are routinely involved in these exercises and they willingly participate in these exercises when requested. Class 7 products are moved safely all over the world every day of the year, and the IAEA reports that since 1963 when transport standards for these goods were set, there has not been a transport accident involving Class 7 materials where there has been significant radiological impact.

No.	Submitter	Submission and/or issue	Response to comment
		repaired or the violation corrected before it is allowed to proceed." Violations included faulty brake lights; "load security" problems; flat tyres; false log books; damaged air lines; and a driver with no dangerous goods training. In other cases, trucks were allowed to proceed but were issued with enforcement actions for problems with hours of service; annual inspection requirement; missing placards; exceeding gross weight limit; speed limiter; over length combination over height vehicle; and vehicle registration / insurance. Australia has had its share of transport accidents too. In a recent study by the National Transport Insurance, Australia (NTI) on truck accidents there were some key findings that are relevant to WA. Some key findings are listed below: *"Western Australia was noteworthy with the highest proportion (30%) of major crash incidents attributed to fatigue."* *"Queensland and Western Australia continue to be over represented in large incidents when likened to their share of the freight task. We did comment in that report that this could in fact be attributed to the growth in the freight task servicing mining communities usually in remote areas. This again seems to be the case when we chart the actual location of incidents."* *"As highlighted in the 2013 crash report, the worst performing State was Queensland followed by Western Australia."* *"Most incidents occurred between the hours of 1000 and 1600 when the on the road population of commercial vehicles is at its highest."* This point highlights the increased risk factor with more trucks on the road. This is a cumulative risk that should be considered with increased trucks from other mines or proposed mines. *"Truck fires continue to account for 10.7% of large loss incidents with electrical failure accounting for 68.5% of cabin /engine compartment fires."* The public submitter would expect that any future Transport Management Plan would be made available for public scrutiny and comment.	The Transport Management Plan including the Emergency Management Plan and the Emergency Response Assistance Plan would be developed with advice from and to the satisfaction of the Western Australian Emergency Management Committee and be made available to the public as required
10.	CCWA	The public submitter considers that the WA government and EPA should look at how Cameco behaves and operates.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail.

No.	Submitter	Submission and/or issue	Response to comment
		Cameco's incident report contains 54 entries detailing incidents, spills, military ties, leaks and transport accidents from Cameco's operations. Cameco has recently been in the courts for in Canada and the US over allegations of tax avoidance to the tune of $1.5 billion. A few examples are as follows: • Cameco pleaded guilty in 1989 to negligence and was fined $10,000 for leaking 2 million litres of radioactive liquid into a creek. • Inter-Church Uranium Committee (ICUC) from Saskatchewan, Canada, has revealed the export of at least 500 metric tons of depleted uranium to the US military by Cameco. • Sierra Club Canada reported that "As of 2010, water released from Deilmann Tailings in cadmium exceed the Saskatchewan standard by 5,782%. Uranium concentrations were above the standard on average 1,323% and at the high level 10,153%. Radium 226 and 210 concentrations on average exceed the standard by 1,481 and 140%". • At McArthur River, concentrations of arsenic, selenium, and uranium in water effluent have exceeded the standards by 54% for arsenic, 700% for selenium and 1,230% for uranium. Blueberries and fish are contaminated with uranium. The public submitter considers that with allegations of tax fraud, flawed community consultation, radioactive leaks and spills and direct links to the production of depleted uranium weapons it is imperative that the WA government consider this when applying bonds and conditions to ensure compliance. The WA government must do everything in its power to protect the environment and the tax payer from this mine.	Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.
11.	CCWA	The Bureau d'audiences publiques sur l'environment (BAPE) carried out an inquiry into the environment and health impacts or uranium mining in Quebec, Canada. This is the most recent globally comprehensive review to occur.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco operates and complies with regulations and legislation and commits to compliance with any new regulatory requirements should there be changes due to continual improvement in the regulatory framework in which we operate.

No.	Submitter	Submission and/or issue	Response to comment
		The BAPE panel found that there are "significant gaps in scientific knowledge of the impacts of uranium mining on the environment and public health". BAPE recommended that a new regulatory system in Canada would be needed to regulate Uranium mining. This view is at odds with the view and actions of the Department of Mines and Petroleum (DMP) and other WA government agencies that have been making attempts to normalise and integrate uranium into risk based regulations. WA's approach is not only at odds with the BAPE findings but is also at odds with advice given to the DMP from their own advisory group – the Uranium Advisory Group (UAG). UAG was established by the DMP to benchmark WA's regulations for uranium mining with 'World's Best Practice'. There were several areas where WA regulation's fell short (These are detailed in Appendix 3). The UAG made recommendations that the DMP amend the 1999 Tailings guidelines. Inexplicably in the 2013 updated guidelines there is not a single mention of uranium. There are also serious limitations in the DMP's ability to hold companies accountable for non-compliance with environmental conditions. In the *Mining Act 1978* there are no heads of power given to the DMP to regulate or enforce conditions on environment or assess Environmental Management Plans. A DMP report on improving environmental regulations contains many recommendations to improve compliance with the environment. Despite this there are still no legislative powers for the DMP to enforce compliance with environmental obligations. Equally there are no powers for the EPA to enforce environmental conditions imposed by the DMP. In light of the Canadian regulatory problems and lack of scientific evidence the BAPE recommended that uranium mining not be approved. . For WA agencies to press ahead with an industry that has failed to deliver on basic promises of compliance and rehabilitation is irresponsible. The public submitter urges the EPA to consider the BAPE findings and heed the warnings found in the panel's recommendations.	
12.	CCWA	The DMP notes the divergence in royalty rates for uranium in the Mineral Royalty Rate Analysis 2015 - stating:	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.

No.	Submitter	Submission and/or issue	Response to comment
		"The Mining Regulations 1981 apply an ad valorem rate of 5% to uranium sold as a uranium oxide concentrate (yellowcake). The Uranium (Yeelirrie) Agreement Act 1978 (Yeelirrie State Agreement) sets an ad valorem rate of 3.5% for uranium oxide sold in the first seven years after the treatment plant comes into operation. The Yeelirrie State Agreement provides a royalty review mechanism after the first seven years of operation, and every five years thereafter." The DMP has recommended (recommendation 14) that the royalty rate for uranium should be lowered to 3.75% based on processing requirements and citing the current low uranium price. Given that uranium mining requires extensive assessment and regulation and therefore high costs to the State Government the public submitter argues that the 5% reflects the drain on the public service from administering and regulating uranium mine proposals (and potentially active mines). In fact The public submitter advocates for a much higher royalty rate than 5% to better reflect the risk to the environment, public health and the state. The public submitter notes that in Cameco's home town of Saskatchewan they have a tiered royalty rate6 including: • *Basic royalty 5% of gross sales* • *Tiered royalty - tiers increase from 10% to 15% as profit increases* • *Saskatchewan Resource Credit - a credit of 0.75%* While the public submitter disagrees with the DMPs suggestion of reducing the royalty rate for uranium they do agree with the DMP recommendation of removing royalty concessions in State Agreements. The DMP state that: *"The practice of not specifying royalty rates in new State Agreements should continue. Royalty concessions in existing State Agreements should continue to be removed and royalty rates set according to the Mining Act 1978. This should be addressed over time by agreement with the relevant parties as opportunities to renegotiate the agreements arise."* The public submitter recommends that the EPA advise that the State Agreement Act be repealed given that it is out of date and out of step with current regulation and expectations on workers'	

