Appendix 6

SEPP 33 Risk Screening and Preliminary Hazard Analysis

(Total No. of pages including blank pages = 28)

(Note: A colour version of this Appendix is available on the Project CD)

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A6.1 INTRODUCTION

Consideration has been given as to whether the Proposed Modification should be considered a hazardous or potentially hazardous industry under *State Environmental Planning Policy 33 – Hazardous and Offensive Development* (SEPP 33). This assessment was undertaken in accordance with the risk the procedures identified by:

- *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 – January 2011* (SEPP 33 Guidelines);
- *Risk Assessment – Hazardous Industry Planning Advisory Paper No 3* (HIPAP 3);
- *Risk Criteria for Land Use Safety Planning – Hazardous Industry Planning Advisory Paper No 4* (HIPAP 4);
- *Hazard Analysis – Hazardous Industry Planning Advisory Paper No 6* (HIPAP 6); and
- *Assessment Guideline – Multi-level Risk Assessment – May 2011* (Risk Assessment Guideline).

This assessment comprises three components as follows.

- A Risk Screening – to determine if the Proposed Modification is potentially hazardous.
- A Risk Classification and Prioritisation – to determine the level of risk assessment required for those aspects of the Proposed Modification determined to be potentially hazardous.
- A Risk Assessment – undertaken to the level of detail determined by the previous component.

A6.2 RISK SCREENING

This risk screening was undertaken in accordance with the method set out in Section 7 of the SEPP 33 Guidelines.

Table A6-1 identifies the reagents that would be used within the Project Site, including those that were identified in RWC (2010a) and those reagents that would be required for the proposed cyanide leaching operations. The table also identifies the class and packing group for each reagent identified from the Material Safety Data Sheet for each and the relevant screening thresholds for storage of potentially hazardous industries. In addition, **Table A6-2** presents the relevant transportation-related thresholds for the identified reagents.

As indicated in **Tables A6-1** and **A6-2,** sodium cyanide is the only reagent that meets the screening thresholds. The following sub-sections provide an assessment of the risks associated with transportation and storage of this material within the Project Site.

Table A6-1
Hazardous Materials Storage with the Project Site

Material	Class/ Packing Group[1]	Description	Storage Quantity	Storage Location	Approx. Distance to Site boundary	Threshold Limit	Threshold Triggered
Reagents identified in Table 2.5 of RWC (2010a)							
Copper Sulphate Pentahydrate	9/ PGIII	Powder delivered in 25kg bags	1t	Undercover area in processing plant	125m	No limit	No
Potassium Amyl Xanthate	4.2/ PGIII	Powder delivered in 25kg bags	0.9t	Undercover area in processing plant	125m	1t	No
IF6500	ND	Liquid delivered in $1m^3$ IBCs	1 000L	Bunded, undercover area in processing plant	125m	No limit	No
MF351	ND	Powder delivered in 25kg bags	2t	Undercover area in processing plant	125m	No limit	No
Nitric Acid	8/ PGII	Liquid delivered in $1m^3$ IBCs	2 000L	Bunded, undercover area in processing plant	125m	25t	No
LPG	2.1/ -	Gas stored in bulk 3t tank	3t	Adjacent to processing plant	125m	10t/ $16m^3$	No
Proposed Additional Reagents							
Sodium Cyanide	6.1/ PGI	Solid briquettes	22t	Separate bunded area with in processing plant	125m	0.5t	**Yes**
Lime	ND	Powder delivered in bulk	10t	Bulk 10t silo	125m	No limit	No
Caustic	8/ PGIII	Liquid delivered in $1m^3$ IBCs	4 000L	Bunded, undercover area in processing plant	125m	50t	No
Sodium Metabisulphite	ND	Powder delivered in 1t bulka bags	10t	Undercover area in processing plant	125m	No limit	No
Oxygen	2.2/ -	Gas stored in bulk $60m^3$ tank	$60m^3$	Adjacent to processing plant	125m	No limit	No
Hydrogen chloride	8/ PGII	Liquid delivered in $1m^3$ IBCs	5 000L	Bunded, undercover area in processing plant	125m	25t	No
Note 1: ND = Non dangerous							
Source: Big Island Mining Pty Ltd							

Table A6-2
Hazardous Material Transportation

Material	Class/ Packing Group[1]	Average No. of Loads	Threshold Limit	Approximate Load Size	Threshold Triggered
		Loads per Year			
Reagents identified in Table 2.5 of RWC (2010a)					
Copper Sulphate Pentahydrate	9/ PGIII	40	>1 000	1t	No
Potassium Amyl Xanthate	4.2/ PGIII	40	>100	0.9t	No
IF6500	ND	15	-	1 000L	No
MF351	8/ PGII	35	>500	1t	No
Nitric Acid	ND	35	-	1 000L	No
LPG	2.1/ -	10	>500	3t	No
Proposed Additional Reagents					
Sodium Cyanide	6.1/ PGI	6	nil	22t	**Yes**
Lime	ND	25	-	10t	No
Caustic	8/ PGIII	40	>500	4 000L	No
Sodium Metabisulphite	ND	30	-	10t	No
Oxygen	2.2/ -	40	-	60m^3	No
Hydrogen chloride	8/ PGII	40	>500	5 000L	No
Note: ND = Non dangerous					
Source: Big Island Mining Pty Ltd					

A6.3 RISK CLASSIFICATION AND PRIORITISATION

A6.3.1 Overview of the Proposed Modification

Sodium cyanide is a Class 6.1 chemical. Section 2.5.4.4 of the *Environmental Assessment* provides a description of the proposed storage, use and disposal of sodium cyanide. In summary, the material would be delivered to the Project Site in 22t "isotainers" or containers specifically designed for the transportation of such materials. It would be delivered as solid briquettes, mixed with caustic to ensure that the pH of the material remains above 9, thereby limiting the potential for generation of HCN gas. The delivery route(s) would be selected, subject to a risk assessment and approval obtained for their use by the supplier of the material.

On delivery, the isotainer would be transferred to a bunded area, connected to a sparging system and water would be pumped into the isotainer, dissolving the sodium cyanide and transferring the resulting solution to a bunded and secured storage tank.

The sodium cyanide solution would be progressively transferred to bunded leaching tanks to leach the gold from the ore. Following the completion of leaching operations, the tailings slurry would be passed to a thickener where a proportion of the leaching solution would be recovered for reuse. The remainder would be subjected to the Inco cyanide destruction process.

Following cyanide destruction, the tailings would be pumped to the Tailings Storage Facility via a bunded pipeline. The pipeline would be equipped with leak detection monitors and automated pump shut downs. The Tailings Storage Facility would be lined to achieve a permeability of 1×10^{-9}m/s over 900mm or better. The Tailings Storage Facility would also be fenced.

All relevant infrastructure would be inspected multiple times per day.

A6.3.2 Overview of the Assessment Methodology

Appendix 5 of the SEPP 33 Guideline identifies that the Preliminary Hazard Analysis should be undertaken using a multi-level approach to risk assessment. This approach is summarised in **Figure A6-1**. In summary, for those projects determined to be potentially hazardous, three levels of assessment exist as follows.

- Level 1 – Qualitative Analysis where:
  - screening and risk classification and prioritisation indicate there are no major offsite consequences and societal risk is negligible;
  - the necessary technical and management safeguards are well understood and readily implemented; and
  - there are no sensitive surrounding land uses.
- Level 2 – Semi-quantitative Analysis where screening, hazard identification and/or risk classification and prioritisation has identified one or more risk contributors with consequences beyond the site boundaries but with a low frequency of occurrence.
- Level 3 – Quantitative risk analysis where the above requirements cannot be achieved.

In determining the level of assessment required, the risk classification and prioritisation methodology identified in Appendix 1 – Section A1.2 of the Risk Assessment Guideline is to be used.

A6.3.3 Non-transportation Risk Classification and Prioritisation Assessment

A6.3.3.1 Introduction

This risk classification and prioritisation assessment for the storage, use and disposal of sodium cyanide has been undertaken in accordance with the procedure identified in Appendix 1 – Section A1.2 of the Risk Assessment Guideline. The following subheadings correspond with the steps identified in the guideline. A risk classification and prioritisation assessment for transportation of sodium cyanide is presented in Section 5.3.3.

