Cameco Australia Pty Ltd

Kintyre Uranium Project

Chemical and Fuel Storage Management Plan

June 2013

Date	Revision	Description	Author	Approved
20/9/12	D1	Draft	Tetra Tech	SW
05/10/12	2	Final	Tetra Tech	SW
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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 10 km north of the Karlamilyi National Park (formerly Rudall River National Park) border.

A metallurgical plant suitable for the production of up to around 4,400 tpa of UOC as U_3O_8 would be established to treat ore extracted from the open pit using a conventional acid leaching process followed by conventional uranium extraction processes to produce a final UOC product for export. A number of reagents would be used during the metallurgical process.

The Kintyre Project would also require the consumption of energy, primarily in the form of diesel consumption for the production of electricity and for the mining fleet.

This Chemical and Fuel Storage Management Plan applies to the storage and handling of all chemicals and fuel associated with the construction and operation of the Kintyre Project. The disposal of Dangerous Goods and Hazardous Substances (as defined by the *Australian Dangerous Goods Code 2007* and the Australian Safety and Compensation Council) is considered in the Kintyre Project Waste Management Plan. Any leaks or spills of Dangerous Goods and Hazardous Substances outside of bunded areas will be dealt with as described in the Kintyre Project Emergency Response Plan. The handling and transport of Australian Dangerous Goods Code Class 7 - Radioactive Materials is addressed in Radiation Management Plan and Transport Radiation Management Plan.

2 RELEVANT LEGISLATION AND STANDARDS

Legislation and standards applicable to this management plan include but are not limited to:

- Dangerous Goods and Safety Regulations 2007 (WA);
- Australian Dangerous Goods Code;
- Occupational Safety and Health Regulations 1996;
- *Contaminated Sites Act 2003 (WA)*;
- National Code of Practice for the Control of Workplace Hazardous Substances 2007;
- Australian Standard 1940 - The storage and handling of flammable and combustible liquids 2004;
- Australian Standard 3780-2008: the storage and handling of corrosive substances;
- Australian Standard 1345: Pipeline Identification Colours;
- Australian Standard 2022: Anhydrous ammonia – Storage and handling;
- Australian Standard 3833 - The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers 2007;
- Environmental Protection (Controlled Waste) Regulations 2004; and
- Environmental Protection (Unauthorised Discharges) Regulations 2004.

3 ROLES & RESPONSIBILITES

Table 3-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Chemical and Fuel Storage Management Plan.

Table 3-1: Roles and Responsibilities

Position	**Responsibility**
Site Manager	▪ Ensure a current hazardous substances register of all hazardous substances used on site is maintained.
HSE Manager	▪ Implementation and maintenance of the plan. ▪ Undertake assessment and review of the effectiveness of this management plan. ▪ Ensure all staff are aware of their obligations in relation to this plan. ▪ Deliver chemical handling training and inductions.
Operation Managers and Site Supervisors	▪ Ensure the plan is being adhered to by all staff and contractors. ▪ Participate in compliance audits and inspections.
All Cameco personnel, contractors and visitors	▪ Comply with work procedures and safety requirements. ▪ Report any hazards related to the handling and storage of chemicals and fuel.

4 ENVIRONMENTAL MANAGEMENT

4.1 Purpose

The purpose of this Plan is to provide information for the handling and storage of chemicals and fuel to minimise the risk of health and safety and environmental impacts.

The key environmental objectives are:

- to minimise the potential risk for environmental and health and safety impacts as a result of chemical and fuel storage and handling;
- to ensure no release of chemicals or fuel to the environment as a result of handling or storage incidents; and
- to ensure compliance with relevant legislation and standards for the storage and handling of chemicals and fuel.

4.2 Potential Impacts

The potential environmental impacts that may arise from chemical and fuel handling and storage include:

- contamination of surface and ground waters;
- contamination of soils;
- injury or death of fauna;
- contamination and death of vegetation; and
- loss of fauna habitat.

Due to the localised nature of activities at the Kintyre Project site, any impacts from chemicals and fuel will also be localised.

4.3 Chemical Storage and Use

A number of reagents will be used in the metallurgical process. A six week inventory of these reagents will be stored on site. Table 4-1 details the reagent types, their form, indicative annual consumption and stock requirement volumes.

The storage and handling of flammable and combustible liquids within the Kintyre Project area will conform to Australian Standard 1940 – 2004. The storage and handling of corrosive substances (i.e. Class 8 dangerous goods) within the Kintyre Project area will conform to Australian Standard 3780-2008. The ancillary equipment to be used with corrosive substances (e.g. pipework and hoses) will conform to Australian Standard 1345.

In the event that the Project uses transportable tanks for the storage of Anhydrous Ammonia, these tanks and ancillary facilities shall comply with Australian Standard AS 2022.

Table 4-1: Indicative metallurgical reagent consumption, handling and storage methods

Reagent	ADG Code Classification	Handling and storage	Estimated Annual consumption (t)	Required inventory (t)
Sulphuric acid	Class 8 CORROSIVE	98% sulphuric acid solution will be delivered by road tanker and stored in a sulphuric acid tank farm for distribution to the leach and solvent extraction areas.	110,000	12,773
Manganese dioxide (pyrolusite)	Not classified	Pyrolusite will be sourced from the nearby Woodie Woodie mine as crushed manganese ore at 62% manganese dioxide. Road trucks will deliver ore to a receiving bin. Ore will be conveyed to a manganese ball mill. Manganese slurry will be thickened to 50% solids in a conventional thickener and stored in a storage and distribution tank from where it will be pumped to the leach section.	15,000	1,726
Lime	Class 8 CORROSIVE	Quicklime (85% CaO) will be delivered by pressurised tanker and transferred to storage silos. Lime will be slaked with process water to produce milk of lime for distribution to the raffinate treatment tank and tailings neutralisation tanks.	12,000	1,316
Ammonia	Class 2.3 TOXIC GAS	Anhydrous ammonia (liquid ammonia stored and transported under pressure) will be delivered by road tanker and stored in two anhydrous ammonia bullets. Ammonia gas will be distributed to the product precipitation tanks. Ammonium hydroxide solution will also be prepared by reacting ammonia with water and used for in the solvent extraction process.	1,500	144
Hydrogen peroxide*	Class 5.1 OXIDISING	The peroxide system consists of unloading pumps from a peroxide isotanker, storage tank and peroxide dosing pumps to the Fluid Bed precipitation vessel.	500	
Sodium carbonate	Not classified	Sodium carbonate may be delivered either by pressurised tanker and transferred to a storage silo or in one tonne bulk bags which will be added to a solution make up tank as required. Sodium carbonate solution will be pumped from a storage tank to the regeneration mixer settler.	1,000	119

Reagent	ADG Code Classification	Handling and storage	Estimated Annual consumption (t)	Required inventory (t)
Shellsol D70 (kerosene)	Class 3 FLAMMABLE LIQUID	Kerosene will be delivered by road tanker and off-loaded to a storage tank from where it will be pumped to the barren organic tank.	800	89
Alamine 336	Class 3 FLAMMABLE LIQUID	Alamine will be delivered in intermediate bulk containers (IBCs) and pumped to user points.	100	9
Isodecanol	Not classified under ADG code. However, generally classified as a combustible liquid and hence subject to AS 1940.	Isodecanol will be delivered in intermediate bulk containers (IBCs) and pumped to user points.	10	0.7
Flocculant	Various products may be used. Appropriate classification will be applied.	Flocculant will be delivered in powder form to site. The flocculant will be stored in a hopper/silo prior to preparation and distribution to the user points.	200	23

* Ammonia or hydrogen peroxide would be used depending on the selected stripping agent.

4.4 Fuel Storage and Use

The Kintyre Project will also require diesel fuel, primarily for the production of electricity, steam and for the mining fleet.

Diesel would be supplied via road transport, and stored on site in appropriately bunded tanks sized to provide approximately six weeks of plant demand. A summary of the proposed diesel consumption for the year of greatest diesel demand is presented in Table 4-2.

Table 4-2: Indicative annual diesel demand

Demand source	Annual Consumption (ML)	Required inventory (ML)
Mining fleet	15.3	1.76
Electricity generation	12.3	1.41
Total	**27.6**	**3.17**

A six week inventory of diesel will be stored on site, amounting to approximately 3.17 ML.

The storage and handling of flammable and combustible liquids within the Kintyre Project area will conform to Australian Standard 1940 – 2004.

4.5 Environmental Objectives and Performance Indicators

Table 4-3: Environmental Objectives and Performance Indicators

Environmental Objective	Performance Indicators
Minimise the potential risk for environmental and health and safety impacts as a result of chemical and fuel storage and handling.	• Regular monitoring and annual audits of chemical and fuel storage and handling areas, recording incidents and environmental impacts arising from hazardous materials leaks or spills and remedial measures undertaken.
Ensure no release of chemicals or fuel to the environment as a result of handling or storage incidents.	• No release of chemicals or fuel outside of bunded areas. • Prompt (within 12 hours) clean-up of chemical or fuel spills inside of bunded areas. • Regular maintenance (including removal of rainwater within bunding) of chemical and fuel storage areas.
Ensure compliance with relevant legislation and standards for the storage and handling of chemicals and fuel.	• No non-compliances with legislation and standards for the storage and handling of chemicals and fuel.

4.6 Environmental Aspects and Management Strategies

Table 4-4: Environmental Aspects and Management Strategies

Environmental Aspects	Management Strategy
Surface and ground waters Soils Fauna Flora	The management strategy will be based on managing the chemical and fuel storage facilities in accord with the relevant Australian Standards and Cameco's SHEQ Management System. Cameco will ensure that: • All staff will be inducted and trained in appropriate chemical and fuel handling techniques and precautions and made aware of the Spill Response Procedure and Site Emergency Response Plan. • All hazardous materials will be used only for their intended purpose and as described on the packaging. • A register of hazardous materials will be maintained to track from delivery to site to ultimate use or disposal. Also to include Controlled Waste Tracking Forms, details of supplier, quantities, storage location and MSDS information. • Fuel usage of all vehicles will be monitored via fuel logs or a Fuel Management System. • Vehicles will be turned off prior to refuelling. • Loading and unloading of bulk containers will be restricted to appropriately contained areas. • All hazardous materials will be stored in a manner that complies with legislative requirements and standards (AS 1940-2004) utilising storage facilities which, at a minimum, meet the relevant Australian Standard and are appropriate to the type of material being stored. • All hazardous materials will be stored in bunded areas in compliance with relevant regulations, standards and licence conditions. • Transfer points to or from bulk containers will be bunded. • Storage facilities for flammable goods will have bunding capable of storing 110% of the volume of the largest vessel, or 10% of the total volume stored. • Storage facilities for corrosive goods will have bunding capable of storing 110% of the total storage capacity of the facility. Bunds will be constructed from materials substantially immune to attack by any corrosive substance that they may be required to contain. • Bunding will be monitored following all rainfall events and potentially contaminated stormwater removed to the

Environmental Aspects	Management Strategy
	Stormwater Ponds, Evaporation Ponds and Tailings Water Recovery Pond. • Safe access to and egress from storage vessels and facilities will be maintained at all times. • Storage vessels will only be used to store the materials for which they are designed. • Regular monitoring of all storage facilities will be carried out. Records of monitoring will be maintained. • Annual auditing of all storage facilities will be carried out. Records of audits will be maintained. • Preventative maintenance plans will be implemented to ensure storage facilities, storage vessels and handling equipment are appropriately maintained in line with the manufacture's recommendations and Australian Standards.
Surface and ground waters Soils Fauna Flora	In case of a spill the Spill Response Procedure will be implemented. This will include the following procedure: • Assess the risk • Control the spill 1. Isolate spill area 2. Identify spilt substance 3. Obtain assistance if necessary 4. Identify hazards and PPE requirements by referring to the MSDS. • Contain the spill 5. Immobilise spill and isolate drains using spill response equipment. • Clean up the spill 6. Recover spilt product and contaminated material in accordance with the MSDS and necessary safety precautions; 7. Store recovered product and contaminated material within bunded area; 8. Dispose of contaminated material at an appropriately licensed facility. 9. Report the spill to the Incident Register using the Incident Reporting Form. In case of a High Risk spill, the Site Emergency Response Plan will also be implemented.

5 DEMONSTRATING THE OUTCOME (MONITORING)

5.1 Monitoring

The suitability and success of chemical and fuel storage and handling management measures detailed in this plan will be monitored against the associated performance indicators by the Environmental Manager. Site environment inspections will include monitoring to ensure appropriate management measures are being undertaken and the site hazardous materials register is being maintained.

Audits of compliance to State and Commonwealth legislation, guidelines and Australian Standards will be undertaken regularly to maintain appropriate standards of chemical and fuel storage and management.

5.2 Reporting

Any leaks or spills of chemicals or fuels outside of bunded areas will be reported immediately (within 24 hours) to Western Australian Department of Mines and Petroleum (Resources Safety) and the Western Australian Department of Environment and Conservation.

The Annual Environmental Report (AER) will provide detailed information on the effectiveness and implementation of this plan. The AER will also contain a summary of all audits, areas of compliance and noncompliance and remedial actions undertaken.

5.3 Review and Revision

This Plan will be maintained as a live document and will be reviewed on an annual basis, or as necessary, taking into account the results of monitoring and audits undertaken during the year. Significant process changes that result in a change in the type or volume of hazardous materials will be assessed and a determination made regarding the need for an interim update of this plan. Annual reviews will address matters such as the overall design and effectiveness of the plan, progress in environmental performance, incorporation of current leading practice and any changes in relevant legislation and Australian Standards.

Table 5-1: Environmental Management Summary Table

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Chemical and fuel handling and storage	Minimise the potential risk for environmental impacts. Ensure no release of chemicals or fuel to the environment as a result of handling or storage incidents. Ensure compliance with relevant legislation and standards for the storage and handling of chemicals and fuel.	Environmental Manager to monitor performance against specified performance indicators. Audits of compliance to State and Commonwealth legislation, guidelines and Australian Standards will be undertaken regularly to maintain appropriate standards of chemical and fuel storage and management.	Summary of all audits and outcomes detailed in the AER	The Kintyre Project Emergency Response Plan is in place for emergency situations and associated remediation actions related to spills.	Kintyre Project Waste Management Plan Kintyre Project Emergency Response Plan

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Chemical or fuel spill	Minimise the potential risk to personnel and the environment. Ensure no release of chemicals or fuel to the environment.	Spills and clean up measures will be reported in the Incident Register.	Leaks or spills of chemicals or fuels outside of bunded areas will be reported within 24 hours to DMP and DEC. The AER will include detail of all spills required to be reported to the regulators, and remedial actions undertaken.	The Kintyre Project Emergency Response Plan is in place for emergency situations and associated remediation actions related to spills.	Kintyre Spill Response Procedure Kintyre Project Emergency Response Plan.

6 REFERENCES

Standards Australia (1995). Australian Standard 1345-1995: Identification of the contents of pipes, conduits and ducts.

Standards Australia (2003). Australian Standard 2022-2003: Anhydrous ammonia – Storage and handling.

Standards Australia (2007). Australian Standard 3833-2007: The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers.

Standards Australia (2008). Australian Standard 3780-2008: The storage and handling of corrosive substances.

Cameco Australia Pty Ltd

Kintyre Uranium Project

Radiation Management Plan

October 2012

Date	Revision	Description	Author	Approved
31/8/12	D1	Draft	C. Dillon	SW
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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 5 km north of the Karlamilyi National Park.

Cameco has extensive experience in managing radiation exposures in uranium mining, and has a strong commitment to radiation protection. Based on this experience, a corporate Radiation Protection Programme has been developed, and this will be used to set minimum requirements for radiation protection at Kintyre.

Management of radiation has been identified as a key aspect for the Project during the risk assessment undertaken as part of the Environmental Review and Management Programme (ERMP). A detailed radiation management plan and a radioactive waste management plan will be required to be approved prior to commencement. These plans will have details of radiation protection and radioactive waste management specific to the plant and equipment to be installed, and the way in which is to be operated. These detailed designs are not available at the time of writing this plan.

The purpose of this management plan is to set out the principles that will be applied in managing radiation exposure and radioactive waste, and outlines the way these principles will be applied to the Kintyre Project, including an outline of the radiation control methods and an overview of the proposed monitoring.

This plan is considered a live document and will be reviewed and additional detail added, as the Project moves through the design, construction and commissioning phases.

2 RELEVANT LEGISLATION & STANDARDS

Legislation and standards applicable to this management plan include:

- *Radiation Safety Act 1975 (WA).*
- *Mines Safety and Inspection Act 1994 (WA)*.
- Department of Mines and Petroleum (DMP), 2010. Managing naturally occurring radioactive material (NORM) in mining and mineral processing – guideline.
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2003. RPS No. 1 - Recommendations for Limiting Exposure to Ionizing Radiation (1995) and National Standard for Limiting Occupational Exposure to Ionizing Radiation (2002).
- ARPANSA 2005. Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005).
- ARPANSA 2011 Safety Guide for Monitoring, Assessing and Recording Occupational Radiation Doses in Mining and Mineral Processing (2011).
- ARPANSA 2008 Code of Practice for the Safe Transport of Radioactive Material (2008 Edition).

3 RADIATION PROTECTION PRINCIPLES

The fundamental principles of radiation protection have been articulated by the International Commission on Radiological Protection (ICRP). The ICRP is the international authority on radiation protection and has, over many years, established the standard for radiation protection. This is outlined in its “system of dose limitation” which has been incorporated into Commonwealth and State legislation as described in Section 0

The overall approach by Cameco towards the management of radiation is consistent with the recommendations of the ICRP, in particular, the principle of optimisation (ensuring that doses are As Low As Reasonably Achievable [ALARA], taking into account all economic and societal factors).

Radiation and radioactive waste will be optimally managed and controlled at Kintyre through good design and appropriate ongoing operational management systems. The Cameco approach is to establish design criteria and minimum requirements to ensure that radiation is properly managed. Whilst the detailed Project design stage is not scheduled to commence until after environmental approvals have been obtained, this Plan sets out the principles that will be applied in managing radiation exposure and radioactive waste. The Plan will be updated following final design and prior to commencement of operations.

4 RADIATION CONTROL IN DESIGN

An essential element of radiation management is ensuring that appropriate radiation protection measures are incorporated in the earliest stages of design.

The designs for radiation control and radioactive waste management facilities will be developed with a risk management approach, based on the ALARA principle. That is, initial plans of the equipment to be installed will be examined to determine where radiation protection may be required, and options for control will be developed for those areas where requirements have been identified. These will be examined for the degree of protection they afford, and the optimum option will then be determined. Further refinements of control measures will then be considered before the final design is produced. A similar approach will be used in the development of operating procedures. These will be examined to see what tasks may require protection measures, available options will be considered, and from these an optimum procedure will be developed.

The ALARA principle will also be applied during operation. The radiation monitoring plan will collect data on radiation exposures and waste management, and as this data is accumulated, it will be examined to determine if there are ways in which further reductions in exposure can be reasonably achieved. Where such changes can be identified, the management plan will be adapted to incorporate these. This approach will be continued throughout the operation of the Project.

4.1 Radiation Control in the Mine

Access to the main mining areas will be restricted to ensure that only appropriately trained and qualified personnel are able to access the work areas.

The main aspect of the mine requiring radiation protection controls is gamma radiation from high grade areas. Dose rates on ore have the potential to be substantial, and it will be necessary to limit the time spent in these areas by individual workers. This will be achieved by careful rostering and scheduling of those workers operating ore recovery equipment, backed up by detailed monitoring. For production, drill operators and charge up crews who may be required to spend extended time directly on the ore, a workplace exposure plan will be developed based on actual dose rate measurements. The plan would estimate doses (based on exposure time and dose rate) and if necessary require a pad of inert material to be placed to provide some shielding during drilling and charging activities.

In addition to the traditional thermo-luminescent dosimeter (TLD) gamma monitors, direct-reading personal electronic dosimeters will be issued to potentially affected workers and these will allow real-time readout and dose assessment. The results of this monitoring will be regularly reviewed and individuals whose doses may be approaching the relevant limits will be assigned to other duties. Results will also be used to improve other radiation management measures where necessary.

Circumstances giving rise to high concentrations of radon decay products (RnDP) arise from natural processes (e.g. formation of inversions) and are thus not responsive to control. Measures will be taken to limit the exposures arising from such situations. All heavy equipment operating in the pit will have air-conditioned cabs. Continuous RnDP monitoring equipment will be installed to monitor the pit, with direct real-time display of concentrations in the control room. Control limits will be set, in consultation with regulatory authorities, and should RnDP concentrations exceed these levels, all workers not working in air conditioned cabs with effective air filtration will be removed from the pit until levels fall to below the control limit (generally when inversions are broken up after sunrise). Should essential work be required outside of cabs then respiratory protection will be required.

Measures will also be taken to minimise doses from inhalation of radioactive dust. These will include standard dust suppression techniques (wetting of materials before handling, wetting of roadways, provision of dust collection systems on drills etc.), and measures to reduce subsequent exposure (use of respiratory protection and air conditioned cabs).

4.2 Radiation Control in the Plant

The main aspects of processing that will require particular attention to radiation protection are the crushers and associated facilities, and the uranium product handling.

Both wet and dry material will be handled in the processing plant, requiring careful design consideration. The front end of the plant will house the crushing and grinding circuits where dust control is important.

Crushers and conveyor systems will be fitted with appropriate dust control measures, including dust extraction at dust generating sources, with cleaning of the exhaust air using scrubbers or bag houses. During start-up the area will be subject to intensive dust monitoring, to establish exposure levels and to identify any remaining dust sources. Based on the results of monitoring, additional dust control measures may be implemented. In situations where engineering solutions cannot be found, respiratory protection will be used.

After crushing, water will be added to the ore to produce a slurry and spillage control becomes important. All areas will be bunded, with facilities to collect spillage and pump it back to vessels or to the tailings management system. Tanks containing radioactive process slurries will be suitably bunded to capture at least the volume of the tank in the event of a catastrophic failure. The tailings pipeline corridor will bunded, and designed so as to be able to contain spillage from tailings pipeline failures. Pressure sensors will be installed on pipelines to give early warning of failure and automatically cut off flow to affected areas.

The plant will be designed for ease of access, so that spillages can be effectively cleaned up before they become dust sources. Ample wash-down water points and hoses will be supplied for spillage clean-up.

The uranium precipitation, drying, calcining and packing section of the plant handles a product with uranium concentrations of up to approximately 85%. Due to the concentration of uranium in the product, there are specific radiation protection requirements in this area, and in particular, control of dusts arising from this material is very important. The technology for the safe and secure packing of final uranium product into drums has been used for many years at uranium production facilities in Australia. It consists of a totally enclosed packing booth, with an automated drum filling process, operating under negative pressure to prevent any releases of dust. The negative pressure is maintained by an extraction ventilation system, with all air being scrubbed prior to release. Typically, uranium product packing scrubbers remove more than 99% of exhausted dusts and particulates.

The product packing workers would change into dedicated overalls prior to entry to the area, and then be required to change when leaving, including for lunch breaks.

Access to the product drying and packing area will be by ‘swipe-card’, with authorised personnel only allowed access. The swipe-card system will also log entry and exit and will record names and the total amount of time each person spends in this controlled area.

5 GENERAL MANAGEMENT MEASURES

The following section outlines the general management controls that would be applicable across the whole site.

5.1 Access Control

Access to all operating areas will be controlled to ensure that only those who have been properly trained and are aware of any specific radiological protection measures that are necessary can be admitted. As part of this process, controlled and supervised areas will be established for radiation control purposes. A supervised area is one in which working conditions are kept under review but in which special procedures to control exposure to radiation are not normally necessary. The estimated radiation exposures indicate that the supervised areas will include offices, laboratory and administrative areas, the hydrometallurgical plant (except for controlled areas listed below), the waste rock landforms, and the mineralised overburden stockpile.

A controlled area is one in which employees are required to follow specific procedures aimed at controlling exposure to radiation. Controlled areas are likely to include the mine, ore reception, crushing and grinding circuit, the ore sorters, product precipitation drying and packing areas and the tailings management area.

To facilitate control of doses and contamination, the Project area will be divided by fencing into ‘clean’ and ‘potentially-contaminated’ areas. Access to the potentially-contaminated area will be via a security gate. Egress from the potentially contaminated area by vehicle will be via a wheel-wash to ensure that contaminated material will not be transported off-site by vehicles. In general, vehicles that are likely to be regularly in contact with high grade uranium mineralisation (for example mine vehicles) will be kept within the contaminated area. Equipment that must be taken off site (for example for specialist servicing or repair) will be required to be cleaned and checked for contamination by suitably trained staff.

Change-room facilities will be established. These will have a “clean side” and a “dirty side”. Workers will come to work through the clean side and change into work clothes and exit through the dirty side. At the end of shift workers will enter the dirty side, remove their work clothes and shower, then proceed to the clean side where they will change back into clean clothes before returning to camp. All work clothes will be laundered on site.

5.2 Radiation Safety Expertise

Cameco is the world’s largest producer of uranium, and has considerable corporate experience that it brings to the Kintyre Project, including, suitably qualified and experienced radiation safety professionals to assist it during the design, construction and operational phases of the Project.

Sufficient appropriately qualified radiation protection personnel would be employed to implement the radiation management plan and the radioactive waste management plan.

The nominated radiation safety officer would have a direct reporting line to the site general manager.

5.3 Induction and Training

All employees will receive an induction informing them of the hazards associated with the workplace, of which radiation is one hazard. The level of the induction material will reflect the magnitude of the potential risk. For example, workers who may enter higher exposure areas will receive more intensive radiation training. Specific training will be provided to personnel involved in the handling of uranium concentrates.

Managers and supervisors will receive additional training in the recognition and management of situations that have the potential to increase a person's exposure to radiation. This is similar to the Hazard Observation (HAZOB) reporting system, and will also contribute to the annual review of performance of the plans.

5.4 Permitting

A specific radiation safety work permit system will be implemented. Before any non-routine work in a potentially high exposure situation, such as maintenance in the product packing area is undertaken, a work permit will be required, and all conditions on it must be complied with.

5.5 Record keeping

A computer based data management system will be used to store and manage all information relating to radiation management and monitoring.

The system will allow the recording of 'raw' and processed data, together with all relevant supplementary information such as calibration records, dose conversion factors, formulae used to estimate doses and employee occupation, work area, and time spent in various exposure situations.

Information that can be used to identify a person is considered confidential, and only authorised personnel will be able to access such data (including the relevant authorities).

Periodic and Statutory reports will be prepared from information stored in the electronic database. Dose reports would be provided to individuals quarterly and upon request.

5.6 Transport of Radioactive Materials

Transport of radioactive material will be in accordance with national codes of practices and state legislation. Details of transport are outlined in the Transport Management Plan.

5.7 Incident Response

It is not expected that radiological emergencies could arise, however, plans will be prepared for possible incidents or accidents that may result in exposure to radiation or loss of containment of radioactive material as part of the overall site emergency response plan. These plans would include:

- immediate response to medical conditions;
- evacuation of non-essential personnel;
- stabilisation of the source(s) of radiation;
- assessment of the likely source(s) of radiation exposure and the types of radiation; and
- de-contamination of the person(s) and the area.

The plans will also include requirements for post-incident response, including counselling of all people involved or affected by the incident, detailed investigation of the incident, including root-cause analysis to prevent recurrence, and procedures for estimating any radiation doses that may have arisen. Appropriate external experts will be used to assist as required.

5.8 Review of Performance

Radiation results will be reviewed annually to determine the adequacy and effectiveness of engineering and management controls to reduce radiation exposures of people and the environment.

Targets for the following year will be set and progress towards these targets will be monitored (at quarterly intervals).

6 MONITORING

As part of the management of radiation for the Kintyre Project, an occupational and environmental radiation monitoring program would be developed and implemented. The final program will form part of the Radiation Management Plan (RMP) and the Radioactive Waste Management Plan (RWMP) and would be submitted to the appropriate authority for approval prior to operations. The plans would include support systems such as servicing and calibration of monitoring instruments.

Monitoring will depend on the expected levels of exposure. For those who may receive more than 5 mSv per year (sometimes called 'designated' employees) monitoring will be more intensive, and directed to determining the doses that individuals receive. For those expected to receive less than5 mSv/y (non-designated employees) monitoring will be less intensive, and doses will be assessed from the average results of workgroups.

6.1 Workforce Information

It is expected that during mining and processing operations there will be approximately 300 workers onsite at any one time.

6.2 Critical group

The nearest permanent residents to the project are approximately 80 km from the Project. At this distance, doses from emissions from the Project are negligible, and not able to be distinguished from background levels

6.3 Occupational Monitoring Program

Occupational radiation monitoring will be conducted to fulfil two major aims;

- to provide data to assess the doses received by workers, and
- to determine the effectiveness of radiation protection controls.

Error! Reference source not found. provides an outline of a proposed occupational monitoring program.

Table 1: Outline of the proposed occupational radiation exposure monitoring program

Pathway	Measurement Method	Area of Operations
Direct (external) gamma	Thermo-luminescent dosimeter (TLD)	Individual monitoring for people working in areas where their total annual dose is likely to exceed 5 mSv/y. Representative monitoring of other work groups.
Direct (external) gamma	Personal electronic dosimeter	All mine operators that might be spending significant periods on high grade areas.

Pathway	Measurement Method	Area of Operations
Direct (external) gamma	Hand-held, calibrated gamma survey meter	Periodic spot measurements to detect changes in gamma dose rate.
Inhalation of dust containing long-lived, alpha-emitting radionuclides	Personal dust monitors Alpha counters	Individual monitoring for people working in areas where their total annual dose is likely to exceed 5 mSv. Representative (audit) monitoring of work groups.
Inhalation of radon decay products	Continuous radon decay product monitor	Representative (audit) monitoring of work groups.
Ingestion of water containing radionuclides	Gamma or Alpha spectroscopy or chemical analysis by external laboratory	Annual check on potable water supplies.

6.4 Action Levels

As part of the operational ALARA program, a series of action levels would be established to ensure that exposures remain controlled. Action levels are a management tool for reducing exposures, and do not form any part of the dose limitation system. An action level system requires that management take specified remedial action when personnel monitoring results exceeded the specified level. In some cases the action would a formal reporting and investigation procedure. **Error! Reference source not found.** provides an indication of action levels that may be set, and the remedial actions that would be required.

Table 2: Examples of action levels and responses

Radiation	Action Level	Actions
Gamma dose rates	5 µSv/h	Review occupancy, consider relocation if occupied, consider shielding if practicable.
Surface Contamination	4000 Bq/m^2	Immediate cleanup
Dust Concentrations	5 mg/m^3	Identify source and suppress (e.g. water suppression, housekeeping and ventilation)
Personal electronic dosimeter	100 µSv in one week	Review tasks, review occupancy of high exposure situations, consider job rotation.
TLD – (quarterly result)	1 mSv	Investigate and identify source. Redesign workplace or tasks to reduce exposure. Shield if necessary.
RDP Concentrations	5 uJ/m^3	Limit occupancy to air conditioned cabins, require respiratory protection

6.5 Environmental Monitoring Program

In addition to the occupational monitoring program, an environmental radiation monitoring program will be implemented that will build on the existing baseline surveys. The aims of this program are to provide data for the assessment of doses to the public and measure any radiological impacts on the off-site environment, to ensure that the radiation controls for off-site impacts are effective and provide more information on which to base post closure radiation limits.

A detailed environmental monitoring plan will be prepared for approval prior to construction commencing. An outline of the elements of such a plan is shown in **Error! Reference source not found.**.

Table 3: Outline of the environmental radiation management program

Environmental Pathway	Measurement Method	Location and Frequency
Direct (external) gamma	Handheld environmental gamma monitor	Annual survey at perimeter of operational area.
Radon Decay Product Concentrations	Real time monitors	Monitors will rotate between off site locations.
Dispersion of dust containing long-lived, alpha-emitting radionuclides	High volume sampler	Monitors will rotate between approved off site locations.
Dispersion of dust containing long-lived, alpha-emitting radionuclides	Dust deposition gauge	Sampling at identified locations. Samples composited for one year then radiometrically analysed.
Seepage of contaminated water	Groundwater sampling from monitoring bores	A network of monitoring bores will be sampled quarterly and analysed for radionuclides and other constituents.
Run-off of contaminated water	Surface water sampling	Opportunistic surface water sampling will occur following significant rainfall events.
Radionuclides in potable water supplies	Sampling and radiometric analysis	Annually

Appropriate meteorological monitoring will continue to support both the broader environmental monitoring program, and the environmental radiation monitoring program.

6.6 Dose Assessments

Dose to workers will align with national and state guidelines.

6.7 Support Systems

The support system for the monitoring programs will also include:

- recognised sampling methodologies that are documented and regularly reviewed;
- routine instrument calibration programs, including auditing of calibration sources;
- instrument maintenance and repair programs;
- the purchase and use of appropriate monitoring equipment;
- provision of appropriately trained and qualified monitoring personnel;
- review of new equipment; and
- regular external audits of the monitoring program and system.

7 RADIOACTIVE WASTE MANAGEMENT

7.1 Overview

There are four main categories of radioactive waste generated at Kintyre as follows;

- Mineralised waste material that contains uranium at above normal background levels, but may be uneconomical to process.
- Process tailings, which is the residue from processing, being material that has passed through the processing plant and had uranium extracted, leaving the remaining radionuclides in the uranium decay series.
- Water that may have come into contact with radioactive materials including surface run-off, from areas which may contain uranium bearing materials, and leachate that has infiltrated such materials.
- Miscellaneous wastes that may have become contaminated through contact with ores and process residues (referred to as contaminated waste), including discarded conveyor belts, rubber lining material, pipes, filter media and used protective equipment.

7.2 Waste Rock Management

Standard grade-control methods will be used to identify the general type of material during mining. Overburden will be trucked to the waste rock facility, while mined and mineralised material will undergo further analysis using a drive through radiation scanner.

Trucks exiting the mine will pause beneath radiation detectors that distinguish between classes of materials based on their radioactivity. Once scanned, trucks will be directed to one of the following destinations:

- run-of-mine ore stockpile (for material with more than 1,500 ppm U);
- waste rock landform (for waste material with less than 200 ppm U); or
- mineralised overburden stockpiles (for mineralised material with an average grade of 530 ppm U).