No.	Submitter	Submission and/or issue	Response to comment
		health and safety, on royalties and with unrealistic costs to the State.	
13.	CCWA	Uranium accounts for a small percentage of Australian export revenue. In the 2011/12 financial year uranium accounted for 0.19% of national export revenue. From 2011 to 2013 uranium was produced in 21 countries. Countries are therefore competing in a market that is modest in size. There is no sound basis for concluding that there will be any significant increased demand for uranium in the medium to long term. The public submitter considers that along with inflated, inaccurate estimates of nuclear power growth and demand for Australian uranium, predictions regarding the uranium price have also repeatedly proven to be inaccurate and inflated.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.
14.	CCWA	The industry hopes that bilateral nuclear cooperation agreements concluded over the past decade with China, Russia the UAE - along with the nuclear cooperation agreement with India - will lead to export growth. Increased sales to China can be anticipated. Sales to Russia have been suspended - and in any case should they ever be resumed it is likely to be a small market given the slow pace of nuclear power growth in Russia and the country's domestic uranium resources. It is unclear whether significant growth will be achieved in India and current uranium demand is very low. The UAE is building its first reactors so will be at most a small market. There is little prospect for growth in other current export markets for Australian uranium. Plans to expand nuclear power are in trouble in the UK, USA and Canada. Germany and Belgium plan to abandon nuclear power. France plans to reduce its reliance on nuclear power. Taiwan, Finland and Spain have fewer than 10 reactors and remain small markets, Sweden has 10 reactors with no plans for growth under existing government policy. South Korean's nuclear industry has been hit by a series of scandals and South Koreans who consider nuclear power as safe has significantly reduced. The restart of reactors in Japan promises to be a protracted, contentious affair and Japan has a very large uranium inventory. A media release in 2015 by Wyatt Roy, Chair of federal Parliament's Joint Standing Committee on Treaties, stated that selling uranium to India will double the size of the uranium	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.

No.	Submitter	Submission and/or issue	Response to comment
		mining industry in Australia and export revenue could amount to $1.75 billion. It is doubtful from several other projections that the figures will stack up. Also India's nuclear program is in a "deep freeze" according to a November 2014 article in the *Hindustan Times*, and India's Energy Minister Piyush Goyal said in November 2014 that the government remains "cautious" about developing nuclear power and he pointed to waning interest in the US and Europe.	
15.	CCWA	The uranium bubble that peaked in 2007 was a case of speculative mining of the market. This includes practices such as shallow mining, siting in-situ values for possible deposits without reference to the cost, viability or legality of mining. Using a lower cut-off grade of uranium to inflate the size of the estimate, and conflating a tenement application with a Project. Mechanisms have been developed seeking to address the over inflation of resource estimates. Changes to the Joint Ore Reserves Committee code were expected to come into effect in December 2013 – for example a pre-feasibility level study will have to be conducted before including an estimate of an ore reserve in a public report, however deficiencies still remain and uranium mining companies are resisting reform.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.
16.	CCWA	**Radiation** The difference between uranium mining and the mining of most other minerals is radiation exposure. (There are also radiological risks involved with some other mining operations, e.g. rare earths, mineral sands.) The consensus or near-consensus scientific position is that there is no safe level of exposure to ionising radiation. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) states in a 2010 report that *"the current balance of available evidence tends to favour a non- threshold response for the mutational component of radiation-associated cancer induction at low doses and low dose rates.* The 2006 report of the US National Academy of Sciences' Committee on the Biological Effects of Ionising Radiation (BEIR) states that *"the risk of cancer proceeds in a linear fashion at*	**Radiation** It is incorrect to state that the "consensus or near-consensus scientific position is that there is no safe level of exposure to ionising radiation". This is not the case. Just as there is research indicating impacts at low doses, there is research that shows that there may be no effect or even beneficial effects of low levels of radiation exposure. However, the majority of research indicates that there is no evidence of risks or effects of radiation at low doses. (UNSCEAR 2012 Report: "Sources, effects and risks of ionizing radiation"). A discussion on effects of low doses requires a parallel discussion on what level is judged to be safe. It is incorrect to conclude that the concept of very low risk is the same as "no safe level". Applying this logic more broadly would unproductively lead to the cessation of all activities on the planet. A more meaningful discussion is around the level at which a risk becomes acceptable and this comes from a social decision. The Internationally agreed position for radiation is that dose limits be established above which exposures are unacceptable. Aligned with this is a system of dose limitation which aims to optimise exposures. The ICRP calls this the ALARA principle which requires that as well as complying with dose limits and justifying the potential exposure such that the benefits outweigh the risks, the doses shall be kept as low as reasonably achievable (taking social and economic factors into account).