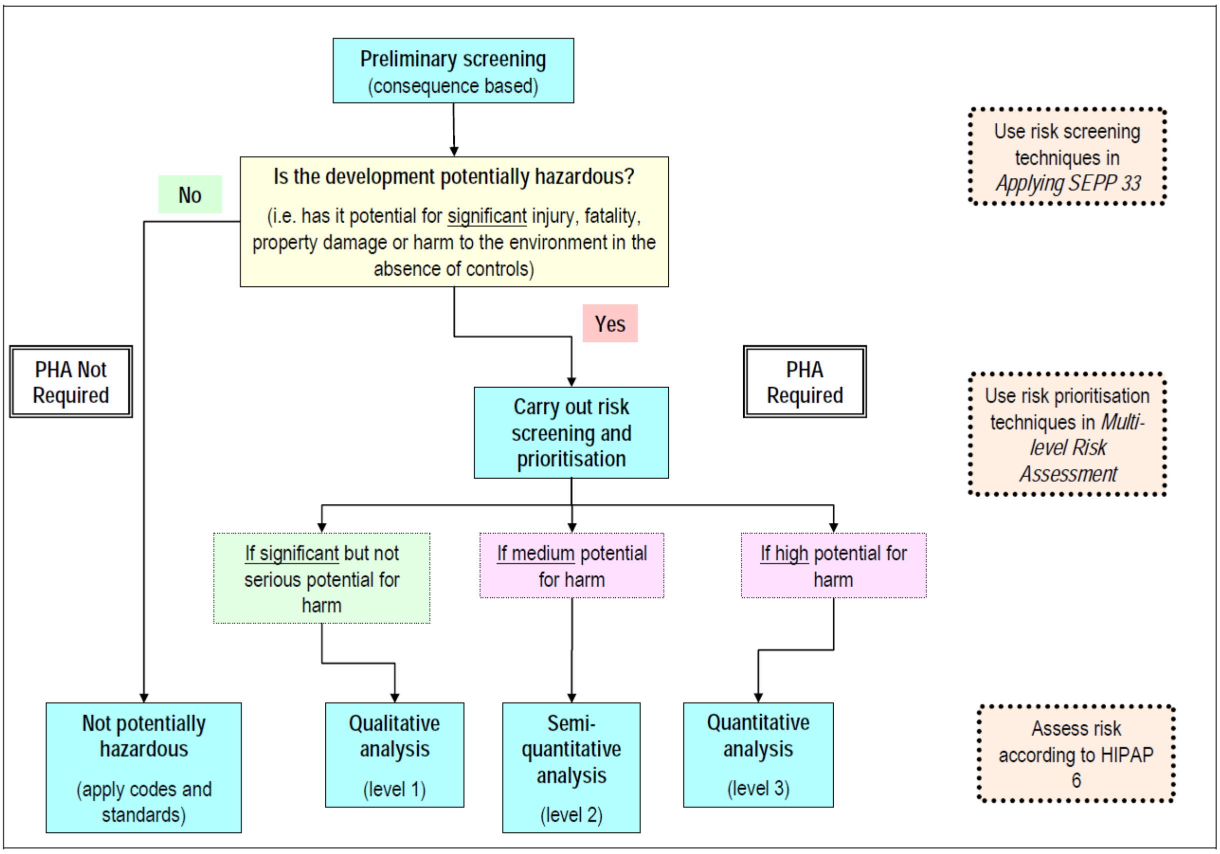


Figure A6-1
MULTI LEVEL RISK ASSESSMENT PROCESS

Source: SEPP 33 Guideline – Figure 11

A6.3.3.2 Scope of the Study

The study area includes the Project Site and immediate surrounds. To avoid duplication, figures and plans presented in the Environmental Assessment are not reproduced in this Appendix. The following present the figures and plans relied on in this assessment.

- Locality Plan – **Figure 1** of the *Environmental Assessment*.
- Proposed Project Site Layout – **Figure 4** of the *Environmental Assessment*.
- Regional Topography and Drainage – **Figure 4.1** of RWC (2010a)
- Local Topography and Drainage – **Figure 4.2** of RWC (2010a).
- Project Site Topography and Drainage – **Figure 4.3** of RWC (2010a).
- Surrounding Landownership – **Figure 4.6** of RWC (2010a).
- Surrounding Residences – **Figure 4.7** of RWC (2010a)

In addition, **Figure A6-2** presents the regional setting of the Project Site, with emphasis on those areas downstream of the Project Site. **Figure A6-3** presents the Project Site and surrounding lands, showing the anticipated location of the sodium cyanide storage tank, carbon-in-leach plant and Tailings Storage Facility as well as surrounding lands.

As identified in Section 4.1.5.2 of RWC (2010a), land uses surrounding the Project Site include the following. **Figure A6-3** presents an overview of the surrounding land uses and **Figure 2** of the *Environmental Assessment* presents land zoning within and surrounding the Project Site.

- Agriculture – principally grazing of sheep and cattle, with some areas of cropping.
- Village and rural residential – the village of Majors Creek is located immediately to the south of the Project Site, with surrounding areas of rural residential land. In addition, agricultural areas surrounding the Project Site include rural residences.
- Nature conservation – The Majors Creek State Conservation Area is located approximately 1km to the southeast of the Project Site.

In addition, land uses downstream of the Project Site include the following (**Figure A6-2**)

- Nature conservation – including the Deua and Monga National Parks.
- Agriculture – including stone fruit orchards within the Araluen Valley.
- Village and rural residential – including the villages of Araluen, the Lagoon and Moruya Heads and scattered areas of rural residential development.
- Urban – including the town of Moruya.

It is noted that some residents of the village Majors Creek, as well as downstream communities and some rural residents, use water from Majors Creek and the creeks and rivers that it flows into it for domestic purposes. Eurobodalla Shire Council draws water for its water supply works from a range of sources, including the Moruya River at Moruya (**Figure A6-2**).

A6.3.3.3 Classification of the Type of Activities and Inventories

As identified in Section A6-2 and **Tables A6-1** and **A6-2**, the only activities that meet the thresholds for preparation of a Preliminary Hazard Analysis include the following. It is noted that transportation of solid sodium cyanide is excluded from this assessment as that aspect will be the subject of a separate approval to be obtained by the supplier of the material

- Storage of sodium cyanide solution within the cyanide storage area.
- Use of sodium cyanide solution within the carbon-in-leach processing plant.
- Disposal of sodium cyanide solution following completion of detoxification operations within the Tailings Storage Facility.

Table A6-3 presents an overview of the location, form, quantity and storage/use conditions for each of the above. **Figure A6-3** presents the location of each of the storage and use facilities described. Further information is provided in Section 2.5.4 of the *Environmental Assessment*.