Two Waste Rock Landforms (WRL) (the North WRL and the West WRL) would be constructed to contain approximately 153 Mt of overburden. The un-mineralised overburden mined during the pit development would be transported to the West WRL and would be stockpiled separately within the final footprint of the West WRL, in an area that would be prepared to manage any potential rainfall infiltration and leachate.

Overburden would be end-dumped from haul trucks onto the prepared foundation of the WRLs in a series of lifts, each of around 10 m, with a final 4.5 m lift prior to closure. Each lift would be battered from the natural angle of repose (around 37 degrees) to around 18 degrees to promote stability. During operations, benches would be maintained between lifts for the management of stormwater run-off and to enhance stability. A number of tipping points would be operated simultaneously, each with a windrow designed as a safety barrier for reversing haul trucks.

A separate stockpile area would be developed for mineralised overburden. The stockpile area would be constructed with a compacted base to minimise seepage to ground water and engineered drainage to capture runoff.

If the stockpiled mineralised overburden was not processed prior to mine closure, the pile would be entirely encapsulated within the un-mineralised overburden stockpile to minimise radon emanation and mitigate the potential for contaminated stormwater runoff post mine closure. Investigations have indicated that the WRLs would be constructed of largely competent rock, and that the proposed design would have adequate factors of safety to ensure its stability in the long-term.

7.3 Radiological Controls for Tailings Management

Tailings from the processing facility will be radioactive and contain the decay products of uranium in approximately the same concentration as in the original ore. The expected concentrations in the tailings cannot be determined until the details of the processing method are determined. However, indicative concentrations of uranium in the solid tailings will be 10-15 Bq/g, with the other radionuclides being approximately 60 Bq/g. Concentrations of radionuclides in the liquid fraction of tailings are expected to be in the range of 0.02 mBq/l (Ra-226) to 50 mBq/l (Th-230).

Tailings handling will be similar to other uranium mines, with tailings being pumped from the processing plant to the tailings management facility (TMF) in a slurry form and deposited in thin layers. The tailings discharge points will be rotated around the tailings area with a cycle time of several weeks, which will allow some drying but will retain the tailings in a damp state to minimise dust generation. Excess liquor will collect near the centre of the facility and will be reused in the plant or pumped to lined evaporation ponds.

The TMF will be designed as a permanent, zero-discharge, single-use facility with a geomembrane lining and leak detections system, using Best Available Technology. Specifically, the TMF will be designed to ensure that tailings are effectively contained in the long term and radiological doses to the proposed workforce, members of the public and non-human biota are as low as reasonably achievable both during operations and following closure.

7.4 Waste Water Management

Water that has come in contact with mineralised material, such as stormwater run off from the ore stockpile or the mineralised overburden stockpile may contain entrained radioactive dusts and sediments. The site will be designed to retain surface water run off from a 1-in-100 year 72-hour storm event on site. The method of control will involve the construction of sedimentation and evaporations ponds, and appropriate collection bunds and channels.

All operational areas in the plant will be bunded with facilities for collecting spillage and returning it to the processing vessels or to the tailings management system.

Waste water from washdown areas and cleanup water would also be captured for treatment and evaporation.

7.5 Miscellaneous Waste Control

This material includes contaminated equipment and wastes from operational areas and would be disposed in an approved manner. A system of separate collection of potentially contaminated wastes from operational areas will be instituted. Where practical, potentially contaminated waste will be decontaminated and disposed of with normal waste streams. Contaminated waste will be collected and initially held in a secure, bunded area. Depending on the nature of the waste several disposal options will be available. These include:

- disposal into the tailings management facility;
- disposal within the waste rock landform in a similar manner to mineralised overburden;
- disposal into the mine pit at the end of operations; or
- disposal into purpose dug trenches in approved locations.

In all cases records of the disposal, including type of material, quantities and locations will be kept.

8 CLOSURE AND REHABILITATION

A Mine Closure and Rehabilitation Plan for the operation will be submitted for approval before commencement of operations. The radiation closure design aim is to ensure that all radioactive material is contained in the long-term so that radiation exposures are as low as reasonably achievable and consistent with natural background levels. The general concepts for managing radiation exposure at closure are outlined below.

8.1 Contaminated Plant and Equipment

All equipment will be tested for contamination. Where recycling is practicable, items will be decontaminated to approved radiation levels before leaving site. Items that cannot be properly decontaminated, or where recycling is impracticable, will be buried on-site, either in the mine pit or in an approved purpose build trench.

8.2 Tailings

The tailings will be allowed to dry sufficiently to allow access for machinery and then covered with inert waste rock to a depth agreed with the regulators to minimise the emanation of radon to an agreed closure level. The walls of the TMF will be armoured to reduce the potential for erosion, and appropriate structures for control of run off will be constructed.

8.3 Mineralised Overburden

If stockpile of mineralised overburden remain at the time of closure, the stockpile would be covered with unmineralised overburden to reduce radon emanation to an agreed level and reduce the risk of erosion exposing the mineralised rock.

8.4 The Unmineralised Overburden

The unmineralised overburden stockpiles would be contoured to reduce the risk of erosion

8.5 Monitoring

The site will be monitored after rehabilitation to ensure that it is free of contamination. Monitoring, including surface monitoring and monitoring of groundwater would continue for a period of time post-closure until agreed Completion Criteria had been achieved to the satisfaction of the regulators.

It is expected that under those conditions radiation exposures to the public would be minimal, and certainly significantly less than those during operation.

Cameco Australia Pty Ltd

Kintyre Uranium Project

Transport Radiation Management Plan

October 2012

Date	Revision	Description	Author	Approved
15/8/12	D1	Draft	Cameco	SW
9/10/12	D2	Final	Cameco	SW

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ACRONYMNS

Term	Description
ADGC	Australian Dangerous Goods Code
ALARA	The As Low As Reasonably Achievable (ALARA) principle
AMSA	Australian Maritime Safety Authority is the Australian Competent Authority responsible for all safety aspects associated with the carriage of radioactive substances on land and at sea
ASNO	Australian Safeguards and Non-Proliferation Office
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
Bq/cm2	Becquerel per centimetre squared – A Becquerel is equal to one nuclear disintegration per second.
CCTV	Closed circuit television
Cameco	Cameco Australia Pty Ltd
Competent Authority	Regulatory authority which administers the various statutory regulations covering transport of radioactive materials and controls emergency action in the event of an incident
C-TPAT IAEA LEMC	Customs-Trade Partnership Against Terrorism International Atomic Energy Agency Local Emergency Management Committee
CPPNM	Convention on the Physical Protection of Nuclear Material
EPIRB	Emergency Position Indicating Radio Beacon
ERMP	Environmental Review and Management Program
GP containers	20ft General Purpose container with minimum external dimensions 6.1m(l) x 2.4m(w) x 2.4m (h)
IAEA	International Atomic Energy Agency
ICAO	International Civil Aviation Organisation

Term	Description
ICRP	International Commission on Radiological Protection
IMO	International Maritime Organisation
LSA	Low specific activity material is radioactive material, which by its nature has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply.
mSv	milli Sievert (one thousandth of a Sievert)
μSv	micro Sievert (one millionth of a Sievert)
NT	Northern Territory
NTP	Nuclear Non-Proliferation Treaty
PN	ASNO Permit to Possess Nuclear Material
PPE	Personal Protective Equipment
Radioactive material	In this document, any material, including UOC, with greater than 1 Becquerel/gram (bq/g) (approx. 80 ppm uranium) is considered a radioactive material.
SA	South Australia
SDS	Safety Data Sheet (previously referred to as Material Safety Data Sheet)
Sv	Sievert - unit of equivalent dose (the biological effect of ionising radiation), defined as that which delivers a joule of energy per kilogram of recipient mass
the Code	Code of Practice for the Safe Transport of Radioactive Material, 2008, Radiation Protection Series No. 21, ARPANSA, Canberra
the Project	Kintyre Uranium Project
TN	ASNO Permit to Transport Nuclear Material
TRMP and ERPP	Transport of Radioactive Material Management Plan and the Emergency Response and Preparedness Plan

Term	Description
Transport Index	The maximum radiation level at 1m from any external surface of the package (uSv/h divided by 10) and rounded up to the first decimal place to determine the transport index.
TSP	Transport Service Provider engaged by Cameco to transport UOC through Australia
TSP Vehicle	Transport Service Provider Vehicle. As defined in paragraph 247 (page 15) of the Code of Practice for Safe Transport of Radioactive Materials.
UN	United Nations
UN2912	United Nations Proper Shipping Name - RADIOACTIVE MATERIAL, LOW SPECIFIC ˽ ACTIVITY (LSA-I) non-fissile or fissile-excepted
UN3077	United Nations Proper Shipping Name - Environmentally Hazardous Substance, Solid, Not Otherwise Specified (NOS)
UOC	Uranium oxide concentrate
US	United States of America
WA	Western Australia

1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 5 km north of the Karlamilyi National Park.

This Transport of Radioactive Material Management Plan and the Emergency Response and Preparedness Plan (TRMP and ERPP) details the overarching framework Cameco intends to implement in order to ensure the safe transport of uranium oxide concentrate (UOC) in accordance with Australian and International requirements. It describes a management system that will ensure the safety of persons and the environment from any potential hazards arising from the transport of UOC from the Kintyre Project.

This TRMP and ERPP applies to UOC that will be sealed in steel 205 L drums and loaded into 20 ft steel general purpose containers for transport via road to the port of Adelaide, for export from Australia. There are expected to be up to 100 transport movements per year, and transport will occur within two States of Australia.

UOC is classed as a dangerous good and would be transported as UN2912, Class 7 – Radioactive Substances, LSA-1.

2 RELEVANT LEGISLATION & STANDARDS

The TRMP and ERPP adopt the position that the latest edition of any Australian, State and Territory Act or Regulation would apply to all radioactive materials at the time of transport. In the case of any international regulatory regimes, such as those produced by the IAEA, the latest edition of those documents would apply to this TRMP and ERPP even if it may not have been adopted in Australian law by relevant jurisdictions at the time of shipment.

2.1 International Atomic Energy Agency

The International Atomic Energy Agency (IAEA) has operated under the auspices of the United Nations since its establishment in 1957. In seeking to ensure the safe, secure and peaceful use of nuclear energy, the focus of the IAEA is on:

- safety and security;
- science and technology; and
- safeguards and verification.

The IAEA has safety standards for international transport of radioactive materials known as TS- R-1 – Regulations for the Safe Transport of Radioactive Material. In addition to TS-R-1, the IAEA also produces supporting documentation including Fundamental Safety Principles – Safety Fundamentals No. SF-1. The regulations address all categories of radioactive material including ores and ore concentrates. They provide for marking, labelling and placarding, documentation, external radiation limits, operational controls, quality assurance, notification of movement of radioactive substances across land and by marine and air transport.

Requirements based on the IAEA regulations have been adopted in about 60 countries, as well as by the International Civil Aviation Organisation (ICAO), the International Maritime Organisation (IMO), and regional transport organisations.

2.2 Australia

Australia has been safely transporting uranium for more than 50 years. All of Australia's uranium is exported for exclusively peaceful purposes, and only to countries and parties with which Australia has a bilateral safeguards Agreement. These Agreements ensure that Australia's nuclear exports remain in exclusively peaceful use, and may only be retransferred to a party with a bilateral safeguards Agreement with Australia.

The Australian Safeguards and Non-Proliferation Office (ASNO) ensures that Australia's international obligations are met under the Nuclear Non-Proliferation Treaty (NPT), Australia's NPT safeguards agreement with the IAEA, the Convention on the Physical Protection of Nuclear Material (CPPNM) and Australia's various bilateral safeguards agreements.

ASNO would issue permits under the *Nuclear Non-Proliferation (Safeguards) Act 1987* to the various parties involved in the movement of UOC, to either Possess Nuclear Material (PN) or Transport Nuclear Material (TN) to approved parties. As well as ASNO permits, Western Australia and the Northern Territory require additional licenses to be held for the transport of UOC in their respective jurisdiction.

The *ARPANSA Code of Practice for the Safe Transport of Radioactive Material, Edition 2008* (the Code) also establishes specific requirements for radioactive substances such as uranium oxide concentrate. This Code adopts the IAEA Recommendations contained in IAEA publication *TS-R-1- Regulations for the Safe Transport of Radioactive Material*, and is incorporated into State and Territory legislation.

Table 1 outlines the relevant legislative instruments in force in both the Commonwealth and the three States and Territories through which UOC will be transported.

Table 1: Legislative Instruments

Commonwealth Legislation	*Australian Radiation Protection and Nuclear Safety Act (1998)* *Nuclear Non-Proliferation (Safeguards) Act 1987* *Customs Act 1901* Customs (Prohibited Exports) Regulations 1958 *Australian Dangerous Goods (ADGC) Code, 7th Edition* *ARPANSA, Code of Practice for the Safe Transport of Radioactive Material 2008* *ARPANSA, Code of Practice, Security of Radioactive Sources, Radiation Protection Series 11* *ARPANSA, Safe Transport of Radioactive Material, Safety Guide, Radiation Protection Series No.2.1, 2008* *Australian Standard AS 3846-1998 The handling and transport of dangerous cargoes in port areas.*
Western Australian Legislation	*Radiation Safety Act 1975.* *WA Radiation Safety (Transport of Radioactive Substances) Regulations 2002.* *Dangerous Goods Safety Act 2004.* *Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007. Dangerous Goods Safety (General) Regulations 2007. Emergency Management Act 2005.* *Emergency Management Regulations 2006 Westplan.*
South Australian Legislation	*Environment Protection Act 1993.* *Dangerous Substances Act 1979.* *Dangerous Substances (Dangerous Goods Transport) Regulations 2008.* *Radiation Protection and Control Act 1982.* *Radiation Protection and Control (Transport of Radioactive Substances) Regulations 2008.* *South Australia State Emergency Management Plan, June 2010*

3 ROLES AND RESPONSIBILITIES

3.1 Cameco

Cameco has been transporting uranium concentrate across Canada and North America for 22 years. In this time they have trucked approximately 90,000 tonnes over 38 million kilometres and developed industry best practice policies, procedures and experience in the handling, transportation and storage of uranium concentrate. This experience will be applied to Cameco's Australian operations to ensure that the highest possible standards are met.

Cameco will be responsible for:

- safe operation of the Kintyre project;
- radiation management relating to all activities at the Kintyre project, including the correct packaging, labelling and placarding of consignments;
- implementation of this TRMP and ERPP;
- compliance with all relevant legislation relating to the transport of radioactive material from the Kintyre project to ASNO approved facilities at the port of Adelaide;
- obtaining all relevant licenses and permits required by legislation for the safe transport of UOC through Australia;
- appointment and management of all contractors who are engaged to carry out aspects associated with this TRMP and ERPP and the transport of UOC from Kintyre;
- maintaining consultative relationships with regulatory authorities who are involved on the safe transport of UOC consignments;
- implementing an Emergency Response Plan and ensuring that resources are available for emergency response, in collaboration with regulatory authorities and local and regional emergency services;
- reviewing and updating all Cameco documentation relating to the transport of radioactive materials in a periodic manner;
- providing training to the transport freight service provider in radiation protection and emergency response; and
- education and training for local emergency services specific to a spill of UOC

3.2 The Transport Service Provider

The Transport Provider(s) contracted to provide transportation services to Cameco will be responsible for:

- obtaining and maintaining all relevant licenses and permits associated with the transportation of UOC for Cameco;
- ensuring that all staff involved in the transportation of UOC are provided with formal training in regards to radiation protection and emergency response;

- implement emergency response plans in the event of an incident or accident while the UOC is in their control;
- compliance with this TRMP and ERPP and all Commonwealth, State and Territory legislation pertaining to the safe transport of radioactive material, including Acts, Regulations, Codes of Practice and Australian Standards;
- compliance with all Australian, State and Territory road regulations, procedures and Codes of Practice relating to transport, including Occupational Health and Safety requirements;
- regular review and testing of Emergency Response Plans relating to the safe transport of radioactive material; and
- ensuring that all documentation relating to the transport of radioactive materials and emergency response is present in the cab of the transport vehicle;

4 APPROACH TO SAFE TRANSPORT

4.1 Cameco Experience

Cameco is one of the world's largest uranium producers accounting for 15% of world production from its mines in Canada, the US and Kazakhstan. Cameco has a long history of safely managing radiation protection in both uranium production and transportation.

Cameco has a management system that integrates: safety and health, radiation protection, environment, quality, emergency preparedness and response, contractor management, and audit programs.

Cameco is committed to the following principles:

- keeping risks at levels as low as reasonably achievable;
- prevention of pollution;
- complying with and moving beyond legal and other requirements;
- ensuring quality of processes, products and services; and
- continually improving our overall performance

4.2 Radiation Protection Program

It is well known that high doses of ionising radiation can cause harm, but there is continuing scientific uncertainty of the effects of at low doses. At levels of dose routinely encountered by members of the public and occupational exposed persons in Australia, there is little or no epidemiological evidence of health effects. Radiation protection standards recognise that it is not possible to eliminate all radiation exposure, but they do provide a system of control to avoid unnecessary exposure to radiation.

The ARPANSA Code of practice for the Safe Transport of Radioactive Material adopts the IAEA recommendations and in doing so incorporates the International Commission on Radiological Protection (ICRP) As Low As Reasonably Achievable (ALARA) principle. The ICRP defines the ALARA principle as:

'the source related process to keep the likelihood of incurring exposures (where these are not certain to be received), the number of people exposed, and the magnitude of individual doses as low as reasonably achievable, taking economic and societal factors into account'

In practical terms, this provides direction that companies should actively demonstrate that public radiation exposure is well within the accepted dose limit of 1 mSv per year, and that measures should be taken to minimise radiation exposure during transport activities, to ensure protection of communities and the environment. For the Project, this will be achieved through the application of the following control measures:

- Shielding – appropriate physical barriers in the form of steel drums and general purpose containers must be used to reduce radiation exposure.

- Time – time spent near the material must be minimised during transport.
- Distance – maintaining appropriate distance from the material when in transport.
- Amount – schedule transports appropriately to minimise the amount of material in storage at any one time.

Personnel who drive the trucks containing the UOC would be monitored with thermo-luminescent dosimeter badges and for the purposes of communicating dose information to drivers, personal electronic dosimeters. Evidence from existing transport operations demonstrate that doses would remain well below radiation worker limits, however control measures will be introduced to minimise radiation exposure as necessary. Further detailed dose assessments are provided in the Radiation Technical Document and Risk Assessment.

A detailed discussion on Radiation Management is contained in the Radiation Management Plan and the Kintyre Project ERMP.

4.3 Transport Route

Cameco proposes to transport UOC from Kintyre to the Port of Adelaide via road. The transport route would be from Kintyre to the Western Australian – South Australian border via Telfer, Marble Bar, Port Hedland, Newman, Meekatharra, Mount Magnet, Sandstone, Leinster, Leonora, Kalgoorlie, Kambalda, Norseman, and the Eyre Highway to the WA/SA border and then on to Adelaide (Figure 1).

The total distance of the preferred road route from Kintyre Mine Site to the border is approximately 3,200 km. This involves travel along sealed roads through remote areas and some towns. All roads proposed to be used for the transport of UOC, with the exception of the existing Kintyre to Telfer road, are existing heavy haulage routes. It is proposed that an average of two road trains per week will operate along the route. Up to five road trains may travel the route during a single week but on average about 100 shipments will occur in a single year. The sealed roads currently carry road trains and other vehicles from a number of different industries. The inclusion of road trains from the Kintyre project at the frequency described above are considered to pose only minimal additional burden on the road infrastructure and minimal additional risk to the degradation of the roads.

Following the announcement by a number of companies to develop uranium mines in Western Australia, the State Government announced it would not permit the export of UOC from Western Australian ports that are located adjacent to residential areas. This effectively means that UOC cannot be exported from Western Australia. Subsequent to this announcement, the State Government announced plans to consider the development of a road to rail transfer hub at Parkeston, just north of Kalgoorlie to allow offloading and transfer of bulk freight between road and rail transport networks. This facility would allow uranium producers to road freight to Parkeston and transfer to rail for the next leg of the journey to the Port of Adelaide. At the time of preparing this TRMP and ERPP, there is no certainty that the Parkeston facility would be developed therefore Cameco has proposed road freight as it is the only option available at the time. If alternatives to the existing transport proposal arose during the life of the Kintyre mine, Cameco would consider the options and seek approval to use the alternative or to change the transport route.

Figure 1: Proposed Preferred UOC Transport Route

4.4 Packaging

The objective of packaging requirements is to ensure that there is no loss of containment during transport of consignments of UOC.

The UOC will be placed into Industrial Packaging Type 1 (IP –1) 205L steel drums in the processing plant and then loaded into plastic lined steel General Purpose (GP) containers conforming to ISO 1496 (Figure 2). The drums will be strapped with Corex strapping (Cordlash CC105) approved by the Australian Maritime Safety Authority (AMSA).

Figure 2: Drums secured safely within a GP container

The doors of the containers containing the UOC will be sealed with bolt type seals, which are consecutively numbered. The bolt security seals would comply with Customs-Trade Partnership Against Terrorism (C-TPAT) and ISO 17712 standards which meet ASNO standards as part of the Security Plan for the movement of UOC from the Project.

Prior to leaving the Project, and in accordance with the Code, a Radiation Safety Officer or delegate will conduct all monitoring for non-fixed surface contamination and will monitor the exterior gamma radiation to confirm the Transport Index (TI).

The TI is an indicative measure of the potential gamma radiation level at 1 m for each 20 ft GP container and is recorded on the Yellow III label. All radiation measurements will be recorded and retained.

4.5 Marking, Labelling and Placarding

In accordance with the Code, all 205 L drums and GP containers will be legibly and durably marked with the gross mass and weight of the receptacle.

All 205 L drums will be appropriately labelled and all GP containers will be placarded correctly. Labels will be Class 7, UN2912, III – Yellow labels conforming to the requirements in the Code (Figure 3).

Figure 3: Category III-Yellow Label displayed on GP container

There will also be a requirement for a UN 3077, Environmentally Hazardous Substance, Solid, Not Otherwise Specified (NOS) placard to be placed on the GP container along with a placard meeting the requirements for a Class 7 UN2912 label (Figure 4 and Figure 5).

Figure 4: Radioactive 7 and Environmentally Hazardous Substance (NOS) placards

Figure 5: Alternative UN2912 placard

Placards and labels will be removed from drums and containers when they are empty.

4.6 Security

The objective of transport security is to prevent unauthorised personnel from acquiring or tampering with radioactive material while it is in transport. The transport of UOC, including the transfers between transport modes from the Project to the nominated export port in Adelaide, occurs in the public domain. While in transit, delays such as modal transfers and waiting times will be kept to a minimum and no longer than absolutely necessary to minimise unauthorised access, theft or other malicious acts.

The IAEA provides guidance in this area, particularly for prudent management practices and appropriate security levels, through a code of conduct for the security of radioactive material. The Security in the Transport of Radioactive Material Code, (IAEA Nuclear Security Series No. 9, 2008) defines security levels based on the radioactivity levels of the contents of a single package of the material being transported. UOC is classified as LSA-I and requires prudent security management practices to be implemented.

4.6.1 Security Plan

A security plan that complies with Australian regulatory requirements and achieves the above objectives would be developed prior to the commencement of transport operations, implemented, periodically reviewed, and communicated to all relevant parties associated with transporting UOC from the Project. The security plan would:

- Allocate responsibilities for security.
- Specify measures to provide advanced transport notification (where required), monitor shipments and maintain records of material transported.
- Include a review of operations and an assessment of vulnerability. Specify measures used to reduce security risks (e.g. driver vetting and security checks).
- Include procedures for reporting and dealing with security threats, breaches and incidents.
- Include provisions to provide threat information on an ongoing basis and actions to be taken in the event of a change in threat level (this is and would continue to be provided by ASNO).
- Include provisions for evaluating, testing, reviewing and updating the security plan.
- Outline measures to secure information and limit distribution of sensitive information.
- Ensure appropriate emergency response and security contingency plans are in place for accidents, breakdowns or any other delays along the approved transport route.

4.7 Road Transport

Cameco recognises that real-time, accurate communications are necessary to the successful transport of UOC and will implement the following requirements:

All road vehicles used to transport UOC from the Project site to Adelaide, would:

- at all times travel in conveys of at least two trucks which would remain in close proximity throughout the journey;
- use trained drivers with all necessary licenses;
- as a minimum, trucks will be outfitted with equipment to communicate quickly, efficiently and reliably with an operational base. This could include two-way radios and satellite phones; and
- a global positioning system (GPS) would be fitted to each prime mover.

A GPS fitted to each truck would provide three main security functions that are outlined below:

- A duress pendant or similar device would be provided to each driver so that if he/she was involved in an en route incident, the pendant may be pressed within 50 m of the vehicle and a duress message would be triggered.
- Out-of-zone requirements (also known as a geo-fence) around the approved road transport routes would be defined, and if a vehicle moved outside these zones (see Section 6.4) or travelled in an alternative direction, a back to base alarm would be generated.
- En route checking (with automatic updates, duress alarms etc. through to an authorised user website) would display the location of vehicles during their journey at both the Project main security gate and Transport Service Provider (TSP) operational centre.

4.8 Storage During Transport

UOC will be stored in designated secure areas that have been approved and licensed by ASNO and/or the relevant state or territory regulator. The designated secure area is Dubai Ports secure facility, Port Adelaide Terminal.

Stringent security protocols are in place in ASNO approved secure areas, including the controls listed below:

- Access to the Ports is controlled by maritime security legislation.
- Inductions for all staff and visitors accessing the Site.
- Security passes issued to staff.
- Visitors escorted at all times.
- Training for all staff in emergency response procedures and security controls.
- CCTV in place.
- Physical barriers to restrict access to containers.
- Appropriate lighting.

4.9 Risk Assessment

A risk assessment for the transport of UOC from the Project site to the Port of Adelaide has been conducted and the results are presented in the ERMP.

5 INCIDENT MANAGEMENT AND EMERGENCY RESPONSE

5.1 Corporate Responsibility

Historically, there have been no reported transport accidents involving radioactive material from Cameco's operations worldwide that have resulted in serious radiological consequences to the environment or communities along transport routes.

Cameco's standards require that qualified company representatives will be dispatched to either support or lead any emergency response activities. Cameco maintains a 24-hour emergency telephone service to report any transportation-related incidents. As in North America, Cameco will retain the services of professional spill response organisations to provide initial response services in support of local emergency response organisations.

5.2 Planning and Preparation

Emergency planning and preparedness for responding to a transport incident involving radioactive material, including UOC, is similar to that required when responding to transport incidents involving other types of dangerous goods. The objective of a program for planning and preparedness for an emergency involving radioactive material should be to assist in building competence and confidence that an emergency arising from a transport accident would be managed effectively.

Cameco has a Corporate Crisis Management Plan (CCMP) that is utilised to coordinate response to any number of potential incidents worldwide, and this would be activated in the event of an incident involving transport of UOC from the Kintyre Project. The CCMP outlines managerial responsibilities for scaling response activities and communicating to responsible parties.

The CCMP provides the foundation for maintaining preparedness and establishing policies in the event of an incident or emergency situation by outlining thresholds for:

- assessing the magnitude of and prioritising incident, emergency or crisis situations;
- escalation of an incident to an emergency or crisis situation;
- activating Incident Management (IMT), Emergency Management (EMT) and Crisis Management (CMT) teams depending on incident, emergency or crisis situations;
- notifying Project and Cameco executive management;
- procedures for notification and activation of Incident Management;
- Emergency Management and Crisis Management teams;
- roles and responsibilities of all IMT, EMT and CMT members; and
- guidelines and checklists to facilitate an effective and organised response.

In line with Cameco's corporate standards for emergency response to an incident involving UOC, Cameco will:

- Establish, equip and maintain an emergency response team that will also be available to assist in the event of an incident.
- Develop an emergency response plan to the satisfaction of state and federal authorities and support agencies.
- Develop a first responders program which will involve Cameco staff working with both professional and volunteer emergency response crews along Cameco's main transport routes to inform them about the properties of uranium, the risks associated with a spill and appropriate first response spill containment.
- Conduct spill response exercises in conjunction with emergency services to trial spill response procedures.

5.3 Training

Training in radiation protection will be provided in induction format to all Cameco employees and contractors engaged at the Kintyre project. Further job specific training will be provided to identify subgroups of employees and contractors, including any personnel involved in the transport, handling, storage, and incident management of UOC.

Job specific training will be tailored for the target audience and may include details on:

- basic physics of radiation;
- exposure pathways;
- controls applied to minimize radiation exposure;
- risks associated with exposure to radiation;
- transport related legislative requirements;
- procedures for responding to incidents;
- responsibilities in radiation protection and management; and
- communication protocols during incident response and management.

Job specific training will be provided to:

- Cameco emergency services personnel;
- State and Federal emergency service organisations who may be expected to respond to an incident involving UOC;
- volunteer emergency response organisations along the transport route; and
- transport personnel involved in transporting UOC.

In addition, health workers who have potential to come into contact with personnel who may be involved in an incident involving transport of UOC will be identified and offered radiation awareness training (i.e. local health clinic workers near Kintyre etc.).

5.4 Safety Precautions

UOC has a slight chemical toxicity. It is weakly radioactive and is only a potential health hazard if inhaled or ingested. Provided precautions are taken to avoid inhalation or ingestion, any spilt UOC would not present a health hazard.

In the event of loss of containment resulting from a transport accident, the main exposure for personnel in attendance is likely to occur through inhaling suspended material (dust). Similar to other spills involving dangerous goods, the use of correct Personal Protective Equipment (i.e. respiratory protection equipment and gloves) and restricting the time spent working around the spilt material would reduce the risk of radiation exposure.

The affected area should be suitably controlled and segregated, and access to enter or remain in the area should be restricted. Qualified persons such as emergency services representatives would take control of the incident and supervise the response operation, including the salvage operation.

5.5 Spill Kit

During all transport activities an incident response kit would accompany the 20 ft GP containers loaded with UOC. The lead road vehicle would carry the incident response kit.

The kit has been designed to assist in safe and efficient containment in the initial stages of a UOC spill during transport. The kit would include, but not be limited to, the following items:

- Personnel Protective Equipment (PPE);
- Emergency Position Indicating Radio Beacons (EPIRB);
- personal hygiene materials;
- workplace first aid kit;
- torches and spare batteries;
- traffic management devices;
- containment equipment;
- recovery equipment; and
- a copy of the Emergency Response Plan.

The spill kits would be held and maintained by the TSP. Procedural control will ensure that the contents of the kits are checked on a regular basis to ensure they are maintained and ready for use at any time during the transport of UOC.

5.6 Reporting

Any incident in which a loss of containment of UOC occurs will be reported to Australian Government and State Authorities as soon as practicable after the incident occurs. As the Police, Fire Brigade and/or local emergency services (i.e. Fire & Emergency Services Authority of Western Australia, State Emergency Service, South Australian Country Fire Service,) are the first line of response, they will already have emergency plans dealing with other dangerous goods as defined in the ADGC. The emergency plan for dealing with radioactive material will conform and integrate as closely as possible with procedures for dealing with other transport incidents involving other classes of dangerous goods.

The emergency response plans for TSPs involved in transporting radioactive material, including UOC, are integrated with those of emergency service providers to ensure a consistent approach to transport accidents where other dangerous goods are involved.

Usually Police would assume overall responsibility for the management of the emergency response. Cameco will dispatch designated representatives to provide specific expertise and advice to on-site incident controllers on radiation, contamination issues, and recovery and rehabilitation matters associated with the transport accident.

5.7 Initial Actions following an incident

Initial actions following an incident would involve:

- assessing the incident;
- gathering and recording facts;
- notifying emergency services as required;
- prioritising the need for rescue, life-saving, first aid, fire control, and control of any other hazards;
- if product had escaped both its steel drum and shipping container, the use of a response kit in the immediate containment of any spill;
- isolating the incident area with barricades to exclude members of the public for at least 25 m in all directions;
- unauthorised people would be kept away from the vehicles until emergency services or Project personnel arrived;
- people at the incident site would be advised to remain upwind and be aware of possible dust;
- upon arrival emergency services would establish a 70 m exclusion zone around the incident site; and
- the incident would be escalated as necessary, by following any instructions provided by emergency services personnel.

5.8 Emergency Response Priorities

When responding to transport incidents involving radioactive material, the priority of the main steps involved are:

- rescue injured personnel and provide any emergency first aid/medical attention required;
- evacuate non-essential personnel and members of the community if required;

- use respiratory protection, protective clothing as outlined in the Safety Data Sheet (SDS) for UOC to reduce the possibility of inhaling radioactive material;
- minimise the time spent nearby, and maximise the distance to, any leaked UOC;
- control fires and other common consequences of transport accidents;
- identify any other associated hazards (e.g. other dangerous goods such as fuel spills, electrical sources) and establish a controlled cordoned-off area;
- control and prevent any additional spread of radioactive contamination.

It must be noted that providing emergency response to personnel requiring treatment for injury as a result of a transport accident is the highest priority and should not be prevented due to any loss of containment of UOC.

6 MONITORING SYSTEMS

Cameco has identified assessment criteria, which will be utilised in order to monitor the effectiveness of their approach to safe transport of UOC, and demonstrate that protection of the environment and community is achieved. These criteria are detailed in Table 2.

Table 2: Assessment Criteria

Item	Objective	Assessment Criteria
Loss of containment of UOC resulting from an incident or accident during transport	No adverse health impacts to the public or emergency response workers due to exposure to UOC.	Doses to members of the public and emergency response workers remain below the internationally accepted limit of 1 mSv/y above natural background
Loss of containment of UOC resulting from an incident or accident during transport	No long term impacts to the environment.	In the event of any loss of containment of UOC, an assessment of potential environmental impacts would be conducted, following existing IAEA or Australian Government recommendations
Non-compliance with this TRMP and ERPP	Regular review of the effectiveness of this TRMP and ERPP according to criteria outlined in section 10	Results of review to be conveyed to Cameco Management and identified actions to be finalised within agreed timeframes
Performance monitoring	Identification, capture, recording and reporting of performance indicators to ensure compliance with safety expectations during transport of UOC	Performance indicators including: • Communications • Compliance with Permits and Chain of Responsibility • Documentation • Driver fatigue management Incidents • Safe loading practices • Scheduling • Speed compliance • Vehicle safety

7 REVIEW

Cameco's system of quality control requires that all documentation be subject to regular review, and review of this TRMP and ERPP and associated documents will be undertaken periodically to ensure:

- All legal obligations are complied with.
- Effectiveness of identified responsibilities.
- Appropriate integration of this TRMP and ERPP within Cameco Safety Management Systems and objectives.