No.	Submitter	Submission and/or issue	Response to comment
		lower doses without a threshold and... the smallest dose has the potential to cause a small increase in risk to humans. " A report in the *Proceedings of the National Academy of Sciences* states: *"Given that it is supported by experimentally grounded, quantifiable, biophysical arguments, a linear extrapolation of cancer risks from intermediate to very low doses currently appears to be the most appropriate methodology.* Demonstrating and quantifying the effects of low-dose, low dose rate exposure to ionising radiation becomes increasingly difficult at ever-lower doses. Yet - despite countless claims to the contrary - around 10 studies have shown effects for doses below 100 millisieverts (mSv). Uncertainties will always persist. In circumstances where people are exposed to low-level radiation, epidemiological studies are unlikely to be able to demonstrate a statistically significant increase in cancer rates. Cancers are common diseases and most are multi causal. Other complications include the long latency period for some cancers, and limited or uneven data on cancer incidence and mortality. The upshot is that cancer incidence and mortality statistics are being pushed up and down by a myriad of factors at any point in time and it becomes impossible or near impossible to isolate any one factor. While there is (and always will be) uncertainty with the Linear No-Threshold model at low doses and dose rates, it is important to note that **the true risks may be either higher or lower than LNT** - a point that needs emphasis and constant repetition because nuclear lobbyists routinely conflate uncertainty with zero risk. The BEIR report states that *"combined analyses are compatible with a range of possibilities, from a reduction of risk at low doses to risks twice those upon which current radiation protection recommendations are based.* " and: *"The committee recognizes that its risk estimates become more uncertain when applied to very low doses." "Departures from a linear model at low doses, however, could either increase or decrease the risk per unit dose."* **Radon** In recent years the International Commission on Radiological Protection (ICRP) has upwardly revised its estimate of the carcinogenicity of radon. The latest ICRP evaluation of epidemiological studies of lung cancer risk from radon and	It is important to recognise that all human activities involve some risk. Risks apply to individuals and to society as a whole and the key question is determining what level of risk is acceptable taking into account all the relevant factors. This is a very complex process and is multidimensional. Risk is not unique to those situations that only involve exposure to radiation and it is important to keep the actual risks from all hazards in perspective. For radiation, natural background radiation exists everywhere in the world at varying levels. The argument to reduce low levels of radiation exposure to people as a result of a practice to absolute zero is not credible when natural background radiation levels vary significantly. Cameco abides by the ICRP approach, and recognises the approach as the basis of sound radiation protection practice. Based on this, Cameco strives, in all operations, to ensure that exposure to workers, the public and the environment remain well controlled and in accordance with the internationally recognised system of dose limitation. In Australia, the ICRP approach is legislated in state and national regulations. The national authority in Australia is ARPANSA which provides detailed guidance, standards and codes of practice to ensure that doses remain well controlled. (Note that Cameco acknowledges that due scientific process requires all perspectives to be investigated and discussed.) **Radon** In 2015, the ICRP formally altered its approach to calculating the risks of exposure to the decay products of radon. The previous epidemiological approach for the decay products of radon has been replaced with the dosimetric approach for determining risk. This uses biological and biokinetic modelling to determine the potential effective doses from the inhalation and ingestion of radionuclides. This revision has resulted in an increase in calculated effective dose by a factor 2.4 for an exposure to the decay products of radon. Cameco notes that the risk factors from the revised approach are inconsistent with those from epidemiology, however acknowledges the recommendations of the ICRP. Although the change in dose factor has yet been adopted in legislation in Australia at this stage, it was used in the estimation of doses for the Yeelirrie project and, using the revised factor doses were shown to be low. **Uranium, Radiation and Health** The method outlined by the submitter uses the "collective dose" concept to estimate impacts to populations from radiation. This is the incorrect use of the concept and this has been noted by the ICRP (ICRP Publication 109). It was developed as an operational tool for the optimisation of exposure scenarios, but was consistently misused as a means of conflating the potential impacts of radiation. The tailings example provided by the submitter refers to the impacts of an annual dose of 0.01mSv/capita, but neglects to recognise that this is small compared to the natural background radiation that exists everywhere and which generally varies between 1 and 10 mSv/year per capita across the planet. In regards to the emission of radon from tailings, Cameco has committed to ensuring that at completion, the tailings cells will be covered and the emission levels of radon would be consistent with the pre mining radon emission levels in the region. During operations, the tailings would be progressively covered and rehabilitated. The air quality modelling presented in the PER, clearly shows that the emissions of radon from the project result in minor temporary increases in radon concentrations are minor (for example 3% at the closest permanent receptor location).

No.	Submitter	Submission and/or issue	Response to comment
		radon progeny indicates that the risk is greater by approximately a factor of two than previously estimated. The ICRP's upwards revision of the hazards associated with radon exposure is clearly inconsistent with specious claims that the 'modern' view is that low level radiation exposure is harmless. ARPANSA has noted that the reassessment of the hazards associated with radon exposure *"will have significant implications for the uranium industry worldwide, particularly for underground uranium mines."* **Uranium, Radiation and Health** The public submitter has provided the following excerpts from published papers: In a paper prepared for the Australian Uranium Association, Sydney University academic Manfred Lenzen states: *"According to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), the global component from mill tailings is the most significant source of radiological exposure in the entire nuclear fuel chain. This holds irrespective of whether the 1993 or 2000 assessment is taken as a basis. Taking the higher estimate as more realistic, 150 Sv/GWe translate into 55.5 kSv globally, which is equivalent to an annual dose of about 0.01 mSv/capita if the entire world population were equally exposed. This estimate agrees well with ranges given in the assessment of uranium mines by Nilsson and Randhem 2008, who state a range of 0.1 to 0.001 mSv/cap."* Using the above figure (55.5kSv) and using a risk estimate for exposure to low-level radiation of 0.05-0.1 cancer fatalities per Sievert, radiation exposure from uranium mine tailings is responsible for 2,775-5,550 deaths annually. A similar analysis is presented by nuclear physicist Richard Garwin. The following discussion on the topic of radiogenic effects from uranium mining is excerpted from a longer paper by Nuclear Radiologist Dr Peter Karamoskos: *"The link between uranium mining and lung cancer has long been established. Certain groups of underground miners in Europe were identified as having increased mortality from respiratory disease as early as the 16th century. Lung cancer as*	Cameco acknowledges the number and variety of publications from various scientists on the subject of radiation protection, but is guided by the international and national authorities on the subject. At an international level, the ICRP provides independent advice on the approach to radiation protection and the acceptable limits of exposure. Cameco also recognises that the linear non threshold theory as propagated by the ICRP is the basis of the system of radiation protection, rather than a definitive statement on risks at low doses. **Uranium companies promote dangerous radiation junk science** In any scientific discussion, it is important that all data and information is considered to ensure the best scientific outcomes. Cameco notes that a healthy scientific environment encourages views, opinions and facts from a wide range of perspectives. The current consensus views regarding radiation and health are propagated by the ICRP and are based on the research and work of UNSCEAR and other agencies. Dr. Douglas Boreham currently holds positions as Professor and Division Head of Medical Sciences at the Northern Ontario School of Medicine (September 2012 - present) and is a Professor in the Department of Medical Physics and Applied Radiation Sciences at McMaster University (2000 - present). He has published over seventy-five peer reviewed scientific manuscripts and is highly regarded for his work in radiation related fields.

No.	Submitter	Submission and/or issue	Response to comment
		the cause was not recognised until the 19th century. The radioactive gas, radon, was identified as the cause in the 1950's. Studies of underground miners, especially those exposed to high concentrations of radon, have consistently demonstrated the development of lung cancer, in both smokers and non-smokers. On this basis, the International Agency for Research on Cancer (IARC) classified radon as a carcinogen in 1988. In 2009, the ICRP stated that radon gas delivers twice the absorbed dose to humans as originally thought and hence is in the process of reassessing the permissible levels. Previous dose estimates to miners need to be approximately doubled to accurately reflect the lung cancer hazard.*"* *"The Biological Effects of Ionising Radiation VI report (1999) reviewed eleven cohort studies of 60,000 underground miners with 2,600 deaths from lung cancer, eight of which were uranium mines in Europe, North America, Asia and Australia. These found a progressively increasing frequency of lung cancer in miners directly proportional to the cumulative amount of radon exposure in a linear fashion. Smokers had the highest incidence of lung cancer, as would be expected; however, the greatest increase in lung cancer was noted in non-smokers. The highest percentage increase in lung cancer was noted 5-14 years after exposure and in the youngest miners."* *"Uranium miners are also exposed to IR (ionising radiation) directly from gamma radiation and the dose from this is cumulative to that from radon. At the Olympic Dam underground uranium mine, the total dose per miner is approximately 6mSv, of which 2-4 mSv (allowing for the new ICRP dose coefficients) are due to radon and the balance due to gamma radiation."* *"Most modern uranium mines have air extraction systems and monitored ambient measures of radon concentrations to ensure levels remain low. Current levels of radon in underground uranium mines are only a fraction of mines over one hundred years ago. Furthermore, miners are given personal protective equipment (PPE) including masks to filter out the radioactive particulate matter. However, many underground miners find the masks extremely uncomfortable, especially in the hot underground environment they must contend with. It is estimated that up to 50% of underground uranium miners in Australia do not use their masks, and thus drastically increase their risk of lung cancer, whilst underestimating their actual*	