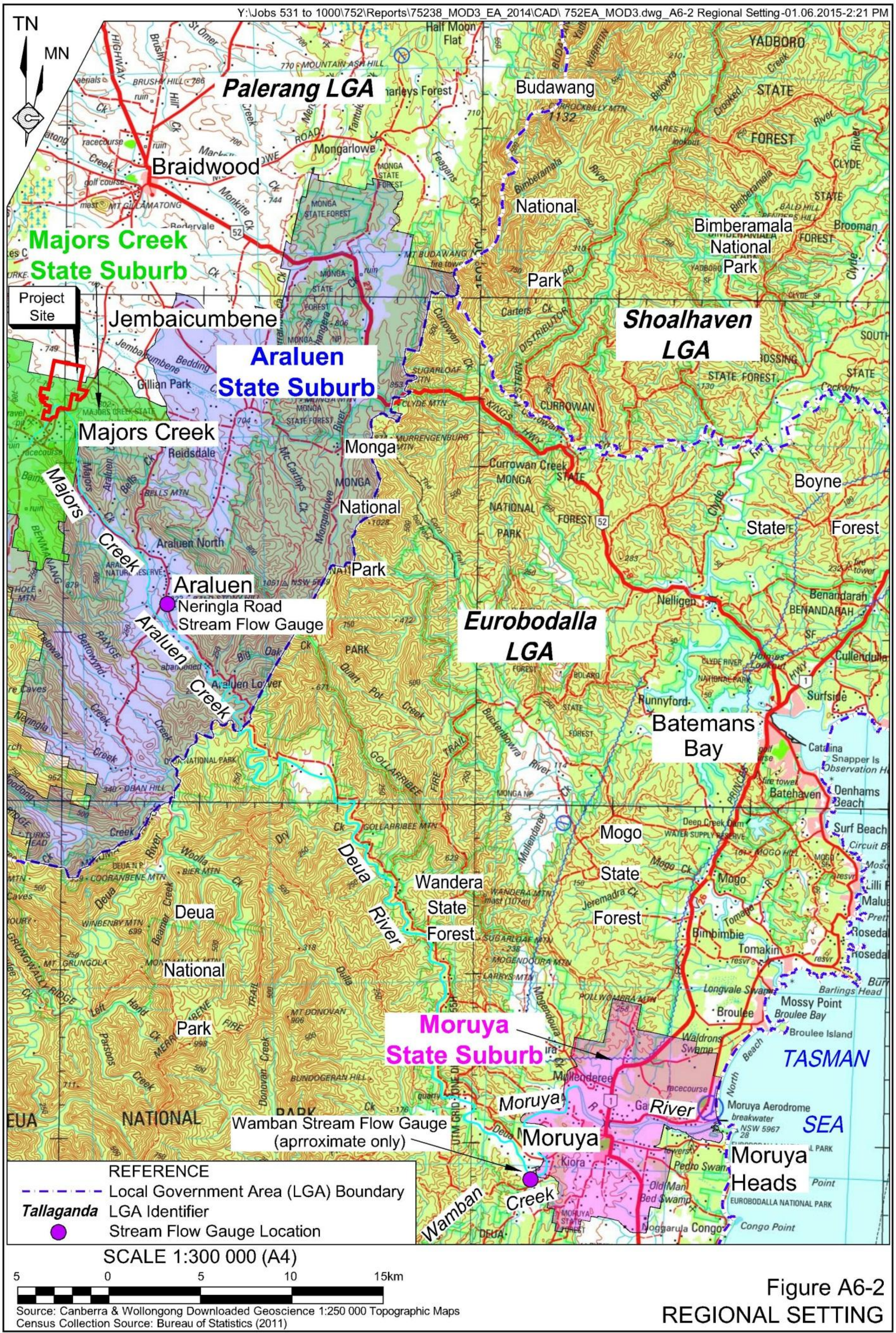


Figure A6-2
REGIONAL SETTING

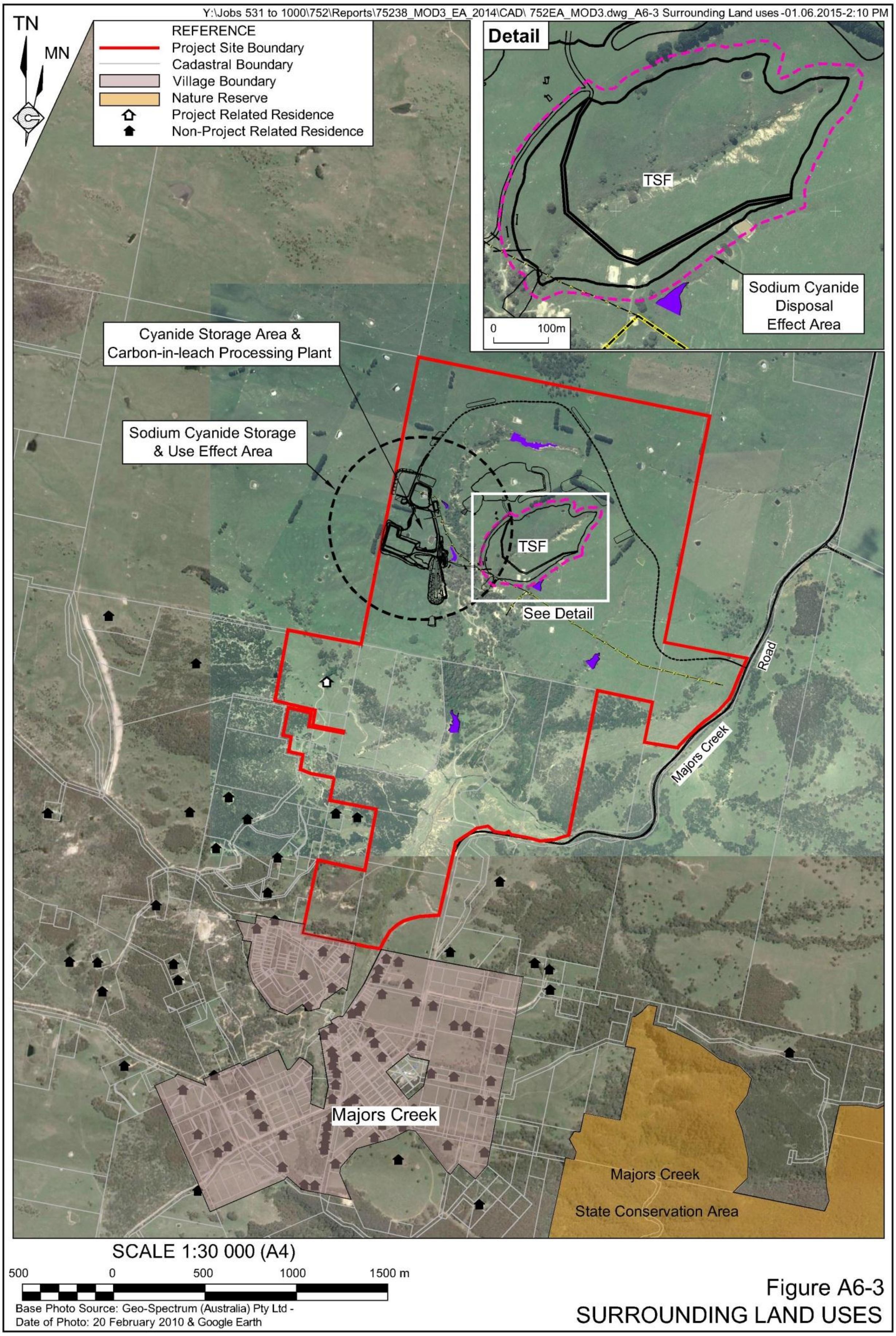


Figure A6-3
SURROUNDING LAND USES

Table A6-3
Overview of Storage and Use Conditions

Location	Form	Maximum Anticipated Quantity	Storage / Use Conditions and Controls
Storage of Sodium Cyanide			
Cyanide storage area	Solution	90kL	• Approximate concentration – 0.25kg/L cyanide. • pH – >9. • Concrete sealed sparging/transfer area with roll over bunds and a blind sump. • Single above ground tank within a secure, concrete bunded and covered storage area with blind sump. • Automated dosing pump with automatic shutdown in the event of transfer pipe failure. • Fixed and personnel HCN gas monitors and alarms. • Access restricted to authorised personnel only. • Multiple daily inspections.
Use of Sodium Cyanide			
Carbon-in-leach processing plant	Solution	Eight tanks, with a maximum capacity of 540kL	• Approximate concentration – 2 000mg/L (Tank 1) to 600mg/L (Tank 6). • pH – >9. • Concrete bunded leaching area with blind sump and pump and sufficient capacity to retain a minimum of 110% of the largest tank, plus surge capacity. • Automated sodium cyanide and lime dosing systems. • Inline cyanide concentration monitoring (multiple times per day) and adaptive management to control cyanide concentration and pH. • Fixed and personnel HCN gas monitors and alarms. • Access restricted to authorised personnel. • Multiple daily inspections.
Disposal of Sodium Cyanide			
Tailings Storage Facility	Solution	5 000m^3	• Inline analyser measuring WAD cyanide levels after completion the INCO cyanide destruction process • Concentration – <30mg/L WAD cyanide at discharge from the cyanide destruction circuit, with WAD cyanide concentration in the supernatant pond managed to ensure suitable concentrations in the event of an extreme rainfall event. • pH – >9 on discharge. • Tailings Storage Facility designed and constructed in accordance with Dam Safety Committee engineering requirements and certified by a suitable independent engineer. • Floor and walls of the Tailings Storage Facility constructed and tested to achieve a permeability of 1 x 10^{-9}m/s over 900mm or better. • Industry standard underdrainage and seepage detection and collection infrastructure installed. • Restricted access to authorised personnel. • Facility fenced, including burial of the lower section of the fence, to limit access for fauna. • Multiple daily inspections.
Source: Big Island Mining Pty Ltd			

A6.3.3.4 Estimation of Consequences

Introduction

The *Risk Assessment Guidelines* provides an assessment methodology based on the document *Manual for the classification of risks due to major accidents in process and related industries* published by the International Atomic Energy Agency in 1996 (IAEA, 1996). Based on that methodology, Section A1.2.4 of the *Risk Assessment Guidelines* identifies the following formula for estimating the consequence of an accident involving a hazardous substance.

$$Ca,s = A \times d \times f_A \times fm.$$

Where	*Ca,s*	=	*the external consequences.*
	A	=	*affected area.*
	d	=	*population density within the affected area.*
	fA	=	*correction factor for the distribution of population in the affected area.*
	fm	=	*correction factor for mitigation effects.*

It is noted that the *Risk Assessment Guidelines* for a Preliminary Hazard Analysis relate to the potential for human fatalities associated with a catastrophic failure of the sodium cyanide containment systems within the Project Site. It is acknowledged that non-lethal consequences may also occur and that significant environmental damage would also result from such a failure. While such outcomes are relevantly a matter for consideration in the *Environmental Assessment*, they do not form a component of the assessment required to determine if the Proposed Modification is a hazardous project.

It is also acknowledged that partial failures of the containment systems may occur, including, for example, failure of transfer pipes or leakage of the Tailings Storage Facility. Such partial failures are also not a component of the assessment identified by the *Risk Assessment Guidelines* unless they are likely to result in human fatalities surrounding the Project Site.

Affected Area

IAEA Table IV(a) of the *Risk Assessment Guidelines* presents a classification of substances by effect categories. Based on that classification the effect distance and area are identified in IAEA Table V. **Table A6-4** identifies the effect distance and area of effect and **Figure A6-3** presents each on a plan.