The TRMP and ERPP may be subsequently modified as a result of any review to ensure that it remains valid and relevant to the operational and regulatory environment.

8 REFERENCES

Safeguards (Act)	Nuclear Non-Proliferation (Safeguards) Act 1987 (Cth)
IAEA Nuclear Security Series No. 9, 2008	IAEA - The Security in the Transport of Radioactive Material Code
ISO 1496	ISO1496 International Standards Organisation: Freight Containers - Specification and Testing
ISO 17712	ISO17712:2010 International Standards Organisation: Freight containers -- Mechanical seals
SF-1	IAEA Fundamental Safety Principles – Safety Fundamentals No.SF-1
the Code	ARPANSA Code of Practice for the Safe Transport of Radioactive Material' Edition 2008
TS-R-1	IAEA Regulations for the Safe Transport of Radioactive Material

Cameco Australia Pty Ltd

Kintyre Uranium Project

Emergency Response and Assistance Plan (ERAP)

October 2012

Date	Revision	Description	Author	Approved
15/8/12	D1	Draft	Cameco	SW
9/10/12	D2	Final	Cameco	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 10 km north of the Karlamilyi National Park (formerly Rudall River National Park) border.

Emergency planning and preparedness for responding to a transport incident involving radioactive material, including uranium oxide concentrate (UOC), is similar to that required when responding to transport incidents involving other types of dangerous goods such as flammables, explosives, poisonous gases, corrosives and toxic chemicals.

The objective of a programme for planning and preparedness for an emergency involving radioactive material should be to assist in building competence and confidence that an emergency arising from a transport accident would be managed effectively to minimise the risk to the general public and environment and to minimise any disruption caused by any incident.

In line with Cameco's corporate standards for emergency response to an incident involving UOC, Cameco will:

- Establish, equip and maintain an emergency response team that will also be available to assist in the event of an incident.
- Develop an emergency response plan to the satisfaction of state and federal authorities and support agencies.
- Develop a first responders program which will involve Cameco staff working with both professional and volunteer emergency response crews along Cameco's main transport routes to inform them about the properties of uranium, the risks associated with a spill and appropriate first response spill containment and clean up measures.
- Conduct spill response exercises in conjunction with emergency services to trial spill response procedures.

This document is a part of the Transport Radiation Management Plan for Cameco's operations at the Kintyre project in Western Australia. This document describes the radiation protection program for the public transport of radioactive materials originating from Cameco's operations.

2 SCOPE

This document relates to the preparations and procedures necessary to manage radiation protection activities associated with the transport of all radioactive material originating from the Kintyre project. The response to any emergency situations arising from the transport and storage of radioactive material is also addressed.

The radioactive product being transported and covered by this plan is uranium oxide concentrate. This product is up to 93% by volume U_3O_8. It is classified as LSA-I material, class UN2912. The hazardous properties of LSA-I material are fairly benign in that the material is a dry, dense, heavy, insoluble, non-reactive, non-flammable material and is weakly radioactive.

3 TRANSPORT MANAGEMENT

The UOC produced at Kintyre will be transported via road from the Kintyre Project to the Port of Adelaide for export.

The total distance of the preferred road route from Kintyre project to the Western Australian – South Australian border is approximately 3200kms. This involves travel along sealed roads through remote areas and some towns. It is proposed that an average of two road trains per week will operate along the route. Up to five road trains may travel the route during a single week but on average about 100 shipments will occur in a single year. The sealed roads carry road trains and other vehicles from a number of different industries. The inclusion of road trains from the Kintyre project at the frequency described above are considered to pose minimal additional burden on the road infrastructure and minimal additional risk to the degradation of the roads.

The road transport distance from the border to the Port of Adelaide is approximately 950kms. The Eyre Highway is a classified heavy haulage route and the additional traffic movements created by this project is considered to pose minimal additional burden on the road infrastructure and minimal additional risk to the degradation of the roads.

3.1 Transport Security

The UOC will be placed into Industrial Packaging Type 1 (IP –1) 205L steel drums in the processing plant and then loaded into plastic lined General Purpose (GP) steel shipping containers conforming to ISO 1496. The doors of the containers containing the UOC will be sealed with bolt type seals, which are consecutively numbered. The bolt security seals would comply with Customs-Trade Partnership Against Terrorism (C-TPAT) and ISO 17712 standards which meet Australian Safeguards and Non-Proliferation Office requirements. The packaging, labelling and documentation for each shipment complies with the requirements of the Transport Code.

A minimum of two trucks in convoy will be used to transport UOC from the Project site to Adelaide, and will remain in close proximity throughout the journey. The vehicles will be outfitted with equipment to communicate quickly, efficiently and reliably with an operational base and a global positioning system (GPS) would be fitted to each prime mover.

The GPS fitted to each truck would provide three main security functions:

- A duress pendant for driver security;
- Out-of-zone requirements for defined routes;
- En route checking

3.2 Training and Competence

This section details the training and competency requirements and procedures for the various parties involved in shipments and emergency response. Information provided to these parties will be based on the information presented in this guide but will depend on specific conditions that occur at each incident site.

3.2.1 Transport Operators

A competent person from Cameco with expertise in radiation protection principles will perform a specific radiation induction, including the following information, for drivers routinely transporting radioactive material originating from the Kintyre project:

- The nature of uranium;
- How can personnel be exposed to radiation;
- How can exposure to radiation be prevented or reduced;
- Transport related legislative requirements; and
- The emergency procedures to be followed in the case of an incident.

A record of the radiation induction and training will be maintained in accordance with the Code of Transport with the driver's training file.

3.2.2 Emergency Response Teams

All members of the response teams, including contracted and site based teams, will have been trained in hazardous materials response procedures before being placed on a call out list for shipment response. Information will be provided on:

- The nature of uranium;
- How can personnel be exposed to radiation;
- How can exposure to radiation be prevented or reduced;
- Procedures to be followed during clean up; and
- Practical demonstration of clean up procedure.

In addition to training Cameco emergency response teams, training will be provided to State and Federal emergency service and volunteer first responder organisations along the route that may be expected to respond to an incident involving UOC.

3.2.3 Stevedores and Forklift Operators

The stevedores and fork lift operators employed to load the containers will be given information periodically so that they will be educated in the hazards of handling this material.

4 INCIDENT MANAGEMENT AND ERAP ACTIVATION

A risk assessment of the transport of UOC has been conducted and is an appendix to the Cameco Transport Radiation Management Plan. The risk assessment identified several scenarios, their consequences and their likelihoods. The possible incidents have been categorised as follows;

- **Category 1 Incident** – This category is the most critical type of incident. It involves a vehicle accident, possible injuries and the loss of containment and spillage of the UOC.
- **Category 2 Incident** – This is an incident in which vehicles have been damaged, with possible injuries but there no loss of containment of the UOC
- **Category 3 Incident** - Category 3 incident is an unscheduled delay. A vehicle breakdown, protestor activity, or any situation that results in a delay to the progress of the shipment may cause this type of incident

4.1 Cameco ERAP Activation

While the scale of the response initiated by Cameco will be dictated by the category of the incident, the activation of this emergency response plan generally proceeds through four stages described in the plan.

- **Stage 1:** Initial Activation – Cameco Australia will operate a 24-hour, 365-day/year emergency phone line at the Kintyre Project site.
- **Stage 2:** Immediate Actions - When the Cameco technical advisor has the appropriate information he/she starts the actual process of responding to the incident. This involves the initial mobilization of the Cameco emergency response team and typically a contracted emergency response provider.
- **Stage 3:** Emergency Action – Deployment of Cameco emergency response teams from Kintyre or contractor teams from Port Hedland or Kalgoorlie depending on the location of the incident. It will involve the coordination of the contracted emergency response team followed up by mitigation and clean up activities.
- **Stage 4:** Incident termination and after-action review.

Regardless of the situation, response priorities are guided by the following 3 principles:

- The protection of human life;
- The protection of the environment; and
- The protection of property

It should be noted the above stages may occur concurrently during the initial phase of the response. For example, during a transport incident, the contracted response company may be mobilised as one of the initial actions as well as some immediate regulatory notifications.

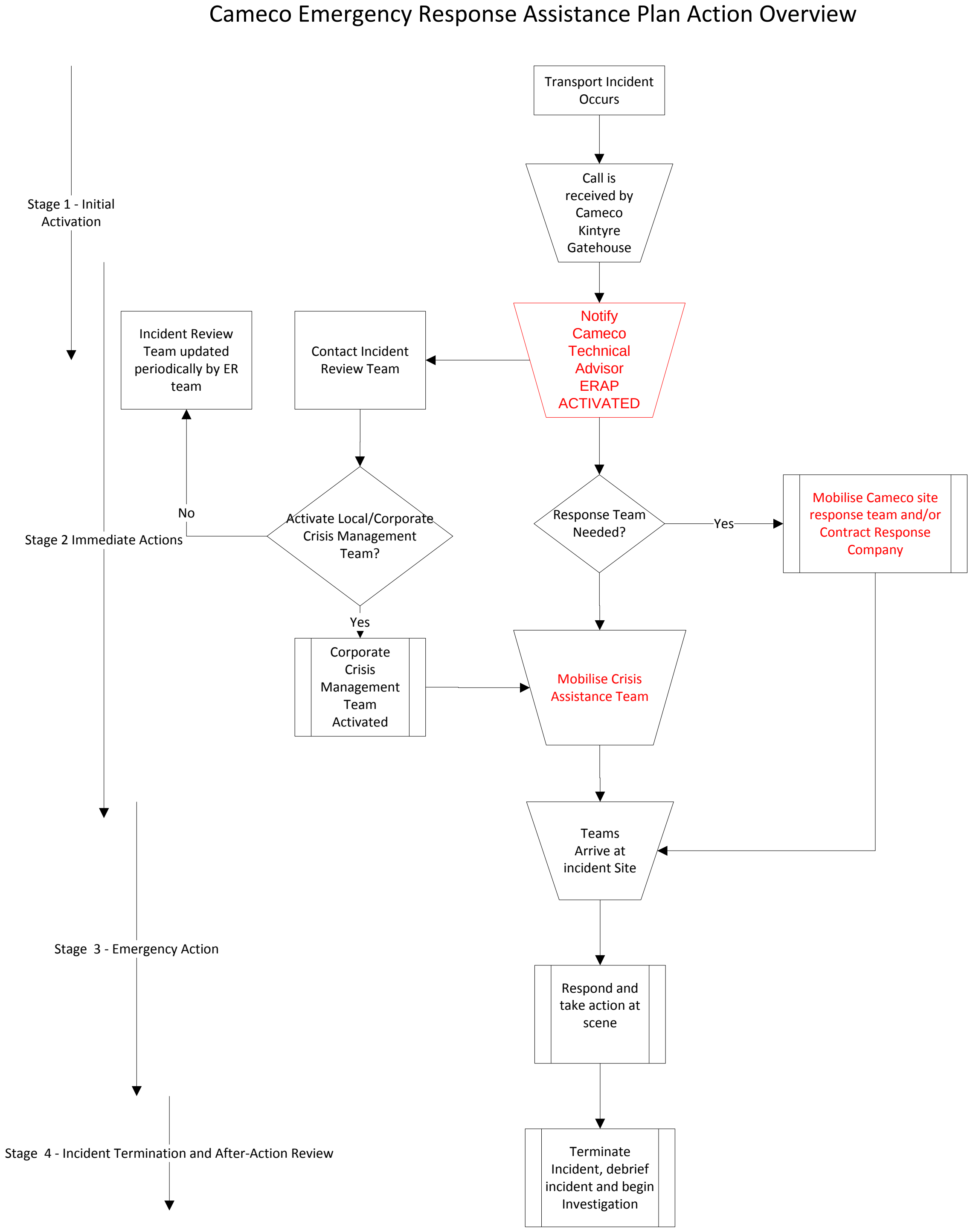

Figure 4-1 ERAP flowchart

4.2 Stage 1 – Initial Activation

The Kintyre mine site will have a security gatehouse that will be a manned 24 hours a day. The role of the gatehouse is to check employees and vehicles entering the site and also act as the first point of call for any incidents either on or off site. In the event of a transport incident any phone calls made to an emergency hotline will be answered by a staff member of the gatehouse. Staff will be trained in how to respond to calls made to the emergency hotline and initiate the ERAP depending upon the category of the incident.

4.3 Stage 2 - Emergency Response Coverage

Due to the large distances of the transport of product from the Kintyre project to Kalgoorlie or Adelaide. Cameco intends to employ contractor emergency teams to assist in the mitigation and clean-up of an incident. These teams are to be based at sites such as Port Hedland and Kalgoorlie, Port Augusta and Adelaide and in addition to site based emergency teams intend to cover the entire transport route so that response to an incident is practicable and timely.

In addition to Kintyre site, Port Hedland and Kalgoorlie based response teams, Cameco will also develop a Mutual Aid Agreement with other mining projects or organisations along the transport route that will have the equipment and capabilities to assist in the event of a transport incident.

Technical Advisors

The following people can provide technical advice both on the telephone and at a scene of a transport accident involving Cameco products. As well as Australian technical advisors Cameco Corporation have experts available from their Canadian Operations.

- Emergency Response Co-ordinator
- Radiation Safety Coordinator (Perth Office and Kintyre based)
- Environmental Officer (Perth Office and Kintyre based)

4.4 Stage 3 – Emergency Action

This section describes the actions recommended to stabilise, mitigate and clean up an incident involving UOC.

The International Atomic Energy Agency publication *Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material, TS-G-1.2 (ST-3)*, describes three phases of an incident. Cameco adopts this same terminology and a description of the three phases follows;

Initial Phase

The discovery and reporting phase in which initial actions are taken to protect people, including the driver or first responders themselves and make a notification so that assistance may be mobilized. No direct offensive actions are taken during this phase unless the person has been trained and equipped to act.

Accident Control Phase

The "mitigation phase" in which action is taken to bring the incident under control. People with injuries are attended to, fires are extinguished, and leaks are stopped or contained.

Post Emergency Phase

This phase is also called the "clean up phase" where the immediate and acute danger is over and the situation has stabilized. Activities performed during this phase include product transfers, container repair, repackaging operations and contaminated soil (and product) recovery, excavation and removal from the site.

4.5 Guidance for Post-Emergency Phase of an incident involving LSA-I UN2912 Material

The response to an incident involving UN2912 (uranium oxide concentrate) is less complicated than incidents involving many their dangerous goods transported within Australia. The hazardous properties of LSA-I material are fairly benign in that the material is a dry, dense, heavy, insoluble, non-reactive, non-flammable material and is weakly radioactive. The actions recommended follow industry standard practices for mitigating dry heavy metal oxide releases. Recovery of the solids via hand tools, excavating equipment or possibly mechanical means (HEPA vacuum) is the recommended method. The most important part of the response is the initial actions of the first responders and not the actual clean up phase as this is fairly straight forward. Cameco will provide radiological equipment and trained radiation specialists for all incidents where Cameco ERAP is activated for a Class 7 radioactive material.

4.6 Stage 4 – Incident Termination and After Action Review

The final stage of an incident can be separated into two components. The first is the incident termination that occurs at the incident site. Response teams terminate the incident by cleaning up the site, removing all equipment and materials. The final on site activity is an incident debriefing. This will be led by the incident commander or designate who reviews the incident from start to finish making note of areas for improvement as well as recording the positive aspects of the incident.

5 RESOURCES

5.1 Communication

Communications during transport incidents are conducted mainly via mobile and satellite phones. The emergency response team's emergency equipment inventory contains a satellite phone. Operating site emergency response equipment includes two-way radios as well as radios in most site vehicles including emergency response vehicles. Computers and wireless PDA's may also be utilized for enhancing communications during an incident.

Media relation representative(s) are also activated during a response as needed. .

5.2 Logistic Support

Cameco will mobilise to a transportation incident in whatever manner is the quickest. Given the chemical and radiological properties of the product, only a small volume of equipment may be needed at the scene. The nature of the product, do not dictate a large quantity of equipment being needed at the scene. The contract emergency response providers will maintain much of the equipment required, including personal protection equipment such as "tyvek" coveralls, and respiratory protection equipment. As such, a charter aircraft or an SUV would be adequate for the emergency response team to travel to the scene of a remote incident. The Kintyre site will maintain dedicated emergency response vehicles that can mobilise in short order to an incident in the vicinity the mine.

5.3 Equipment and materials

An inventory of contractor emergency response team and Kintyre site's emergency equipment will be identified. The contracted responders are required to carry a minimum quantity of spill equipment and PPE. Cameco maintains dedicated emergency response radiation monitoring equipment. The following portable radiation monitoring equipment is maintained and is located at Cameco corporate office in Perth. Similar equipment is maintained and is available for use at the Kintyre site. Procedures for use and calibration are maintained at Kintyre and the Perth office

This radiation monitoring equipment includes the following:

- Surface α, β contamination meter
- Gamma dose rate radiation meter

Trained radiation personnel will operate this equipment at the incident site.

5.4 Personnel

5.4.1 Corporate resources

Corporate resources are available by phone 24/7 to support activities and requirements surrounding the incident.

5.4.2 Contractor(s) retained to support ERAP

Cameco responds to all activations of the ERAP and also Cameco will retain a contract emergency responder within WA to provide field response services.

Cameco endeavours to arrive first at an incident, however if this is not feasible, Cameco's contract emergency response services will arrive to assist first responders until Cameco (or Cameco's representative through Mutual Assistance) arrives. Cameco will always respond directly for activation of the ERAP. Cameco provides direct services for remediation and the contract services assist where applicable under Cameco's direction. Cameco acts and provides direction in the field to comply with the requirements specified by the jurisdiction in charge (e.g. police or municipality), and appropriate regulators.

5.4.3 Contractor verification by plan holder

Cameco trains and assesses all ER contractors periodically that may respond to a Cameco incident.

5.5 Mutual aid

Cameco will endeavour to enter an MOU with the owners of other uranium projects along the transport route to assist with any transport incidents.

6 PREPAREDNESS

6.1 Training

A variety of training will be conducted in support of Cameco's ERAP. These awareness sessions will be offered to the following:

- Emergency response team and Kintyre site teams will undergo regular (suggest annual) training
- Cameco support staff will be trained on ERAP
- All Cameco Transportation of Dangerous Goods courses will contain ERAP awareness section
- Contracted emergency responders will receive training on the ERAP
- Local emergency services along Cameco transport routes to receive awareness training which describes the ERAP and what they can expect from Cameco in the event of an incident in their region.
- Cameco looks for opportunities to reach first response organizations through presentations made at HAZMAT and safety conferences.

6.2 Exercises

Tabletop, partial and full-scale exercises will be regularly held at both Cameco's Kintyre site, the Perth office and along the transportation route for our product. The spill simulation will involve local emergency services, third party HAZMAT teams, state, federal environment and transport representatives and Cameco ERT team members. All exercises will be documented and critiqued with valuable follow up actions generated from each one.

6.3 Equipment maintenance

Cameco's Kintyre site the Perth office will have dedicated emergency response teams. The team members maintain the equipment and the project response vehicle.

Third party responders own and maintain their own equipment. During the site visits conducted by Cameco, this equipment is verified and assessed against that company's procedures and the required equipment to deal with a Cameco transport incident.

6.4 Annual review of plan

The plan should be reviewed at least on an annual basis, to ensure contact information is up-to-date and the appropriate revisions are completed.

6.5 Audit of plan

An audit of the plan will be conducted periodically either by Cameco Corporate internal auditors or Perth office.

Cameco

Cameco Australia Pty Ltd

Kintyre Uranium Project

Fire Prevention and Management Plan

October 2013

Date	Revision	Description	Author	Approved
13/6/12	D1	Draft	S. Williamson	SW
7/10/13	Final	Final	ENVIRON	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project in the eastern Pilbara region of Western Australia. The Kintyre Project is situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and lies 10 km north of the Karlamilyi National Park (formerly Rudall River National Park) border.

Fire is a natural part of the landscape in this region with fires starting from lightning strikes and from accidental causes such as campfires. Prescribed burns are also undertaken by the Department of Parks and Wildlife (DPaW) and the Martu under the Caring for Country Program.

Wildfires have the potential to threaten mining related infrastructure and pose a risk to human health. Uncontrolled large scale wildfires can cause the loss of some plant species and also destroy habitat critical to the ongoing survival of a number of small marsupial species which are already threatened in the region.

2 RELEVANT LEGISLATION & STANDARDS

Legislation and standards applicable to this management plan include:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Environmental Protection Act 1986* (EP Act);
- *Bushfires Act 1954;*
- *Conservation and Land Management Act 1984;* and
- Environmental Protection (Clearing of Native Vegetation) Regulation 2004.

3 EXISTING ENVIRONMENT

3.1 Fire History

The Project is located in a remote arid environment which can experience severe thunderstorms and cyclonic activity.

Parts of the Kintyre Project area were burnt by a severe fire in 2009 which resulted in changes to the vegetation structure (Bennett Consulting, 2010). A fire burnt an area south of the Project area in winter 2012.

4 ROLES & RESPONSIBILITES

Table 4-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Fire Management Plan.

Table 4-1: Roles and Responsibilities

Position	Responsibility
Environmental Manager	• Implementation and maintenance of the plan. • Undertakes assessment and review of the effectiveness of this management plan.
Environment Superintendent	• Formulate and implement fire fuel surveys • Formulate and implement a program to construct and maintain fire breaks • Undertake consultation with external stakeholders regarding prescribed burning program. • Ensure all staff are aware of their obligations in relation to this plan.
Operation Managers and Site Supervisors	• Ensure that staff and contractors are implementing Hot Works Permits and other fire prevention plans. • Participate in compliance audits and inspections.
All Cameco personnel, contractors and visitors	• Minimise impacts on the environment by reducing the frequency and extent of uncontrolled fires from mining related activities. • Report all incidents involving fires.

5 ENVIRONMENTAL MANAGEMENT

5.1 Purpose

The purpose of this Plan is to outline available information on fire risk and management within Cameco's mining operations and to identify strategies to reduce the risk to mining operations and as achieve positive diversity outcomes across areas of operation.

The key environmental management objectives are:

- Identify the potential direct threats of a wildfire on mining assets, infrastructure and personnel.
- Identify threatened and priority-listed flora and fauna species, within and adjacent to the Project area and strategies to minimise the potential impacts on these species from fire.
- Identify and implement management strategies, for example, working with DPaW and Martu to implement appropriate scale mosaic prescribed burning to achieve positive biodiversity outcomes for Priority-listed species such as Bilby, Mulgara and the Rock Wallaby within the Project area.

5.2 Potential Impacts

5.2.1 Fauna

The Department of Environment (DoE) lists a number of impacting processes for significant species listed under the EPBC Act. The impacts upon Bilby, Mulgara and Rock-wallaby from the proposed Kintyre Project have been assessed and management measures developed (see Fauna Management Plan).

Changed fire regimes is a major factor in the decline of a large proportion of Australian mammals (Burbidge and McKenzie, 1989), with the main issue being the replacement of mosaic burning of small areas with very extensive but infrequent fires. The Bilby and Mulgara in particular are known to be sensitive to changed fire regimes. The most recent fires in the Kintyre region were in summer 2007/2008 and were very extensive. The only Bilby activity recorded within the Project area is associated with one of the largest patches of hummock grassland that escaped that fire.

5.2.2 Flora

Botanists surveying the Project area also noted significant changes in flora assemblages within the Project area. Flora surveys noted that one Priority 3 flora, *Comesperma pallidum* was recorded in the 2007 survey but not during the 2010 or 2011 surveys possibly as a result of fires in 2007/2008. The vegetation was observed to be recovering in 2011 following high rainfall recorded in early 2011.

5.3 Fire Management

5.3.1 Procedure Management

Fire risk can come from both internal and external sources. Cameco will implement a range of procedures aimed at reducing fire risk from activities being conducted during the construction and operation of the Project. These will include Hot Work Permits and requirements for maintenance of fire extinguishers and fire fighting equipment.

5.3.2 Wildfire Threat Analysis

As part of the implementation of the Fire Management Plan, Cameco will undertake a Wildfire Threat Analysis to better understand the risk to commercial and environmental assets within the Project Area and surrounds. This will consist of the following tasks,

- Develop an infrastructure and asset map, including,
    - physical and economic assets, including, roads and pipeline tracks and corridors, buildings, bores and borefields and any other infrastructure that could be damaged by fire;
    - cultural assets, including Aboriginal heritage sites; and
    - biological assets, including areas surveyed for threatened fauna and flora and recorded locations of activity of threatened species and significant flora.

- Review meteorological records to understand temperature and climate profiles and typical wind speeds and directions for the Project area.

- Assess fire history and fuel load associated with the different vegetation types and lands systems in and around the Project area.

- Determine the wildfire threat.

- Plan and implement fuel reduction burns and any physical firebreaks. In this instance fuel reduction burns would be conducted at the micro level to achieve a mosaic effect of burnt and unburnt areas to improve the habitat for small marsupials while avoiding the locations of marsupials and declared flora.

5.4 Environmental Objective and Performance Indicators

Table 5-1: Environmental Objectives and Performance Indicators

Environmental Objective	Performance Indicators
No negative alteration to fire regimes due to the Project.	• No wildfires as a result of activities conducted by Cameco's staff or contractors.
Maintain the geographic distribution and abundance of significant fauna species within the project area.	No significant or long term change to the abundance and distribution of the conservation significant fauna.
Avoid or minimise adverse impacts on significant flora species.	• No wildfires as a result of activities conducted by Cameco's staff or contractors.
Improve fire management in the region.	• Participate in programs that improve land and fire management within the region.

5.5 Environmental Aspects and Management Strategies

Table 5-2: Environmental Aspect and Management Strategies

Environmental Aspect	Management Strategy
Fire prevention	• A total fire ban will be in place across the Project area. • Hot work permits will be obtained prior to commencing any activity that may create/cause an ignition source. • Fire extinguishers will be readily available in all hot work areas. • All vehicles will be equipped with fire extinguishers to contain any fires if required. • An emergency response plan addressing fire management will be in place. • Personnel will be trained in the use of fire extinguishers. • Audits will be carried out on fire fighting equipment.

6 DEMONSTRATING THE OUTCOME (MONITORING)

Monitoring of compliance will be carried out by completion of a review and implementation of the wildfire threat analysis. In addition, compliance with this plan may also be monitored through external auditing.

6.1 Reporting

The effectiveness and implementation of this plan will be reported in the Annual Environmental Report.

6.2 Contingencies

Should pre-clearance surveys identify the presence of conservation significant fauna species within the Project area, specialist zoologists and DPaW will be consulted with regards to fire management. This will enable appropriate contingency measures to be determined and implemented, if necessary.

6.3 Review and Revision

This plan will be reviewed following the completion of the Wildfire Threat Analysis.

Table 6-1: Demonstrating the Outcome (Monitoring)

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Fire prevention	No fires started as a result of activities conducted by Cameco's staff or contractors	Number of fires recorded With the support of the DPaW and Martu, the introduction of fire breaks using a conservation-oriented fire regime with small area fires at different times of the year to create a mosaic, and including protection of areas occupied by Bilbies Internal audits	AER	Fire extinguishers will be available in all hot work areas and personnel will be trained in their use. Cameco will have an emergency response plan for the Project area, which will include response to fire	Emergency Response Procedure

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Cameco

Cameco Australia Pty Ltd

Kintyre Uranium Project

Dust Management Plan

June 2013

Date	Revision	Description	Author	Approved
5/10/12	D1	Draft	ENVIRON	SW
3/5/13	2	Minor amendments	SW	SW
13/6/13	3	Final	ENVIRON	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 10 km north of the Karlamilyi National Park. The Project has the potential for dust to be generated from its mining and processing operations.

This Dust Management Plan has been developed to ensure that dust emissions from the Project do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards. The scope of the plan includes the proposed dust management and monitoring procedures for the operation of the Project.

Due to the presence of naturally occurring radionuclides at Kintyre, potential dust emissions from the Project will include some radioactive dust. The studies that have been undertaken as part of the Environmental Review and Management Programme (ERMP) indicate that provided that the Project meets the relevant ambient standards for dust outlined within this Plan, then environmental radiation exposure due to radioactive dust is not expected to be significant. As such, this plan relates to the management of all potential dust emissions sources, and does not include specific measures for radioactive dust. The Radiation Management Plan details the proposed radiation management and monitoring procedures for the operation of the Project.

The scope of this Plan does not include dust management procedures in relation to the construction of the facilities, and pertains solely to the operation of the proposed facilities. Dust management procedures during construction are to be detailed in the Construction Dust Management Plan, to be prepared prior to the commencement of construction.

2 RELEVANT LEGISLATION & STANDARDS

Legislation and standards applicable to this management plan include:

- *Environmental Protection Act 1986* (EP Act);
- National Environment Protection (Ambient Air Quality) Measure (Ambient Air Quality NEPM) (NEPC, 2003); and
- relevant Australian Standards that define methods for sampling and analysis of ambient air.

The potential dust impacts of the Project will be regulated pursuant to the provisions of the EP Act. The Ambient Air Quality NEPM specifies national standards for various air pollutants, including PM_{10} (defined as particulate matter with an equivalent aerodynamic diameter of less than 10 microns), and an advisory reporting standard for $PM_{2.5}$ (defined as particulate matter with an equivalent aerodynamic diameter of less than 2.5 microns), as detailed in Section 2.1. This management plan includes an ambient monitoring program detailed in Section 5.6.2.

This plan also references the ambient air quality standards for Total Suspended Particulates (TSP) contained in the *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy 1999* (Kwinana EPP) (refer to Section 2.2), and criteria for deposited dust adopted by the Department of Environment and Conservation (NSW DEC) (2005) (refer to Section 2.3).

2.1 National Environment Protection Measure

The National Environmental Protection Council (NEPC) has developed a range of National Environmental Protection Measures (NEPMs) for protecting various aspects of the environment. These include the Ambient Air Quality NEPM (NEPC, 2003), which sets national standards for various air pollutants, including PM_{10}. The Ambient Air Quality NEPM also sets advisory reporting standards for $PM_{2.5}$. A summary of the Ambient Air Quality NEPM standards for PM_{10} and $PM_{2.5}$ is presented in Table 2-1.

Table 2-1: Ambient Air Quality Standards - NEPM

Particle Size Fraction	Status	Maximum Concentration ($\mu g/m^3$)	Averaging Period	Specified Goal
PM_{10}	Standard	50	24-hour	No more than 5 days per year exceeding standard
$PM_{2.5}$	Advisory Reporting Standard	25	24-hour	Gather data to facilitate a review of the Advisory Reporting Standard
		8	annual	

The Ambient Air Quality NEPM has been developed for the protection of human health, and the PM_{10} standard and $PM_{2.5}$ advisory reporting standard reflect the NEPC's opinion of ambient air quality levels that would not be injurious to human health. Whilst exceedance of these levels may not lead to unacceptable health outcomes (as reflected in the PM_{10} standard itself, which allows for five exceedances per year), it is appropriate that the NEPM standards be used as a platform for developing regulatory limits and management targets for the Project.

2.2 Total Suspended Particulates

The Kwinana EPP specifies ambient air quality criteria for TSP and sulphur dioxide, applicable within the Kwinana Industrial Area and surrounds. The Kwinana EPP defines three regions which are covered by the policy; the industrial zone (Area A), the buffer zone surrounding heavy industry (Area B) and the rural and residential zone (Area C). Table 2-2 presents the Kwinana EPP Standards for TSP that applies within each of the EPP regions.

In the absence of nationally recognised ambient air quality criteria for TSP, the Standard for TSP within the industrial zone (Area A) has been applied within operating areas at the Project site, and the Standard for TSP within rural and residential areas (Area C) has been applied at sensitive receptors, namely the onsite accommodation camp.

Table 2-2: Ambient Air Quality Standards – Kwinana EPP

Particle Size Fraction	Policy Area	Standard ($\mu g/m^3$)	Averaging Period
TSP	A (Industrial Zone)	150	24-hour
	B (Buffer Zone)	90	
	C (Residential and Rural Zone)	90	

2.3 Dust Deposition

The NSW DEC (2005) has adopted criteria for dust deposition which are presented in Table 2-3. These criteria are based on studies undertaken on coal dust deposition in the Hunter Valley in NSW by the National Energy Research Development and Demonstration Council (NERDDC, 1988) and take into account potential amenity impacts. While the dust deposition guideline is expressed as g/m^2/month, the NSW DEC has indicated that the monthly average deposition (to be compared against the criteria) is to be determined from data spanning no less than one year, so as to account for seasonal variations.

Table 2-3: Dust Deposition Criteria

Type	Criteria (g/m^2/month)	Averaging Period
Maximum increase in deposited dust level	2	Annual
Maximum total deposited dust level	4	Annual
Notes: NSW DEC (2005) notes that deposited dust is to be assessed as insoluble solids as defined by AS 3580.10.1 (1991). This standard has since been superseded by AS/NZS 3580.10.1 (2003).		

3 EXISTING ENVIRONMENT

3.1 Region

The Project is located in a remote area in the East Pilbara Region of Western Australia, approximately 260 km north-east of Newman, and 90 km south of Telfer. Dominant land uses in the subregion are unallocated crown land, conservation areas and mining leases.

The nearest sensitive receptor to the Project site is the onsite accommodation camp, located approximately 1.9 km south of the Tailings Management Facility (TMF) (Figure 1). The Telfer mine site and accommodation village is the nearest offsite receptor, followed by the local indigenous communities of Parnngurr, 80 km southeast of the Project; and Punmu, 113 km northeast of the Project. However, it is considered unlikely that dust emissions from the Project would have any significant impact at these receptors given their distance from the site.