No.	Submitter	Submission and/or issue	Response to comment
		radiation dose (since this is calculated assuming PPE's are used)." *"The Olympic Dam doses mentioned above are typical of modern mine practices. The average miner at Olympic Dam is in his twenties and stays on average five years at the site. A typical calculation using the linear no threshold model and the latest BEIR-VII figures of radiation carcinogenesis risks indicates miners at Olympic Dam therefore have a 1:420 chance of contracting cancer, most likely lung cancer. Note that as the research demonstrates risk of developing lung cancer is greater for younger workers. These risks are not insubstantial. Radiation safety and risk principles can be quite complex and it is debatable whether miners have the training to understand the basis of such risks, or are even informed of these risks in a comprehensive and accurate manner that they can comprehend and make an informed work decision."* **Uranium companies promote dangerous radiation junk science** In May 2012, 48 Australian medical practitioners signed the following statement calling on Toro Energy to stop promoting dangerous radiation junk science. A similar statement was signed by 39 Australian medical practitioners in 2014; questioning Cameco's decision to sponsor speaking events by Boreham (Appendix 5 and 6). In 2008 Boreham visited Australia to work with Toro Energy, Uranium One and Heathgate Resources in the area of employee radiation training and community consultation on radiation and uranium. In 2010, Boreham spoke at a 'Radiation Information Seminar' in Adelaide which was co-hosted by the Australian Uranium Association and Toro Energy. BHP Billiton and Rio Tinto were sponsors of a 2011 conference that included Boreham on the speaking platform - with no speakers presenting the mainstream scientific understanding of radiation/health. Thus many of the uranium companies in Australia have been actively promoting views directly at odds with the consensus / near-consensus scientific position that there is no safe level of exposure to ionising radiation.	

No.	Submitter	Submission and/or issue	Response to comment
		ARPANSA (and equivalent state/territory bodies) could and should take a proactive role promoting established science to counter the self-serving promotion of fringe views by uranium companies. The public submitter considers that the Uranium company representatives should explain to the WA Government why they have promoted self-serving contrarian views regarding radiation and health instead of promoting the accepted scientific understanding that there is no safe level of exposure to ionising radiation.	
17.	CCWA; Proforma 1	**Safeguards** The public submitter is of the view that there are many problems and limitations with the international safeguards system. In articles and speeches during his tenure as IAEA Director General from 1997- 2009, Dr. Mohamed El Baradei said that the Agency's basic rights of inspection are *"fairly limited",* that the safeguards system suffers from *"vulnerabilities"* and *"clearly needs reinforcement",* that efforts to improve the system have been "*half-hearted',* and that the safeguards system operates on a "shoestring budget... comparable to that of a local police department". Problems with safeguards include: 1. Chronic under-resourcing. El Baradei told the IAEA Board of Governors in 2009: "I would be misleading world public opinion to create an impression that we are doing what we are supposed to do, when we know that we don't have the money to do it." Little has changed since 2009. Meanwhile, the scale of the safeguards challenge is ever-increasing as new facilities are built and material stockpiles grow. 2. Issues relating to national sovereignty and commercial confidentiality adversely impact on safeguards. 3. The inevitability of accounting discrepancies. Nuclear accounting discrepancies are commonplace and inevitable due to the difficulty of precisely measuring nuclear materials. The accounting discrepancies are known as Material Unaccounted For (MUF). There have	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.

No.	Submitter	Submission and/or issue	Response to comment
		been incidents of large-scale MUF in Australia's uranium customer countries such as the UK and Japan. 4. Incorrect/outdated assumptions about the amount of fissile material required to build a weapon. 5. The fact that the IAEA has no mandate to prevent the misuse of civil nuclear facilities and materials - at best it can detect misuse/diversion and refer the problem to the UN Security Council. As the IAEA states: *"It is clear that no international safeguards system can physically prevent diversion or the setting up of an undeclared or clandestine nuclear programme.* Numerous examples illustrate how difficult and protracted the resolution (or attempted resolution) of such issues can be, e.g. North Korea, Iran, Iraq in the 1970s and again in the early 1990s. Countries that have breached their safeguards obligations can simply withdraw from the NPT and pursue a weapons program, as North Korea has done. 6. Safeguards are shrouded in secrecy - to give one example, the IAEA used to publish aggregate data on the number of inspections in India, Israel and Pakistan, but even that limited information is no longer publicly available. 7. There are precedents for the complete breakdown of nuclear safeguards in the context of political and military conflict - examples include Iraq, Yugoslavia and several African countries. 8. Currently, IAEA safeguards only begin at the stage of uranium enrichment. Application of IAEA safeguards should be extended to fully apply to mined uranium ores, to refined uranium oxides, to uranium hexafluoride gas, and to uranium conversion facilities, as well as enrichment and subsequent stages of the nuclear fuel cycle. The Joint Standing Committee on Treaties (JSCT) recommended in 2008 that *"the Australian Government lobbies the IAEA and the five declared nuclear weapons states under the NPT to make the safeguarding of all conversion facilities mandatory."* However the Australian Government rejected the recommendation in its 2009 response to the JSCT report.	

No.	Submitter	Submission and/or issue	Response to comment
		9. There is no resolution in sight to some of the most fundamental problems with safeguards such as countries invoking their right to pull out of the Nuclear Non-Proliferation Treaty (NPT) and developing a weapons capability as North Korea has done. More generally, responses to suspected non-compliance with safeguards agreements have been highly variable, ranging from inaction to economic sanctions to UN Security Council-mandated decommissioning programmes. Some states prefer to take matters into their own hands: Israel bombed and destroyed a nuclear reactor in Iraq in 1981, the US bombed and destroyed a reactor in Iraq in 1991 and Israel bombed and destroyed a suspected reactor site in Syria in 2007. In 1982 Mike Rann identified the core problem: *"Again and again, it has been demonstrated here and overseas that when problems over safeguards prove difficult, commercial considerations will come first.* **Australia's uranium export policy / customer countries** Here brief comment is made about the choice of uranium customer countries. In 1998, the then Director-General of the Australian Safeguards and Non-proliferation office (ASNO) said: *"One of the features of Australian policy... is very careful selection of our treaty partners. We have concluded bilateral arrangements only with countries whose credentials are impeccable in this area."* That was not true at the time (e.g. sales to declared nuclear weapons states that pay scant regard to their NPT obligations) and it is certainly not true now. The federal government permits uranium sales to: • repressive, secretive countries (e.g. China and Russia - albeit the case that sales to Russia have been suspended) • nuclear weapons states that are not fulfilling their disarmament obligations under the Nuclear Non-Proliferation Treaty (US, Russia, China, France, UK) or countries that are not NPT signatories, i.e. India • countries that have not ratified the Comprehensive Test Ban Treaty (China, USA, India)	