Table A6-4
Overview of Storage and Use Conditions

Type	Classification	Comment
Storage of sodium cyanide solution within Cyanide Storage Area		
Effect Category	EIII	Very High Toxicity. Storage within Tank Pit. Quantity 10-50t.
Effect Distance	200m to 500m	
Effect Area	8ha	
Use of sodium cyanide solution within Carbon-in-leach Plant		
Effect Category	EIII	Very High Toxicity. Storage within Tank Pit. Quantity 10-50t.
Effect Distance	200m to 500m	
Effect Area	8ha	
Disposal of sodium cyanide solution within Tailings Storage Facility		
Effect Category	A III	Low toxicity – maximum 30mg/L WAD cyanide is unlikely to have an adverse impact on humans (see Section 2.5.2). Storage within Tailings Storage Facility. Quantity up to 500m^3.
Effect Distance	Up to 25m	
Effect Area	0.02ha	
Note: Terminology and classification consistent with IAEA Table IV(a) and IAEA Table V of the *Risk Assessment Guidelines*		

Population Distribution and Correction Factor

The *Risk Assessment Guidelines* require that the population distribution within the affected area identified above should be determined or estimated based information presented in IAEA (1996). **Figure A6-3** presents the affected areas associated with the proposed storage, use and disposal of sodium cyanide. In each case, the land within the affected area is either owned by the Proponent or is surrounding agricultural land. In both cases, there are no residences with the affected areas and the population density, for the purposes of this assessment, is zero.

As the Effect Area category is III, the population distribution factor identified in IAEA Table VII is 1.

It is noted, however, that a number of populated areas exist downstream of the Project Site. Data from the 2011 Census indicates that the following areas had the following populations in 2011. **Figure A6-2** presents the census collection areas that correspond with the following.

- Majors Creek State Suburb – 220 people.
- Araluen State Suburb – 293 people.
- Moruya State Suburb – 3 855 people.
- Eurobodalla Local Government Area – 35 741.

Mitigation Correction Factor

IAEA Table VIII identifies that a population density mitigation factor of 0.05 should be applied to toxic liquid substances.

Calculation of External Consequences

Using the formula identified previously, **Table A6-5** identifies the external consequence of catastrophic failure of the containment systems associated with the storage, use or disposal of sodium cyanide.

Table A6-5
Overview of Storage and Use Conditions

Activity	Affected Area (ha)	Population Density	Population Correction Factor	Mitigation Correction Factor	Estimated Number of Fatalities
Storage of Sodium Cyanide	8	0	1	0.05	Nil
Use of Sodium Cyanide	8	0	1	0.05	Nil
Disposal of Sodium Cyanide	0.2	0	1	0.05	Nil

Notwithstanding the above, it is acknowledged that the affected area associated with a catastrophic failure of the containment systems associated with the storage, use and disposal of sodium cyanide would be larger than the affected area identified by the *Risk Assessment Guidelines*. In particular, it is noted that should sodium cyanide be discharged to Spring Creek, it would flow to Majors Creek, Araluen Creek the Deua River and Moruya River, prior to discharge to the Pacific Ocean. Individual residents, as well as Eurobodalla Shire Council, take water from each of these creeks and rivers for domestic purposes. As a result, potential exists for fatalities associated with a discharge of sodium cyanide to Spring Creek.

It is noted, however, that the Proponent has implemented a Downstream Water Users Group. At the time of finalisation of that document, that Group had 40 members, including Eurobodalla Shire Council. The Proponent continues to add residents and others to that Group as requested. All members of the Group have provided the Proponent with emergency contact details. In the event of an on-site incident, the Proponent’s communication protocol identifies that all members of the Group are to be contacted immediately and advised of the incident and recommended precautionary measures to be implemented. In the case of discharge of sodium cyanide to Spring Creek, that recommendation would be to immediately cease using water from the affected water courses until further testing can be undertaken. The Proponent would then arrange for an alternate supply of water for domestic purposes in accordance with the intent of Condition 23 of Schedule 3 of PA 10_0054.

In addition, the Proponent would amend the *Pollution Incident Response Management Plan* required under the Project’s Environment Protection Licence to include a catastrophic failure of the containment system or discharge of sodium cyanide to Spring Creek. That plan would include wide notification of the incident, including via the media, and liaison with relevant emergency services, government agencies and Palerang Council and Eurobodalla Shire Council.

Finally, the Proponent notes that Spring Creek is a very minor component of the overall Deua/Moruya River catchment and that significant downstream dilution of any discharge as a result of a catastrophic failure of the containment systems would be expected to occur. **Table A6-6** presents the proportion of each of the identified catchments represented by Spring Creek.

As a result, and irrespective of other significant impacts that would result, the Proponent contends that a discharge of sodium cyanide would, irrespective of other very significant environmental impacts, be unlikely to result in a human fatality downstream of the Project Site.

Table A6-6
Spring Creek Catchment as a Proportion of Downstream Catchments

Catchment[1]	Catchment Area (km^2)	Spring Creek as a Proportion of Total Catchment
Spring Creek above Majors Creek	Approximately 3	100%
Araluen Creek above the Neringla Road Gauge	170	1.8%
Deua River above the Wamban Gauge	1389	0.22%
Moruya River above the mouth	1669	0.18%
Note 1: See **Figure A6-2** for gauge locations		
Source: Draft Water Sharing Plan for the Deua River Unregulated and Alluvial Water Sources		

A6.3.3.5 Estimation of Probability

The *Risk Assessment Guidelines* provides a probability estimation methodology based on IAEA (1996). Section A1.2.5 of the Guidelines identifies the following formula for estimating the probability of an accident involving a hazardous substance.

$$N_{i,s} = N^*_{i,s} + n_l + n_f + n_o + n_p$$

Where $N_{i,s}$ = *Probability number*

$N^*_{i,s}$ = *average probability number for the class of facility*

n_l = *the frequency of loading/unloading operations*

n_f = *safety systems associated with flammable substances (where applicable)*

n_o = *organisational and management safety*

n_p = *wind direction towards the populated area*

The relationship between the probability number and the frequency value P is given by the formula:

$$N = | \log10\ P |$$

Storage of Sodium Cyanide

The following apply to the storage of sodium cyanide within the sodium cyanide storage area. References in parenthesis indicate the Table in IAEA (1996) from which the identified value has been drawn.

- N*i,s = toxic liquid or 5 (IAEA Table IX).
- nl = six times per year or +0.5 (IAEA Table X(a)).
- nf = not relevant as sodium cyanide solution is non-flammable.
- no = average industry practice or 0 (IAEA Table XII).
- np = Effect Area category is III and the area of affect is not populated (see Section 3.3.4.4, however, for the purposes of this assessment assume 5%). As a result, the wind direction correction factor is 1.5.

As a result, the probability number for storage of sodium cyanide is as follows.

Ni,s = 5 + 0.5 + 0 + 0 + 1.5 = 7

As a result, based on the conversions provided in IAEA Table XIV, the probability of an accident associated with the storage of sodium cyanide is 1×10^{-7} events per year which is the equivalent of one event every 10 million years.

Use of Sodium Cyanide

The following apply to the use of sodium cyanide within the carbon-in-leach plant.

- N*i,s = toxic liquid 4 (IAEA Table IX).
- nl = Not relevant as sodium cyanide is transferred by pipe and is not delivered or unloaded.
- nf = not relevant as sodium cyanide solution is non-flammable.
- no = average industry practice or 0 (IAEA Table XII).
- np = Effect Area category is III and the area of affect is not populated (see Section 3.3.4.4, however, for the purposes of this assessment assume 5%). As a result, the wind direction correction factor is 1.5.

As a result, the probability number for storage of sodium cyanide is as follows.

Ni,s = 4 + 0 + 0 + 0 + 1.5 = 5.5

As a result, based on the conversions provided in IAEA Table XIV, the probability of an accident associated with the storage of sodium cyanide is 1×10^{-6} events per year which is the equivalent of one event every million years.

Disposal of Sodium Cyanide

The following apply to the disposal of sodium cyanide within the Tailings Storage Facility.

- N*i,s = 5 (IAEA Table IX).
- nl = Not relevant as tailings would be transferred by pipe and would not delivered or unloaded.
- nf = not relevant as sodium cyanide solution is non-flammable.
- no = average industry practice or 0 (IAEA Table XII).
- np = Effect Area category is III and the area of affect is not populated (see Section 3.3.4.4, however, for the purposes of this assessment assume 5%). As a result, the wind direction correction factor is 1.5.

As a result, the probability number for storage of sodium cyanide is as follows.

Ni,s = 5 + 0 + 0 + 0 + 1.5 = 6.5

As a result, based on the conversions provided in IAEA Table XIV, the probability of an accident associated with the storage of sodium cyanide is <u>1 x 10^{-7} events per year</u> which is the equivalent of one event every 10 million years.