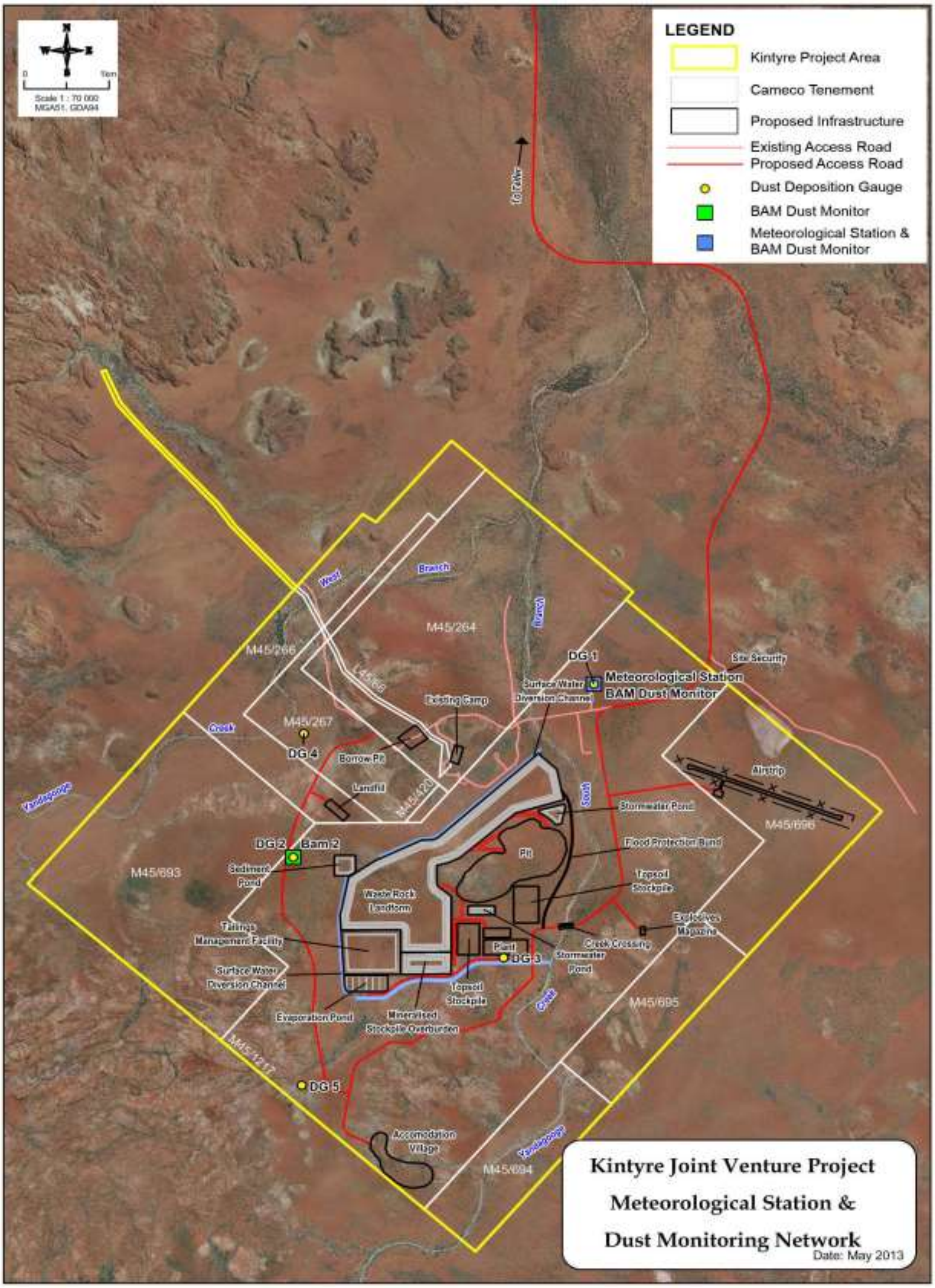
3.2 Climate

The climate of the East Pilbara Region is arid with summer rainfall. The predominant winds of the region are from the southeast and northwest.

Since the inception of the Project, a series of monitoring programs have been undertaken within the region in order to define the meteorological characteristics, summarised below:

- prevailing winds originate from the southeast quadrant and dominate the autumn, winter and late-summer months. Winds during spring and early-summer exhibit a greater degree of variability and the frequency of west-north-westerly winds increases;
- average monthly wind speed is around 3.5 m/s. Peak wind speeds are generally experienced during the summer months and tend to correspond with winds from the southeast. The maximum 15-minute average wind speed recorded by the site monitoring was 18.5 m/s in February 1997;
- annual average temperature is around 25ºC. The highest maximum daily temperatures are generally recorded during the summer months and can reach over 40ºC. Lower temperatures are recorded during the winter months, the monthly averages tending around 10ºC. Higher evaporation rates are also associated with higher temperatures during the summer months and lower rates with the cooler winter months;
- total annual rainfall varies between years. However, the highest monthly rainfalls tend to occur in the summer months, indicative of the influence of cyclonic conditions in the region; and
- higher measurements of relative humidity and lower measurements of barometric pressure also tend to coincide with wetter summer months, which may experience some cyclonic effects. Lower humidity and higher pressures are more common during the drier winter months (Dames & Moore, 1990; 1998).

Figure 1: Dust monitoring network and meteorological station monitoring locations



3.3 Regional Dust Levels

Ambient dust concentrations in the Pilbara region can be naturally high due to:

- low rainfall and high evaporation rates, which result in dry soils more prone to lift-off;
- relatively sparse natural vegetation;
- frequent high winds; and
- frequent uncontrolled bush fires.

The cumulative effect of the naturally high regional dust levels, together with emissions from the Project, has the potential to generate dust impacts.

Cameco commenced baseline meteorological and particulate monitoring in July 2010. The particulate monitoring network consists of a continuous Beta Attenuation Monitor (BAM) to measure PM_{10} and five dust deposition gauges. Table 3-1 presents a summary of the results of the ambient particulate monitoring.

Table 3-1: Results of Ambient Particulate Monitoring

Parameter	Highest Result	Averaging Period	Duration of Monitoring
PM_{10} Concentration	39 µg/m^3	24-hour	August 2010 – present
Dust Deposition	2.0 g/m^2/month	monthly	July 2010 – present

The maximum 24-hour average PM_{10} concentration recorded at the Project site between August 2010 and June 2011 was 39 µg/m^3 and this was recorded under moderate (4 m/s) south-westerly winds. Whilst the highest measured concentration is below the NEPM 24-hour Standard for PM_{10} of 50 µg/m^3, compliance with the Standard cannot be demonstrated reliably due to the low data recovery rates achieved during this period of the monitoring program. A maximum monthly dust deposition rate of 2 g/m^2/month was measured at the Project site between July 2010 and June 2011, with the average deposition rate being less than 2 g/m^2/month.

Monitoring of dust deposition levels was previously undertaken at five locations in and around the Project site between June 1996 and July 1998. The monthly deposition data collected at these sites showed that the natural dust deposition level in the area were relatively high and regularly approached or exceeded 4 g/m^2/month. The lower dust deposition rates recorded during the more recent monitoring may be attributable to higher rainfall during 2010/2011 than occurred between 1996 and 1998. It is also possible that greater levels of vegetation cover were present during 2010/2011 than between 1996 and 1998 due to the higher rainfall that had occurred in the region.

4 ROLES & RESPONSIBILITES

Table 4-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Dust Management Plan.

Table 4-1: Roles and Responsibilities

Position	Responsibility
Environmental Manager	• Implementation and maintenance of the plan. • Undertakes assessment and review of the effectiveness of this management plan.
Environment Superintendent	• Ensure all staff are aware of their obligations in relation to this plan. • Deliver dust management education and induction awareness training to field personnel. • Formulate and implement compliance audits and inspections of dust management practices. • Formulate and implement dust monitoring programs and maintain site records of monitoring results. • Notify the relevant authority(s) in the event of an incident involving potential dust excursion, and liaise with stakeholders as required.
Operation Managers and Site Supervisors	• Ensure the plan is being adhered to by all staff and contractors. • Participate in compliance audits and inspections.
All Cameco personnel, contractors and visitors	• Conduct activities in accordance with the plan, and related operating procedures. • Report all incidents involving potential dust excursions.

5 ENVIRONMENTAL MANAGEMENT

5.1 Potential Impacts of Dust Emissions

5.1.1 Health Impacts

Health risks posed by inhaled dust particles are influenced by both the penetration and deposition of particles in the various regions of the respiratory tract and the biological responses to these deposited materials (Environment Australia, 1998).

Particle size is the primary determinant of the depth to which particles can penetrate the human respiratory tract. Since smaller particles are able to penetrate further into the lungs than larger particles, they are generally of more concern from a health perspective. Exposure to small dust particles can cause or exacerbate respiratory conditions such as asthma.

As a general rule PM_{10} is considered 'inhalable'. These particles can be inhaled through the nose and throat and become deposited in the trachea and bronchia sections of the lungs, potentially causing adverse health impacts.

$PM_{2.5}$ is a subset of PM_{10}, and is considered 'respirable'. Due to their smaller size, $PM_{2.5}$ particles can travel further through the respiratory system. $PM_{2.5}$ may penetrate the lung's unciliated airways and become lodged in the alveolar region. The health implications of this can be more pronounced than is the case for particles lodged higher in the respiratory tract.

An ambient air quality standard exists in Australia for PM_{10} while $PM_{2.5}$ is has an advisory reporting standard as discussed in Section 2.1.

Some dust particles can generate accelerated health impacts due to their shape or chemical nature. Examples of this are asbestos fibres (known carcinogens) and crystalline silica dust (which can form scar tissue on the lungs). Fibrous minerals have been identified within the Kintyre Uranium deposit. The Fibrous Minerals Management Plan addresses the management of all potential sources of exposure to fibrous minerals.

5.1.2 Other Impacts

Aside from the potential health impacts, dust may also have an adverse impact upon amenity and vegetation health. Amenity impacts may include:

- preventing members of the community from undertaking outdoor activities in comfort;
- soiling clothing on washing lines;
- dust build-up on buildings and vehicles requiring frequent washing; and
- staining of surfaces.

Amenity impacts are typically assessed according to the concentration of Total Suspended Particulates (TSP) in ambient air and dust deposition rate.

Where dust deposition is high over a sustained period, it can form a physical barrier on vegetation to restrict natural processes such as photosynthesis. Some species of plant are more sensitive to these effects than others.

5.2 Dust Management Measures

The preliminary engineering design for the Project incorporates industry best practice for dust mitigation and control in order to minimise dust generation to be as low as reasonably achievable. This approach will continue to be applied through to the final detailed engineering design stage of the Project. Specific design elements of the Project that will minimise dust generation include:

1. *Enclosed Processing under Negative Pressure*: Critical areas of the processing plant will be enclosed and operated under negative building pressure, with exhaust gases from the ventilation system scrubbed prior to being discharged, minimising dust emissions. Critical areas of the processing plant include those that handle dry material containing high uranium content, and hence pose the greatest risk of occupational exposure to radioactive dust. The product drying and packaging area of the processing plant will be fully enclosed and operated under negative pressure.

2. *Exhaust Scrubbers*: Less critical areas of the processing plant will be semi-enclosed (enclosed apart from entry and exit openings) and exhaust gases will be scrubbed prior to being discharged. The Primary and Secondary Crushing circuits, Radiometric Sorter, conveyors and transfer stations will all be semi-enclosed and fitted with exhaust scrubbers.

3. *Spillage Clean-up within Processing Plant*: The processing plant will be designed to ensure ease of access to areas where spillages may occur, such as within bunded areas, so that spillages can be effectively cleaned up before they dry and become potential dust sources.

4. *Water Sprays*: Water sprays will be used within the following areas and activities to minimise dust emissions from mining related activities:

    a. drilling and blasting;
    b. various material handling operations, such as excavation, truck loading and unloading, bulldozing and reclaiming;
    c. Run of Mine (ROM) stockpiles and Waste Rock Landforms (WRLs); and
    d. Primary Crushing circuit.

5. *Slurried Tailing Deposition*: Tailings handling will be similar to other uranium mines, with tailings being pumped from the processing plant to the Tailings Management Facility (TMF) in a slurry form and deposited in thin layers. The tailings discharge points will be rotated around the tailings area with a cycle time of several weeks,

which will allow some drying but will retain the tailings in a damp state to reduce dust generation.

Once operational, other general dust control measures will also be implemented as required to minimise dust generation across all areas of the Project, including:

- the use of water carts on haul roads and other unsealed areas affected by wind erosion;
- speed restrictions for heavy vehicles;
- good housekeeping practices to ensure that dust does not accumulate within the processing plant;
- open areas subject to wind erosion will be sealed or revegetated if practical; and
- inspection and maintenance protocols for dust control equipment to ensure high availability of this equipment.

5.3 Environmental Objectives and Performance Indicators

Table 5-1: Environmental Objectives and Performance Indicators

Environmental Objective	Performance Indicators
Dust emissions from the Project do not adversely affect environmental values or the health, welfare and amenity of people and land uses	• 24-hour average PM_{10} concentrations as a result of emissions from the Project to be less than NEPM standard at the nominated monitoring locations (the dust concentration target). • Annual average total deposited dust level to be less than 4 g/m^2/month at the nominated monitoring locations (the dust deposition target).

5.4 Environmental Aspects and Management Strategies

Table 5-2: Environmental Aspects and Management Strategies

Environmental Aspect	Management Strategy
Human health Vegetation health Amenity	Design dust mitigation and management: • Areas of the processing plant that handle dry material containing high uranium content will be enclosed and operated under negative building pressure, with exhaust gases from the ventilation system scrubbed prior to being discharged. • The product drying and packaging area of the processing plant will be fully enclosed and operated under negative pressure. • The Primary and Secondary Crushing circuits, Radiometric Sorter, conveyors and transfer stations will all be semi-enclosed and fitted with exhaust scrubbers. Tailings dust management: • Tailings will be pumped from the processing plant to the Tailings Management Facility (TMF) in a slurry form. • Tailings discharge points will be rotated around the tailings area with a cycle time of several weeks to retain sufficient moisture to minimise dust generation. Operational dust management: • Spillages within the processing plant will be cleaned up before they dry to prevent them becoming potential dust sources. • Water sprays will be used within the following areas and during the following activities to minimise dust emissions associated with mining related activities: − drilling and blasting; − various material handling operations, such as excavation, truck loading and unloading, bulldozing and reclaiming;

Environmental Aspect	Management Strategy
	- Run of Mine (ROM) stockpiles and Waste Rock Landforms (WRLs); and - Primary Crushing circuit. • Water carts will be used on haul roads and other unsealed areas affected by wind erosion. • Speed restrictions will be in place for heavy vehicles. • Housekeeping practices to ensure that dust does not accumulate within the processing plant. • Open areas will undergo progressive rehabilitation where practical, or may be sealed to minimise dust generation. • Inspection and maintenance protocols will be implemented for dust control equipment to ensure optimum operation. A dust monitoring program will be implemented.

5.5 Environmental Outcome

This Plan has been developed to ensure that dust emissions from the Project do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

The ambient standards for dust that will be adopted as initial targets to assess ambient dust concentrations and dust deposition are summarised in Table 5-3. The targets are to be applied outside of the immediate operating areas of the Project site, at nominated monitoring locations defined in Figure 1.

Table 5-3: Ambient Dust Concentration and Deposition Targets

Particle Size Fraction	Averaging Period	Target	Units	Reference
PM_{10}	24-hour	50	µg/m^3	NEPC, 2003
Dust Deposition	Annual	4 [1]	g/m^2/month	NERDDC, 1988
Notes: [1] Maximum total deposited dust level.				

The ambient dust concentration target has been established for the PM_{10} size fraction, rather than for $PM_{2.5}$ or TSP. Studies conducted as part of the ERMP (ENVIRON, 2013) indicate that the 24-hour average ground-level concentrations (GLCs) of TSP, PM_{10}, $PM_{2.5}$ predicted at the on-site accommodation camp are a similar ratio of the standard and as such compliance with the PM_{10} standard is also expected to indicate compliance with the TSP and $PM_{2.5}$ standards.

In the event of an exceedance of the targets, Cameco will investigate the likely causes and assess possible contributions from the Project's operations. If these are deemed to be significant then Cameco will implement remedial actions and contingencies as described in Section 5.8.

5.6 Demonstrating the Outcome (Monitoring)

5.6.1 Monitoring Objectives

The objectives of the dust monitoring program are:

- to provide real-time ambient dust concentration data to assist with the identification and management of dust emissions from the Project's operations;
- to determine compliance with the ambient dust concentration and dust deposition targets (Table 5-3); and
- to assess the impact of ongoing operations of the project on air quality.

5.6.2 Dust Monitoring Program

To achieve the stated monitoring objectives, a dust monitoring program will be implemented that involves a network of a Beta Attenuation Monitor and five dust deposition gauges. The meteorological station that was installed at the Project site in 2010 will continue to be operated. The indicative location of the monitoring sites is shown in Figure 1.

The BAM technology has been selected for this Project to provide continuous and real-time PM_{10} concentration data. The benefits of continuous particle monitoring are that it enables real-time analysis of dust concentrations that can facilitate rapid response to events where high dust emissions are occurring, and the real-time particulate monitoring data can also matched with coincident meteorological data to potentially identify emission sources associated with any high ambient particulate concentrations recorded.

The dust monitoring program will be conducted in accordance with the relevant Australian Standards that define the methods for sampling and analysis of ambient air, as follows:

- AS/NZS 3580.9.11 (2008) – Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM10 beta attenuation monitors;
- AS/NZS 3580.10.1 (2003) – Methods for sampling and analysis of ambient air – Determination of particulate matter – Deposited matter – Gravimetric method;
- AS 3580.14 (2011) – Method for sampling and analysis of ambient air – Meteorological monitoring for ambient air quality monitoring applications; and
- AS/NZS 3580.1.1 (2007) – Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment.

Cameco commits to carrying out routine inspections and maintenance on all of the equipment used for the dust monitoring program. The routine inspections will be logged, reported to management, and work orders logged for equipment that requires maintenance.

The dust monitoring program outlined in this Plan will be maintained for at least 12 months following commissioning of the Project. Based upon the first 12 months of monitoring data, the scope of the monitoring required on an ongoing basis will be reviewed, and at least every two years thereafter.

5.7 Reporting

Dust monitoring results will be reported to the Department of Environment and Conservation (DEC) in accordance with relevant Licence conditions. The DEC will also be notified of any environmental incidents that result in non-compliance with regulatory requirements in accordance with relevant Licence conditions.

A summary of the dust monitoring results will be provided in the Annual Environmental Report (AER), such that performance against the ambient concentration and dust deposition targets (Table 5-3) can be assessed. The AER will also contain a summary of all Dust Incident Investigations raised in response to events involving dust measurements above the ambient concentration and dust deposition targets outlined in Table 5-3 (refer to Section 5.8).

5.8 Contingencies

Based on the results of the real-time monitoring, alert levels for ambient PM_{10} concentrations for various averaging periods will be determined to ensure that dust control actions are implemented in a timely manner to reduce the emissions from identified Project related sources should elevated concentrations be recorded.

The alert levels will be established so that they are low enough to allow adequate response time to reduce the risk that concentrations greater than the 24-hour NEPM PM_{10} standard occur, but are high enough to ensure that they do not unduly disrupt normal operations (without due cause). The alert levels will be reviewed on a routine basis against monitoring results.

In the event that the results of the dust monitoring program indicate an exceedance of the dust concentration or dust deposition targets outlined in Table 5-3, or in the event of any other significant dust related incident, the following action will be taken:

- immediate inspection, and implement temporary control and internal notification of the incident;
- determine if the incident was associated with Project activities;
- record date, time, duration and root cause of the incident or exceedances;
- using a risk based approach, determine severity of incident and priority, taking into account the nature and extent of the environmental impact;
- identify personnel to be involved in investigation and mitigation actions;
- identify and implement corrective actions to be undertaken or planned to mitigate adverse environmental consequences;
- follow up on recommendations to ensure corrective actions are completed;
- identify if changes to work practices or operations are required to ensure that the incident will not re-occur together with a timetable for implementation of those changes; and
- advise relevant stakeholders of final outcome of incident management (as necessary) or any long term initiatives proposed to manage residual impacts from the incident.

5.9 Review and Revision

This plan will be reviewed based upon the results of the first 12 months of ambient monitoring data following commissioning of the Project, then every two years thereafter. In the event that the results of the dust monitoring program indicate significant exceedances of the dust concentration or dust deposition targets outlined in Table 5-3, the plan will be revised prior to the completion of a two year period.

Table 5-4: Environmental Management Summary Table

Environmental Issue	Environmental Outcome (Management Objective)	Management Measures	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies
Ambient Dust	▪ 24-hour average PM_{10} concentrations as a result of emissions from the Project to be less than NEPM standard at the nominated monitoring locations (the dust concentration target). ▪ Annual average total deposited dust level to be less than 4 g/m^2/month at the nominated monitoring locations (the dust deposition target).	▪ Monitoring current and forecast wind conditions to reduce off-site dust as a result of blasting and other activities; ▪ Undertake visual inspections for dust generation on a regular basis; ▪ Use of water trucks and water cannons in areas that could produce dust such as haul roads, service corridors and other active surfaces; ▪ Progressive rehabilitation to minimise exposed areas; ▪ Ensure that all contractors and staff involved with all operations undertake a site-specific induction to raise awareness including the importance of dust control;	▪ Conduct continuous and real-time ambient PM_{10} concentration monitoring for at least 12 months following commissioning of the Project. ▪ Conduct dust deposition monitoring on a monthly basis for at least 12 months following commissioning of the Project. ▪ Ambient PM_{10} monitoring data	All ambient dust monitoring results will be reported on a routine basis, in accordance with relevant Licence conditions, and in the AER. Any environmental incident that results in an exceedance of the dust concentration or deposition targets, found to be related to emissions from the Project, will be reported. The reports will be submitted to the DEC and other relevant regulatory authorities, and made available to stakeholders upon request.	Alarm triggered when results of the real-time ambient PM_{10} monitoring indicate “alert” level exceeded, and that dust control actions are required. An environmental incident investigation will be conducted if ambient dust monitoring results indicate the dust concentration or deposition targets were exceeded. The investigation will identify changes to work practices or operations required to ensure that the incident will not re-occur.

Environmental Issue	Environmental Outcome (Management Objective)	Management Measures	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies
		▪ Ensure dust monitoring is undertaken and results are reviewed; and ▪ Ongoing consultation with stakeholders to determine the success of the dust management measures.			

6 REFERENCES

Dames and Moore (1990). Kintyre Project Meteorology – Annual Report 1989. Report prepared for Canning Resources Pty Ltd, December 1990.

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NSW DEC (2005). Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales. NSW Department of Environment and Conservation. 26 August 2005.

NEPC (2003). National Environmental Protection (Ambient Air Quality) Measure. National Environmental Protection Council. Canberra.

NERDDC (1988). Air Pollution from Surface Coal Mining: Measurement, Modelling and Community Perception, Project No. 921, National Energy Research Development and Demonstration Council, Canberra.

Cameco Australia Pty Ltd

Kintyre Uranium Project

Waste Management Plan

October 2012

Date	Revision	Description	Author	Approved
16/10/12	D1	Draft	Tetra Tech	SW
16/10/12	1	Final	ENVIRON	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 10 km north of the Karlamilyi National Park (formerly Rudall River National Park) border.

The Project will consist of an open-cut uranium mine, process plant and associated infrastructure. The Project will produce up to 4400 tonnes (approximately eight million pounds) per year uranium oxide concentrate (UOC) as U_3O_8 equivalent, and is anticipated to operate for approximately 13.5 years. It is anticipated the Project would require a construction workforce of up to 500 employees and an operational workforce of up to 450 employees, around 200 of which would be on-site at any one time. An Accommodation Village of around 250 rooms would be constructed for a fly-in-fly-out (FIFO) workforce to be used during construction and operations.

2 PURPOSE

This Environmental Management Plan (EMP) has been prepared by Cameco in order to address the environmental issues associated with the production and disposal of different waste types that will be generated throughout the construction and operation of the Project. The Kintyre operations will produce a wide range of waste materials including domestic and industrial waste, waste water from sewage treatment, chemical and hydrocarbon wastes, and recyclable wastes.

The objectives of this plan are to:

- minimise the impact of waste disposal on the local and regional environment and prevent pollution;
- maximise the recycling and re-use of wastes, wherever practicable; and
- ensure waste management practices conform to current laws, industry standards and waste disposal guidelines.

This plan applies to all solid wastes, liquid waste from the wastewater treatment plant (WWTP) and other liquid waste generated during the Project development. This plan does not cover management of waste rock, process tailings or the management of radioactive waste. These issues are addressed in the Radiation Management Plan and the Mine Closure and the Radiation Management Plan.

3 RELEVANT APPROVALS, LEGISLATION & GUIDELINES

3.1 Approvals

Cameco currently operates an approved landfill facility at the Project to manage the waste generated from the Kintyre Camp and regional exploration activities. The Category 89 facility (Putrescible landfill site) has been approved by the Department of Environment and Conservation (DEC) under the *Environmental Protection Act 1986 (WA)* (Works Approval W4884/2011/1). The facility has been designed and approved to handle 1,500 tonnes of waste per annum and is currently valid to the 15th May 2014. It is anticipated that Cameco will seek to extend this approval timeframe, the amount of waste that can be handled by the facility and the size of the landfill once approval has been granted to develop the Project.

3.2 Applicable Legislation

In order to effectively manage waste generated by the Project Cameco is obliged to comply with specific Commonwealth and Western Australia State legislation. This legislation includes the following:

- *Environmental Protection Act 1986 (WA);*
- *Environmental Protection Regulations 1987 (WA);*
- *Environmental Protection (Controlled Wastes) Regulations 2004 (WA);*
- *Contaminated Sites Act 2003 (WA);*
- *Dangerous Goods Safety Act 2004 (WA);*
- *Health Act 1911 (WA);*
- *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974 (WA)*
- *Mines Safety and Inspection Act 1994 (WA); and*
- *Environment Protection (Rural Landfill) Regulations 2002 (WA).*

3.3 Guidelines

The following guidelines are also relevant to the Project:

- *Used Tyre Strategy for Western Australia (Waste Management Board, 2005)*; and
- *Landfill Waste Classifications (as amended) (Department of Environment, 1996).*

4 ROLES AND RESPONSIBILITIES

Table 4-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Waste Management Plan.

Table 4-1: Roles and Responsibilities

Position	Responsibility
Environmental Manager	• Ensuring implementation and maintenance of the plan. • Ensuring that waste is being managed in accordance with this plan and that corrective actions are taken where required. • Identifying and implementing reduce, reuse, recycle and recover opportunities at the project site to the extent that is reasonably practicable. • Ensuring a process is established for tracking waste volumes generated and disposed of or managed through the 4R's principles. • Ensuring that the environmental aspects associated with waste management are properly reflected in the project environmental aspects register. • Undertaking an assessment and review of the effectiveness of this management plan.
Operation Managers and Site Supervisors	• Ensure the plan is being adhered to by all staff and contractors. • Participate in compliance audits and inspections.
Camp Manager	• Ensuring that camp waste, including domestic and kitchen waste is managed in accordance with this procedure, including proper management of the site landfill facility.
Environmental Advisors	• Formulate and implement an inspection/monitoring program. • Ensure that all staff are aware of their obligations in relation to this plan. • Identifying and implementing reduce, reuse, recycle and recover opportunities at the project site to the extent that is reasonably practicable. • Ensuring a process is established for tracking waste volumes generated and disposed of or managed

Position	Responsibility
	through the 4R's principles. • Deliver waste management education and induction awareness training to field personnel. • Maintain site records of inspections and implement monitoring programs. • Ensuring that the Waste Recycling Plan is implemented.
Mining and Processing Managers	• Ensuring that industrial and drill waste management is undertaken in accordance with this procedure.
All Cameco personnel, contractors and visitors	• Dispose of all waste in accordance to this plan. • Report any breaches against this plan as an environmental incident.

5 ENVIRONMENTAL MANAGEMENT

5.1 Waste Streams

Construction and operational activities of the Project will generate a number of different types of wastes including:

- Non-process solid wastes (including organic debris and general refuse);
- Non-process liquid wastes; and
- Controlled wastes.

5.1.1 Non-process solid wastes

Inert waste such as excess fill and building rubble would be directed to an on-site landfill licensed under the Environmental Protection Act. General refuse excluding scrap metal, cardboard and plastics will also be directed to a landfill. Used tyres will be disposed of to landfill as per Part 6 of the Environmental Protection Regulations 1987.

Cardboard, plastics and scrap metals will be collected for transport offsite to an approved recycling depot.

5.1.2 Non-process liquid wastes

Non-process liquid wastes including stormwater, potable water treatment plant brine and vehicle wash-down water would be directed to various storage facilities depending on the quality. Any storm water or other streams of waste water that is suitable to be used as process water will be directed to storage facilities so that it can be directed to the processing circuit. Other water that is not of suitable quality would be directed to the evaporation ponds for evaporation. These ponds are lined. Sewage wastes generated in the administration and accommodation facilities would be treated in a package sewage treatment plant, with the treated effluent being used for dust suppression or landscaping irrigation.

5.1.3 Controlled wastes

All controlled wastes, as defined in Schedule 1 of the Environmental Protection (Controlled Waste) Regulations 2004, would be collected and removed for recycling or disposal at a licensed off-site facility. Should there be any hazardous waste on site, this would be segregated from non-hazardous waste and managed in accordance with the relevant licence conditions issued under the *Environmental Protection Act 1986 (WA)*, or appropriate Australian or international standards. Cameco will work with its suppliers to maximise container recycling options.

5.2 Waste Management Hierarchy

Responsible waste management can be accomplished through the use of the hierarchy practices reduce, re-use, recycling, recover, treat and dispose of responsibly. Elements of these practices are detailed below.

Reduction at source: eliminate or decrease where practicable, the volume, concentration or toxicity of a waste stream through:

- process optimisation and proper maintenance;
- substitution;
- material elimination;
- management and control of inventories; and
- improved housekeeping.

Where wastes cannot be reduced at source, the next preferred waste management options are re-use and recycle. A number of waste streams can be reused or recycled if they are correctly segregated.

- re-use: use the materials or products more than once, in their original form.
- recycle/recovery: convert wastes into usable materials and/or extract energy or materials from wastes.
- treatment: destroy, detoxify and/or neutralise residues through processing.
- responsible disposal: use appropriate methods to responsibly dispose of any waste streams that remain after all practicable source reduction, re-use, recycle/recovery and treatment options have been implemented.

5.3 Waste Management Practices

Table 5-1 outlines the practices that Cameco will put in place to ensure the waste is responsibly managed at the Project.

Examples of these wastes and proposed management practises for phases of the mining project are listed in Table 5-2.

A preliminary Implementation Plan is considered in Table 5-3.

Table 5-1: Waste Management Practices

Management Actions	Timing	Responsibilities
Putrescible (Class II) Landfill		
1. Putrescible landfill will be operated and maintained at Kintyre.	Ongoing	Manager Operations
2. All putrescible landfills will be licensed or registered as appropriate under the *Environmental Protection Act 1986* and operated under the conditions attached to any licence or registration.	Ongoing	Environmental Superintendent
3. Regular housekeeping inspections of each landfill facility will be conducted with the emphasis on detection of windblown rubbish, evidence of feral animal activity or deposition of inappropriate material. Filing of incident reports and implementation of contingency actions will occur as necessary.	Ongoing	Manager Operations Environmental Superintendent
Contaminated Soil (Class III) Bioremediation Landfarm		
4. Bioremediation landfarms will be operated at Kintyre. Should the quantity of contaminated soil be anticipated to exceed 1000 tonnes per year at the landfarm, then the landfarm will be licensed and managed in accordance with licence conditions under the *Environment Protection Act 1986 (WA)*.	Ongoing	Manager Operations (operation of landfarms); Environmental Superintendent (monitoring of compliance).
5. Details of contaminated soil deposited at the landfarm will be recorded (including date deposited, type of material deposited and volume (cubic metres).	Ongoing	Manager Operations
6. Soil will be regularly aerated and spread to facilitate remediation. Records of scheduled aerating (tilling) will be maintained in the Landfarm Register at each location.	Ongoing	Manager Operations
7. A sampling procedure will be developed and soil hydrocarbon content will be monitored every six months. Target hydrocarbon level is 200 mg/kg.	Procedure	Environmental Superintendent
8. Application of water and fertiliser to contaminated material to accelerate remediation will not be undertaken unless materials accumulate to levels beyond those stated on the licence or registration.	As required	Environmental Superintendent
Other Waste		
9. Material not suitable for placement in the landfills and which is not inert will be removed from site and disposed of by a licensed waste disposal contractor.	Ongoing	Environmental Superintendent

Management Actions	Timing	Responsibilities
10. Where logistical considerations allow, recycling of waste materials should be conducted. Opportunities for recycling should be reviewed on a regular basis.	Ongoing	Environmental Superintendent
Sewage Disposal		
11. Sewage treatment plants at Kintyre will be operated in accordance with licence conditions issued under the *Environmental Protection Act 1986*.	Ongoing	Manager Operations
12. Regular inspections of the sewage treatment plant and irrigation areas will be conducted with the emphasis on ensuring the facilities are operating correctly, and surface water and weed management. Filing of incident reports and implementation of contingency actions will occur as necessary.	Ongoing	Environmental Superintendent
Compliance		
13. Conduct checks of compliance with all licence and registration conditions.	Annually	Environmental Superintendent

Table 5-2: Waste Management

Waste Type	Proposed Management Practise	
Solid Waste	Building rubble	Used as fill where appropriate, otherwise directed to the landfill.
	Scrap metal	Collected on site, cleared of any radiation contamination and removed from site for recycling Any material not able to be cleared of radiation contamination would be disposed of within the proposed Bulk Low-Level Radioactive Materials Waste Disposal Facility to be established on site.
	Putrescible	Collected on site and composted.
	Cardboard	Collected on site, baled and removed for recycling.
	Plastics	Collected on site, baled and removed for recycling.
	Timber	Collected on site, reused where appropriate (e.g. Pallets) or disposed of in the landfill or burned.
	Glass	Collected on site, crushed and removed for recycling.
	Cigarette butts	Collected on site and buried in landfill.
Liquid Waste	Sewage and grey water	Treated in a package sewage treatment plant with the treated effluent used in landscape irrigation.
	Potable Brine water	Discharged to the tailings management facility for evaporation.
	Wash down bay water and sludge	Hydrocarbon content removed by oil/water separator. Water recycled and then evaporated. Sludge removed and placed in waste rock dump.
Controlled wastes	Waste Oil	Collected on site and removed for recycling.
	Hydrocarbon contaminated waste	To be separated into two streams for recycling.

