



8 ENVIRONMENTAL RISK ASSESSMENT

8.1 Risk assessment methodology

Environmental risk assessment is the process undertaken to identify, evaluate and mitigate potential environmental impacts of a proposed development. As the environmental assessment for the Facility included input from a wide range of technical disciplines, a Proposal based environmental risk assessment was undertaken to ensure consistency in determining the level of risks.

A standardised approach to evaluating significance of risks does not replace the methodologies used by technical disciplines to identify or assess impacts, nor does it replace methods of impact assessment prescribed by existing guidance. Rather, it adds to the impact assessment by providing clear, more readily comparable conclusions regarding the significance of impacts.

The risk assessment methodology has been devised by the proponent based upon the broad definitions, methodology and principles outlined in AS/NZS ISO 31000:2009. The standardised risk assessment for the Proposal involved the following steps:

8.1.1 Hazard identification

- The identification of potential environmental hazards associated with various components ('aspects') of the Proposal.
- Identifying the nature of the identified hazards (defined as 'beneficial', 'neutral' or 'adverse').

8.1.2 Pre-mitigation risk

- Assessing the 'likelihood' of an identified hazard occurring.
- Defining the 'consequence' of the hazard occurring, as described by impacts of health and safety, environmental, financial, Proposal delivery or social impacts.
- As a product of the likelihood and consequence, determining the pre-mitigation composite risk index i.e. 'risk' (CRI = likelihood x consequence).

8.1.3 Identifying required mitigation

- Identifying the mitigation required to control the risk as a consequence of likelihood of the hazard.
- Identifying the mitigation required to control the risk as a consequence of the hazard.
- Documenting the owner of those mitigation actions, the time and cost implications and detailing a review date.



8.1.4 Post-mitigation risk

- Reassessing the 'likelihood' of an identified hazard occurring in light of the implemented mitigation.
- Reassessing the 'consequence' of the hazard occurring in light of the implemented mitigation.
- As a product of the mitigated likelihood and consequence, determining the post-mitigation composite risk index i.e. 'risk'. This is often termed as 'residual risk' or occasionally 'current risk'.

The environmental and social systems, resources and receptors potentially affected by the Proposal were defined through desktop based research, field surveys and preliminary consultation with key agencies within the WA Government, regional stakeholders and local communities.

8.1.5 The nature of an identified hazard

By definition, a 'hazard' is described as a source of potential harm, but as the risk assessment methodology may be used to identify beneficial impacts in this context a 'hazard' is identified as impact of the Proposal of whatever nature). For the purposes of this assessment the following descriptors are used:

- **Beneficial:** The hazard has a potential beneficial impact upon the environment.
- **Neutral:** The hazard has neither a beneficial or adverse impact on the environment. Occasionally, the term 'benign' is used. Typically, a hazard would be categorised as having a neutral nature post-mitigation.
- **Adverse:** The hazard has a potentially adverse impact on the environment.

8.1.6 Evaluating likelihood

The likelihood of a hazard and an impact occurring can be described in terms of probability. Overlaying this is the need to recognise that uncertainty may be associated with potential risks occurring, particularly during the initial risk assessment process. Where scientific uncertainty exists, a precautionary approach was taken which identified a higher level of risk. Each identifiable impact can be assigned a likelihood of occurring, ranging from rare to almost certain.

In simplifying the potential impacts for the purpose of a risk assessment, an element of subjectivity is introduced. The purpose of the risk assessment is not necessarily to agree on the probability of any particular impact, but to facilitate an understanding of the relative probability of different impacts.

The pre-mitigation assessment of likelihood needs to account for the probability of an identified hazard occurring, assuming the incorporation of 'designed-in' mitigation that would be required to comply with legislation, relevant guidance, or otherwise which is intrinsic to the design specification upon which the development proposal has been based.



Columns two to four in Table 8-1 give descriptions that elaborate on the possible likelihood categories. These are presented to help view the impact from different perspectives.

Table 8-1 Likelihood of a hazard

Likelihood	Description	Probability	Mid-interval	Community outlook
Almost certain	Is expected to occur in most circumstances	0.91–1.00	0.95	Almost everyone affected
Likely	Would probably occur in most circumstances	0.61–0.90	0.75	Most people affected
Possible	Might occur at some time	0.41–0.60	0.50	Many people affected
Unlikely	Could occur at some time	0.11–0.40	0.25	Some people affected
Rare	May occur only in exceptional circumstances	0.01–0.10	0.05	Few or no people affected or interested

8.1.7 Evaluating consequence

To determine the consequence of potential impacts, clearly described thresholds were developed which included the scale of impact, its geographic extent, duration, ecological and social sensitivity, reversibility, cumulative effects and likelihood of occurrence.

In simplifying the potential impacts for the purpose of a risk assessment, an element of subjectivity is introduced. The purpose of the risk assessment is not necessarily to agree on the defined consequence of any particular hazard, but to facilitate an understanding of the relative impacts.

The pre-mitigation assessment of consequence needs to address the severity of an identified hazard occurring, assuming the incorporation of ‘designed-in’ mitigation that would be required to comply with legislation, relevant guidance, or otherwise which is intrinsic to the design specification upon which the development proposal has been based.