A6.3.3.6 Estimation of Societal Risk

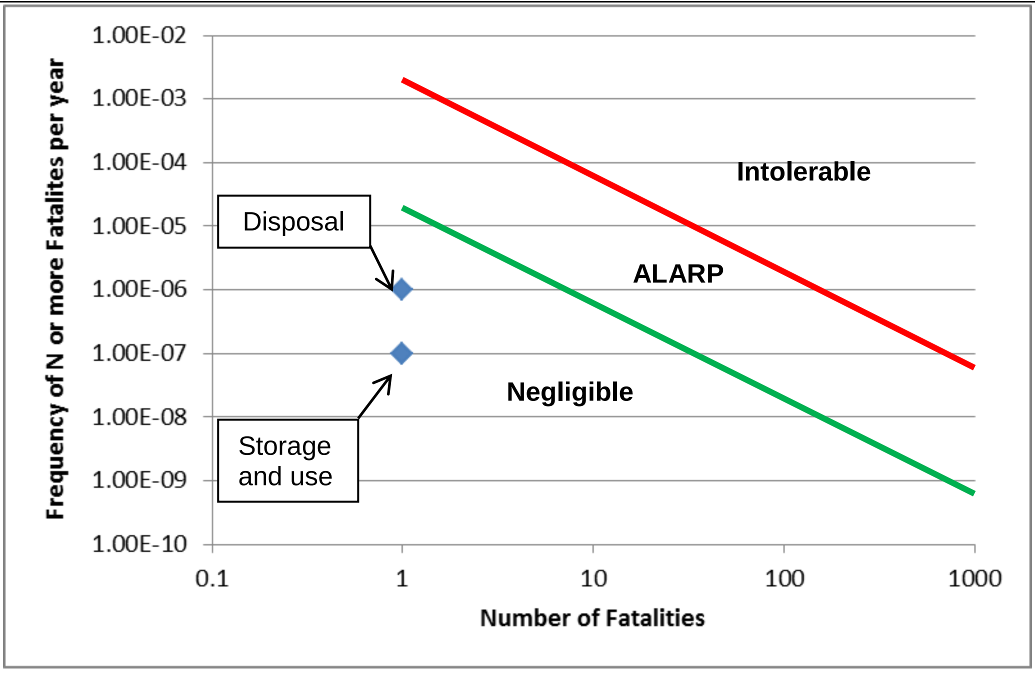
The estimated consequence and probability of a catastrophic failure of the containment systems for the storage, use and disposal of sodium cyanide are presented in the preceding subsections. The *Risk Assessment Guidelines* identify in Section A1.2.5 that the calculated frequency and consequences should be plotted and compared with the classifications presented on Figure 6 of the Guidelines. **Figure A6-4** presents the results of the consequence and probability analysis for the storage, use and disposal of sodium cyanide. It is noted that as the axis of the graph are logarithmic, the anticipated number of fatalities per event have been rounded from zero to one.

A6.3.3.7 Determination of Assessment Level

Section 3.1.2 of the *Risk Assessment Guidelines* identify that a Level 1 – Qualitative Risk Analysis should be undertaken for all activities for which the initial screening thresholds have been exceeded, in the present case, the storage, use and disposal of sodium cyanide. The Guidelines identify that the following four conditions need to be satisfied to justify a Level 1 – Qualitative Risk Analysis. Commentary in relation to the applicability of each of the conditions to the Project is also provided.

- All points on the indicative societal risk curve produced from the risk classification and prioritisation should be below the negligible line.

  As shown on **Figure A6-4**, each of the identified activities fall below the negligible line.



Note 1: ALARP = As low as reasonably practicable

Figure A6-4
MULTI LEVEL RISK ASSESSMENT PROCESS

- There should be no events with consequences extending significantly beyond the site boundary at a frequency of greater than 1×10^{-7}.

  The only activity for which the expected frequency of occurrence is greater than 1×10^{-7} is "use of sodium cyanide." However, as illustrated in **Figure A6-3,** the affected area would not be significantly beyond the site boundary.

- The process or operation should be well understood and covered by established and recognised standards and codes of practice.

  Cyanide leaching of gold is an activity that has been undertaken since the late 1800s. Currently, more that 80% of annual world gold production is undertaken using this methodology and the processes associated with the storage, use and disposal of sodium cyanide are well understood. Finally, the Cyanide Code provides well recognised standards and codes of practice which, as a signatory to the Code, the Proponent is bound to comply with.

- If there are any off-site consequences these will not impact on any sensitive adjoining land use.

  As indicated on **Figure A6-3**, the Effect Area for the proposed storage and use of sodium cyanide is largely contained within the Project Site. A small section of the Effect Area would be on agricultural land located adjacent to the Project Site. This land would not be classified as a sensitive adjoining land use. In addition, ToxConsult (2015b) has undertaken a detailed risk assessment of potential downstream impacts and determined that potential human and ecological risks downstream of the Project Site would be negligible.

In light of the above, the Proponent contends that a Level 1 – Qualitative Risk Assessment is appropriate.

A6.3.4 Transportation Risk Classification and Prioritisation Assessment

It is noted that the assessment methodology identified by the Risk Assessment Guidelines applies principally to premises, not transportation operations. As a result, a qualitative approach has been taken to determining the risk classification and prioritisation. This approach has relied upon the following commitments in relation to transportation of sodium cyanide.

- Transport sodium cyanide as solid briquettes mixed with caustic to ensure that the pH of the material remains above 9.5 to limit the potential for the generation of HCN the maximum extent practicable.
- Transport sodium cyanide in purpose built containers designed to limit the potential for discharge of the contents in the event of a traffic incident.
- Ensure that multiple transportation routes are identified, including a principal transportation route and alternate routes in the event that the principal route is blocked by a traffic accident, natural disaster or similar unplanned event.
- Ensure that the transport routes are selected in accordance with the procedure identified in *Hazardous Industry Planning Advisory Paper No 11 – Route Selection* prepared by the NSW Department of Planning in 2011.
- Ensue that a detailed risk assessment and driver instruction list for the transportation routes are completed are reviewed as road conditions change.
- Obtain all required approvals and licences for transportation of sodium cyanide.
- Ensure that all transportation operators are provided with detailed training, including in emergency management and the conditional requirements of all licences, approvals and general road transport regulations, and that these are strictly complied with at all times.

Section 3.1.2 of the Risk Assessment Guideline identify that a qualitative risk assessment is appropriate where the following conditions are satisfied.

- *All points on the indicative societal risk curve produced from the risk classification and prioritisation should be below the negligible line.*

  An assessment against the societal risk curve has not been undertaken. However, the Proponent notes that the engineering and other controls identified above would ensure that the risk of a human fatality associated with a transportation-related incident would be extremely rare. This is evidenced by the fact that Orica, the largest supplier of sodium cyanide in Australia, has not had a single transportation-related discharge of sodium cyanide using the isotainer system in the 20 years since it was introduced and that if such a discharge did occur, the elevated pH of the material would prevent the discharge of hydrogen cyanide gas.

  As a result, the Proponent contends that the societal risk associated with transportation of sodium cyanide would be negligible.

- *There should be no events with consequences extending significantly beyond the site boundary at a frequency of greater than 1 x 10^{-7}.*

  As this assessment addresses transportation-related hazards, reference to a site boundary is not appropriate. However, the Proponent notes that the previous argument in relation to the negligible risk of a human fatality associated with the transportation of sodium cyanide would equally apply to this condition.

- *The process or operation should be well understood and covered by established and recognised standards and codes of practice.*

  Transportation of dangerous goods, including sodium cyanide, is a common and well understood practice that is the subject of a range of regulatory and other standards and codes of practice, including the Australian Dangerous Goods Code and the Cyanide Code.

- *If there are any off-site consequences these will not impact on any sensitive adjoining land use.*

  This would be a matter for determination once the final transportation route(s) are selected. However, the Proponent notes that this matter is addressed by Section 2.6 - Environmental and Land Use Safety Considerations included in the document Hazardous Industry Planning Advisory Paper No 11 – Route Selection. The matters identified in that section would be taken into consideration in selecting routes for transportation of sodium cyanide.

As a result, the Proponent contends that a qualitative risk assessment of the proposed transportation operations is appropriate

A6.3.5 Qualitative Risk Assessment

A6.3.5.1 Preparation of the Qualitative Risk Assessment

This subsection presents the qualitative risk assessment prepared for the Proposed Modification. The assessment was undertaken on 7 October 2014 at the Proponent's offices in Melbourne. The assessment was facilitated by Mr Tony Davis, Chief Operations Officer for the Proponent. The following personnel, and their area of expertise, participated in the assessment.

- Mr James Dornan – Project Engineer with the Proponent – overall project design and implementation.
- Mr Mitchell Bland – Principal Environmental Consultant with RWC – general environmental management and impacts.
- Mr Andrew Goulsbra – Principal Process Engineer with east Riding Mining Services – specialist metallurgical advice in relation to the transportation, storage, use and disposal of sodium cyanide.
- Dr Roger Drew – Toxicologist and Risk Assessor with ToxConsult – specialist advice in relation to the effect of cyanide on fauna and ecology in the environment.
- Ms Tarah Hagen – Environmental Toxicologist and Risk Assessor with ToxConsult – specialist advice in relation to the effect of cyanide on humans.