No.	Submitter	Submission and/or issue	Response to comment
		• countries with a history of weapons-related research based on their civil nuclear programs (South Korea and Taiwan). **Provisions in bilateral agreements - enrichment and reprocessing** In addition to IAEA safeguards, countries purchasing Australian uranium must sign a bilateral agreement. However there are no Australian inspections of nuclear materials stockpiles or facilities using Australian Obligated Nuclear Materials (AONM - primarily uranium and its by-products such as plutonium) - Australia is entirely reliant on the inadequate and underfunded inspection system of the IAEA. The most important provisions in bilateral agreements are for prior Australian consent before Australian nuclear material is transferred to a third party, enriched beyond 20% uranium-235, or reprocessed. However no Australian government has ever refused permission to separate plutonium from spent fuel via reprocessing (and there has never been a request to enrich beyond 20% U-235). Even when reprocessing leads to the stockpiling of plutonium (which can be used directly in nuclear weapons), ongoing or 'programmatic' permission has been granted by Australian governments. Hence there are stockpiles of Australian-obligated separated plutonium in Japan and in some European countries. Japan, a major customer of Australian uranium, has a nuclear 'threshold' or 'breakout' capability - it could produce nuclear weapons within months of a decision to do so, relying heavily on facilities, materials and expertise from its civil nuclear program. An obvious source of fissile material for a weapons program in Japan would be its stockpile of plutonium - including Australian obligated plutonium. In April 2002, the then leader of Japan's Liberal Party, Ichiro Ozawa, said Japan should consider building nuclear weapons to counter China and suggested a source of fissile material: *"It would be so easy for us to produce nuclear warheads; we have plutonium at nuclear power plants in Japan, enough to make several thousand such warheads.*" Similar comments are made on a semi-frequent basis by Japanese politicians. Japan's plutonium program increases regional tensions and proliferation risks. Diplomatic cables in 1993 and 1994 from US Ambassadors in Tokyo describe Japan's accumulation of plutonium as *"massive"* and	

No.	Submitter	Submission and/or issue	Response to comment
		questioned the rationale for the stockpiling of so much plutonium since it appeared to be economically unjustified. A March 1993 diplomatic cable from US Ambassador Armacost in Tokyo to Secretary of State Warren Christopher, obtained under the US Freedom of Information Act, posed these questions: *"Can Japan expect that if it embarks on a massive plutonium recycling program that Korea and other nations would not press ahead with reprocessing programs? Would not the perception of Japan's being awash in plutonium and possessing leading edge rocket technology create anxiety in the region?"* Japan's plutonium stockpiling and reprocessing plans continue to cause regional concern - for example China has recently voiced concern. Moreover it continues to complicate efforts to prevent other regional countries (esp. South Korea) from going down the same plutonium/reprocessing path. Despite this, Australia continues to provide open-ended ('programmatic') approval for Japan to separate Australian-obligated plutonium. The government could and should prohibit the stockpiling of Australian-obligated Plutonium. At the very least, the government should revert to the previous Australian policy of requiring approval for plutonium separation / reprocessing on a case-by-case basis. It is frequently claimed that the *"strict"* or *"stringent"* conditions placed on AONM encourage a strengthening of non-proliferation measures generally. However by permitting the stockpiling of plutonium the Australian government is not 'raising the bar' but is setting a poor example and encouraging other uranium exporters to adopt or persist with equally irresponsible policies. While the Australian government does not have the authority to prohibit stockpiling, it does have the authority to permit transfers and reprocessing of AONM and could therefore put an end to the stockpiling of Australian-obligated plutonium. **Not all facilities processing AONM are subject to IAEA inspections** Australia allows the processing of AONM in facilities that are not covered by IAEA safeguards at all. While AONM is meant to be subject to IAEA safeguards from the enrichment stage onwards, ASNO is willing to make exceptions.	

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		For example ASNO has recommended that the Australian government agree to the processing of Australian uranium in unsafeguarded enrichment plants in Russia and the recommendation was readily accepted by the federal government. ASNO states: *"Russia does not propose to place these enrichment facilities on its Eligible Facilities List because the facilities were never designed for the application of safeguards and could not be readily adapted for safeguards purposes."* The enrichment facilities would not require any adaptation whatsoever. Russia simply needs to permit the application of safeguards and the IAEA could then adopt safeguards measures such as inspections, the use of video monitoring etc. **Australia's uranium exports are shrouded in secrecy** Nuclear transfers and developments demand the highest level of transparency, however this is often not the case. Some example of unjustified secrecy include the refusal of successive Australian governments to publicly release: 1. Country-by-country information on the separation and stockpiling of Australian-obligated plutonium. 2. 'Administrative Arrangements' which contain vital information about the safeguards arrangements required by Australia. 3. Information on nuclear accounting discrepancies (Material Unaccounted For) including the volumes of nuclear materials, the countries involved, and the reasons given to explain these accounting discrepancies. The JSCT recommended that: *"Further consideration is given to the justification for secrecy of Material Unaccounted For"*. 4. There is no legitimate justification for the secrecy surrounding MUF. ASNO has done no better than to cite commercial confidentiality. All MUF information, past, present and future, should be reported publicly and this should be done on a country-by-country and facility-by-facility basis. Some other countries (e.g. Japan) release MUF data and thus Australia's secrecy clearly fails to meet best practice.	

No.	Submitter	Submission and/or issue	Response to comment
		5. The quantities of AONM held in each country are confidential. ASNO states: "The actual quantities of AONM held in each country, and accounted for by that country pursuant to the relevant agreement with Australia, are considered by ASNO's counterparts to be confidential information." **Uranium sales to India** The public submitter considers that the Australian government has recently further compromised the safeguards system by signing a nuclear cooperation agreement with India that weakens safeguards standards in many respects. The Australian Parliament's Joint Standing Committee on Treaties (JSCT) argued that uranium sales to India should not proceed until stringent conditions have been met. Instead of taking this sound advice the government has, shamefully, rejected JSCT's recommendations. In its current form the agreement has been strongly opposed by, among others, a former Director General of the Australian Safeguards and Non-Proliferation Office (John Carlson), a former Chair of the Board of Governors of the International Atomic Energy Agency (Ronald Walker), a former Assistant Director of the US Arms Control and Disarmament Agency (Prof. Lawrence Scheinman), and an Australian nuclear arms control expert (Crispin Rovere). John Carlson, who headed Australia's safeguards office for 21 years, argued that the agreement with India *"represents a serious weakening of Australia's ... safeguards conditions"* and that weaknesses in the agreement *"mean Australian material could be used in support of India's nuclear weapon program.* It is likely that there will now be sustained pressure for Australia to apply equally inadequate standards to other countries. As John Carlson noted in a submission to JSCT: *"If the Government does compromise Australia's safeguards conditions, inevitably this will lead to other agreement partners asking for similar treatment."* The public submitter considers that other nuclear and uranium exporting countries are likely to follow Australia's lead and weaken their safeguards requirements. This disturbing and cascading retreat from responsibility would further compromise non-proliferation objectives and mechanisms.	