Table 8-2 give descriptions that elaborate on the possible consequence categories. These are presented to help view the impact from different perspectives.



Table 8-2 Consequence of a hazard

Descriptor	Description (examples)				
	Health	Environmental	Financial loss	Proposal delivery	Social
Catastrophic	Death	Toxic release offsite with detrimental effect	Cessation of production capability/huge financial loss	Proposal incapable of completion/Un viable	No social licence to operate
Major	Extensive injuries	Offsite release with no detrimental effects	Loss of production capability Major financial loss	Proposal can only be completed with major changes (redesign)	Reactive media plan, recovery plan, working committees
Moderate	Medical treatment required	Onsite release contained with outside assistance	High financial loss	Proposal can be completed with moderate changes	Additional meetings
Minor	First aid treatment	Onsite release immediately contained	Medium financial loss	Proposal can be completed with changes	Additional local engagement
Insignificant	No injuries	None	Low financial loss	Trivial	Insignificant

8.1.8 Evaluating risk

The risk of an identified hazard (sometimes also called the ‘significance’) was determined as a product of the likelihood of the hazard and its consequence on the environment, resource, social value or receptor that it would potentially impact, or as a consequence to the delivery of the Proposal, assuming that the mitigation required to comply with legislation, relevant guidance and the design specifications for the Proposal have been implemented.

In order to standardise the significance rating assigned to potential environmental impacts, a matrix was developed and two multi-disciplinary workshops were held by key members of the environmental assessment team in May and October 2015 and again in April 2016.

A generic set of risk criteria is defined (refer to Table 8-3) and enables a consistent description of both adverse and beneficial impacts. In each chapter, the significance criteria are made relevant to the topic being considered.



Table 8-3 Generic significance criteria

Significance	Criteria
Extreme	These impacts are considered critical to the decision making process. They tend to be permanent, or irreversible, or otherwise long term, and can occur over large scale areas. These effects are generally but not exclusively associated with sites and features of and/or the impacts of national importance. Typically, mitigation measures are unlikely to remove such effects.
High	These impacts are likely to be of importance in the decision making process. They tend to be permanent, or otherwise long to medium term, and can occur over large or medium scale areas. Environmental receptors are high to moderately sensitive, and/or the impacts are of state significance.
Medium	These impacts are relevant to decision making, particularly for determination of environmental management requirements. These impacts tend to range from long to short term, and occur over medium scale areas or focused within a localised area. Environmental receptors are moderately sensitive, and/or the impacts are of regional or local significance.
Low	These impacts are recognisable, but acceptable within the decision making process. They are still important in the determination of environmental management requirements. These impacts tend to be short term, or temporary and at the local scale.
Eliminated	As a result of mitigation, the likelihood and/or the consequence has been removed.

8.1.9 Risk assessment matrix

Based on the assessment of likelihood and consequence, any foreseeable impact can be assigned a risk rating. The environmental assessment is at this point intended to focus on potentially significant environmental risks and impacts.

Table 8-4 is to be read as a matrix, with increased consequence across the top and increased likelihood on the far left column. Any potential impacts that fall in the top left of the matrix are therefore addressed as *key environmental issues requiring detailed environmental assessment* in the PER. Impacts that fall into the bottom right of the matrix are addressed as *other issues* in the PER.

Table 8-4 Risk matrix

Consequence \ Likelihood	Eliminated	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Eliminated	High	High	High	Extreme	Extreme
Likely	Eliminated	Medium	Medium	High	High	Extreme
Possible	Eliminated	Low	Medium	Medium	High	High
Unlikely	Eliminated	Low	Low	Medium	Medium	High
Remote	Eliminated	Low	Low	Low	Medium	Medium
Eliminated	Eliminated	Eliminated	Eliminated	Eliminated	Eliminated	Eliminated

8.1.10 Duration

This assessment also requires consideration of the duration of the impact (refer to Table 8-5) and any relevant EPBC Act Significant Impact Guidelines for Matters of National Environmental Significance.



Table 8-5 Relative duration of environmental effects

Duration of environmental effects	Period
Temporary	Days to months
Short-term	Up to 1 year
Medium-term	From 1 to 5 years
Long-term	From 5 to 50 years
Permanent/irreversible	Over multiple generations

8.1.11 Uncertainty

The uncertainty of risk is evaluated according to the following descriptors:

- **Low:** the risk has been determined through quantitative assessment procedures, or is determined to a high degree by a person with adequate skill and experience to make the assessment.
- **Medium:** the risk has been evaluated through qualitative assessment and represents a reasonable estimate of risk under normal circumstances.
- **High:** the risk is largely unknown.

8.1.12 Potential impacts

The initial risk assessment takes into consideration outline management and mitigation measures including design changes within the development of the proposal. The residual risk assessment takes into consideration additional mitigation measures identified as necessary to lower the significance, frequency or risk of an impact occurring.

The results of the environmental risk assessment for the Proposal are contained within Appendix A.2. This combined with the OEPA's guidelines for the preparation of a PER and the contents of the ESD identified the key issues for consideration.