A6.3.5.2 Assessment Methodology

To ensure consistency, the qualitative risk assessment was undertaken using the Proponent's internal risk assessment methodology. That methodology is broadly consistent with AS/NZS 4360:2004.

Initially, the group identified key risk or potential classes of incidents that may result in adverse environmental or community safety incidents. These were then divided into three categories, namely transportation, storage and use and disposal of sodium cyanide. As previously noted, the Proponent would ensure that the supplier of the sodium cyanide used within the Project Site would obtain all required approvals for the transportation of the product to the Project Site. As a result, this aspect of the Project has not been assessed.

Each potential incident was then assessed in the absence of controls to determine the likelihood and potential consequence of the event, with the respective classifications presented in **Tables A6-7** and **A6-8**. These were then used to identify the inherent risk ranking in the absence of relevant controls based on the methodology presented in **Table A6-9**. Proposed management and mitigation measures were then assumed and the residual risk ranking determined.

Finally, it is noted that ToxConsult (2015b) includes a risk assessment prepared in accordance with guidelines prepared by the Australian and New Zealand Environment and Conservation Council, the US EPA and the Western Australia Department of Environment and Conservation. That report is presented in **Appendix 3**. The report, was prepared by Dr Drew and Ms Hagen, participants in this risk assessment, and while not consistent with the above methodology, has been referred to in determining likely consequences associated with a potential discharge of cyanide within the Project Site.

Table A6-7
Qualitative Likelihood Rating

FACTOR	VARIABLES				
Number of People Involved	>10	6-10	3-5	2	1
F1 Score	**(10)**	**(8)**	**(5)**	**(2)**	**(1)**
Number of times Task is done	Greater than once a day	Once per day	Once per week	Once per month	Once per year
F2 Score	**(10)**	**(8)**	**(5)**	**(2)**	**(1)**
Probability of unwanted event from arising from task	Is expected to occur in most (>90%) occasions	Is expected to occur on many (75%-90%) occasions	Is expected to occur on some (25%-75%) occasions	Is expected to occur in infrequent (10%-25%) occasions	Is expected to occur on rare (<10%) occasions
F3 Score	**(10)**	**(8)**	**(5)**	**(2)**	**(1)**
Combined Score (F1xF2xF3)	401-1 000	151-400	31-150	6-30	1-5
Likelihood	Almost Certain 5	Likely 4	Possible 3	Unlikely 2	Rare 1

Source: Big Island Mining Pty

Table A6-8
Qualitative Consequence Rating

DESCRIPTION				
CONSEQUENCE	**Injury**	**Illness**	**Environment**	**Property Damage/ Process Loss**
A. Low	Minor Injury	Minor illness, e.g. headache, nausea	Little or no environmental impact	Low financial loss (<$5 000)
B. Minor	Medical Treatment Injury Alternate Duties Injury, reversible lost time injury	Medical Treatment illness, e.g. skin rashes, reversible lost time illness	Small and/or localised impact	Medium financial loss ($5 000 - $20 000)
C. Moderate	Irreversible lost time injury Permanently Disabling injury	Irreversible lost time illness, e.g. permanent hearing loss or permanently disabling illness	Substantial environmental impact	High financial loss ($20 000 - $50 000)
D. Major	Fatality	Fatal illness or disease	Serious environmental impact	Major financial loss ($50 000 - $500 000)
E. Catastrophic	Multiple Fatality	Multiple fatalities caused by illness or disease	Disastrous and/or widespread environmental impact	Huge financial loss (>$500 000)

Source: Big Island Mining Pty

Table A6-9
Risk Rating Matrix

		Consequence Severity				
		A. Low	**B. Minor**	**C. Moderate**	**D. Major**	**E. Catastrophic**
Likelihood	**5. Almost Certain**	High 11	High 16	Extreme 20	Extreme 23	Extreme 25
	4. Likely	Moderate 7	High 12	High 17	Extreme 21	Extreme 24
	3. Possible	Low 4	Moderate 8	High 13	Extreme 18	Extreme 22
	2. Unlikely	Low 2	Low 5	Moderate 9	High 14	Extreme 19
	1. Rare	Low 1	Low 3	Moderate 6	High 10	High 15

Source: Big Island Mining Pty

A6.3.5.3 Qualitative Risk Assessment Results

Table A6-10 presents the results of the Qualitative Risk Analysis.

Table A6-10
Results of the Qualitative Risk Analysis

		Inherent Risk (without controls)					Residual Risk (with controls)					
Risk/unwanted Event	**Cause**	**Assessment Reasoning**	**Likelihood**	**Consequence**	**Risk**	**Rank**	**Risk Reduction Measures**	**Assessment Reasoning**	**Likelihood**	**Consequence**	**Risk**	**Rank**
Sodium Cyanide Transportation												
Rupture of tank containing sodium cyanide briquettes	Catastrophic traffic accident Truck roll over	Rare = 1 x 2 x 1 = 2 Consequence = localised spill of briquettes, substantial environmental harm if discharged into watercourse, otherwise small/localised impact	Rare	Moderate	Moderate	6	All transportation operations in accordance with the Cyanide Code and the *Australian Dangerous Goods Code*. All transportation using suitably designed transportation systems. Detailed risk assessment for transport route. High accident or sensitive environmental areas avoided. Only identified route(s) used. Only dangerous goods licenced drivers and vehicles used. All drivers subject to competency tests. All vehicles maintained to manufacturers specifications. MSDS and Chemalert information retained by driver and Proponent. Effective communication between driver, supplier and the Proponent. *Emergency Management Plan* for Cyanide Transportation prepared and implemented.	Rare = 1 x 2 x 1 = 2 Consequence = localised spill of briquettes, substantial environmental harm if discharged into watercourse, otherwise small/localised impact	Rare	Moderate	Moderate	6
Failure of tank, including failure or unplanned opening of valves	Manufacturing fault Failure of valve safety shutoff Operator error	Rare = 1 x 2 x 1 = 2 Consequence = localised spill of small quantity of briquettes, small/localised impact	Rare	Minor	Low	3	All transportation operations in accordance with the Cyanide Code and the *Australian Dangerous Goods Code*. All transportation using suitably designed transportation systems. Inspection and maintenance of transportation equipment, including decommissioning of faulty plant. Operator training and competency testing. Regular supplier and Proponent audits. **Emergency Management Plan** for Cyanide Transportation prepared and implemented.	Rare = 1 x 2 x 1 = 2 Consequence = localised spill of small quantity of briquettes, small/localised impact	Rare	Minor	Low	3
Fire resulting in release of HCN gas	Truck/equipment fire Bushfire impacts on truck	Rare = 1 x 2 x 1 = 2 Consequence = discharge of HCN gas may effect bystanders/emergency response personnel, dissipation/dispersion of gas likely to prevent catastrophic consequences	Rare	Major	High	10	All transportation operations in accordance with the Cyanide Code and the *Australian Dangerous Goods Code*. All transportation using suitably designed transportation systems. No transportation during periods of road closure or potential road closure as a result of natural disaster, road works or traffic accident. All vehicles maintained to manufacturers specifications. Operator training and competency testing. Regular supplier and Proponent audits. *Emergency Management Pla* n for Cyanide Transportation prepared and implemented. Appropriate labelling of load in accordance with the *Australian Dangerous Goods Code*	Rare = 1 x 2 x 1 = 2 Consequence = discharge of HCN gas may effect bystanders/emergency response personnel, dissipation/dispersion of gas likely to prevent catastrophic consequences	Rare	Major	High	10
Theft or loss of vehicle/trailer carrying cyanide	Loaded truck is stolen enroute Loaded trailer is stolen enroute	Rare = 1 x 2 x 1 = 2 Consequence = Unknown, assume major	Rare	Major	High	10	Only identified transportation route used. Meal and other breaks strictly controlled. GPS tracking of trucks and trailers.	Rare = 1 x 2 x 1 = 2 Consequence = Unknown, assume major	Rare	major	High	10
Sodium Cyanide Use												
Discharge/spillage during transfer to on-site storage tank	Hose or fitting failure Operator error	Likelihood - Rare (2 x 2 x 1 = 4) Consequence - Moderate (limited volume of high concentration solution resulting in substantial environmental impact)	Rare	Moderate	Moderate	6	Isotainer and storage tank bunded to 110% of tank volume with blind sump Detailed operator procedures Emergency stop and shutoff valves	Likelihood - Rare (2 x 2 x 1 = 4) Consequence - Low (spilt material contained and easily cleaned up, limited potential for discharge to the environment)	Rare	Low	Low	1
Catastrophic failure of on-site storage tank	Undetected pipe/fitting failure Tank failure	Likelihood - Rare (1 x 1 x1) Consequences - Catastrophic (up to 50kL of high concentration solution. Likely to discharge to Spring Creek. Widespread environmental impact)	Rare	Catastrophic	High	15	Storage tank bunded to 110% of tank volume with blind sump Regular inspections of tank Ongoing maintenance Access to storage area limited to authorised personnel	Likelihood - Rare (1 x 1 x1) Consequences - Low (spilt material contained and easily cleaned up, limited potential for discharge to the environment)	Rare	Low	Low	1
Leakage during transfer from storage tank to process plant	Pump or pipe/fitting failure	Likelihood - Unlikely (1 x 10 x 1 = 10) Consequence - Minor (limited volume of high concentration solution in plant area only resulting in localised environmental impact)	Unlikely	Minor	Low	5	Processing plant within sealed and bunded area Regular inspections of pipework and fittings Ongoing maintenance	Likelihood - Unlikely (1 x 10 x1) Consequences - Low (spilt material contained and easily cleaned up, limited potential for discharge to the environment) **ALARP**	Unlikely	Low	Low	2