Waste Type	Proposed Management Practise	
		• oil filters, and • other contaminated wastes including rags and other contaminated wastes, packaged for transport and removed for licenced disposal.
	Hydrocarbon contaminated soil	Treat in a bioremediation landfarm.
	Chemical containers	Work with chemical supply company to achieve full recycling of empty containers. Return to supplier.
	Reagent bags	Work with reagent supply company to achieve full recycling of reagent bags. Return to supplier.
	Lead acid batteries	Collected on site and removed for recycling.
	Engine coolant	Collected on site and diluted with water and applied to roads for dust suppression.
	Medical waste	Collected at nominated locations, aggregated and disposed to a licenced facility.

Table 5-3: Implementation Plan for Waste Management and Recycling at Kintyre

WASTE STREAM	ISSUE	OBJECTIVE	STATUS	TIMING
Hydrocarbon Waste	Waste hydrocarbon including used oil, filters and hydrocarbon contaminated waste represents a significant volume of hazardous waste material. As this waste cannot be disposed of in the existing landfill a recycling/approval disposal option is necessary.	Establish facilities on site to store waste oils and oily waste in facilities suitable for the material to be back loaded to Perth for recycling. Set up arrangements with transport company and recycling company to receive waste oil.	• Completed for exploration phase. • Include requirement for hydrocarbon waste. management in construction and mining contracts. • Review with contractors.	Prior to the letting of tender documents for the mining contract
Cardboard, aluminium, steel cans, plastic drink bottles, kitchen oil and fat	Kitchen consumables and food and drink containers present opportunities for recycling as does waste kitchen oil and fat.	Establish recycling stations at appropriate points across site and collection and storage facilities for facilities on site to store waste oil in facilities suitable for the material to be back loaded to Perth for recycling. Set up arrangements with transport company and recycling company to receive waste kitchen oil.	• Completed for exploration phase. • Include requirement for recycling consumables and kitchen wastes in mine services contract. • Review with contractor.	Prior to the letting of tender documents for the services contract

WASTE STREAM	ISSUE	OBJECTIVE	STATUS	TIMING
Process Chemical Containers	Process chemical suppliers may supply some consumables in non-recyclable containers.	Reduce the number of process chemical containers coming to site and ultimately ending up in Landfill.	• Completed for exploration phase. Some products now being delivered in bulk recyclable containers. Recycling options developed for other 20L plastic containers.	• Work with supplier to determine the opportunity to purchase fluids in recyclable bulk containers. • Include clauses in supply contracts to ensure containers are taken off site for reuse or recycling by the supplier.
Wooden Pallets	Incoming freight is loaded on pallets. Currently pallets are not returned to suppliers.	Maximise opportunities for return and burn the remainder.	• Investigate the opportunities to return pallets. • Work with suppliers and freight companies to ensure pallets are returned.	• During construction and operation.
Industrial Waste	Construction and operation can generate potentially significant quantities of waste including scrap steel, and rubble.	Review opportunities for the reduction and recycling of waste streams		• Review for each new contract.
Controlled Waste	The medical facility is likely to generate small volumes of controlled medical waste.	Establish procedures for the safe disposal of controlled waste.	• Only small amounts generated during exploration.	• Health and safety advisors to establish collection and disposal procedures prior to the commencement of mining.

6 MONITORING

Monitoring will occur through regular inspection of waste facilities, through sampling and analysis of material being disposed of at the Landfill and recycling stations, and through compliance checks.

7 PERFORMANCE INDICATORS

The following performance indictors will be utilised to measure the performance of this EMP:

- Number of incident reports relating to waste management issues;
- Compliance with licence conditions; and
- Level of awareness of waste management practices amongst personnel at site.

8 RECORDS AND REPORTING

Written records of inspections, compliance checks and incident reports related to waste management will be made and kept on file. Any incidents relating to waste management and with the potential for environmental impact will be reported to the statutory authorities at the earliest possible opportunity.

An overview of the site's performance in waste management will be presented in the Annual Environmental Report. The report will outline any material issues that arose during the previous year that had the potential to cause, or did cause an adverse environmental impact. The report will also outline what action was taken in respect of these issues and the effects that these actions had.

9 ABBREVIATIONS & DEFINITIONS

Controlled Waste	Materials classified as 'Controlled Wastes' are listed in Schedule 1 of the Western Australian
Effluent	Wastewater, treated or untreated, that originates from a treatment plant, sewer, or industrial outfall. Examples of effluent include separated produced formation water, and sewage treatment plant discharge.
Hazardous Liquid Waste	Used or waste liquids that have the potential to harm the environment or living organisms. Examples include, but are not limited to, oil, lubricants, paint, acids, solvents, paint, sewage and coolants.
Hazardous Waste	Components of the waste stream that poses a threat or risk to public health, safety or the environment (includes substances that are toxic, infectious, mutagenic, carcinogenic, teratogenic).
Waste	The Landfill Waste Classifications and Waste Definitions 1996 (DEC 1996) define waste as: i) any substance that is discarded, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration in the environment ii) any discarded, rejected, unwanted, surplus or abandoned Substance iii) any otherwise discarded, rejected, unwanted surplus or abandoned substance intended for sale or for recycling, reprocessing, recovery, or purification by a separate operation from that which produced the substance iv) any substance described in regulations under the *Environmental Protection Act 1986 (WA*) as waste.
Waste Water	Sewage and other contaminated liquid waste streams. Examples include, but are not limited to, grey water, wash down water, oily water and chemically contaminated water.

10 REFERENCES

Department of Environment and Conservation (DEC) (1996). The Landfill Waste Classifications and Waste Definitions.

Cameco

Cameco Australia Pty Ltd

Kintyre Uranium Project

Surface Water Management Plan

October 2013

Date	Revision	Description	Author	Approved
21/9/12	D1	Draft	Tetra Tech	SW
05/10/12	2	Final	Tetra Tech	SW
3/5/13	3	Final	ENVIRON	SW
28/10/13	4	Final	SW	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90km south of the Telfer Mining Centre and 10 km north of the Karlamilyi National Park (formerly Rudall River National Park) border.

Development of the Kintyre Project will involve clearing and ground disturbance which have the potential to impact existing surface water flows. The purpose of this Surface Water Management Plan is to identify potential impacts, outline management measures and assign responsibilities to minimise potential impacts to surface water resulting from the Kintyre Project.

The Kintyre Project Mine Closure Plan will detail surface water management measures following the completion of mining.

2 RELEVANT LEGISLATION AND STANDARDS

Legislation and standards applicable to this management plan include, but are not limited to:

- *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act);
- *Environmental Protection Act 1986 (WA)* (EP Act)*;*
- *Wildlife Conservation Act 1950 (WA)* (WC Act)*;*
- Environmental Protection (Unauthorised Discharges) Regulations 2004;
- *Rights in Water and Irrigation Act 1914 (WA);*
- *Soil and Land Conservation Act 1945 (WA);*
- National Water Initiative Objectives 2009;
- National Water Quality Management Strategy, No 7: Australian Guidelines for Water Quality Monitoring and Reporting, 2000;
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)
- Pilbara Water in Mining Guideline (Department of Water, 2009); and
- EPA Position Statement No. 2: Environmental Protection of Native Vegetation in Western Australia;
- Stormwater Management Manual for Western Australia (Department of Water, 2004-2007).

3 ROLES & RESPONSIBILITES

Table 3-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Surface Water Management Plan.

Table 3-1: Roles and Responsibilities

Position	**Responsibility**
Environmental Manager	▪ Implementation and maintenance of the plan. ▪ Undertakes assessment and review of the effectiveness of this management plan.
Environmental Superintendent	▪ Ensure all staff are aware of their obligations in relation to this plan. ▪ Maintain site records of surveys and implement monitoring programs.
Operation Managers and Site Supervisors	▪ Ensure the plan is being adhered to by all staff and contractors. ▪ Participate in compliance audits and inspections.
All Cameco personnel, contractors and visitors	▪ Minimise impacts on surface water from construction and mining activities.

4 EXISTING ENVIRONMENT

4.1 Regional

The Kintyre Project is located within the Sandy Desert River Basin (River Basin 025) which is an internally draining basin within the Western Plateau Drainage Division No. 12 (AWRC, 1975). The Sandy Desert River Basin is an internally draining basin. It is not gauged by the Department of Water and there are no published data listed in the Australian Water Resources Station Catalogue. A detailed description of the surface water environment is provided in MWH (2011).

4.2 Local

Locally the Kintyre Project lies within two tributaries of the Yandagooge Creek referred to as the South Branch and the West Branch. The drainage in the upper reaches of the creeks occurs within relatively incised channels which widen to include significant floodplain storage in the area surrounding the Project area. The South Branch and West Branch converge immediately downstream of the Project site and flow north to the Coolbro Creek. Coolbro Creek then follows an easterly path into the Great Sandy Desert where the drainage eventually dissipates into sand dunes. The Yandagooge Creek channels surrounding the Project area are well defined, approximately one to two metres deep and have coarse sand and gravel beds, characteristic of rivers in the Pilbara.

The creeks in the region are generally dry and flow only in response to heavy rainfall, when they may flow for several days. Semi-permanent surface water pools exist in the vicinity of the Project area in the northern, central and southern creeks of the Coolbro Hills (Dames and Moore, 1996). The most significant of these are Pinpi Pool upstream (south of the Project area) on the eastern branch of the Yandagooge Creek; Rock Pool north of the Project area on a minor tributary to Yandagooge Creek; and Duck Pool north of the Project Area on Coolbro Creek, upstream of the confluence with Yandagooge Creek.

Water quality of the stream water has been monitored on a number of occasions including during recent flood events. The water quality of the flood waters is generally fresh, however slightly elevated natural radionuclide values have been observed during these flood events from naturally occurring material.

Using topographical information, the catchment area of the South Branch has been estimated to be approximately 300 km^2 and the West Branch approximately 170 km^2. The major runoff generating areas are the sandstone and quartzite outcrops (MWH, 2011). Previous hydrological investigation suggested that the more impermeable soil in the West Branch produces more runoff per unit area than the South Branch (Dames and Moore, 1996).

Rainfall data from the Telfer climate station shows a good annual correlation to the rainfall recorded at Kintyre, for the period of record available, indicating that the Telfer data are useful for looking at longer term regional rainfall trends. The largest rainfall event recorded at Telfer was in March 2004 as a result of Cyclone Fay where 372 mm of rainfall was recorded in three days which resulted in wide spread flooding.

5 ENVIRONMENTAL MANAGEMENT

5.1 Purpose

The purpose of this Surface Water Management Plan is to outline management measures, monitoring and reporting requirements, and assign responsibilities to minimise potential impacts to surface water resulting from the Kintyre Project.

The key environmental objectives are:

- To maintain the integrity, ecological functions and environmental values of the watercourses.
- To maintain the quantity and quality of surface water so that existing and potential environmental values, including ecosystem maintenance, are protected.

5.2 Potential Impacts

The proposed mining and process plant are to be located between the two branches of the Yandagooge Creek. The Project surface water control infrastructure has been designed to firstly, protect the mine site from the impacts of a flooded Yandagooge Creek, and, secondly to capture and retain all process discharges and potentially contaminated surface water runoff from within the Project area for re-use. The design basis for flood protection and retention facilities is shown in Table 5-1.

The footprint of the mining and processing operations is relatively small, covering approximately 1,500 ha (of which approximately 500 ha will be cleared) which represents around 2% of the Yandagooge Creek catchment area. The proposed mining and process areas will be protected by a flood protection embankment in areas that may be subjected to inundation during major rainfall events.

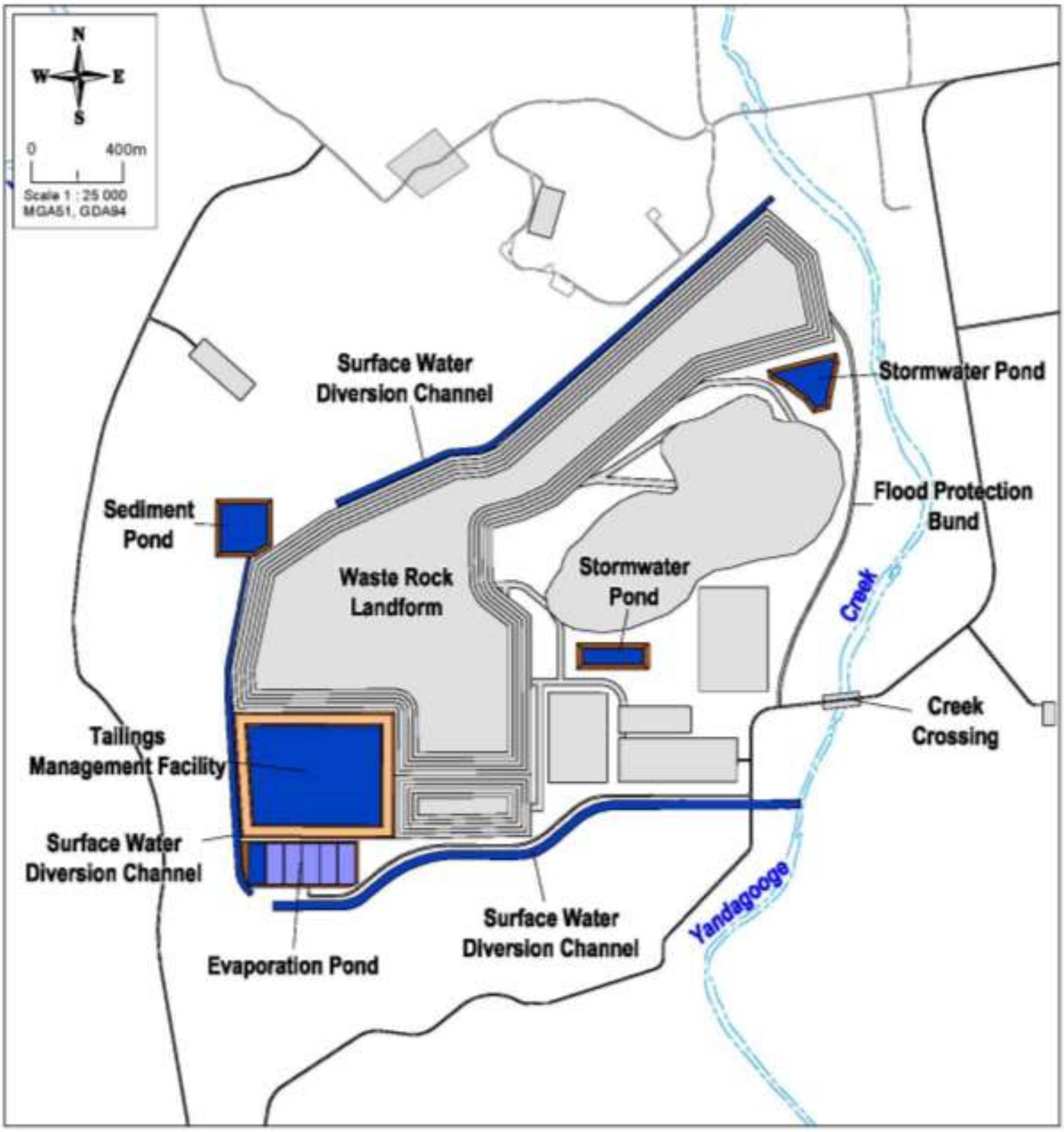

Figure 5-1 Surface Water Management Infrastructure

The flood study undertaken by MWH (2011) indicates that flood flows from the West Branch of Yandagooge Creek are unlikely to be a flood risk to the Project. The flood protection embankment will be required primarily to protect the mine from flood flows from the South Branch of Yandagooge Creek, following flood events larger than the 10 year annual recurrence interval (ARI). A comparison of the modelled flow regime for the base case scenarios (pre-mining) and the flood protection embankment scenarios shows negligible impacts in terms of discharges, flood depths and velocity for events up to and including the 100 Year ARI event when the flood protection embankment is installed.

For the 1,000 year ARI event and probable maximum flood (PMF) event, the flood protection embankment diverts significant flow away from the left bank area, out of the main channel and into a break-out overflow channel on the opposite bank (right bank). The proposed flood protection embankment reduces the floodplain width at the closest point to the creek from 1.5 km to 0.8 km, and forces more flow onto the right bank overflow channels. Depths on the right bank floodplain are predicted to increase by approximately 0.5 m to 1.0 m for 2.5 km downstream. These effects are considered significant; however, they are associated with rare events (MWH, 2011).

Increased flow velocities around the flood protection embankment may cause localised scour and increased sediment load. With the reduction of floodplain width the local velocities for events equivalent to or larger than the 20 year ARI will be increased, leading to higher scour forces. This would be rare and would be partly offset by the retention of a 120 m wide buffer of stable vegetation each side of the creek during the mine operations. Potential scour over the mine footprint will be reduced due to the protection of the flood protection embankment (MWH, 2011).

Large areas of the Pilbara are predisposed to soil erosion because of their susceptible, often fine textured soils, land degradation (removal of vegetation that exposes the fragile soil structure) and the highly intense rainfall that is experienced. During a large rainfall event, the background mobilisation of natural sediments within the Yandagooge catchment is expected to be high (MWH, 2011). The impact of the proposed flood protection embankment is expected to have a minimal impact in comparison to the high sediment loading from the natural surrounding environment in large rainfall events (MWH, 2011).

Generally, the mining operations will not significantly impact on the natural flow regime of the Yandagooge Creek with respect to the timing and volume of natural flow in the creek system. The proposed flood protection embankment would minimally impact the natural timing and magnitude of flows in the South Branch but not impact on the total volume of downstream flow.

The overall size of the footprint area that is to be isolated from the existing catchment area is relatively small and so the loss of catchment runoff to the drainage system is considered negligible.

Other disturbances to the natural surface water drainage systems are likely to be associated with the construction of access roads to the site. Any structure such as a concrete flood way built across the drainage systems would be designed to have minimal disturbance to the natural flow system, allowing the surface water flows to continue on its normal flow path unimpeded.

Water quality of the stream water has been monitored on a number of occasions including recent flood events. The water quality of the flood waters is generally fresh, however slightly elevated natural radionuclide values have been observed during these flood events from naturally occurring material.

The development of the minesite between the two branches of the creek is not expected to have a significant impact on the stream flow characteristics of the system. Similarly Cameco does not expect the Project to have any impact on the water quality of the system.

5.3 Management of Potential Impacts

The basis for the design of surface water management features at Kintyre is, firstly, to keep cross country runoff and flood water from Yandagooge Creek off the Project Area, and, secondly to have the capacity to store rainwater captured on site.

The proposed flood protection bund will be constructed between the pit and Yandagooge Creek for a PMF +1-metre flood event. Cameco has designed this based on a minimum 200 m offset from the Yandagooge Creek and a minimum of 30 m offset from the pit (for geotechnical reasons). The width of this bund is up to 50m wide and the height is up to 6m. The levee joins natural features to the north and south of the proposed Project Site as shown in Figure 5-1.

Surface water diversion channels would be constructed on the western and northern sides of the Project Area. They have been designed to divert the runoff around the Project Area and minimise the volume of water entering the project area.

These have been have been designed to 1 in 100-year 72 hour event ARI to capture cross country runoff.

Cameco’s flood model used for the design is considered conservative. This uncertainty will be updated prior to mining using additional information obtained on an ongoing basis and the Surface Water Management Plan and will be based on the latest guidance from the Bureau of Meteorology.

Facilities within the site including the Tailings Management Facility and the Evaporation Pond will be designed to capture surface water runoff in an extreme event. Specifically the design basis for these facilities will be Extreme (400mm) in 72 hours plus 1.0 m freeboard.

If the event the capacity of the TMF was exceeded, excess water from the TMF will be pumped to evaporation ponds, which have been designed to contain the volume of runoff from the extreme storm event from the TMF with one meter of freeboard during average climatic conditions.

In the event of a more extreme event, additional capacity will be obtained by discharging captured rainfall from these facilities into the open pit.

The design basis for the infrastructure is summarised in Table 5-1.

Runoff from areas such as that from the process area and stockpiles which may be potentially contaminated (with elevated levels of radionuclides) will be captured for use in the processing plant or otherwise directed to the Evaporation Pond.

Stormwater management at the TMF will be managed via a perforated riser system designed to redirect stormwater that collects on the TMF surface, and the construction of two diversion channels to redirect TMF runoff flows for evaporation. The top of the TMF will be graded to direct flows to the risers. Flows will then be combined into an overdrain pipe which will direct the captured stormwater to the Evaporation Pond.

Runoff from the TMF slopes will be captured in one of two diversion channels, which will direct the runoff to the Evaporation Pond.

The Evaporation Pond will also store surface water collected within the boundaries of the metallurgical plant. The potential for leaks and spills from pipelines and process water circuits will be managed through the installation of leak detection equipment. Pipelines will be bunded where necessary.

In the event that storage capacity of the TMF and evaporation ponds was exceeded and storm water was directed to the open pit, upon resumption of operations the water stored in the Pit would be used for mineral processing of stockpiled ore until the Pit was emptied.

Table 5-1: Kintyre surface water management basis for design

Surface Infrastructure	Design Basis	Duration (hr)	Rainfall (mm)
Surface Water Management (ponds and channels)	1:100 + 0.5 m freeboard	72	266
Tailings Management Facility Design	Extreme Event (400mm) + 1.0 m freeboard	72	400
Evaporation Ponds Design	Extreme Event (400mm) + 0.5 m freeboard	72	400
Pit Bund Conceptual Design	PMF + 1 m freeboard	6	680

Cameco has modelled the flow volumes for various ARI events to determine the relative volumes compared to the volume of the open pit to determine the circumstanced under which the Pit might fill and overflow to the environment. The results are shown in the table below.

Table 5-2: Kintyre impacts of a flood event on the Open Pit

ARI	Without levee	With failed levee	With levee
1:100	Contained	Contained	Contained
1:1000	Contained	Contained	Contained
PMF	Overtopped	Overtopped	Contained

Note: “Contained” – means the flood waters are contained within the Pit. “Overtopped” – means the flood water fill the open pit and overtop.

Cameco has committed to construct the levee wall the ARI design standard of PMF plus 1m and has established that discharge from the pit will not occur based on the long-term structural integrity of the PMF +1 levee.

5.4 Environmental Objectives and Performance Indicators

Table 5-3: Environmental Objectives and Performance Indicators

Environmental Objective	Performance Indicators
To maintain the integrity, ecological functions and environmental values of surrounding watercourses.	• No loss of environmental values as a result of changes to the surface water flow and quality regime. • No significant impact on ecologically significant vegetation as a result of surface water flow changes. • No material release of hydrocarbons, contaminated stormwater or other contaminants from the Project area (e.g. radionuclides).
To maintain the quantity and quality of surface water so that existing and potential environmental values, including ecosystem maintenance, are not adversely impacted.	• No significant increase in turbidity of surface water flows as a result of Cameco's operations. • No material release of hydrocarbons, contaminated stormwater or other contaminants from the Project area (e.g. radionuclides).

5.5 Environmental Aspects and Management Strategies

Table 5-4: Flood Mitigation – Periodic Monitoring and Inspection Plan

Periodic Monitoring and Inspection		
Frequency		Action
Annual prior to wet season (to be completed between October 1 – 15)		Inspection of all drainage features, with silt and debris removal, and backfill and compaction of voids to original design grades.
Event-based Monitoring and Inspection		
Rainfall Depth Measured Onsite	Stage Observed in Yandagooge Creek	Response
Trace	Measurable Flow Event	Inspection of all site drainage features, with silt and debris removal, and backfill and compaction of voids to original design grades. Monitor water quality of runoff.
100 mm 24 hr or 135 mm in 72 hr (10-yr ARI)	At levee toe	Implement site emergency response plan and chemical and fuel storage management plan Post-flood inspection of all site drainage features and flood protection embankment, with silt and debris removal, and backfill and compaction of voids to original design grades.
130 mm 24 hr or 170 mm in 72 hr (20-yr ARI)	1 m above levee toe	Implement site emergency response plan and chemical and fuel storage management plan. Post-flood inspection of all site drainage features and flood protection embankment, with silt and debris removal, and backfill and compaction of voids to original design grades.
170 mm 24 hr or 220 mm in 72 hr (50-yr ARI)	2 m above levee toe	Implement site emergency response plan and chemical and fuel storage management plan. Post-flood inspection of all site drainage features and flood protection embankment, with silt and debris removal, and backfill and compaction of voids to original design grades.
Extreme Event 400mm in 72 hr	3 m above levee toe	Implement site emergency response plan. Post-flood inspection of all site drainage features and flood protection embankment, with silt and debris removal, and backfill and compaction of voids to original design grades. Geotechnical testing and stability assessment of flood protection embankment.

310 mm 24 hr or 376 mm in 72 hr (1,000-yr ARI)	4 m above levee toe	Implement site emergency response plan. Post-flood inspection of all site drainage features and flood protection embankment, with silt and debris removal, and backfill and compaction of voids to original design grades. Geotechnical testing and stability assessment of flood protection embankment.
1000 mm 24 hr or 1720 mm in 72 hr (PMP)	5 m above levee toe	Implement site emergency response plan. Post-flood inspection of all drainage features, with silt and debris removal, and backfill and compaction of voids to original design grades. Geotechnical testing and stability assessment of flood protection embankment.

Table 5-5: Environmental Aspects and Management Strategies

Environmental Aspect	**Management Strategy**
Clearing and Ground Disturbance	• A creek protection buffer 120 m wide each side of the creek will be established and maintained to protect the environmental form and function of the creek. Other than for two creek crossings, no clearing will be permitted within this buffer. • Outside of the buffer, disturbance to native vegetation and land clearing will be minimised and undertaken in accordance with the Flora and Vegetation Management Plan. • Progressive rehabilitation of disturbed areas will be undertaken in accordance with the Kintyre Project Mine Closure Plan. • No unauthorised driving off tracks. • Water collected from disturbed areas would be treated for reuse in the processing plant or for dust suppression as required.
Infrastructure Upgrade	• The Flood Protection Embankment will be constructed to capture surface water runoff from a 1-in-100 year 72-hour storm event. • The Flood Protection Embankment will be progressively constructed to protect only those areas of the Project to be developed in accordance with the mine plan.

Environmental Aspect	Management Strategy
	• The Flood Protection Embankment, surface water diversion channels, stormwater ponds and evaporation pond will be inspected after all rainfall events. • Stormwater collected from within the Flood Protection Embankment would, where practicable, be used as a preferred supplement for water supplies provided from pit dewatering to meet demand within the Project. This water would be used in preference to groundwater from the dedicated wellfields. • During road construction, culverts will be installed where flows are likely to cause safety issues or significantly impact engineering standards of the road. • Leak detection equipment will be installed for pipelines and in the process water circuits. • Pipelines will be bunded where necessary. • Surface water flow paths will be reinstated at closure in accordance with the Kintyre Project Mine Closure Plan.
Waste Control	• Implement the Waste Management Plan. • The landfill will meet the requirements of the Environmental Protection (Rural Landfill) Regulations 2002. • Hazardous waste will be removed and disposed of by a licensed contractor, or buried in the on-site Landfill.
Hydrocarbon and Chemicals	• Hydrocarbons and chemicals will be transported, stored and used in accordance with Australian standards and guidelines. Specific management measures are outlined in the Kintyre Project Chemical and Fuel Storage Management Plan. • Spill kits will be made available on site and reflect the quantity of hazardous materials stored. • Hydrocarbon and chemical spills will be immediately cleaned up and the incident reported.

6 DEMONSTRATING THE OUTCOME

6.1 Monitoring

The suitability and success of surface water management measures detailed in this plan will be monitored against the associated performance indicators by the Environmental Manager. Site environment inspections will include monitoring to ensure appropriate management measures are being undertaken.

Water quality monitoring within the catchment area will be completed monthly when water is present. Analyses will include total dissolved solids, total suspended solids, pH, EC and major ions. Analyses will specifically include key metals and radionuclides found in the waste rock and ore extracted during mining. Site specific water quality guidelines will be developed in accordance with ANZECC Guidelines (2000).

Three Surface Water Monitoring Stations will be established within the Yandagooge Creek system. The purpose of the monitors is to capture water samples during a flood event for an assessment of water quality and provide Cameco with the opportunity to continue to refine the catchment rainfall and runoff model developed for the Yandagooge Creek. The stream height recording station will record stream flow, the rate of rise and stream height and the rising stage water sampler takes samples of water during a flood event.

Analyses of samples taken from flood events will specifically include sediment load and key metals and radionuclides found in the waste rock and ore extracted during mining.

The movement of sediment and alluvial materials will be monitored by means of a LiDAR survey of the Project Area and the Yandagooge Creeks downstream of the Project Area. A survey will be completed before construction commences to establish baseline topography. Replicate surveys will be completed every five years or after major flood events (100 year ARI or greater), and again following the completion of site closure works.

An aerial gamma survey of the Project Area and the Yandagooge Creeks downstream of the Project Area will be completed prior to the commencement of construction to establish a baseline gamma emission estimate. A replicate survey will be completed again following the completion of site closure works.

Periodic inspection of culverts, flood ways and stormwater management infrastructure will be undertaken including assessment of adjacent vegetation to determine if water ponding, water starvation or erosion is occurring that could affect vegetation health. All surface water management infrastructure (including fixed monitoring equipment) will be inspected after rainfall events.

6.2 Contingencies

Should monitoring indicate the environmental objectives of this plan are not being met, remedial actions will be undertaken. These may include:

- Erosion control and bank stabilisation;
- Repair of any eroded or scoured areas;
- Reclamation of sediment or other waste materials lost from the site during flood events (e.g. materials eroded from Waste Rock Dumps);
- Revegetation to improve erosion resistance; and
- Reinstating any damaged bund surfaces, with redesign of erosion protection engineering if necessary.

6.3 Reporting

The Annual Environmental Report (AER) will provide detailed information on the effectiveness and implementation of this plan. The AER will contain results of the various monitoring tasks, a summary of all audits, areas of compliance and noncompliance and remedial actions undertaken.

6.4 Review and Revision

This Plan will be maintained as a live document and will be reviewed every three years or as necessary, taking into account the results of monitoring and audits undertaken during the year. Reviews will address matters such as the overall design and effectiveness of the plan, progress in environmental performance, incorporation of current leading practice and any changes in relevant legislation and Australian Standards.

Table 6-1: Environmental Management Summary Table

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Clearing and Ground Disturbance	• Maintain the integrity, ecological functions and environmental values of the watercourses.	• Monitoring by Environmental Manager against environmental objectives and performance criteria	AER	Undertake remedial action as required: • Erosion control • Bund repair • Revegetation	Ground Disturbance Procedure Kintyre Project Mine Closure Plan
Infrastructure Upgrade	• Maintain the quantity and quality of surface water so that existing and potential environmental values, including ecosystem maintenance, are protected.	• Periodic water quality monitoring • Periodic inspection of culverts, flood ways and stormwater management infrastructure will be undertaken. All surface water management infrastructure will be inspected after rainfall events.	AER	Undertake remedial action as required: • Erosion control • Bund repair • Revegetation • Redesign of bunds as necessary	Ground disturbance procedure Kintyre Project Mine Closure Plan
Waste Control			AER	Implement a Waste Management Plan	Kintyre Project Waste Management Plan
Hydrocarbons and Chemicals			AER	Implement the Chemical and Fuel Storage Management Plan and the Site Emergency Response Plan	Kintyre Project Chemical and Fuel Storage Management Plan Site Emergency Response Plan

7 REFERENCES

MWH (2011). Kintyre Flood Study: Flood plain modelling and protection options. Report prepared for Cameco. November 2011.

Dames and Moore (1996). Summary Report 1988 – 1992 Kintyre Surface Water Monitoring Program. Report prepared for Canning Resources.

Cameco Australia Pty Ltd

Kintyre Uranium Project: Groundwater Management Plan

November 2012

Date	Revision	Description	Author	Approved
1/9/12	D1	Draft	Pennington Scott	SW
20/11/12	Final	Final	Cameco	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 5 km north of the Karlamilyi National Park (formerly Rudall River National Park) border. The Kintyre Project area lies in the far eastern Pilbara, within Rudall Complex rocks of the Paterson Orogen.

This section outlines the potential impacts of the Project on groundwater and the proposed management measures. Groundwater management has been identified as a key aspect for the Project during the risk assessment undertaken as part of the Environmental Review and Management Programme (ERMP).

The purpose of this management plan is to both meet the legislative requirements and provide a framework for Cameco to responsibly meet any changing environmental obligations over the life of the Project.

2 RELEVANT LEGISLATION AND STANDARDS

Legislation and standards applicable to this ERMP include:

- *Rights in Water and Irrigation Act 1914 (WA)*
- *Management of Water in mining in Western Australia (Department of Water, 2012)*
- *Environmental Water Provisions Policy (Water and Rivers Commission, 2000)*
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ARMCANZ and ANZECC, 2012)*
- *Australian Drinking Water Guidelines (NRMMC, 2011)*

3 EXISTING ENVIRONMENT

3.1 Region

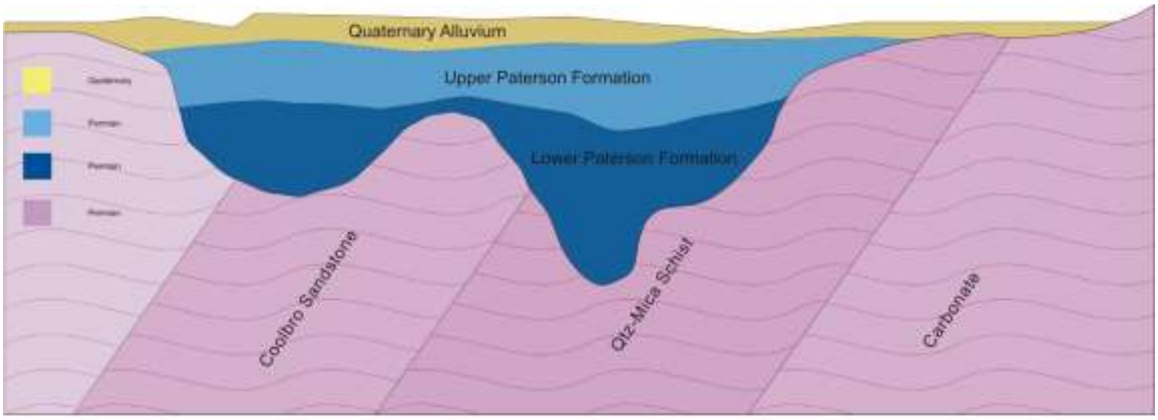
The Kintyre deposit lies within rocks on the Rudall Complex, a sequence of deformed Proterozoic age metamorphic rocks. These rocks were carved by glaciers during the Permian Period, which formed large valleys that were infilled by sand, silt and gravel as the glaciers receded. The Permian glacial valleys remain as active drainages, forming the catchment to the Yandagooge and Coolbro Creeks, as well as the Rudall River. The Permian-age sediments laid down in the valleys, the Paterson Formation, form the most important local aquifer.