8.2 Mitigation identification and residual impact assessment

Once the pre-mitigation risks were determined, relevant mitigation measures were developed. Key considerations for the preferred mitigation measures were to:

- Be appropriate in terms of effort and expense to the scale and nature of the impact.
- Target the protection and/or restoration of the resources affected.
- Respond to the appropriate level in the 'mitigation hierarchy' i.e. avoid > minimise > rehabilitate > manage > offset/compensate.
- The level of mitigation measures proposed should respond to the significance of the relevant impacts identified. For example:
 - An impact considered to be of extreme significance (where not simply considered grounds for a fundamental re-design of the Proposal) would need to be met with a high level of mitigation that avoids, eliminates or makes provisions for full offsetting or



compensation in advance and ensures that measures are demonstrably effective. Compliance with international and national standards and the use of specialists with internationally or nationally recognised expertise would be required in development and implementation. A high level of ongoing monitoring would be required.

- Conversely an impact that was considered to be of low significance may either not need mitigation at all or only require management by control of impacts through day to day management with only occasional monitoring required as validation.

Table 8-6 provides a summary of the approach that was implemented when developing mitigation and management measures. This approach ensured that the level of mitigation proposed for each impact was appropriate and in proportion to the level of impact significance.

Once mitigation and management measures were identified, residual impacts were assessed. As previously stated, the pre-mitigation risk assessment assumes the incorporation of 'designed-in' mitigation that is required to comply with legislation, relevant guidance, or otherwise which is intrinsic to the design specification upon which the development proposal has been based.

This was achieved through assessing and describing the effects of mitigation and subsequently, how the proposed measures would reduce: (i) the likelihood of the hazard; and/or (ii) the consequence of the hazard.

8.3 Indirect impacts

Indirect impacts were considered within the environmental assessment for the Proposal. For example, vibration effects from the blasting of geological strata during mine shaft construction may permanently dislodge rocks on surrounding hills which may in turn have adverse impacts on cultural heritage or landscape and visual amenity. Each technical discipline considered both direct and indirect impacts of the Proposal by undertaking the following steps:

- Clearly identifying the cause/effect relationships between each action and impact.
- Taking a conservative approach by assuming the most significant likely magnitude of the relevant impact.
- Clearly stating factors affecting the worst case and likely case outcomes.



Table 8-6 Management and mitigation measures

Initial impact significance rating	Mitigation response
Extreme	Risks must be designed out, eliminated or fully offset or compensated with offset and/or compensation measures in place before the Proposal proceeds. International and national standards would need to be complied with and specialists with internationally or nationally recognised expertise should be involved in development and implementation of mitigation and offsetting. High level of ongoing monitoring is required to confirm effectiveness of mitigation measures and whether additional mitigation or other corrective actions are required.
High	High impacts must be avoided wherever possible and otherwise offset or fully compensated. An environmental bond must be in place. Ongoing monitoring is recommended to confirm effectiveness of mitigation and management measures.
Medium	Management of impact would be required and closely monitored to check that impacts are not more severe than predicted. Replacement may be required where consequence of the action on resources of low or moderate value is extreme (i.e. complete loss of the resource). Rehabilitation of disturbed areas is likely and monitoring required to check effectiveness of mitigation measures.
Low	Management of impacts should be addressed in day to day management. Monitoring may be required to validate that impacts are low.
Eliminated	No mitigation or management is typically required.

8.4 Cumulative impacts

Cumulative impacts can be defined as impacts on the environment, which result from the incremental impact of an action when added to other past, present or reasonably foreseeable future actions, regardless of what agency or person undertakes those other actions (Carroll and Turpin 2009).

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time or from a combination of concurrent effects from a single action. They can be additive, synergistic or interactive and can result in impacts that are larger, more significant and longer lasting than is the case with individual impacts and their effects.

There is no defined process for undertaking cumulative impact assessments (CIA) within Australia. Considerations related to cumulative impacts are included in the Commonwealth Environment Protection and Biodiversity Conservation Regulations 2000.

The above Regulations state the need to assess cumulative impacts in relation to World Heritage Areas and Ramsar sites but do not provide any guidance on scoping and carrying out CIA. Table 8-7 describes the approach taken for the Proposal in determining potential cumulative impacts.



Table 8-7 Cumulative impact methodology

Method	Comment
Spatial boundaries	Setting boundaries is the process of establishing the limits of the area to be assessed for cumulative impacts and the identification of activities within this boundary. The primary spatial boundary for the CIA is the Proposal footprint – this is the area that is under project control and responsibility, i.e. the Proposal Area. However, boundaries can vary from issue to issue and need to reflect ecosystem requirements rather than artificial boundaries.
Temporal boundaries	Cumulative impacts during the construction phase are likely to be short-term and localised to the Proposal footprint and immediate surrounds. Operation phase impacts are more likely to be medium to long-term (e.g. continuing for more than two years after the activity has ceased, or ongoing) and to extend beyond the Proposal footprint.
Proposal approach	Cumulative impacts have been addressed separately within each of the individual chapters in order to reflect the differing spatial and temporal boundaries of each environmental aspect.