Table A6-10 (Cont'd)
Results of the Qualitative Risk Analysis

		Inherent Risk (without controls)					Residual Risk (with controls)					
Risk/unwanted Event	**Cause**	**Assessment Reasoning**	**Likelihood**	**Consequence**	**Risk**	**Rank**	**Risk Reduction Measures**	**Assessment Reasoning**	**Likelihood**	**Consequence**	**Risk**	**Rank**
Reaction with other chemicals	Inappropriate storage of reagents	Likelihood - Rare (1 x 1 x 1 = 1) Consequence - Minor (limited volume of reagents in plant area only resulting in localised environmental impact)	Rare	Minor	Low	3	Processing plant within sealed and bunded area Separate storages of incompatible reagents Immediate clean up of reagent spills	Likelihood - Rare (1 x 1 x 1 = 1) Consequence - Low (material contained and easily cleaned up, limited potential for discharge to the environment)	Rare	Low	Low	1
Failure of single leach tank	Rupture of side wall Valve failure	Likelihood - Unlikely (1 x 10 x 1 = 10) Consequence - Catastrophic (up to 70kL of moderate concentration solution (2,000ppm to 200ppm cyanide) in plant area. Likely to discharge to Spring Creek. Widespread environmental impact)	Unlikely	Catastrophic	Extreme	19	Leach tanks bunded to 110% of largest container (plus surge capacity) Pump back and clean up equipment available Regular inspections of tanks, including integrity of tank walls Ongoing preventative maintenance program	Likelihood - Unlikely (1 x 10 x 1 = 10) Consequence - Low (spilt material contained and easily cleaned up, limited potential for discharge to the environment) **ALARP**	Unlikely	Minor	Low	5
Concurrent failure of multiple leach tanks	Sabotage Aircraft impact Earthquake	Likelihood - Rare (1 x 10 x 1 = 10) Consequence - Catastrophic (up to 540kL of moderate concentration solution (2,000ppm to 200ppm cyanide) in plant area. Likely to discharge to Spring Creek. Widespread environmental impact)	Rare	Catastrophic	High	15	Plant area contained within surface water management area that would result in 100% containment of spilt material Tanks designed and constructed to Australian Standards Access restricted to authorised personnel Plant continuously monitored	Likelihood - Rare (1 x 10 x 1 = 10) Consequence - Moderate (spilt material contained including in unsealed areas, clean up costs $20,000 to $50,000) **ALARP**	Rare	Moderate	Moderate	6
Tank overflow	Density imbalance of concentrate between tanks Power failure Screen obstruction	Likelihood - Almost certain (5 x 10 x 10 = 500) Consequence - Major (discharge of moderate concentration solution (2,000ppm to 200ppm cyanide) in plant area. May to discharge to Spring Creek. Serious environmental impact)	Almost Certain	Major	Extreme	23	Leach tanks bunded to 110% of largest container (plus surge capacity) Pump back and clean up equipment available Operating procedures outlining required densities of solution Regular inspections of tanks, including screens and wipers Ongoing preventative maintenance program Access restricted to authorised personnel Plant continuously monitored Backup power source	Likelihood - Possible (5 x 10 x 1= 50) Consequence - Low (spilt material contained and easily cleaned up, limited potential for discharge to the environment) **ALARP**	Possible	Low	Low	4
Generation of HCN gas affecting fauna	Low pH (<9) in leach tank Operator error in addition of chemicals	Likelihood - Possible (2 x 10 x 5 = 100) Consequence - Minor (limited number of birds or bats potentially impacted)	Possible	Minor	Moderate	8	Operating procedures outlining required pH levels and cyanide concentrations Automated monitoring equipment and alarms (for personnel safety purposes) Lighting design to discourage insectivorous bats	Likelihood - Unlikely (2 x 10 x 1 = 20) Consequence - Minor (limited number of birds or bats potentially impacted) **ALARP**	Unlikely	Minor	Low	5
Discharge of fumes from gold room	Failure if fume collection system Failure of scrubber	Likelihood - Likely (2 x 8 x 10 = 160) Consequence - Minor (limited volumes of air, low concentrations of pollutants, small, localised impact)	Likely	Minor	High	12	Use of fume hoods and scrubbers Regular inspections Ongoing preventative maintenance program Regular monitoring of discharge air quality	Likelihood - Rare (2 x 8 x 1 = 16) Consequence - Minor (limited volumes of air, low concentrations of pollutants, small, localised impact)	Rare	Minor	Low	3
Sodium Cyanide Disposal												
Discharge of tailings to Tailings Storage Facility with unacceptable concentration of cyanide	Incorrect reagent dosage Failure of detoxification circuit Failure of monitoring equipment	Likelihood - Likely (2 x 10 x 10 = 200) Consequence - Moderate (death of a limited number of exposed fauna in the Tailings Storage Facility)	Likely	Moderate	High	17	Operating procedures outlining required reagent dosage levels and operation of the detoxification circuit Regular monitoring of cyanide concentration in leach and detoxification circuits, including automated alarms Training of personnel	Likelihood - Unlikely (2 x 10 x 1 = 20) Consequence - Moderate (death of a limited number of exposed fauna in the Tailings Storage Facility) **ALARP**	Unlikely	Moderate	Moderate	9
Discharge of tailings to natural drainage during transfer to Tailings Storage Facility	Pipe failure Failure of the pipe containment structure Failure of automatic pump shutoff	Likelihood - Possible (1 x 10 x 5 = 50) Consequence - Catastrophic (potentially large volume of tailings flows to Spring Creek and then downstream, widespread environmental impact, <$500,000 clean up costs)	Possible	Catastrophic	Extreme	22	Engineering controls, including bunded containment structure with catch sumps, double skinned pipes over creek, pressure sensors, automated alarms and pump/valve shutoffs Regular inspections, including structural integrity testing Ongoing preventative maintenance program	Likelihood - Unlikely (1 x 10 x 1 = 10) Consequence - Minor (limited volume of tailings flows to Spring Creek and then downstream, localised environmental impact, <$20,000 clean up costs) **ALARP**	Unlikely	Minor	Low	5
Discharge of seepage to groundwater	Failure of the Tailings Storage Facility Liner Failure of seepage collection/monitoring network	Likelihood - Possible (1 x 10 x 10 = 100) Consequence - Minor (potential for limited discharge to surface water, localised environmental impact)	Possible	Minor	Moderate	8	Engineered liner tested during construction to ensure compliance with permeability requirements Seepage collection and monitoring system maintained and monitored Adaptive management in the event that seepage detected	Likelihood - Unlikely (1 x 10 x 1 = 10) Consequence - Minor (potential for limited discharge to surface water, localised environmental impact) **ALARP**	Unlikely	Minor	Low	5