No.	Submitter	Submission and/or issue	Response to comment
18.	Denmark Env. Centre; PS3; PS10; PS21; PS34; PS36; PS43; PS47; PS49; PS53; PS54; PS55; PS57; PS61; PS63; PS68; PS69; PS70; PS74; PS78; PS80; PS82; PS84; PS86; PS101; PS105; PS109; PS112; PS114; PS115; PS127; PS130; PS135; PS137; PS138; PS139; PS148; Proforma 1	Submitters consider uranium mining and nuclear power is not economically worthwhile; impacts outweigh any financial gain: • The low grade means royalties are likely to be low, and therefore there will be a very poor return to the state. • Uranium mining in WA is not an economically worthwhile proposition. Whatever the gain will not compensate for the damage caused. Cheaper alternatives to power generation exist. • As the ore is low grade yellowcake, royalties are likely to be low. The financial gain to WA will be minimal and hardly worth the risks of contamination, environmental degradation and transport accidents. • Nuclear energy is not economic. It costly to set up and decommission. • Uranium is toxic to life and the wealth it creates. • Submitters were concerned that there would be long lasting impacts on human life, animals and the planet for financial gain and profits. • Dangers of uranium outweigh the benefits and are disproportionate to any financial return. • Good and useful purposes of uranium are recognised but it should not be mined simply for financial gain. • Assurances of safety (environmental and health) have been violated over profits. • Government should turn away from short term profits from resource mining and look into research and development investments.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.

No.	Submitter	Submission and/or issue	Response to comment
19.	Denmark Env. Centre; PND(WA); R. Chapple; PS8; PS16; PS23; PS33; PS35; PS36; PS43; PS55; PS57; PS61; PS63; PS64; PS68; PS70; PS81; PS82; PS84; PS85; PS86; PS89; PS93; PS99; PS104; PS105; PS106; PS107; PS109; PS110; PS111; PS113; PS117; PS118; PS120; PS123; PS128; PS129; PS134;	Submitters consider that nuclear power is not the answer; renewable energy is a better alternative: • Renewables are now cheaper than uranium, are more greenhouse friendly, safer, does not produce any toxic by-products and will increasingly be the preferred option for power generation. • Cameco should be focussing on renewable energy. Uranium in a non-sustainable fossil fuel and should not be used. • It is immoral and unethical to use dangerous technology when there are safer technologies available, such as renewable methods. • Renewable energy is rapidly becoming more cost competitive than nuclear energy. • Uranium is not required for future power generation. It is dangerous and expensive to use. • Nuclear energy is not clean/green and is not the solution to climate change. • Safer and more viable alternatives such as renewable energy or non-chemical based agriculture are available and should be used. Further research should be undertaken in alternative sources of energy. • Uranium promises an easy solution for energy. We need more time to solve the energy challenges currently faced.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.

No.	Submitter	Submission and/or issue	Response to comment
	PS135; PS134; PS144; Proforma 1		
20.	Denmark Env. Centre; PND(WA); CCWA; Uniting Church; PS1; PS3; PS8; PS10; PS16; PS17; PS19; PS20; PS35; PS38; PS40; PS44; PS45; PS49; PS50; PS51; PS52; PS55; PS63; PS65; PS66; PS70; PS77; PS81; PS82; PS89; PS91; PS93; PS99; PS100; PS106;	Submitters opposed to nuclear armaments and downstream impacts: • Australia's policy of selling to countries which have not signed the Nuclear Non-Proliferation Treaty means that we as the source should evaluate potential downstream environmental and social impacts. • Little progress has been made on the international framework of treaties to eliminate unacceptable weapons of mass destruction. • The health risk broadens as the uranium is processed and used for nuclear power. Australian uranium fuelled Fukushima's critically damaged reactors, inflicting health consequences on Japanese communities and beyond. • The unavoidable contribution of uranium mining to the nuclear fuel cycle, including the proliferation of nuclear weapons, is an issue of great concern. • The risks involved with extracting, storing, transporting and processing the ore and its by-products are much too high to be approved as a safe activity. It also creates a danger that criminal groups could obtain and sell or use uranium or waste products for terrorist purposes • Let us consider our future generations and put greater importance on our community and environment before money. • What right do the nuclear industry have to administer doses of carcinogenic radioactive material to all life forms and future generations without their consent? • Weapons grade byproducts of the nuclear industry are used to produce depleted uranium weapons. This could endanger human lives and cause birth defects, as evident from the aftermath of the Gulf War. • The extraction of uranium is expensive and would require astronomical costs for decommissioning the plants involved in the nuclear cycle. • Uranium supplies a fuel cycle that has massive costs and liabilities.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.

No.	Submitter	Submission and/or issue	Response to comment
	PS108; PS112; PS117; PS124; PS127; PS128; PS142; PS145; Proforma 1; Proforma 2	• Nuclear power stations take years to come online and once they do, require vast quantities of water which is a scarce commodity. • International safeguards do not work	
21.	Denmark Env. Centre; PND(WA); R Chapple; PS1; PS3; PS4; PS7; PS8; PS11; PS12; PS14; PS15; PS17; PS18; PS21; PS24; PS26; PS30; PS31; PS32; PS35; PS36; PS37; PS38; PS39; PS40; PS42; PS45; PS47; PS49;	Submitters concerned with the track record of the proponent: • Cameco has a poor record of operation overseas with allegations of tax fraud, flawed community consultation, radioactive leaks and spills and direct links to the production of depleted uranium weapons. There is a public record of mining operation accidents/incidents. Cameco have non-compliances with transport regulations. Essentially, we question the value of statements from the company regarding its management of this Project based on its previous record. Cameco has also faced tax avoidance charges. In order to deal with Uranium a company should have an exceptional record of social and environmental responsibility. Allegations about Cameco should be investigated and finding provided to the community. If allegations are true then providing a licence to operate to this company would be a negligent action. • Concern that the uranium industry will say that uranium is natural and mining activities do not expose workers to significantly greater levels of radiation than background radiation. • Proponents of uranium have minimal knowledge of mammalian biology, genetics, zoology or medicine and the ability for the food chain to concentrate certain chemicals many times over, whether they are radioactive or not, with severe consequences to people, especially children and significant costs to our health care system. • Uranium miners are masters at avoiding compensation and have damaged the environment. • Concern that mining industry lobby against regulations and red tape therefore take no responsibility.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.