3.2 Groundwater Occurrence

The main aquifer units in the Kintyre area are located in Permian sand, gravel and conglomerate deposits of the Paterson Formation, and fractured and weathered sandstone of the Coolbro Sandstone. Smaller local aquifers are present in Cenozoic deposits where saturated, and in secondary permeability features within basement rocks of the Rudall Metamorphic Complex. Regional and local aquifer qualities are summarised in Table 3-1. Figure 3-1 is a schematic diagram showing the distribution of aquifers in the region.

Table 3-1: Summary of Aquifer types in the Kintyre area

Aquifer	Geological unit	Average thickness (m)	Bore yield (kL/day)	Aquifer potential	Lithology
Cenozoic	Alluvium	15	Minor	Minor	Unconsolidated localised sedimentary aquifers
Upper Paterson	Paterson Formation (upper unit)	50	100 to 1,500	Minor to Major	Glacio-lacustrine clay, siltstone and sand
Lower Paterson	Paterson Formation (lower unit)	100	100 to 1,700	Minor to Major	Fluvioglacial sand, gravel and basal conglomerate
Coolbro	Coolbro Sandstone	>1,000	200 to 800	Major where sheared	Sandstone
Rudall fractured rock	Rudall Metamorphic Complex	>1,000	<50 to 250	Minor	Schists, carbonates, quartzite



Please note: Not to scale

Figure 3-1 Schematic geological cross-section in the Kintyre region

3.2.1 Cenozoic Aquifer

Cenozoic deposits are generally unsaturated over most of the Project area, although thicker, deeper deposits are coincident with branches of the Yandagooge Creek. Isolated lens-like aquifers form where sands are present below the watertable. Cenozoic deposits do not form a significant aquifer.

3.2.2 Upper Paterson Aquifer

The upper unit of the Paterson Formation has significant storage potential, and generally forms an extensive clayey sand aquifer with a lower aquitard associated with the fine-grained glacio-lacustrine facies (Figure 3-2). Analysis of pumping tests suggests that the aquitard is leaky and there is a weak connection to the aquifer beneath.

3.2.3 Lower Paterson Aquifer

Tillite and fluvioglacial sand and gravel form an aquifer of varying spatial extent in the lower portion of the Paterson Formation (Figure 3-2). Sequences of interbedded sand with loose running basal sand and gravel are the highest yielding for groundwater. The unit has a saturated thickness of up to 105 m and is typically confined beneath glacio-lacustrine sediments of the upper Paterson Formation.

3.2.4 Coolbro Sandstone Aquifer

Although the Coolbro Sandstone is a recrystallised sandstone and siltstone with close to zero primary porosity, there are some weathered and highly fractured areas that yield water. Several bores drilled into the Coolbro Sandstone aquifer have targeted potentially high permeability areas within the Kintyre Shear Zone, though all exhibited some boundary effects during pump testing.

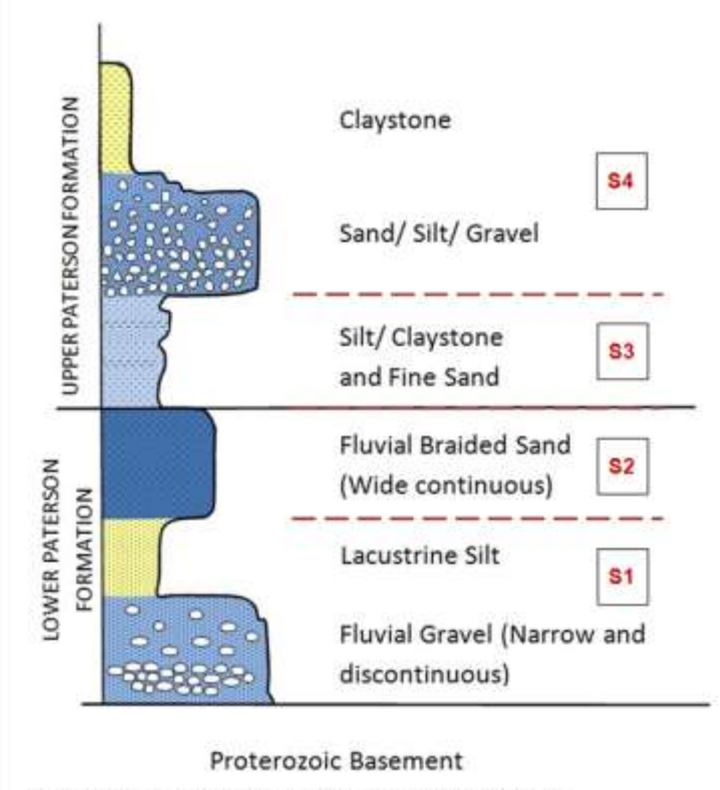


Figure 3-2: Paterson Formation facies present in bores in the Project Area

3.2.5 Rudall Fractured Rock Aquifer

Proterozoic rocks in the Rudall area have no primary porosity, but secondary porosity exists within fault and shear structures. Rocks of the Rudall Metamorphic Complex are generally less productive and contain poorer quality groundwater than the Coolbro Sandstone.

3.3 Groundwater Recharge

Using the chloride mass balance method the recharge rate at Kintyre varies between 5% and 1.2% of rainfall. A recharge value of around 1% rainfall is most likely, which would be equivalent to an annual recharge rate of about 3.5 mm.

3.4 Groundwater chemistry

Groundwater salinity in the Project area is variable, but is generally fresh to moderately saline. The lowest salinity water (TDS <1,000 mg/L) is found in Coolbro Sandstone and in the Paterson aquifer between 5 to 10 km west and north of Kintyre.

Groundwater type in the region varies from sodium bicarbonate, to sodium chloride, to calcium sulphate, with sulphate, bicarbonate and chloride concentrations noticeably elevated in bores surrounding the Rudall Complex at Kintyre. Elsewhere, such as in the borefield, water remains sodium chloride type. The groundwater chemistry distribution suggests that there is interaction between the groundwater and aquifer materials around the Kintyre deposit area, where Rudall Complex rocks lie near the surface.

The groundwater chemistry distribution also indicates that groundwater flow is away from the immediate area of the proposed Kintyre pit area, but does not extend far towards the borefield.

3.5 Groundwater Dependent Ecosystems

The Project is bounded by two creek lines along which the species *Eucalyptus camaldulensis* (River Red Gum), with *Corymbia opaca* (Desert Bloodwood) growing just above the creek line (Figure 3-3). Both have been known to have groundwater dependence in other parts of the state. Review of these vegetation areas in the hydrogeological investigation indicates that they are likely not groundwater dependent at the Project site (Pennington Scott, 2012a).

Several ephemeral rock pools also lie within the Project area. Review of the hydrology of these pools indicates that they are primarily surface water fed, with little or no connection to the underlying aquifers (Pennington Scott, 2012b).

3.6 Subterranean Fauna

A subterranean fauna assessment (Bennelongia, 2012) found that although there were a few previously undescribed species, the faunal assemblage at Kintyre was unremarkable and was similar to other assemblages found throughout the Pilbara. The study found that the habitat distribution was sufficiently wide that mining, dewatering and borefield operations would not pose a significant threat to subterranean ecosystems.

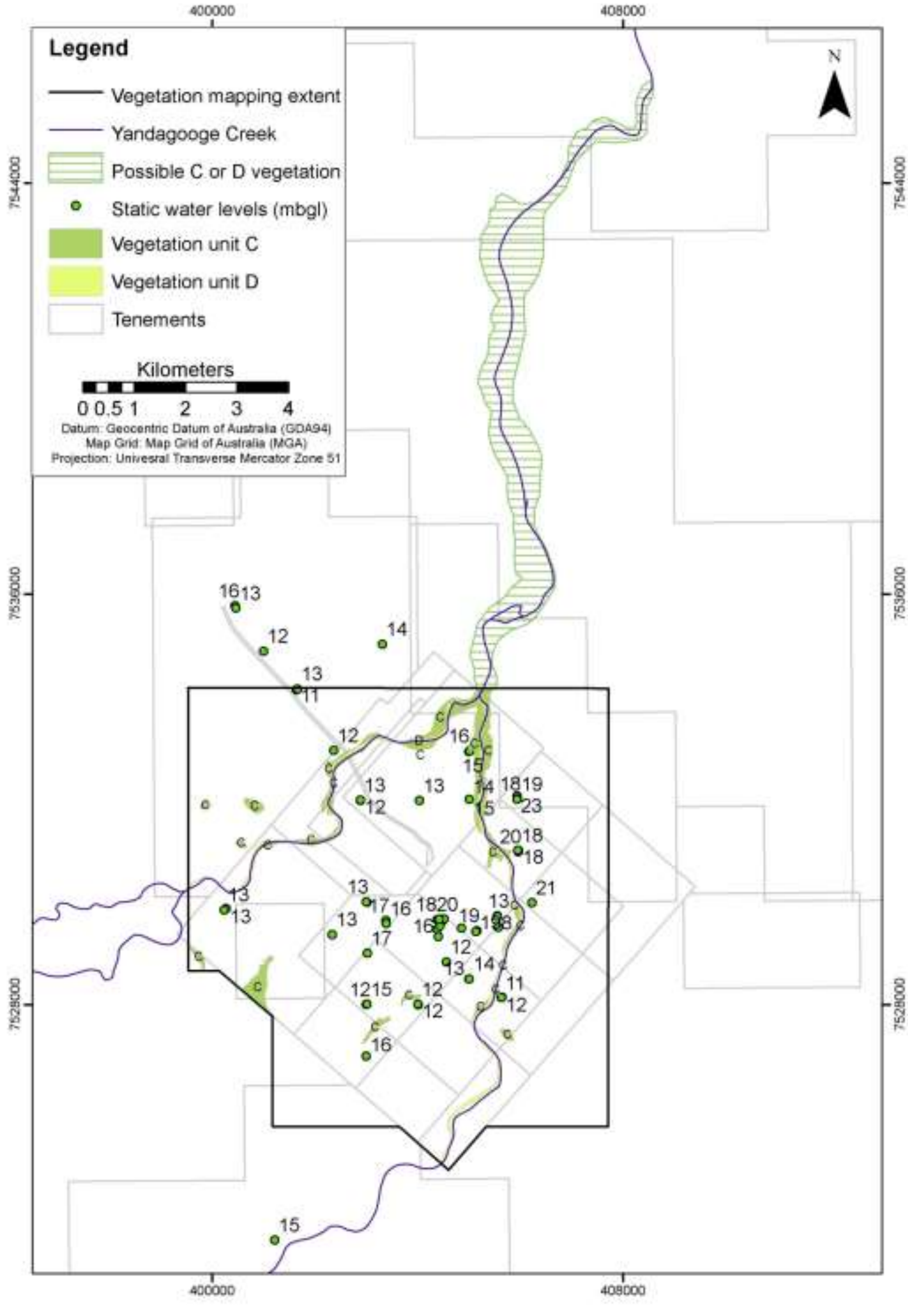


Figure 3-3: Potential Groundwater Dependent Vegetation within Project area

4 ROLES & RESPONSIBILITES

Table 4-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Groundwater Management Plan.

Table 4-1: Roles and Responsibilities

Position	Responsibility
Environmental Manager	• Implementation and maintenance of the plan. • Undertakes assessment and review of the effectiveness of this management plan.
Environment Superintendent	• Formulate and implement groundwater monitoring programmes. • Ensure all staff are aware of their obligations in relation to this plan. • Deliver groundwater education and induction awareness training to field personnel; including risks of contamination and spills and encouraging low water usage. • Maintain site records of surveys and implement monitoring programmes.
Operation Managers and Site Supervisors	• Ensure the plan is being adhered to by all staff and contractors. • Participate in compliance audits and inspections.
All Cameco personnel, contractors and visitors	• Minimise impacts on groundwater quality and volume from construction and mining activities. • Report all incidents involving spills and potential contamination events.

5 ENVIRONMENTAL MANAGEMENT

5.1 Purpose

The purpose of this Plan is to identify, assess and minimise potential environmental impacts of Cameco's mining operations on groundwater and aquifers within its areas of operation. Management objectives are integral to ensuring the correct operation of the bores, in order to optimise efficiency while minimising impacts on other users and the environment. The management objectives are:

- To maintain the quality and quantity of groundwater so that environmental values, including ecosystem maintenance, are protected;
- To avoid groundwater contamination; and
- To maintain surface water flow and quality so that environmental values are protected.

5.2 Potential Impacts

Dewatering and borefield abstraction will lower the water table in the region, which may have follow-on effects. This management plan and monitoring programme has been established to minimise the potential for these impacts. The potential impacts have been summarised below.

5.2.1 Sustainable Abstraction

Groundwater modelling has estimated the expected drawdown in both the borefield and around the pit area. There is a possibility that drawdown in the borefield or in the wider region is greater than anticipated, which will affect the long term sustainability of water abstraction.

Management of the borefield and pit dewatering is complex as they have contrasting aims; the borefield aims to maximise abstraction but minimise drawdown, whereas dewatering aims to maximise drawdown with minimal abstraction.

5.2.2 Groundwater Quality

Water quality in the region has the potential to increase in salinity as abstraction continues. Other groundwater components are not likely to change over the life of the mine.

5.2.3 Groundwater Contamination

Leakage from the Tailings Storage facility, enhanced groundwater movement from the pit area due to mining activities, leakage of hydrocarbons from storage tanks, and increased nitrogen due to explosives associated with mining, all have the potential to introduce contaminants to the groundwater.

5.2.4 Groundwater Dependent Ecosystems

Potential Groundwater Dependent Ecosystems (GDE) could be affected by excessive drawdown, depriving the ecosystem of water. As yet, no GDEs have been defined in the Kintyre area, but as monitoring continues some GDEs may be identified.

5.2.5 Subterranean Ecosystems

An impact assessment on the local subterranean fauna has indicated that the mining, dewatering, and borefield operations are unlikely to have an impact on subterranean fauna (Bennelongia, 2012).

5.2.6 Surface Water Flow and Rock Pool Water Levels

Investigations have shown that surface water flow and rock pool water levels are unlikely to be influenced by groundwater levels and more likely reflect precipitation. Stream flow gauges and monitoring bores positioned near rock pools will be used to demonstrate there is no impact due to dewatering or borefield activities.

5.3 Environmental Objective and Performance Indicators

Table 5-1: Environmental Objectives and Performance Indicators.

Environmental Objective	Performance Indicators
Maintain a sustainable abstraction from the borefield	• No excessive drawdown in monitoring bores
Maintain groundwater quality	• No substantial change in key groundwater parameters (comparison with pre-mining data)
Avoid groundwater contamination	• No substantial change in potential contaminant concentration (comparison with pre-mining data).
Avoid or minimise impact on ground water dependent ecosystems	• No decline in the condition and foliage cover of trees along water courses or flood plain areas. • No tree deaths.
Avoid or minimise impact on subterranean ecosystems	• No change in either species types or species proportion (comparison with pre-mining data).
Avoid or minimise the impact on stream flow and rock pool water levels	• No change in stream flow or rock pool water level due to groundwater abstraction and dewatering activities

5.4 Environmental Aspects and Management Strategies

Table 5-2: Environmental Aspects and Management Strategies.

Environmental Aspect	Management Strategy
Groundwater Abstraction	• Monthly abstraction from production bores • Monthly recording of water levels in monitoring bores
Groundwater Quality	• Monthly (first week of the calendar month) EC and pH testing from all production bores to rapidly detect any potential deterioration and apply the triggers and contingencies described in Section 7 • Six monthly testing of the comprehensive suite as per the DoW Operational Policy 5.12 (EC, pH, TDS, dissolved oxygen, Hardness (HCO_3) and total hardness ($CaCO_3$), alkalinity, Ca, Mg, Na, K, NH_3, PO_4, CO_3, Cl, SO_4, NO_3, NO_2, SiO_2, Al, As, Cd, Cr, Fe^{2+}, Pb, Mn, Hg, SE, Zn, total nitrogen (TKN) and total phosphorus) of all active production bores to detect any change in overall water quality as a result of the programme • Six monthly testing for gross alpha, gross beta and potassium40 beta in a nominal 5-8 selected monitoring bores around the pit and tailings
Groundwater contamination	• Six monthly testing of the comprehensive suite from monitoring bores installed down gradient of the pit and TSF to check for contamination • Six monthly testing of the comprehensive suite from monitoring bores installed around the TSF
Ground water dependent ecosystems	• Monthly recording of water levels in monitoring bores near potential GDEs • Monthly recording of EC and pH in monitoring bores near potential GDEs
Subterranean ecosystems	• Annual monitoring of species types and distribution
Stream flow and rock pool water levels	• Stream gauge for water level monitoring • Monthly water levels in monitoring bores near rock pools • Photographic monitoring of sites annually
Water Efficiency	• Visual inspections of pipes and bores will be performed monthly to ensure efficiency and reduce loss of water due to leakage • The site will also use an Environmental Awareness Programme to encourage lower water use

6 DEMONSTRATING THE OUTCOME

6.1 Monitoring Programme

The groundwater monitoring programme is summarised in the table in Section 5.4. Monitoring data will be complied on a quarterly basis for internal reporting to ensure compliance with licence conditions. The data (both tabular and graphical) from the monitoring programme and a hydrogeological assessment of these data will be provided in an annual report. Details of the monitoring are provided below.

6.1.1 Abstraction

A meter approved under the *Rights in Water and Irrigation (Approved Meters) Order 2009*, will be installed and properly calibrated in each production bore prior to any abstraction from the bore. Meters will be installed in accordance with the DoW's Guidelines for Water Meter Installation 2009.

Following the commencement of water abstraction at each bore, meter readings will be taken and recorded on a monthly basis for each bore in the first week of each month. The water meters will be tested annually to ensure they are accurate to within manufacturer specifications and adjusted when necessary.

6.1.2 Water Levels

Water levels will be monitored monthly (first week of the calendar month) at all production bores and a series of selected monitoring bores that are representative of the regional impacts. Water levels in all monitored bores will be measured using an electronic dip meter, following the cessation of pumping in that bore for at least three hours.

6.1.3 Water Quality

All production bores and fourteen (14) monitoring bores (selected as a representative group) will be tested for water quality. Water quality monitoring will take a tiered approach:

- Monthly (first week of the calendar month) EC and pH testing from all production bores to rapidly detect any potential deterioration and apply the triggers and contingencies described in Section 0;

- Annual testing of the comprehensive suite as per the DoW Operational Policy 5.12 (EC, pH, TDS, dissolved oxygen, Hardness (HCO_3) and total hardness ($CaCO_3$), alkalinity, Ca, Mg, Na, K, NH_3, PO_4, CO_3, Cl, SO_4, NO_3, NO_2, SiO_2, Al, As, Cd, Cr, Fe^{2+}, Pb, Mn, Hg, SE, Zn, total nitrogen (TKN) and total phosphorus) of all active production bores to detect any change in overall water quality as a result of the programme; and

- Annual testing for gross alpha, gross beta and potassium40 beta in a nominal 5-8 selected monitoring bores around the pit and tailings.

Samples will be collected according to *Australian Standard 5667 – Water Quality – Sampling,* and particularly Part 11: – Guidance on Sampling of Groundwaters. At least three casing volumes will be pumped from each bore prior to samples being taken. Samples will be stored according to laboratory requirements and transported as soon as practical to a NATA certified laboratory for analysis.

The quality of groundwater around the Kintyre Uranium Project has been investigated and monitored since 1987 by a variety of groups (Dames & Moore 1988; Hydro-Resources, 1997; MWH, 2010/2011a; Pennington Scott 2012). The data sets from each organisation over this extensive period of time have resulted in sound baseline monitoring values. Historical data (pre-mining) will be compared with annual water quality results, the objective being to distinguish between natural variability and potential mine-derived solutes, and to indicate increasing variation from baseline or background levels. As mining operations develop, water quality management and guidelines will be reviewed an updated as new data becomes available.

6.1.4 Water Efficiency

Visual inspections of pipes and bores will be performed monthly to ensure efficiency and reduce loss of water due to leakage. The site will also use an Environmental Awareness Programme to encourage lower water use.

6.1.5 Environmental Impacts

Prior to the start of abstraction from the dewatering bores or the production borefield, representative shallow monitor bores will be installed adjacent to sensitive vegetation and Pinpi Rockhole. While project investigations indicate that these features are unlikely to be groundwater dependent, these bores will be included in the water level monitoring programme as a precaution. A stream gauge will also be installed in Yandagooge Creek and monitored during streamflow events.

Vegetation in direct proximity to the water supply areas and areas of high traffic will be closely monitored in order to ensure the efficacy of dust and drain management.

6.2 Interpretation and Reporting of Results

All data will be summarised and evaluated before preparation of the Kintyre Annual Monitoring Report.

Water level data will be evaluated with respect to hydrogeological modelling detailed in Tetra Tech (2012). Water quality data will be evaluated with respect to baseline data compiled in Pennington Scott (2012) and historical data from Dames & Moore (1988), Hydro-Resources (1997) and MWH (2010;2011a).

Reporting of results obtained from the monitoring of bore water levels and water quality will discuss:

- Any significant changes in water levels in the borefield, comparing them to the expected response from modelling;
- Changes in the water levels around the pit, comparing them to the expected response from modelling;
- Any significant changes in water levels in monitoring bores near rock pools;
- Any significant changes in EC and pH above the trigger levels;
- Any significant changes in metal content, radio-isotope, or nitrogen content above the trigger levels;
- Any significant changes in stream flow or rock pool water level that cannot be explained by precipitation rates; and
- The volume of water abstracted from the borefield and the pit.

6.3 Contingencies

Hydrogeological modelling has established the expected maximum drawdown in the borefield and around the pit due to abstraction. Triggers have been set at 1.1 times the expected drawdown. Specific triggers may be set for bores in areas of sensitive vegetation or near rock pools if warranted by further investigations of these features.

Baseline data for water chemistry and regional water levels were established in a sampling programme in 2012. Trigger levels are set at 1.25 baseline data levels.

Triggers and contingencies are detailed in Table 6-1. Trigger levels to initiate a response from Cameco are:

- If there is a decrease in static water level near the water supply borefield greater than 1.1 times the expected drawdown.
- If recorded TDS or EC is 1.25 times the baseline, or pH changes by more than 1 unit.
- If any metal or radio-isotope concentration is 1.25 times the baseline, or if nitrogen levels (as nitrate or nitrite) increase by 1.25 times.
- If any other anolyte concentration is 1.5 times the baseline;
- If stream flow and rock pools show a visible reduction in flow regime or water level unrelated to weather conditions.

If a trigger level is exceeded Cameco commit to implementing:

- A hydrogeological assessment to determine the cause of the trigger level exceedance;
- If necessary implement changes to accommodate or ameliorate the trigger level breach. This could include:
  - reconfiguring abstraction, such as reducing the draw from nearby production bores, or construction of new production bores further from the impacted feature;
  - developing new sources of water such as undeveloped parts of the Coolbro Sandstone aquifer;
  - changing the timing of abstraction; or
  - reducing abstraction from the borefield;
- Explore improvements to the trigger levels based on the new data; and
- Report any exceedances in the Annual Monitoring Report.

6.4 Review and Revision

This plan will be reviewed following mine commissioning, then every two years thereafter or as significant information comes to light.

Table 6-1: Environmental Management Summary Table

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Groundwater abstraction	No excessive drawdown in monitoring bores	Monthly abstraction volumes recorded	Annual Monitoring Report and Triennial Aquifer Review	Reduce or cease abstraction until water levels recover to 90% expected drawdown.	Groundwater abstraction
Groundwater quality	No substantial change in key groundwater parameters	Monthly EC and pH recorded. Six-monthly complete analysis of selected bores.	Annual Monitoring Report and Triennial Aquifer Review	Test surrounding bores to identify the spatial extent of groundwater chemistry change Review climate data to determine if the impact is natural variability Reduce drawdown in bores around that feature if required	
Avoid groundwater contamination	No substantial change in potential contaminant concentration	Six monthly complete analysis of selected bores Reporting of all spills and leaks.	Annual Monitoring Report and Triennial Aquifer Review	Test surrounding bores to identify the spatial extent of groundwater chemistry change Review tailings management strategy and infrastructure	
Avoid or minimise impact on ground water dependent ecosystems	No decline in the condition and foliage cover of trees or vegetation along water courses or flood plain areas.	Monthly SWL recorded in monitoring bores.	Annual Monitoring Report and Triennial Aquifer Review	Further investigation to confirm the impact is Project-related Change the distribution or timing of abstraction to reduce impact around the feature Expand the borefield to reduce the draw on sensitive areas Develop alternative aquifers	Flora and Fauna Management Plan

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Avoid or minimise the impact on stream flow and rock pool water levels	Surface water flow and rock pool levels remain consistent with pre-mining conditions	Stream gauges used during surface flow events. Monitoring of water levels in rock pools. Monitoring of water levels in monitor bores near rock pools	Annual Monitoring Report and Triennial Aquifer Review	Further investigation to confirm the impact is Project-related Change the distribution or timing of abstraction to reduce impact around the feature Expand the borefield to reduce the draw on sensitive areas Develop alternative aquifers Augment flows with pumped groundwater	Maintain surface water flow

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Cameco Australia Pty Ltd

Kintyre Uranium Project

Flora and Vegetation Management Plan

October 2013

Date	Revision	Description	Author	Approved
14/8/12	D1	Draft	Bennett / ENVIRON	SW
10/6/13	2	Final	ENVIRON	SW
7/10/13	3	Final	ENVIRON	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 5 km north of the Karlamilyi National Park in the Little Sandy Desert bio-region.

The following document outlines the potential impacts of the Project on flora and vegetation and the proposed management measures. Management of flora and vegetation has been identified as a key aspect for the Project during the risk assessment undertaken as part of the Environmental Review and Management Programme (ERMP).

The purpose of this management plan is to meet the legislative requirements and provide a framework for Cameco to responsibly meet any changing environmental obligations over the life of the Project.

2 RELEVANT LEGISLATION & STANDARDS

Legislation and standards applicable to this management plan include:

- *Environment Protection and Biodiversity Conservation Act 1999*;
- *Environmental Protection Act 1986*;
- *Wildlife Conservation Act 1950*;
- *Agriculture and Related Resources Protection Act 1976*; and
- EPA Guidance Statement No. 51 (Guidance for the Assessment of Environmental Factors, Terrestrial flora and vegetation surveys for environmental impact assessment in Western Australia, 2004).

3 EXISTING ENVIRONMENT

3.1 Region

The Kintyre Project lies within the Rudall Subregion (LSD1) subregion of the Little Sandy Desert Bioregion (Figure 3-1). The regions are described by the Interim Biogeographical Regionalisation for Australia (IBRA) classification system (Environment Australia 2000, McKenzie *et al*. 2003). The Little Sandy Desert Bioregion falls within the Bioregion Group 4 classification (bioregions of the Eremaean Botanical Province, native vegetation is largely contiguous but is generally not used for commercial grazing, EPA 2004).

The general features of the Little Sandy Desert subregion are summarised by Kendrick (2001). Vegetation comprises:

1. Sparse shrub-steppe over *Triodia basedowii* on stony hills;
2. River Gum communities along drainages with bunch grasslands on alluvial deposits and associated with ranges;
3. Extensive areas of tussock grass associated with foot slopes; and
4. Extensive *Triodia* hummock grasslands on hills and surrounding plains.

The climate of the region is arid with summer rainfall. The sub-region is 1,078,070 ha and includes the headwaters and course of the Rudall River. Dominant land uses in the subregion are unallocated crown land and conservation areas, mining leases, and the Parnngurr Aboriginal Community near Cotton Creek.

Kendrick (2001) lists several rare features significant to the region. These include:

- The upper Rudall river, draining into Lake Dora – this is one of two arid zone rivers, with near permanent wetlands along its course, flowing from uplands across the desert and into a major salt lake within the Little Sandy Desert.
- Small permanent rockhole wetlands associated with ranges and uplands - these are locally significant water sources, with high biological and cultural significance.
- Karlamilyi National Park – part of the national park is contained in LSD bioregion. Karlamilyi itself may provide a seasonal refuge to wildlife.

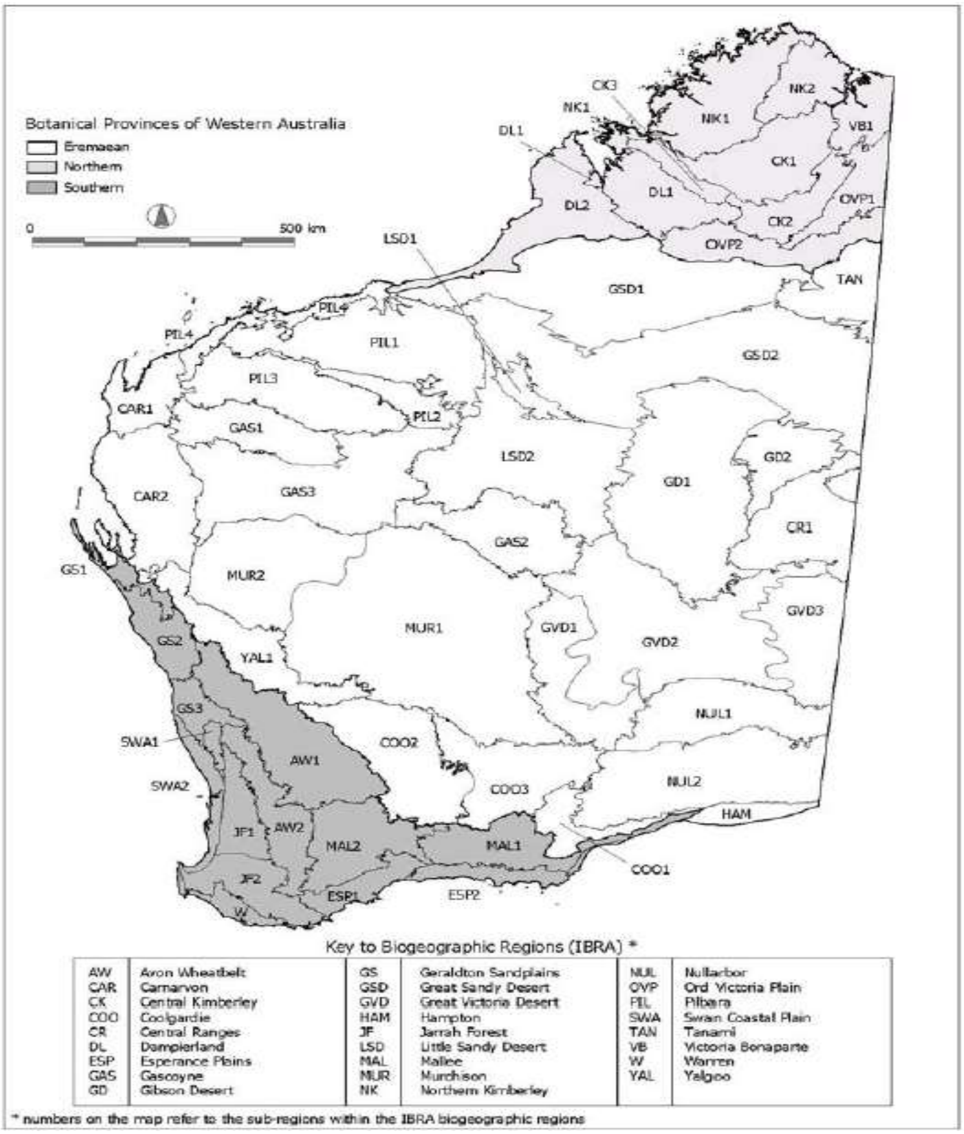


Figure 3-1 IBRA Subregions in Western Australia

3.2 Vegetation

Comprehensive flora and vegetation studies have been undertaken in the Kintyre area and over the proposed access road corridor between 1986 and 1992, 2007, 2010, 2011 and 2012. These surveys have resulted in vegetation maps being compiled for the Kintyre area (Figure 3-2 and 3-3).

A total of 34 vegetation units were recorded during the 2007 and 2010 surveys. These units are grouped according to the following landforms: hillsides; base of hills; sand dunes; flat red sandy soils; lower slopes above creek; creek lines; and claypans. Bennett Environmental Consulting (2010) noted that the vegetation within the site varied with the rocks and associated soils.

The hillslopes in the northern section of the lease had scattered shrubs of *Acacia robeorum, Grevillea wickhamii* and *Senna glutinosa* as the dominant shrubs. *Acacia retivenea* was observed only in the southern area of the lease where the rocks were more schistose than in the northern area. *Eucalyptus leucophloia* was only recorded on a few hillslopes and was not a common taxon.