Table A6-10 (Cont'd)
Results of the Qualitative Risk Analysis

		Inherent Risk (without controls)					Residual Risk (with controls)					
Risk/unwanted Event	**Cause**	**Assessment Reasoning**	**Likelihood**	**Consequence**	**Risk**	**Rank**	**Risk Reduction Measures**	**Assessment Reasoning**	**Likelihood**	**Consequence**	**Risk**	**Rank**
Discharge of supernatant water to natural drainage from the Tailings Storage Facility (assessment based on Knight Piésold (2015))	Catastrophic failure of Tailings Storage Facility embankment Over topping	Likelihood - Possible (1 x 10 x 10 = 100) Consequence - Catastrophic (potential for discharge of a very large volume of tailings and supernatant water, disastrous and widespread environmental impact)	Possible	Catastrophic	Extreme	22	Tailings Storage Facility designed in accordance with relevant design standards, taking into account earthquake and rainfall-related risks Construction supervised and certified by appropriately qualified independent engineer Suitable underdrainage installed Temporary and permanent spillways installed to permit safe discharge of water during a rainfall event that exceeds the design criteria Operate the Tailings Storage Facility in accordance with the operating procedures, including minimising the volume of the supernatant pond Managing the concentration of free cyanide in the supernatant pond to ensure discharge concentrations would be acceptable Regular inspections, including of the structural integrity of the embankment Ongoing monitoring, including of the underdrainage system Adaptive management	Likelihood - Unlikely (1 x 10 x 1 = 10) Consequence - Minor (free cyanide concentration in Spring Creek less than ANZECC (2000) 95% trigger value) **ALARP**	Unlikely	minor	Low	5
Discharge of return water to natural drainage	Failure of return pipe Failure of the containment structure Failure of automatic pump shutoff	Likelihood - Possible (1 x 10 x 5 = 50) Consequence - Moderate (potentially large volume of return water flows to Spring Creek and then downstream, substantial environmental impact)	Possible	Moderate	High	13	Detoxification of tailings stream prior to discharge to TSF, followed by natural degradation of WAD cyanide Engineering controls, including bunded containment structure with catch sumps, double skinned pipes over creek, pressure sensors, automated alarms and pump/valve shutoffs Regular inspections, including structural integrity testing Ongoing preventative maintenance program	Likelihood - Unlikely (1 x 10 x 1 = 10) Consequence - Minor (Limited volume of return water flows to Spring Creek and then downstream, minor environmental impact) **ALARP**	Unlikely	Minor	Low	5
Death or injury to avian fauna accessing supernatant pond	Access to the supernatant pond by avian fauna Concentration of WAD cyanide sufficient to result in death	Likelihood - Possible (1 x 10 x 10 = 100) Consequence - Moderate (substantial number of individual animals affected, substantial environmental impact)	Possible	Moderate	High	13	Detoxification of tailings stream Minimise the volume of the supernatant pond Multiple other water sources within close proximity Regular monitoring of Tailings Storage Facility Adaptive management in the event fauna deaths are detected	Likelihood - Unlikely (1 x 10 x 1 = 10) Consequence - Minor (very limited number of individual animals affected, minor environmental impact) **ALARP**	Unlikely	Minor	Low	5
Death or injury to terrestrial fauna accessing supernatant pond	Access to Tailings Storage Facility by terrestrial fauna Slipping on HDPE liner or becoming bogged in tailings and unable to escape Concentration of WAD cyanide sufficient to result in death	Likelihood - Possible (1 x 10 x 10 = 100) Consequence - Moderate (substantial number of individual animals affected, substantial environmental impact)	Likely	Moderate	High	17	Construct exclusion fence, including subsurface return Detoxification of tailings stream Minimise the volume of the supernatant pond Multiple other water sources within close proximity Regular monitoring of Tailings Storage Facility Adaptive management in the event fauna deaths are detected	Likelihood - Unlikely (1 x 10 x 1 = 10) Consequence - Minor (substantial number of individual animals affected, substantial environmental impact) **ALARP**	Unlikely	Minor	Low	5

In summary, all identified incidents with the potential to result in adverse environmental or community safety impacts were determined to have a residual risk rating of Low or Moderate, with two potential incidents retaining a residual risk rating of High. In all cases of Moderate or High, the risks have been reduced to as low as reasonably practicable (ALARP). In those cases, the likelihood of the particular incident occurring has been reduced to Rare or Unlikely and the imposition of further controls would be unlikely to result in further reduction in the likelihood of the incident. Similarly, the consequence has been reduced as far as practicable, with further controls unlikely to further reduce the impact of a potential incident.

The following presents a description and discussion of all potential incidents with a residual risk rating of Moderate or above. As separate approval is to be sought for transportation of sodium cyanide, residual risks associated with that component of the Project are not discussed further.

- Rupture of the tank containing sodium cyanide briquettes (residual risk - moderate).

  This potential incident would require a catastrophic traffic accident to rupture the tank containing the sodium cyanide. The maximum discharge would be 22t of sodium cyanide mixed with caustic to ensure that the pH of the material remains above 9.5. In the vast majority of cases, spilt sodium cyanide would simply be collected and removed from site, with the surrounding soils tested for contamination and remediated as required. In the event that the incident occurred during a rainfall event or the material discharged into a waterway, additional remediation measures may be required.

  The Proponent contents that the measures proposed in **Table A6-10**, including risk assessments for all transportation routes, the use of specifically designed cyanide containment systems and the proposed maintenance and driver training systems, would result in the risk of a transportation-related incident being reduced to as low as reasonable practicable. In addition, it is noted that Orica, the principal Australian-based supplier of sodium cyanide, has previously stated that it has not had a single discharge of sodium cyanide during transportation operations using isotainers in the 20 years since they were introduced.

  As a result, the Proponent contends that the risk of discharge of sodium cyanide as a result of tank rupture is as low as reasonably practicable.

- Fire resulting in release of HCN gas (residual risk - high).

  This potential incident would require a vehicle carrying sodium cyanide to either catch fire and burn, or be involved in an accident with another vehicle that caught fire. Alternatively, such an incident may be the result of a vehicle transporting sodium cyanide being caught in a bushfire or similar. The MSDS for sodium cyanide indicates that it is non-flammable, but may decompose under high temperature to release HCN gas.

  The Proponent contends that the control measures proposed in **Table A6-10**, including the requirement to only use specifically designed containment systems and to inspect and maintain mobile plant would minimise the potential for fire related incidents associated with the vehicle transporting the sodium cyanide.

Similarly, the requirement to undertake a risk assessment of the transportation route and ensure that all drivers are appropriately licenced and trained would minimise the risk of a collision with another vehicle. In addition, the requirement to halt transportation operations in the event of a road closure on the identified transportation route(s) and the requirement to identify alternate transportation routes would minimise the potential for a vehicle transporting sodium cyanide to be caught in a bushfire or similar.

Finally, in the event that a vehicle transporting sodium cyanide was involved in a fire, external labelling of the load in accordance with the *Australian Dangerous Goods Code* as well as the proposed *Emergency Management Plan* would result in appropriate emergency response and evacuations, minimising the potential for human fatalities.

As a result, the Proponent contends that the risk of discharge of HCN gas as a result of fire or adverse impacts resulting from such a discharge is as low as reasonably practicable.

- Theft or loss of vehicle/trailer carrying cyanide Residual Risk = high

  This potential incident would require a vehicle or trailer carrying sodium cyanide to be stolen during transportation. The Proponent contends that the control measures proposed in **Table A6-10**, including the use of GPS trackers and controls on breaks during the journey, would result in the risk of theft or loss of sodium cyanide being reduced to as low as reasonably practicable.

- Concurrent failure of multiple leach tanks – Residual risk = Moderate.

  This potential incident would require an external incident that exceeded the design criteria of the leach tanks, resulting in multiple, concurrent failures of the tanks and discharge of the leach slurry. The proposed bunding would be designed to contain 110% of the volume of the largest tank. However, in the event of multiple tank failures, the bund would be likely to be overtopped, causing the slurry to discharge into the plant area before flowing down slope towards a sediment basin located at the base of the ROM Pad (RCB01). In the event that the capacity of the sediment basin is exceeded, the material would flow to the boxcut and then to the underground mine. Under no circumstances, would the material discharge to Spring Creek

  The likelihood of an external event resulting in the concurrent failure of multiple tanks is extremely rare. However, given the fact that the “task” is classified as occurring multiple times per day (requiring an F2 score of “10”), the minimum likelihood is “Unlikely”.

  Similarly, in the event of a discharge of leach slurry outside the bunded area, the anticipated clean-up costs would be likely to be between $20 000 and $50 000. As a result, the consequence classification would be “Moderate”, requiring a residual risk classification of “Moderate”.

Installation of bunding to fully contain the volume of all leach tanks would require very significant capital, disturbance of a larger area and operational inefficiencies for limited environmental gain. As a result, further controls would not be practicable.

- Discharge of tailings to Tailings Storage Facility with unacceptable concentration of cyanide – Residual Risk = Moderate.

  This potential incident would require a concurrent failure of the cyanide detoxification circuit and the related cyanide monitoring instrumentation. Such a discharge would have the potential to release supernatant water to the Tailings Storage Facility with WAD cyanide concentrations that could exceed the required discharge criteria. In the event that fauna were to access the supernatant pond immediately following the discharge, potential exists for fauna deaths.

  Given the fact that the "task" is classified would be continuous, requiring an F2 score of "10", the minimum likelihood is "Unlikely".

  In accordance with the Precautionary Principle, the Proponent has assumed that such an event may result in the death of a limited number of individual threatened species, most likely birds or bats, resulting in a substantial environmental impact. As a result, the consequence classification would be "Moderate", requiring a residual risk classification of "Moderate".

  Installation of further controls, such as measures to prevent avian fauna access to the supernatant pond (netting, floating balls, flashing lights, noise sources, etc.), have been proven to be of limited effectiveness (NICNAS, 2010). As a result, further controls would not be practicable.