No.	Submitter	Submission and/or issue	Response to comment
	PS50; PS53; PS60; PS61; PS79; PS80; PS101; PS106; PS111; PS124; PS127; PS142; Proforma 1; Proforma 2	• There is concern that the proponent cannot be trusted to protect the environment and health from radioactive pollution. Cameco was responsible for over 150 spills of radioactive material and contaminated water at uranium mines. A number of Australia medical professionals have also noted that Cameco is spreading misinformation that low level radiation is harmless.	
22.	Kalgoorlie – Boulder Chamber of Commerce & Industry; PS1; PS36; PS43	Transport Management – Assurance that transport routes have a transport management plan to deal with fatigue, incident management in collaboration with regional authorities. Significant breaches of risk and safety controls in mining in WA. Increased risk of transport accidents due to the distance the ore will travel on the roads, putting the environment and human heath at risk.	Detail of Cameco's Corporate Transport Standards, Emergency Preparedness and Response Program and Emergency Response Assistance Plan are provided in Section 2.4.5 of the PER. Prior to commencement of operations Cameco will be required to develop a Radiation Protection Programme which outlines a Transport Management Plan and a Source Security Transport Plan for approval by the regulators, under the State Radiation Safety (Transport of Radioactive Substances) Regulations 2002. These documents will need to consider the risks of transporting UOC from Yeelirrie to Port Adelaide. Under the *Mines Safety and Inspection Act 1994*, Cameco will be required to have an approved Project management plan (PMP) in place before any construction or mining operations commence. The PMP must be submitted to the State Mining Engineer for assessment, and approved prior to start-up.
23.	PND(WA); PS2; PS4; PS6; PS8; PS10; PS12; PS14; PS18; PS20; PS23; PS27; PS30; PS31; PS34; PS38; PS39;	Submitters support Traditional Owners in their opposition to mining at Yeelirrie: • Yeelirrie Traditional Owners say "Wanti – leave it in the ground". Nuclear Power is unnecessary, unwanted and uneconomic and therefore should be left in the ground. • Aboriginal people are united in their clear opposition to mining on their country, as the whole landscape is critical to them, not just the sites. The proposal violates their sense of caring for their country. • Uranium mining and its impact to Aboriginal people is deplorable. • Past mining, such as rum jungle has left areas so degraded that traditional owners are unable to use them.	Cameco has undertaken a range of consultation and communications activities and these will continue throughout the planning and implementation phase should the Project be approved. The notion that Aboriginal people are united against the Project is not true. Just like the non-indigenous community, there are numbers for and against most things, including mining and uranium. While Cameco has met with some people who do not want the Project to proceed, we have also met with many others who want the opportunity to be part of a regional economy, to have jobs and the opportunity to stay in the region and be able to pursue education and employment opportunities which Projects like Yeelirrie offer. Cameco has discussed the Heritage landscape in Section 9.11 of the PER and has made commitments to ongoing consultation about heritage.

No.	Submitter	Submission and/or issue	Response to comment
	PS42; PS44; PS45; PS47; PS51; PS54; PS59; PS60; PS61; PS63; PS64; PS65; PS67; PS69; PS70; PS71; PS74; PS75; PS76; PS77; PS79; PS80; PS81; PS84; PS85; PS87; PS89; PS90; PS93; PS94; PS95; PS96; PS97; PS98; PS99; PS100; PS101; PS103; PS104; PS106; PS107; PS108; PS109; PS111;	• Consideration and respect should be given to Traditional Owners, their knowledge and their wishes. They have a good understanding of the land and know the soil must not be disturbed. • Their rights should not be undermined for financial gain. Yeelirrie is also a culturally significant area and mining would impact on the local community. • The rights of the Aboriginal people are exercising pursuant to Section 111 of the EP Act come under the authority of the Native Title Act 1993.	

No.	Submitter	Submission and/or issue	Response to comment
	PS112; PS118; PS119; PS120; PS122; PS123; PS124; PS125; PS126; PS127; PS128; PS129; PS131; PS132; PS136; PS137; PS139; PS142; PS143; PS144; PS146; PS148; PS149; Proforma 1; Proforma 2		
24.	PND(WA); Uniting Church; PS10; PS19; PS20; PS22; PS34; PS35; PS40; PS42; PS47; PS52; PS53; PS55; PS58;	Submitters concerned with the long-term storage of nuclear and radioactive waste; impacts to future generations: • PND (WA) believes that Western Australia can make a great contribution to moving the nuclear disarmament agenda forward simply by leaving uranium deposits in the ground. If WA becomes a uranium exporter, there would likely be pressure to accept returned waste from its use. • There is no accounting for the hazardous waste produced from full nuclear cycle of which uranium mining is the beginning process. Existing deep nuclear waste sites containing waste have all leaked. Storage of nuclear waste from the nuclear industry should be resolved before further consideration of uranium mining.	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.

No.	Submitter	Submission and/or issue	Response to comment
	PS59; PS61; PS63; PS64; PS65; PS69; PS70; PS73; PS74; PS76; PS77; PS80; PS81; PS82; PS86; PS87; PS88; PS90; PS92; PS96; PS98; PS100; PS103; PS104; PS106; PS108; PS113; PS116; PS117; PS120; PS124; PS125; PS127; PS128; PS130; PS134; PS138; PS139; PS140; PS142; PS143; Proforma 1;	• Safely isolating the long-lived waste from nuclear power plants remains an unsolved quest after seven decades of commercial nuclear power experience. • There is no way to dispose of the by-products of uranium once it's been used. It continues to emit harmful radiation dangerous to humans and animals. This means committing to long term storage measures. • Radioactive waste cannot be safely stored. • Humans are yet to demonstrate that they can unleash nuclear energy in an environmentally sustainable manner. • Australia cannot commit to the provision of long term storage for this dangerous waste material. • Who can guarantee the continuing safe storage of such material once the profit from its use is gone? • Who will monitor the storage for thousands of years? • Would leave a legacy for future generations to deal with. • The country who produces the uranium waste should keep it. • Miners are only here in the short term but people of this region will be living here for generations. • There is enough mined uranium to satisfy medical applications and that required for aging nuclear plants should come from decommissioned war heads. • It is certain that the long term impacts of mining uranium can be utterly devastating, including immediate impacts to people, plants and animals. • Waste of the nuclear industry, more lethal than tobacco and asbestos • Radioactive for greater than 100,000 years • Radioactive waste poses a public health risk • Once mined, uranium is considered a "dangerous good" – accident waiting to happen • Safety and containment records from other uranium mines aren't great. • Using low grade ore results in greater impact due to more waste. • This is a breach in human rights.	