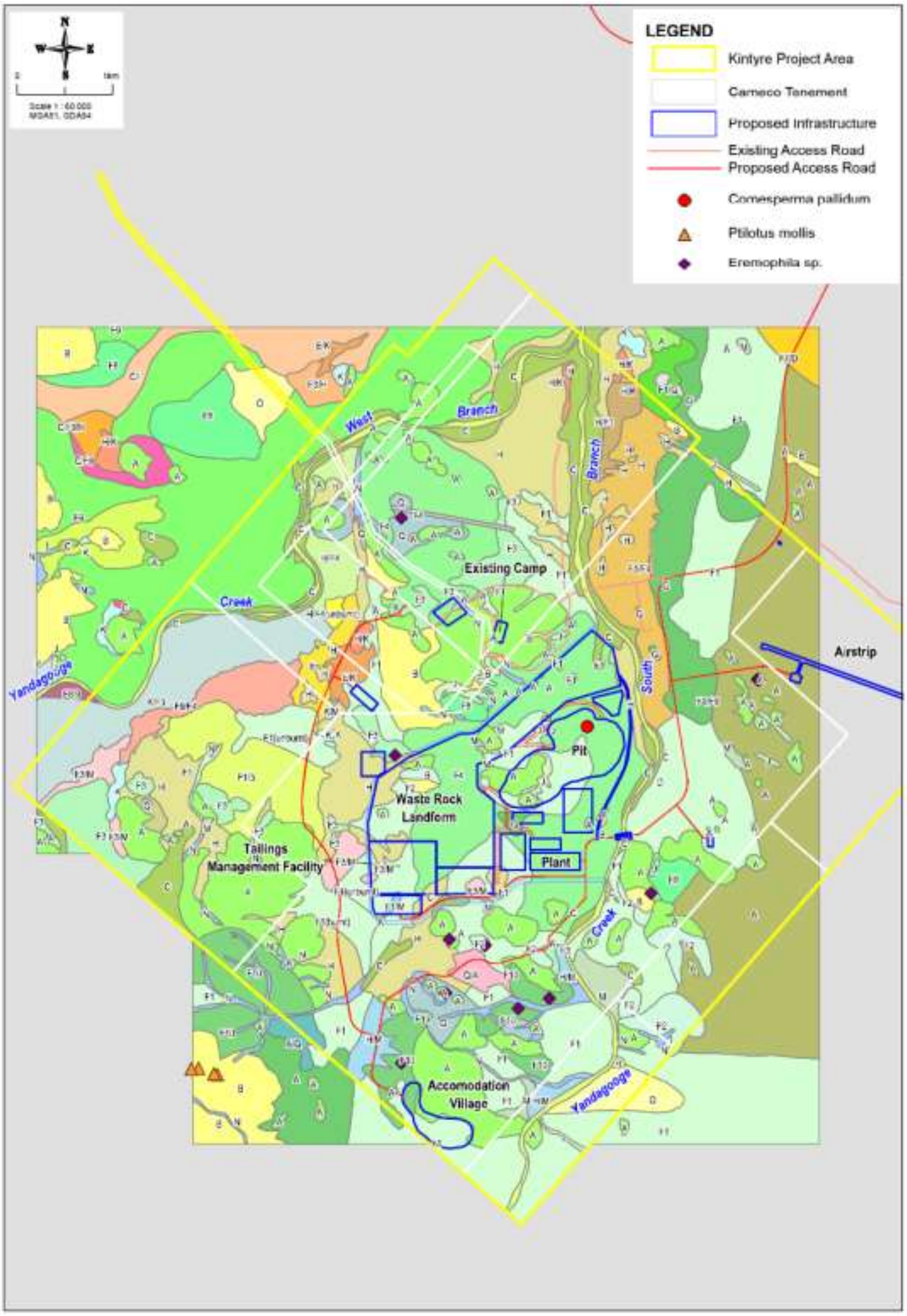
The sandy soils typically supported *Triodia basedowii* and *Triodia schinzii* associated with *Acacia ligulata* and *Stylobasium spathulatum*. The latter taxon was more common on the raised dunes rather than on the flatter sandy soils. *Dicrastylis georgei* and *Lachnostachys roseoazurea* were typically associated with the sandy soils across the lease.

The drainage lines varied with the taxa located on the hill slopes or flat areas. As an example *Acacia retivenia* was common in the drainage lines in the south of the lease but less common in the north of the lease. *Grevillea wickhamii* occurred across all vegetation units and did not appear to be restricted to a specific soil (Bennett Environmental Consulting, 2010).

A comparison was made between the vegetation units recorded in 2010 and those described in Hart Simpson & Associates (1994, 1997). Bennett Environmental Consulting (2007, 2010) noted that fire had changed the make up of the units between the surveys although when the sampling sites (quadrats and opportunistic sites) were overlain on the original vegetation map there was a reasonable correlation between them.

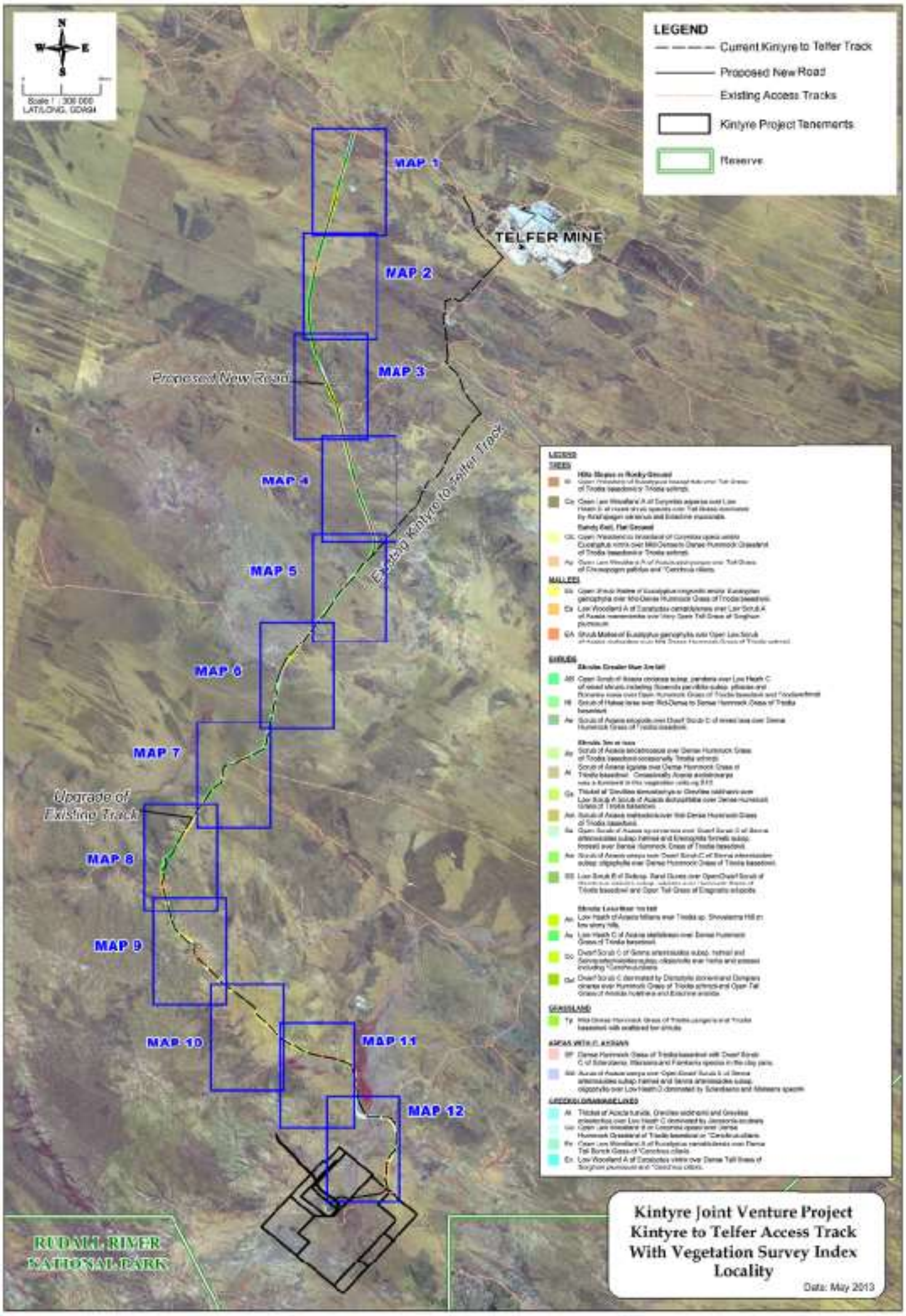
The vegetation condition of the Project area varied from degraded to excellent with most of the area recording a good or higher vegetation condition. Buffel Grass (**Cenchrus ciliaris*) was the dominant weed at the site with a few locations of Kapok Bush (**Aerva javanica*) recorded.

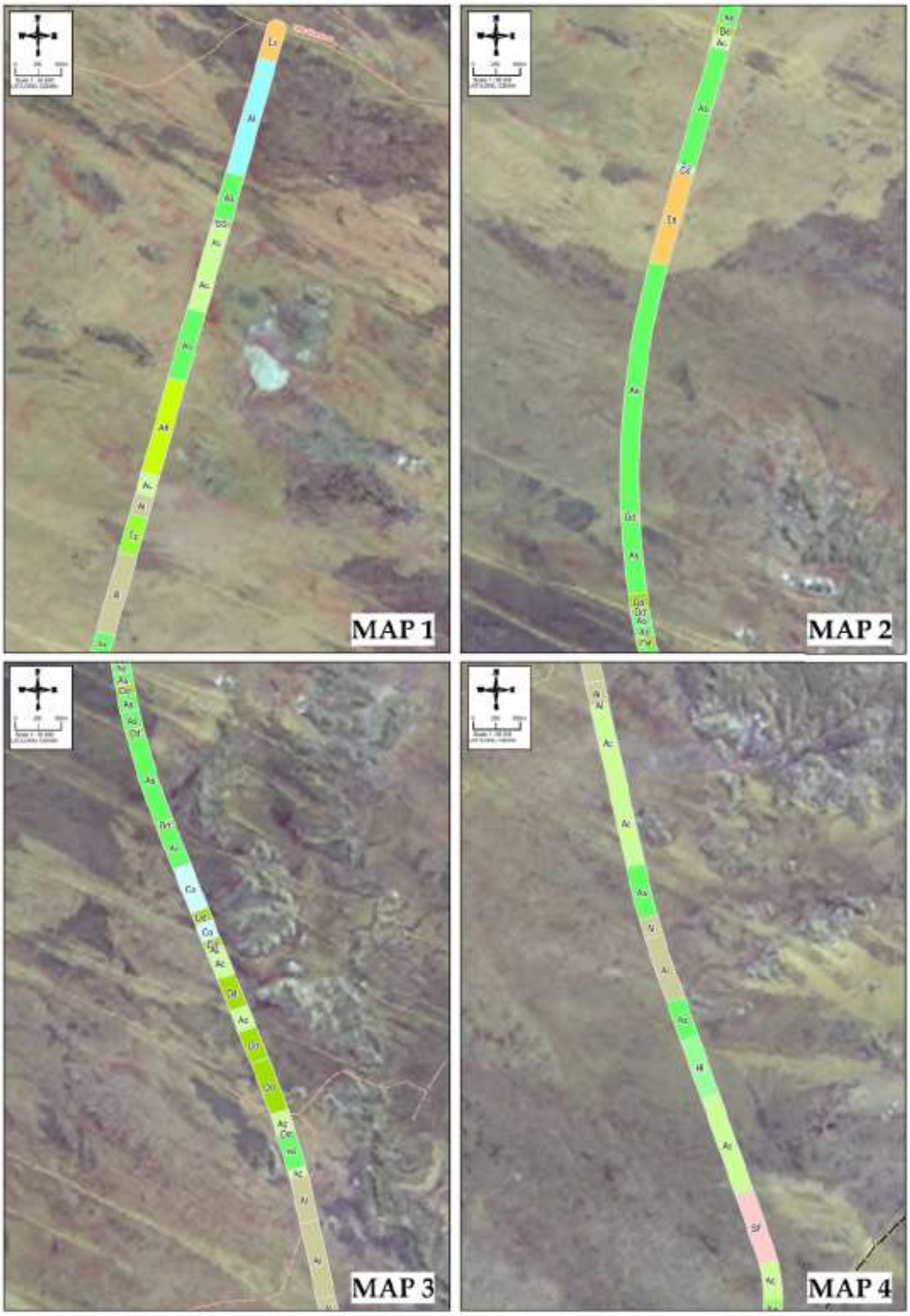
Figure 3-2 Vegetation Map of the Project area

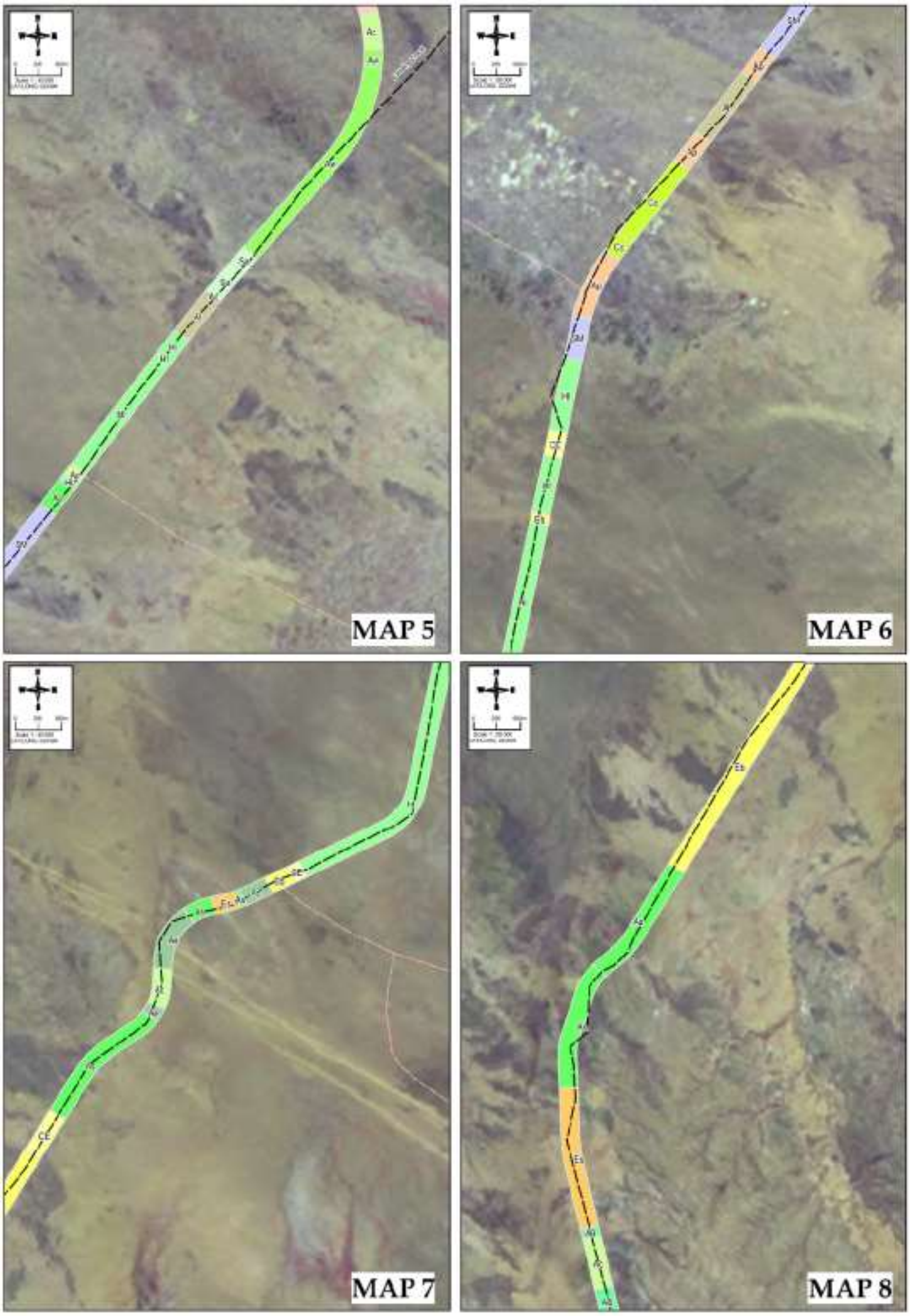


VEG TYPE	DESCRIPTION 1	DESCRIPTION 2
C	Woodlands	Woodland of *Corymbia opaca*
D	Woodlands	Woodland of *Eucalyptus camaldulensis* in river channels
I	Shrublands	*Acacia dictyophleba* over the hard spinifex *Triodia basedowii* and the soft spinifex *Triodia pungens*
R	Shrublands	Mulga shrubland
A	Hummock Grass Steppe	Hard spinifex *Triodia wiseana*
F1	Shrub Steppes	*Acacia ancistrocarpa* and *A. ligulata* over the hard spinifex *Triodia basedowii*
F2	Shrub Steppes	*Acacia retivenia* over the hard spinifex *Triodia wiseana*
F3	Shrub Steppes	*Acacia inaequilatera* over the hard spinifex *Triodia basedowii* and the soft spinifex *Triodia pungens*
F4	Shrub Steppes	Mixed low shrubs over the hard spinifex *Triodia basedowii*
F8	Shrub Steppes	Grevillea and Acacia shrubs over mixed spinifex on sand
F9	Shrub Steppes	*Acacia dictyophleba* over the hard spinifex *Triodia basedowii*
F10	Shrub Steppes	*Acacia wanyu* over the hard spinifex *Triodia wiseana*
G	Shrub Steppes	Sparse shrubs over the hard spinifex *Triodia basedowii*
O	Mallee Steppe	Mallees of *Eucalyptus odontocarpa* over the hard spinifex *Triodia basedowii*
B	Tree Steppe	Trees of *Eucalyptus leucophloia* over the hard spinifex *Triodia wiseana*
L	Grasslands	*Xerochloa laniflora* grassland
E	Scrubs	Chenopod dwarf scrub
H	Shrub Savanna	Senna over grass
J	Complexes	Sand dunes
K	Complexes	Claypans with little or no vegetation
M	Complexes	Sparse shrubs on clay soils
N	Complexes	Drainage lines of Acacia and other shrubs over the soft spinifex *Triodia pungens*
P	Complexes	Bare stony slopes
Q	Complexes	White quartzite scree slopes
	Airfield	Tracy Airfield

Figure 3-3 Vegetation Maps of the Access Road




MAP 1
MAP 2
MAP 3
MAP 4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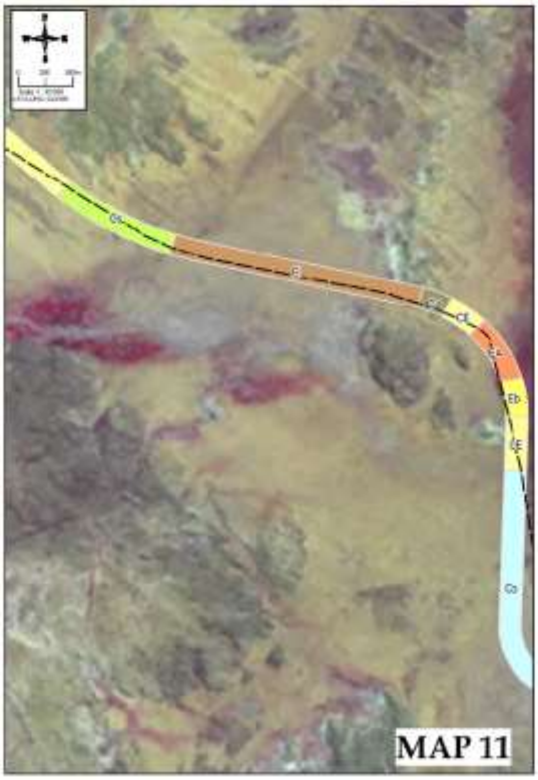
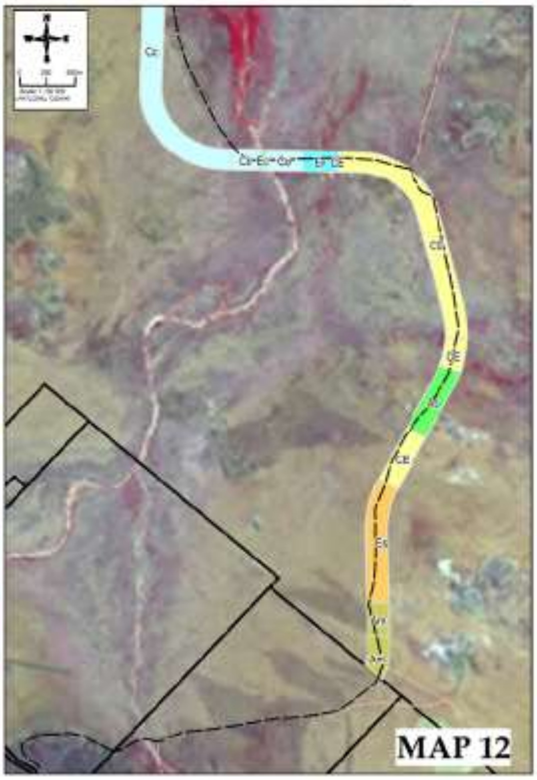
MAP 9


MAP 10


MAP 11


MAP 12

LEGEND

TREES

Hills Slopes or Rocky Ground

El	Open Woodland of Eucalyptus leucophloia over Tall Grass of Triodia basedowii or Triodia schinzii.
Ca	Open Low Woodland A of Corymbia aspersa over Low Heath C of mixed shrub species over Tall Grass dominated by Amphipogon caricinus and Eriachne mucronata.

Sandy Soil, Flat Ground

CE	Open Woodland to Woodland of Corymbia opaca and/or Eucalyptus victrix over Mid-Dense to Dense Hummock Grassland of Triodia basedowii or Triodia schinzii.
Ap	Open Low Woodland A of Acacia pachycarpa over Tall Grass of Chrysopogon pallidus and *Cenchrus ciliaris.

MALLEES

Eb	Open Shrub Mallee of Eucalyptus kingsmillii and/or Eucalyptus gamophylla over Mid-Dense Hummock Grass of Triodia basedowii.
Es	Low Woodland A of Eucalyptus camaldulensis over Low Scrub A of Acacia marramamba over Very Open Tall Grass of Sorghum plumosum.
EA	Shrub Mallee of Eucalyptus gamophylla over Open Low Scrub of Acacia melleodora over Mid-Dense Hummock Grass of Triodia schinzii.

SHRUBS

Shrubs Greater than 3m tall

AB	Open Scrub of Acacia coriacea subsp. pendens over Low Heath C of mixed shrubs including Scaevola parvifolia subsp. pilbarae and Bonamia rosea over Open Hummock Grass of Triodia basedowii and Triodia schinzii.
Hl	Scrub of Hakea lorea over Mid-Dense to Dense Hummock Grass of Triodia basedowii.
Ae	Scrub of Acacia eriopoda over Dwarf Scrub C of mixed taxa over Dense Hummock Grass of Triodia basedowii.

Shrubs 3m or less

Ac	Scrub of Acacia ancistrocarpa over Dense Hummock Grass of Triodia basedowii occasionally Triodia schinzii.
Al	Scrub of Acacia ligulata over Dense Hummock Grass of Triodia basedowii. Occasionally Acacia ancistrocarpa was a dominant in this vegetation units eg S10.
Gs	Thicket of Grevillea stenostachya or Grevillea wickhamii over Low Scrub A Scrub of Acacia dictyophleba over Dense Hummock Grass of Triodia basedowii. .
Am	Scrub of Acacia melleodora over Mid-Dense Hummock Grass of Triodia basedowii.
Sa	Open Scrub of Acacia synchronicia over Dwarf Scrub C of Senna artemisioides subsp. helmsii and Eremophila forrestii subsp. forrestii over Dense Hummock Grass of Triodia basedowii.
Aw	Scrub of Acacia wanyu over Dwarf Scrub C of Senna artemisioides subsp. oligophylla over Dense Hummock Grass of Triodia basedowii.
SS	Low Scrub B of Sida sp. Sand Dunes over Open Dwarf Scrub of Corchorus sidoides subsp. sidoides over Hummock Grass of Triodia basedowii and Open Tall Grass of Eragrostis eriopoda.

Shrubs Less than 1m tall

Ah	Low Heath of Acacia hilliana over Triodia sp. Shovelanna Hill on low stony hills.
As	Low Heath C of Acacia stellaticeps over Dense Hummock Grass of Triodia basedowii.
Cc	Dwarf Scrub C of Senna artemisioides subsp. helmsii and Senna artemisioides subsp. oligophylla over herbs and grasses including *Cenchrus ciliaris.
Dd	Dwarf Scrub C dominated by Dicrastylis dorrienii and Dampiera cinerea over Hummock Grass of Triodia schinzii and Open Tall Grass of Aristida holathera and Eriachne aristida.

GRASSLAND

Tp	Mid-Dense Hummock Grass of Triodia pungens and Triodia basedowii with scattered low shrubs.

AREAS WITH CLAYPANS

SF	Dense Hummock Grass of Triodia basedowii with Dwarf Scrub C of Sclerolaena, Maireana and Frankenia species in the clay pans.
SM	Scrub of Acacia wanyu over Open Dwarf Scrub C of Senna artemisioides subsp. helmsii and Senna artemisioides subsp. oligophylla over Low Heath D dominated by Sclerolaena and Maireana species.

CREEKS / DRAINAGE LINES

At	Thicket of Acacia tumida, Grevillea wickhamii and Grevillea eriostachya over Low Heath C dominated by Jacksonia aculeata.
Co	Open Low Woodland B or Corymbia opaca over Dense Hummock Grassland of Triodia basedowii or *Cenchrus ciliaris.
Ec	Open Low Woodland A of Eucalyptus camaldulensis over Dense Tall Bunch Grass of *Cenchrus ciliaris.
Ev	Low Woodland A of Eucalyptus victrix over Dense Tall Grass of Sorghum plumosum and *Cenchrus ciliaris.

4 CONSERVATION SIGNIFICANT SPECIES

4.1 Rare and Priority Flora Species

Significant flora that have been recorded in the Project area and along the access road are outlined in Table 4-1 and shown on Figure 3-2 and Figure 3-3.

Table 4-1: Significant Flora Recorded in the Project Area and Along the Access Road

Conservation Category	Species	Location
P2	*Acacia auripila*	Recorded historically in the Kintyre region by Hart Simpson & Associates (1994b, 1997). Not recorded in recent surveys.
P2	*Eremophila* sp. Rudall River (formerly small-leaved form of *Eremophila tietkensii*)	Recorded from scree slopes at several locations within the Kintyre leases in 2012
P2	*Goodenia hartiana*	Recorded historically in the Kintyre region by Hart Simpson & Associates. Not recorded in recent surveys.
P2	*Thysanotus* sp. Desert East of Newman (RP Hart 964)	Recorded from four sites along the access road in 2011 and historically in the Kintyre region by Hart Simpson & Associates
P3	*Comesperma pallidum*	Recorded from the Project area within the proposed pit (1 plant) in 2007 and not recorded since, possibly due to fire
P3	*Indigofera ammobia*	Recorded from one site along the access road.
P4	*Ptilotus mollis*	Recorded at 10 locations across the Project area in 2012 and historically by Hart Simpson & Associates.

4.2 Groundwater Dependent Vegetation

The Project is bounded by two creek lines along which the species *Eucalyptus camaldulensis* (River Red Gum), with *Corymbia opaca* (Desert Bloodwood) growing just above the creek line. *E. camaldulensis* is known to use both groundwater and water held in the unsaturated vadose zone (above the watertable) depending on soil water availability (DoW, 2010). *C. opaca* may also be groundwater dependent (O'Grady *et al*., 2010), although there is no literature to indicate this is the case in Western Australia.

The vegetation units within the vicinity of the Project area which are possibly phreatophytic are listed below (Figure 4-1):

- C: Minor drainage line with Woodland of *Corymbia opaca*; and
- D: River channels with Woodland of *Eucalyptus camaldulensis*.

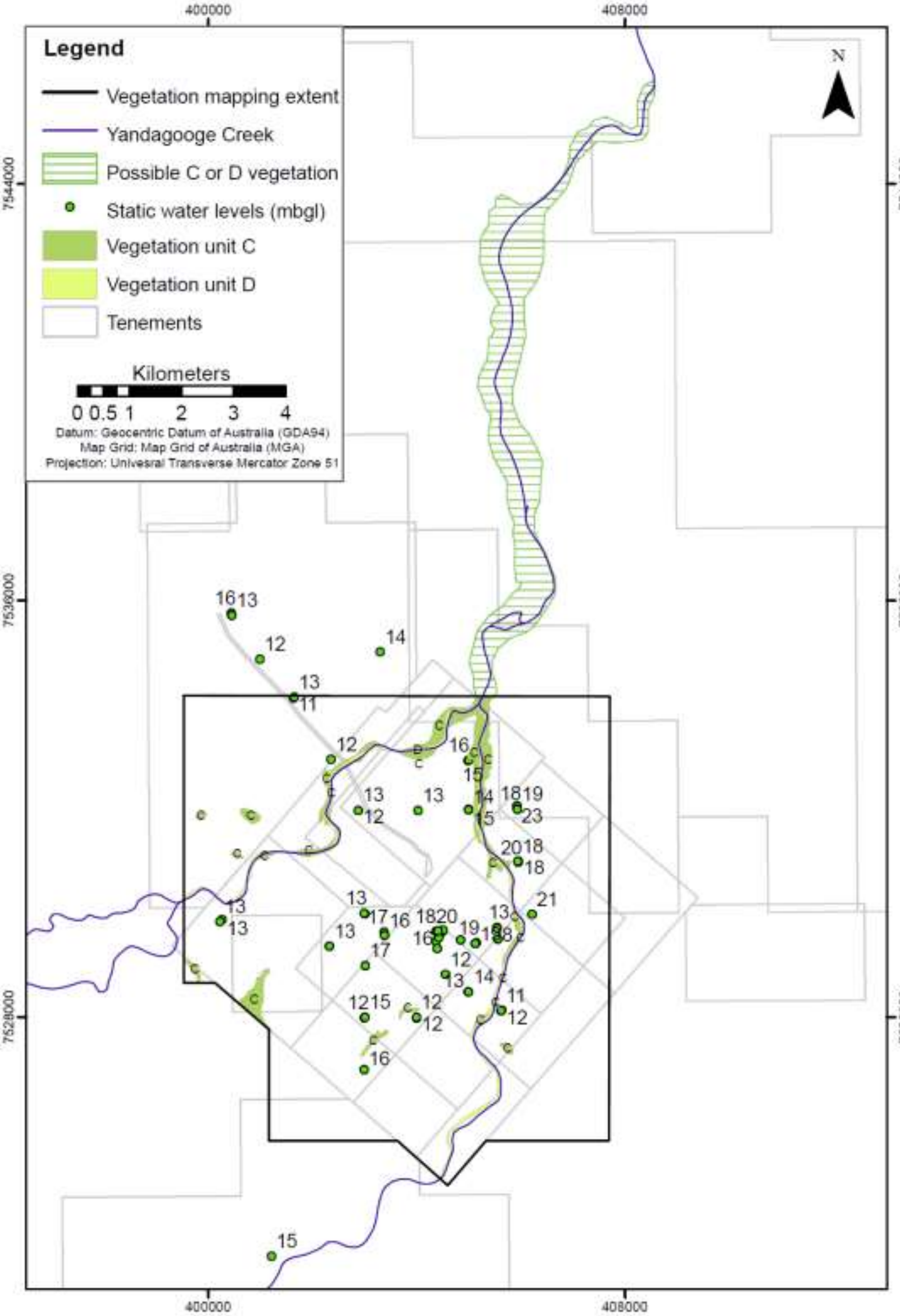


Figure 4-1 Potential Groundwater Dependent Vegetation within Project area

4.3 Communities of Conservation Significance

None of the vegetation units recorded within the survey area are listed by Department of Parks and Wildlife (DPaW) as Threatened or Priority Ecological Communities. Three communities of conservation significance by Kendrick (2001) for the Rudall River area were recorded from the area. These are:

- Shrubland, mulga scrub (Beard [1975] Vegetation Code 39). A small area of this unit was recorded in the south eastern portion of the lease on a sandy slope above a creek in Hart Simpson and Associates vegetation unit R.
- *Triodia wiseana* Grass Steppe on stony hills (Beard [1975] Vegetation Code 157). This unit was recorded at one quadrat within Hart Simpson and Associates vegetation unit A and possibly another quadrat in vegetation unit F3, but the latter site included low shrubs.
- Mixed Shrub Steppe between sandhills with *Triodia schinzii* (Beard [1975] Vegetation Code 136). Although there are several areas where *Triodia schinzii* was the dominant grass there was only one quadrat in community J where it occurred between sand hills.

5 ROLES & RESPONSIBILITES

Table 5-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Flora and Vegetation Management Plan.

Table 5-1: Roles and Responsibilities

Position	Responsibility
Environmental Manager	• Implementation and maintenance of the plan. • Undertakes assessment and review of the effectiveness of this management plan.
Environment Superintendent	• Formulate and implement flora and vegetation surveys, monitoring programs and liaise with stakeholders regarding feral animal control. • Ensure all staff are aware of their obligations in relation to this plan. • Deliver flora and vegetation education and induction awareness training to field personnel. • Maintain site records of surveys and implement monitoring programs.
Operation Managers and Site Supervisors	• Ensure the plan is being adhered to by all staff and contractors. • Participate in compliance audits and inspections.
All Cameco personnel, contractors and visitors	• Minimise impacts on native flora and vegetation from construction and mining activities. • Report all incidents involving significant species.

6 ENVIRONMENTAL MANAGEMENT

6.1 Purpose

The purpose of this Plan is to identify, assess and minimise potential environmental impacts of Cameco's mining operations on flora and vegetation populations within its areas of operation.

The overall environmental outcome is to maintain the abundance, diversity, geographic distribution and productivity of native flora and vegetation in the area, and to rehabilitate areas impacted by the Project using local species to produce a stable, self-sustaining ecosystem and landform.

The key objectives of this management plan are:

- Identify the potential direct and indirect impacts on threatened, priority-listed and conservation significant species and vegetation units, within the Project area;
- Identify strategies to minimise the potential impacts on threatened, priority-listed and conservation significant species and vegetation units; and
- Identify and implement management strategies and monitoring to manage and measure impacts on flora and vegetation within the Project area.

6.2 Potential Impacts

6.2.1 Clearing and Ground Disturbance

Cameco plans to clear and construct the Kintyre Project area and upgrade associated access roads. While some of the Project area has been disturbed by past and present exploration activities, the majority of the site is uncleared and clearing of native vegetation will be required. This may affect flora and vegetation in the following ways:

- loss of individuals plant species and habitat through vegetation clearing;
- reduction in extent of vegetation units;
- fragmentation of vegetation units;
- potential clearing of areas outside the designated clearing envelope; and
- potential development of unauthorised tracks through vegetation.

6.2.2 Infrastructure Upgrade

Improved access to the area may encourage more people to visit Karlamilyi National Park, placing pressure on natural resources and increasing the risk of fire. Tracks within the National Park are not regularly maintained and would not support a significant increase in vehicles without damage to soil structure and vegetation. Any weeds which may be growing near the access road may also be transported into the National Park from seeds picked up by vehicles using the access road.