No.	Submitter	Submission and/or issue	Response to comment
	Proforma 2		
25.	PS1; PS147	Concern about a natural disasters such as cyclone, earthquake, fire or flood occurring and causing a huge ecological and economic impact in WA. Concern about the environmental and economic risk within Western Australia as a result of disasters such as cyclone, earthquakes, fire, flood which occur at Yeelirrie. There is no assurance that a uranium industry disaster will not occur in Western Australia, and there is no hope of rectifying a significant ecological and economic impact.	Extreme natural events such as cyclones, earthquake, figure and flood are discussed in Section 7.7. These data have been taken into consideration in Project design, for example with regards to stormwater management (Section 9.4), TSF design (Appendix D) and final landform design (Section 8.12 and Appendix O).
26.	PS2; PS17; PS26; PS27; PS31; PS33; PS35; PS36; PS40; PS43; PS51; PS53; PS54; PS60; PS61; PS63; PS64; PS65; PS67; PS68; PS70; PS71; PS72; PS74; PS75; PS76; PS77; PS78; PS79; PS80;	General opposition to uranium mining and nuclear power; concerns with safety and health impacts: • Uranium is unnecessary, unwanted and should be kept in the ground. • Uranium mining brings danger. • Objection to uranium mining simply on the precautionary principle of avoiding harm. It is impossible to prove beyond reasonable doubt that the products of mining, processing, use and disposal of the nuclear industry can be guaranteed to be safely and harmlessly stored for approximately 250,000 years it will take for the radioactivity to degrade. • Uranium is unsafe and poses risks to local communities and workers. • The nuclear power industry is dangerous. The technology is not safe and prone to failure, and there are examples of nuclear disasters in the past. • The effects of uranium such as from accidents are disastrous and causes devastation. This is evident from past examples. • Uranium is harmful and toxic, and should not be used at all for any purpose including medicine. • Uranium creates radioactive waste and poses a long term public health risk. • Uranium mining creates hazardous by-products, which can get transported by air or water and impact on humans and the environment. • Accidents at uranium mines are more dangerous than other mines due to the potential to release carcinogenic particles	Comments noted. The Submission raises issues beyond the scope of the EPA's environmental impact assessment under s. 44 of the *Environmental Protection Act 1986* (WA) and has therefore not been addressed in detail. Cameco would be happy to provide responses to any of the specific issues if requested by the EPA.

No.	Submitter	Submission and/or issue	Response to comment
	PS81; PS82; PS83; PS84; PS85; PS89; PS90; PS91; PS93; PS94; PS95; PS96; PS98; PS99; PS100; PS101; PS102; PS104; PS105; PS103; PS107; PS108; PS111; PS112; PS113; PS114; PS115; PS116; PS117; PS118; PS119; PS120; PS121; PS123; PS124; PS125; PS126; PS128; PS129; PS130; PS132; PS133; PS134; PS135;	into the environment. This can cause significant impacts to health. • Uranium is dangerous and radiation from the mine could cause long term health hazards. It can cause impacts on the health of children and future generations. • The mine would risk the health and wellbeing of animals and humans living close to the mine. • Uranium used in peace and war does not create a better planet. • The world does not need another nuclear accident. • The environment must be protected, or it will no longer be fit for living. • Environmental degradation and health risks are well documented. • Opposition to the economic reliance on mining, and to come up with new ideas and solutions. • Opposition to mining as untouched wilderness areas are invaluable for psychological health. • If you wouldn't have it in your neighbourhood, you have no right to force it in other neighbourhoods. • Uranium has many negative effects on the earth, people and wildlife. • Uranium mining would have dangerous consequences for people. • Uranium mining has a poor record when it comes to safety. • The long term risks and hazards posed by the nuclear industry are not manageable. • Implications of uranium mining are long term. • Australian uranium becomes global nuclear pollution. • Progress should be made to reduce global population and consumption to reduce demand for uranium. • Environmental catastrophe with irreversible consequences • Contamination of the environment. • Progress should move away from uranium fission, which is dangerous, but towards safer types of fission and fusion. • Australia has a reputation for being a clean and safe country. This is another step towards destroying what is good here.	

No.	Submitter	Submission and/or issue	Response to comment
	PS136; PS137; PS138; PS139; PS140; PS141; PS142; PS143; PS144; PS145; PS146; PS148; PS149; PS100; Proforma 1; Proforma 2		
27.	PS86	Development could impact on the balance of the ecosystem.	The PER presents the results of comprehensive biological surveys. The results of the work completed suggest the Project can be managed without having a significant impact on the environment.
28.	PS90	This proposal will breach s50A of the EP Act. The objective of the EP Act is to protect and nurture ecosystems and biodiversity. The Minister should apply Section 51B and declare the area to be an environmentally sensitive area.	Cameco has undertaken comprehensive studies to understand the environment and how to manage the potential impacts of the Yeelirrie Project were it to proceed. Cameco has a comprehensive policy approach to safety, health, the environment and quality which will ensure the impact of the Project is acceptable and managed.
29.	PS98	Approval should not be given unless it can be satisfied that mining uranium including the long term implications will not cause environmental harm.	The process that the company are currently engaged in, the environmental impact assessment process, provides the opportunity for assessment of the likely impacts of the Project and approval would only be granted if the EPA and the Minister considered that the Project would not cause environmental harm.
30.	PS147	The uranium industry and representative bodies are constantly decrying the regulation approach. They would rather have nil responsibilities and accountability.	Cameco and the industry works closely with government agencies and regulators at State and Federal level to ensure that regulation is clear and effective. It is in the industries best interests to have strong regulation to provide confidence to the community.
31.	PS147	Proactive audits on existing mines are rarely conducted by the EPA due to funding pressures and the expanse of Western Australia. The economic turn down will result in further pressures on regulatory bodies (through job cuts) and additional uranium mines would further weaken the regulatory inspection capability.	Recently both of Cameco's projects in Western Australia were visited by regulating agencies. The Yeelirrie Project despite having no activity has been visited and inspected twice in the last two years, while the Kintyre exploration Project was audited in 2015. Regulatory agencies have been upskilling in relation to uranium exploration and mining and Cameco's experience is in contrast to the sentiment expressed by the submitter.

No.	Submitter	Submission and/or issue	Response to comment
32.	PS62; PS150	Support was given for the proposal.	Comment noted.
33.	PS60	We do not know what the consequences to the universe are from destroying atoms in nuclear reactors. There is research that establishes the connection between atoms and the universe.	The Project does not involve destroying atoms or nuclear reactors. The comment is beyond the scope of this assessment.
34.	PS53	Legislation is not adequate to provide sufficient safe guards in relation to this product.	Cameco believes the suite of Guidelines, Codes and Regulation, developed at a global, national and State level applied to mining, milling and shipment of uranium and radiation management provides very robust safeguards for the environment and public health.
35.	Proforma 1	Little confidence in the EPA's process and its decisions	Cameco considers the EPA's processes supported with the advice of other agencies provides a robust process for Project approvals in Western Australia.
36.	Proforma 1	Uranium is mined as pitchblende ore, which have low level radioactivity and remain as tailings, but these tailings are in the form of a very light powder which readily becomes air and waterborne.	The submitter should note that ore at Yeelirrie is Carnotite and not Pitchblende. Tailings management is addressed in Section 6.5.4 of the PER. Cameco has presented a number of management options to control dust from the tailings storage facilities including keeping the areas moist, which will both limit dust and radon exhalation.
37.	Proforma 2	Concerns that Oakajee port will be used for Uranium export	The proposal is limited to road transport of product from the mine to the Port of Adelaide. While Cameco cannot predict what might happen in the future, it is currently Government policy not to allow export through a Western Australian port. See additional comments in the response to comment number 8 in the General Section.

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