6.2.3 Abstraction of Groundwater

The abstraction of groundwater for pit dewatering and borefield operation could impact on groundwater dependent (phreatophytic) ecosystems, through a reduction in water available to phreatophytic vegetation if there is a connection between the aquifer being targeted by pumping operations and the near-surface water table. Modelling of groundwater drawdown indicates that after three years of dewatering the groundwater level will be lowered by 3 m, and after nine years of dewatering it is predicted to fall by a further 12 m - 17 m.

Given that the natural depth to groundwater recorded in the area that these species occur is greater than that recorded in groundwater-dependent communities of *E. camaldulensis* in other areas of the Pilbara, Cameco considers that it is unlikely that *E. camaldulensis* are groundwater dependant in the Kintyre area. They are more likely to rely on seasonal flooding and moisture held in the unsaturated vadose zone along the creekline. Therefore, the health of the trees is more likely to be influenced by drought than drawdown.

However, if there are some *E. camaldulensis* trees that are accessing groundwater via deep tap roots, then there may be localised impacts within Community D near the pit and North Bore where drawdown exceeds the rate of 1 m per year (i.e. 10 m drawdown contour at end of mine life of ~10 yrs).

6.2.4 Introduced Flora

The invasion of weeds into areas where none are presently recorded is a potential impact from development of the Project. Seeds may be carried into the Project area on vehicles and machinery brought into the area, or in soil moved within the Project area. Weeds have the potential to impact on native vegetation in the following ways:

- degradation of vegetation condition by out-competing native species;
- reduction in landform stability; and
- reducing viable habitat for native fauna species.

Buffel grass, (*Cenchrus ciliaris)* is found across much of the Project area. Kapok bush (*Aerva javanica)*, has been recorded in fewer locations within the Project area.

6.2.5 Fire Management

Accidental fires arising from mining activities could have a detrimental effect on surrounding flora and vegetation. Detrimental impacts include loss of individuals and habitat, and alteration of the composition of vegetation communities.

In addition to accidental fires, the traditional practice of burning carried out by local indigenous groups may also result in negative impacts on flora and vegetation if the burning is frequent and carried out without a full knowledge of traditional methods.

6.2.6 Dust

Dust from non-sealed roads through the Project area and disturbed areas could impact flora and vegetation through:

- smothering;
- erosion; and
- water used for dust suppression may be saline and may therefore be detrimental to vegetation health.

6.3 Environmental Objective and Performance Indicators

Table 6-1: Environmental Objective and Performance Indicators

Environmental Objective	Performance Indicators
Maintain the native vegetation outside of areas of proposed disturbance.	• No clearing outside the designated areas of disturbance. • No clearing within the areas proposed for disturbance without an internal permit. • No disturbance of Declared Rare Flora without Ministerial approval.
Avoid or minimise impact on ground water dependent ecosystems	• No decline in the condition and foliage cover of trees along water courses or flood plain areas. • No tree deaths.
Avoid or minimise the introduction and spread of weed species	• No increase in the occurrence of weeds within the Project area.
Awareness of environmental outcomes by all site personnel.	• Documented induction materials and management procedures.

6.4 Environmental Aspects and Management Strategies

Table 6-2: Environmental Aspects and Management Strategies

Environmental Aspect	Management Strategy
Clearing and Ground Disturbance	• Disturbance to native vegetation and land clearing will be minimised and undertaken in accordance with Cameco's Ground Disturbance Procedure. • A site vegetation clearing permit must be completed and authorised by site Environmental Advisor prior to any ground disturbance. • Clearing must not be conducted during or immediately after rain to reduce the risk of erosion and damage to soil structure. • If populations of significant species are identified within the Project boundary (e.g. lay down areas or storage areas), alternative areas must be considered and evaluated where practicable. • If populations of Priority species are identified within the Project boundary and disturbance to those areas cannot be avoided, the Department of Environmental Regulation (DER) must be consulted prior to ground disturbance. • No unauthorised driving off tracks. Access to areas of native vegetation near the accommodation village and other Project areas will be restricted to minimise the risk of unauthorised disturbance. • Areas no longer required during operations will be progressively rehabilitated and monitored in accordance with the Mine Closure and Rehabilitation Plan. • Where practicable seed will be collected from plants prior to removal to ensure that the same genotype and correct taxa are rehabilitated into the area. Seed collected will be stored in air tight (but not plastic) containers to ensure their viability.

Environmental Aspect	Management Strategy
Groundwater Abstraction	• Undertake seasonal vegetation condition monitoring on trees along creeks and floodplains within the drawdown zone and at control sites using established quadrats. If signs of stress are observed, more frequent monitoring will be initiated. • Implement contingency measures outlined in the Groundwater Management Plan should a decline in vegetation health be observed within the predicted drawdown zone and correlated with changes in groundwater levels.
Introduced Flora	• All earth moving equipment and other vehicles or machinery will be cleaned of all soil and seeds before mobilisation into new clearing areas. • Where possible, vehicles will be site dedicated. • Areas within the Project area that are being stripped of topsoil will be checked for weeds prior to movement. • The occurrence of weeds will be mapped annually and weed control will be undertaken for infestations.
Fire Management	• Implement the Fire Prevention and Management Plan including maintenance of fire breaks. • Hot work permits will be obtained prior to commencing any activity that may create/cause an ignition source. • Fire extinguishers will be readily available in all hot work areas. • Personnel will be trained in the use of fire extinguishers. • Response to fire will be addressed in the site Emergency Response Plan. • Liaise with DPaW and traditional owners to assist in the implementation of a landscape scale fire management programme, to create a mosaic of fire ages. • Liaise with DPaW to prepare fire risk mapping of areas adjacent to the Project area and to plan and implement fire breaks for mine asset protection.
Dust	• Control dust on roads and disturbed areas in accordance with the Dust Management Plan. • Ensure any brackish or saline water used for dust suppression is retained within disturbed areas. Water truck operators will be made aware of potential overspray onto vegetated areas, particularly during windy conditions. • Monitor vegetation condition every six months, along unsealed roads and adjacent to disturbed areas.

Environmental Aspect	Management Strategy
Offsite Impacts	• Selected vegetation monitoring quadrats established prior to construction will be monitored as baseline reference sites annually both inside the Project area and outside the Project area (as control sites) for species presence and vegetation condition including weed cover. • Liaise with DPaW and indigenous stakeholders regarding management of indirect impacts on Karlamilyi National Park from improved access as a result of the upgrade of the Kintyre access road.

7 DEMONSTRATING THE OUTCOME (MONITORING)

Bennett Environmental Consulting Pty Ltd established permanent 50m x 50m quadrats throughout the lease area, including along creeks and floodplains, in 2007 and 2010. The quadrats established in 2007 were late in the season following on from high rainfall. Those established in 2010 were after a very dry season and a severe fire six to 12 months previously. Several of these quadrats were re-monitored in 2011 after high rainfall earlier in the year. When the quadrats were established a photograph was taken from the NW corner of each quadrat, and the average height of vegetation and percentage cover was recorded.

The locations of these quadrats and data obtained from these quadrats is presented in Bennett Environmental Consulting (2007) and (2010) and provides the baseline information for monitoring of vegetation.

7.1 Monitoring Programmes

During operations the monitoring programme will include the following monitoring:

- Six monthly monitoring in November and May for vegetation condition within Communities C and D both within and outside of the potential groundwater drawdown area;
- Annual monitoring in June for weeds along established transects and dust impacts on vegetation along selected unsealed roads and adjacent to disturbed areas; and
- Annual monitoring in June of selected vegetation quadrats of vegetation condition and species diversity, both within and outside of the Project area.

7.1.1 Monitoring of Communities C and D

Condition monitoring of selected sites within Communities C and D both within and outside of the potential groundwater drawdown area will be undertaken twice a year following the dry season and before the wet season (November) and following the wet season (May). Selected sites will be marked with permanent markers. Monitoring will involve a photograph from the NW corner of the site and basic condition monitoring as described in Casson *et al*. (2009) or equivalent reference.

7.1.2 Weed monitoring

To ensure that weeds are not being spread from the Project area, it is proposed to establish transects in susceptible areas such as along roads, creeklines, fuel delivery points, washdown bays and tyre storage bays. Each transect will be 2 m wide and 50 m long. At 0 m and then every 10 m, a 2m x 2m quadrat will be set out and monitored for the presence of weed species and vegetation condition. These will be monitored biannually in March/April following seasonal rainfall and August/September in active areas to record the number of weed plants and area of bare ground. Monitoring will involve a photograph from 0 m along the transect and basic condition monitoring as described in Casson *et al*. (2009)

or equivalent reference. If data indicates weeds are spreading then Cameco will control these infestations.

The monitoring will also take into consideration dust deposition when assessing vegetation condition.

7.1.3 Vegetation condition and baseline monitoring

Annual monitoring will be undertaken at selected vegetation quadrats established prior to construction of the Project. Monitoring will be undertaken in June (which is when baseline surveys have previously been undertaken) and will include taking a photograph from the northwest corner of the quadrat and assessment of vegetation condition and plant diversity as described in Casson *et al*. (2009) or an equivalent reference. This will give a comparative picture of the original data collected and will continue to provide a reasonable assessment of the condition of the quadrats.

Species present and abundance vary considerably under natural conditions and monitoring should take these into account. Causative factors may be:

- amount of rainfall and when it occurs;
- time since fire;
- prolonged heat;
- development of shade, restricting plants unable to tolerate this condition; and
- natural senescence.

Cameco is proposing to monitor throughout operations and after mine closure in accordance with the Mine Closure and Rehabilitation Plan.

7.2 Interpretation and Reporting of Results

Reporting of results obtained from the monitoring of quadrats and transects should discuss:

- any changes in vegetation noted in the photographic record taking into consideration any natural conditions that have occurred since the previous monitoring event;
- any decline in condition of the trees along creeks and the flood plains showing major stress e.g. loss of foliage cover, increase in the number of dead branches;
- any changes in the vegetation adjacent to working area and village;
- any increase in weeds along tracks, possible reasons why that has occurred and proposed management;
- any impact that dust is having on the vegetation; and
- results of progressive rehabilitation monitoring.

Reporting of results obtained from monitoring:

- Photographic record will be undertaken annually at the same month each year e.g. June/July with the results presented to the Department of Environment Regulation (DER) and Department of Mines and Petroleum (DMP) at the end of the annual environmental reporting period.
- Any change in tree condition within Communities C and D (along and adjacent to drainage lines) identified by monthly monitoring as a result of groundwater abstraction will be reported to the DER and Department of Water (DoW). Results of condition monitoring are to be presented to the DER and DMP in the annual environmental report.
- The results of the annual vegetation monitoring shall be presented to DER and DMP in the annual environmental report. Any variations observed in vegetation around the working areas, accommodation village and along road verges shall be included.
- Following the commencement of rehabilitation, monitoring will be undertaken to provide data on the number of tree, shrub, grass and annual species as well as cover and the overall condition of the vegetation. A statistical analysis of the results will be undertaken and a comparison made of the improvement or decline of rehabilitated areas.

7.3 Contingencies

If a statistically significant change (decline) is considered the result of a natural event such as drought, natural senescence or fire, then no contingency response is required.

If a significant change is recorded that can be attributed to the Project then the following should occur:

- If there is a saline water/oil/chemical spill, operations in that area would cease until the leak is halted and spill cleaned up (including removal of contaminated soil). Affected areas would be revegetated once soil conditions are conducive to plant growth;
- If there is a marked decrease in condition of trees along creeks and floodplains near the mine or water supply borefields then water levels and/or water quality would be checked. If a decline in vegetation condition is correlated to groundwater drawdown, then contingency measures from the Groundwater Management Plan should be implemented.
- If weed cover is 25% or higher, or has spread into previously weed-free areas then weed control (spraying or manual removal) will be undertaken prior to seed set. Weed control in rehabilitated areas is critical, particularly for Buffel Grass as this is often one of the first colonisers after disturbance.
- If vegetation decline or death is as a result of dust impacts, then additional dust control measures will be implemented in affected areas in accordance with the Dust Management Plan.

7.4 Review and Revision

This plan will be reviewed following pre-clearance surveys, then every two years thereafter. In the event that conservation significant species are identified within the Project area prior to the completion of a two year period, the plan will be revised in consultation with botanists and DPaW.

Table 7-1: Environmental Management Summary Table

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Clearing and ground disturbance	To maintain the abundance, diversity and productivity of flora at the species and ecosystems levels.	Internal auditing to monitor compliance with clearing permit conditions. Record of number of incidents.	Reporting in AER	Rehabilitate any areas disturbed outside the authorised clearing area. Should pre disturbance surveys identify the presence of significant species Department of Parks and Wildlife (DPaW) will be consulted on alternative actions	Ground Disturbance Procedure
Abstraction of groundwater affecting groundwater-dependent vegetation	Maintain vegetation health within Communities C and D near the mine and water supply borefields	Bi-annual photographic and condition monitoring. Groundwater levels.	Any change in tree condition correlated with groundwater drawdown to be reported to DER and DoW. Reporting in AER	Implement contingency measures from Groundwater Management Plan	Groundwater Management Plan
Introduced Flora	No increase in weed cover within the Project area or adjacent areas.	Annual weed monitoring transects.	Reporting in AER	Implement weed control where weed cover is 25% or more, or has spread into previously weed-free areas.	

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Fire impacts on vegetation	No accidental fires as a result of the Project	Internal auditing to monitor compliance with Hot Work Permits.	Any accidental or wildfires in area reported in AER.	Liaise with DPaW and traditional owners to assist in the implementation of a landscape scale fire management programme, to create a mosaic of fire ages.	Fire Prevention and Management Plan
Dust affecting vegetation health	No decline in vegetation health as a result of dust	Annual monitoring of transects for dust impacts.	Reporting in AER	Implement additional dust controls in accordance with the Dust Management Plan	Dust Management Plan
Indirect off-site impacts	To maintain the abundance, diversity and productivity of flora at the species and ecosystems levels.	Annual vegetation monitoring of selected quadrats.	Reporting in AER	Liaise with DPaW and indigenous stakeholders regarding management of indirect impacts on Karlamilyi National Park from improved access.	

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Cameco

Cameco Australia Pty Ltd

Kintyre Uranium Project

Fauna Management Plan

October 2013

Date	Revision	Description	Author	Approved
15/8/12	D1	Draft	Bamford Consulting Ecologists	SW
16/10/12	2	Draft	ENVIRON	SW
14/6/13	3	Final	ENVIRON	SW
7/10/13	4	Final	ENVIRON	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project. The Kintyre Project is situated approximately 260 km northeast of Newman, 90 km south of the Telfer Mining Centre and lies 5 km north of the Karlamilyi National Park in the Little Sandy Desert bio-region.

2 RELEVANT LEGISLATION AND STANDARDS

Legislation and standards applicable to this management plan include:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Environmental Protection Act 1986* (EP Act)*;*
- *Wildlife Conservation Act 1950* (WC Act)*;*
- EPA Guidance Statement No. 56 (Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, 2004); and
- EPA and DPaW (formerly known as DEC) (Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment 2010).

3 EXISTING ENVIRONMENT

3.1 Region

The Kintyre Project lies within the Rudall Subregion (LSD1) of the Little Sandy Desert Bioregion (Figure 3-1). The regions are described by the Interim Biogeographical Regionalisation for Australia (IBRA) classification system (Environment Australia, 2000, McKenzie *et al*., 2003). The Little Sandy Desert Bioregion falls within the Bioregion Group 4 classification (bioregions of the Eremaean Botanical Province, native vegetation is largely contiguous but is generally not used for commercial grazing, [EPA, 2004]).

The general features of the Little Sandy Desert subregion are summarised by Kendrick (2001). Vegetation comprises:

1. Sparse shrub-steppe over *Triodia basedowii* on stony hills;
2. River Gum communities along drainages with bunch grasslands on alluvial deposits and associated with ranges;
3. Extensive areas of tussock grass associated with foot slopes; and
4. Extensive *Triodia* hummock grasslands on hills and surrounding plains.

The climate of the region is arid with summer rainfall. The sub-region is 1,078,070 ha and includes the headwaters and course of the Rudall River. Dominant land uses in the subregion are unallocated crown land and conservation areas, mining leases, and the Parnngurr Aboriginal Community (Cotton Creek).

Kendrick (2001) lists several rare features significant to the region. These include:

- The upper Rudall River, draining into Lake Dora – this is one of two arid zone rivers, with near permanent wetlands along its course, flowing from uplands across the desert and into a major salt lake within the Little Sandy Desert.
- Small permanent rockhole wetlands associated with ranges and uplands - these are locally significant water sources, with high biological and cultural significance.
- A high number of arid zone reptiles, particularly skinks (*Ctenotus* and *Lerista* species).
- Karlamilyi National Park – part of the national park is contained in LSD bioregion. Karlamilyi itself may provide a seasonal refuge to wildlife.

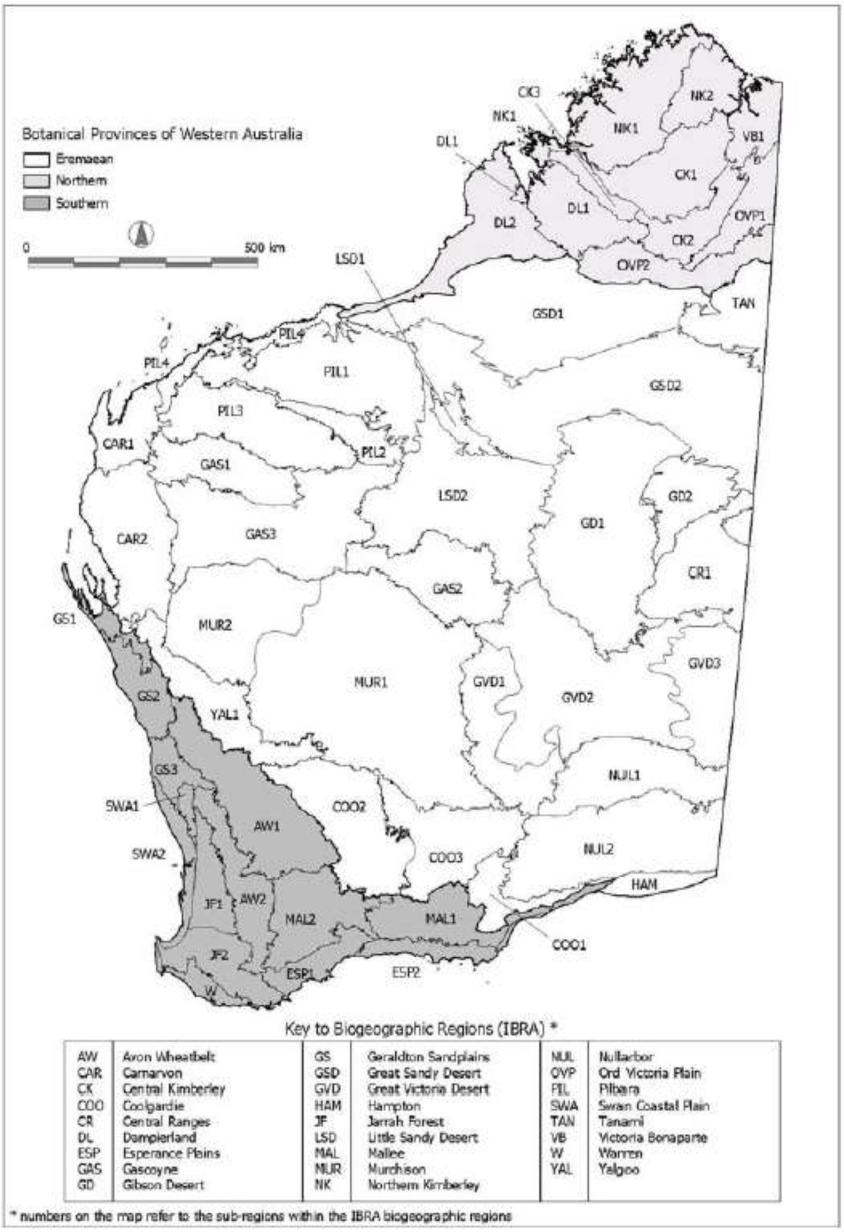

Figure 3-1 IBRA Subregions in Western Australia

3.2 Vegetation

Comprehensive flora and vegetation studies have been undertaken in the Kintyre area between 1986 and 2012. These surveys have resulted in a vegetation map being compiled for the Kintyre area.

A total of 34 vegetation units were recorded during the 2007 and 2010 surveys. These units are grouped according to the following landforms: hillsides; base of hills; sand dunes; flat red sandy soils; lower slopes above creek; creek lines; and claypans. Bennett Environmental Consulting (2010) noted that the vegetation within the site varied with the rocks and associated soils.

The hillslopes in the northern section of the lease had scattered shrubs of *Acacia robeorum*, *Grevillea wickhamii* and *Senna glutinosa* as the dominant shrubs. *Acacia retivenea* was observed only in the southern area of the lease where the rocks were more schistose than in the northern area. *Eucalyptus leucophloia* was only recorded on a few hillslopes and was not a common taxon.

The sandy soils typically supported *Triodia basedowii* and *Triodia schinzii* associated with *Acacia ligulata* and *Stylobasium spathulatum*. The latter taxon was more common on the raised dunes rather than on the flatter sandy soils. *Dicrastylis georgei* and *Lachnostachys roseoazurea* were typically associated with the sandy soils across the lease.

The drainage lines varied with the taxa located on the hill slopes or flat areas. As an example *Acacia retivenia* was common in the drainage lines in the south of the lease but less common in the north of the lease. *Grevillea wickhamii* occurred across all vegetation units and did not appear to be restricted to a specific soil (Bennett Environmental Consulting, 2010).

A comparison was made between the vegetation units recorded in 2010 and those described in Hart Simpson & Associates (1994a, 1997). Bennett Environmental Consulting (2007, 2010) noted that fire had changed the make up of the units between the surveys although when the sampling sites (quadrats and opportunistic sites) were overlain on the original vegetation map there was a reasonable correlation between them.

3.3 Fauna Assemblages

Based on database and literature reviews, and field investigations undertaken from 1986 to 1992 (Hart Simpson and Associates, 1994b) and recently by Bamford Consulting Ecologists, the vertebrate fauna assemblage is expected to be composed of 282 species, including: eight frog, 96 reptile, 132 bird, 39 native mammal and eight introduced mammal species. An additional eight mammal species were recorded in the Kintyre area from owl pellets, however these species are now considered extinct in the region.

There are 194 extant species that have been recorded at Kintyre by either Hart Simpson and Associates (1994b) or Bamford (2007), including 11 species of conservation significance. A total of 27 conservation significant species is expected to occur within the region.

4 CONSERVATION SIGNIFICANT SPECIES

Of the 27 conservation significant species that have been identified to potentially occur in the Kintyre Project area:

- 12 are of high significance (Conservation Significance [CS] Level 1), being listed under legislation;
- 10 are of moderate conservation significance (Conservation Significance Level 2), being listed as priority species by the Department of Parks and Wildlife (DpaW); and
- five are of local significance (Conservation Significance Level 3), because they have restricted distributions or are listed as declining species in the region.

Conservation significant species include:

1.	Northern Quoll	*Dasyurus hallucatus*	(CS1)
2.	Greater Bilby	*Macrotis lagotis*	(CS1)
3.	Orange Leaf-nosed Bat	*Rhinonicteris aurantius*	(CS1)
4.	Northern Marsupial Mole	*Notoryctes caurinus*	(CS1)
5.	Great Desert Skink	*Egernia kintorei*	(CS1)
6.	Crest-tailed Mulgara	*Dasycercus cristicauda*	(CS1)
7.	Peregrine Falcon	*Falco peregrinus*	(CS1)
8.	Night Parrot	*Pezoporus occidentalis*	(CS1)
9.	Rainbow Bee-eater	*Merops ornatus*	(CS1)
10.	Princess Parrot	*Polytelis alexandrae*	(CS1)
11.	Fork-tailed Swift	*Apus pacificus*	(CS1)
12.	Eastern Great Egret	*Ardea modesta*	(CS1)
13.	Ghost Bat	*Macroderma gigas*	(CS2)
14.	Spectacled Hare-Wallaby	*Lagorchestes conspicillatus leichardtii*	(CS2)
15.	Brush-tailed Mulgara	*Dasycercus blythi*	(CS2)
16.	Western Pebble-mound Mouse	*Pseudomys chapmani*	(CS2)
17.	Lakeland Downs Mouse	*Leggadina lakedownensis*	(CS2)
18.	Long-tailed Dunnart	*Sminthopsis longicaudata*	(CS2)
19.	Bush Stone-curlew	*Burhinus grallarius*	(CS2)
20.	Australian Bustard	*Ardeotis australis*	(CS2)
21.	Grey Falcon	*Falco hypoleucos*	(CS2)
22.	Woma	*Aspidites ramsayi*	(CS2)

23. Kultarr	*Antechinomys laniger*	(CS3)
24. Northern Brushtail Possum	*Trichosurus vulpecula*	(CS3)
25. Rock Wallaby	*Petrogale rothschildi*	(CS3)
26. Barking Owl	*Ninox connivens*	(CS3)
27. Rufous-crowned Emu-wren	*Stipiturus ruficeps*	(CS3)
28. Striated Grasswren	*Amytornis striatus whitei*	(CS3)

It should be noted that all conservation significant species that could potentially occur within the greater Project area are listed, whether or not they were recorded during field surveys. This is because fauna are highly mobile, often seasonal and frequently cryptic. Therefore, the precautionary approach is taken in that if a significant species is expected to be present and suitable habitat is available, the assumption is made that the species is present or may be present within the life of the Project.

Of the 27 conservation significant species, this management plan will address the potential impacts on the 12 CS1 species and 10 CS2 species. Note that the CS3 species are likely to benefit from management actions for the species of higher significance.

4.1 Significant Species Recorded in the Project Area

Significant fauna species most relevant to the Project are the Greater Bilby and Crest-tailed Mulgara. These have been recorded in spinifex sandplain with open Acacia shrubland (Bamford et al., 2012).

The Greater Bilby is listed as 'Vulnerable' under the EPBC Act and 'Schedule 1' under the WC Act. This species was formerly found in a wide range of habitat types across the continent. Current populations are now restricted to a variety of "tall shrublands, open woodlands, hummock grasslands and sparse forblands" (Maxwell *et al*., 1996).

The Greater Bilby has been recorded from old bone material found in an owl roost (Hart Simpson and Associates, 1994a) and from the Kintyre site in 1998 (C. Gupanis pers. comm.). Bamford Consulting Ecologists recorded a single Bilby via a motion-sensor video camera and observed scats, tracks and active burrows within the Project area during the 2010 and 2011 surveys (Figure 4-1). In 2010 this specimen was recorded 3.6 km north west of the Mine camp near the North Bore Road on the northern side of Yandagooge Creek West Branch (Browne-Cooper and Bamford, 2010). In 2011, further Bilby sightings were made in the same general location (possibly the same animal). Evidence of Bilby activity was also sighted along the proposed access road (Bamford Consulting Ecologists, 2011) (Figure 4-2).

In the Project area Greater Bilbies were recorded in spinifex sandplain with open Acacia shrubland and sparse low Eucalypt woodland on red sandy loam including drainage lines. This environment is widespread in the Kintyre area, however, it appears that Bilbies are sparse and patchily distributed. This species is potentially widespread in the greater

Kintyre and Rudall River region but is probably scarce due to impacts from extensive recent fires and predation by feral species (Bamford et al., 2012).

There are two recognised species of Mulgara in Western Australia; the Crest-tailed Mulgara (*Dasycercus cristicauda*) and the Brush-tailed Mulgara (*D. blythi*). For nearly 30 years only one species - *D. cristicauda* - has been recognised. A recent review reclassified Mulgara as two separate species (Woolley, 2005, 2006). Due to the historic taxonomic confusion, there is some uncertainty of the distribution of the two Mulgara species. The Brush-tailed Mulgara is listed as Priority 4 by the DPaW in WA, but is not recognised under EPBC legislation. It is known to occur in spinifex grasslands, and burrows in flats between sand dunes (Woolley, 2008).

The Crest-tailed Mulgara is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act and is found primarily in Sandhill Canegrass (*Zygochloa paradoxa*) dominated dunes, Nitre Bush (*Nitraria billardierei*) grasslands, and Sandhill Canegrass flats near salt lakes (Woolley, 2008). It is also possible that both species occur in close proximity to each other (Bamford *et al*., 2012). A recent study in the Northern Territory found the two species to be sympathetic, with the Crest-tailed Mulgara occurring along dune supporting spinifex, and the Brush-tailed Mulgara occurring on spinifex flats between dunes (Pavey *et al.*, 2011). The Crest-tailed Mulgara has been recorded 100 km east of Newman (Phoenix Environmental, 2011).

Within the Project area, Bamford Consulting Ecologists identified active and recently active Mulgara burrows along the proposed access road in red sandy plains with or without mixed Acacia shrubs and spinifex (Bamford Consulting Ecologists, 2011). One active burrow and several inactive burrows were also located approximately 15 km southeast of the Exploration Camp (Browne-Cooper and Bamford, 2010) (Figure 4-1). Mulgara were also recorded along the access road (Figure 4-2). The available data indicate that Mulgara is low in numbers and patchily distributed within suitable habitat across the Project area, although the species was not be observed. However, as the EPBC Act does not currently recognise *D. blythi* as a separate species, SEWPaC would consider any Mulgara within the Project area to be *D. cristicauda* (Bamford et al., 2012).

4.1.1 Short-range Endemic Fauna

Bamford Consulting Ecologists (2007) undertook an opportunistic search of the Project area for potential Short-range Endemic (SRE) invertebrates such as millipedes, land snails and scorpions, and no specimens were found.

Further investigations into short range endemic species were undertaken as part of the 2010 investigations. Four potential SRE specimens were collected during the survey; a Pseudoscorpion (*Oratemnus* sp.), Mygalomorph spider (*Aname armigera* group) and two scorpions (*Urodacus "yashenkoi"*). Of these, the Pseudoscorpion is likely restricted to creeklines and other moist habitats. The distribution of the Pseudoscorpion is unknown but the specimen found was located outside the proposed area of disturbance. The mygalomorph spider is widespread in the Pilbara, although may be a species complex, so the distribution of the species recorded at Kintyre is uncertain. The specimen that was recorded occurred outside of the proposed area of disturbance. It was concluded that the scorpions were not SREs.

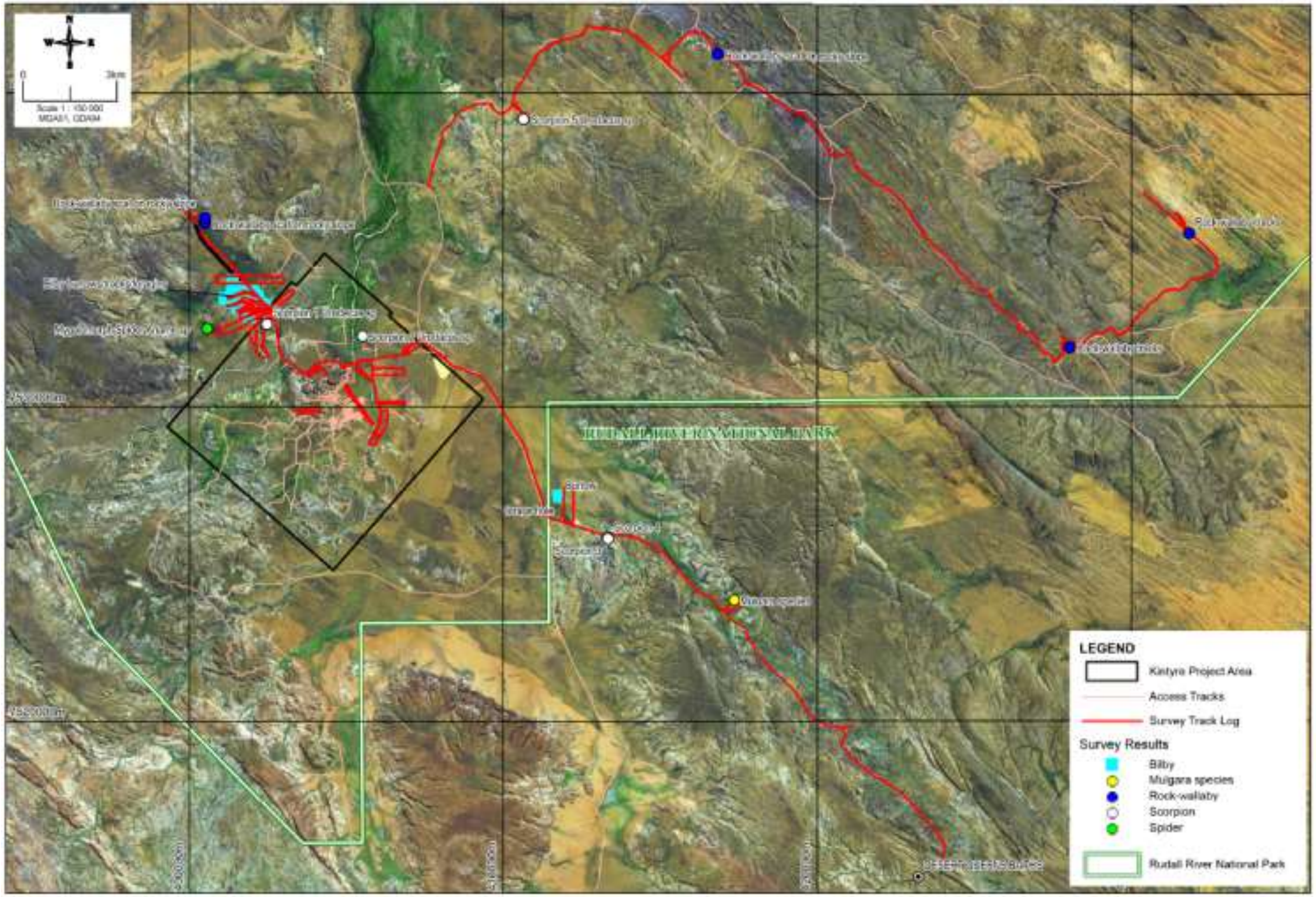

Figure 4-1 Significant Fauna Species Recorded Near the Project Area

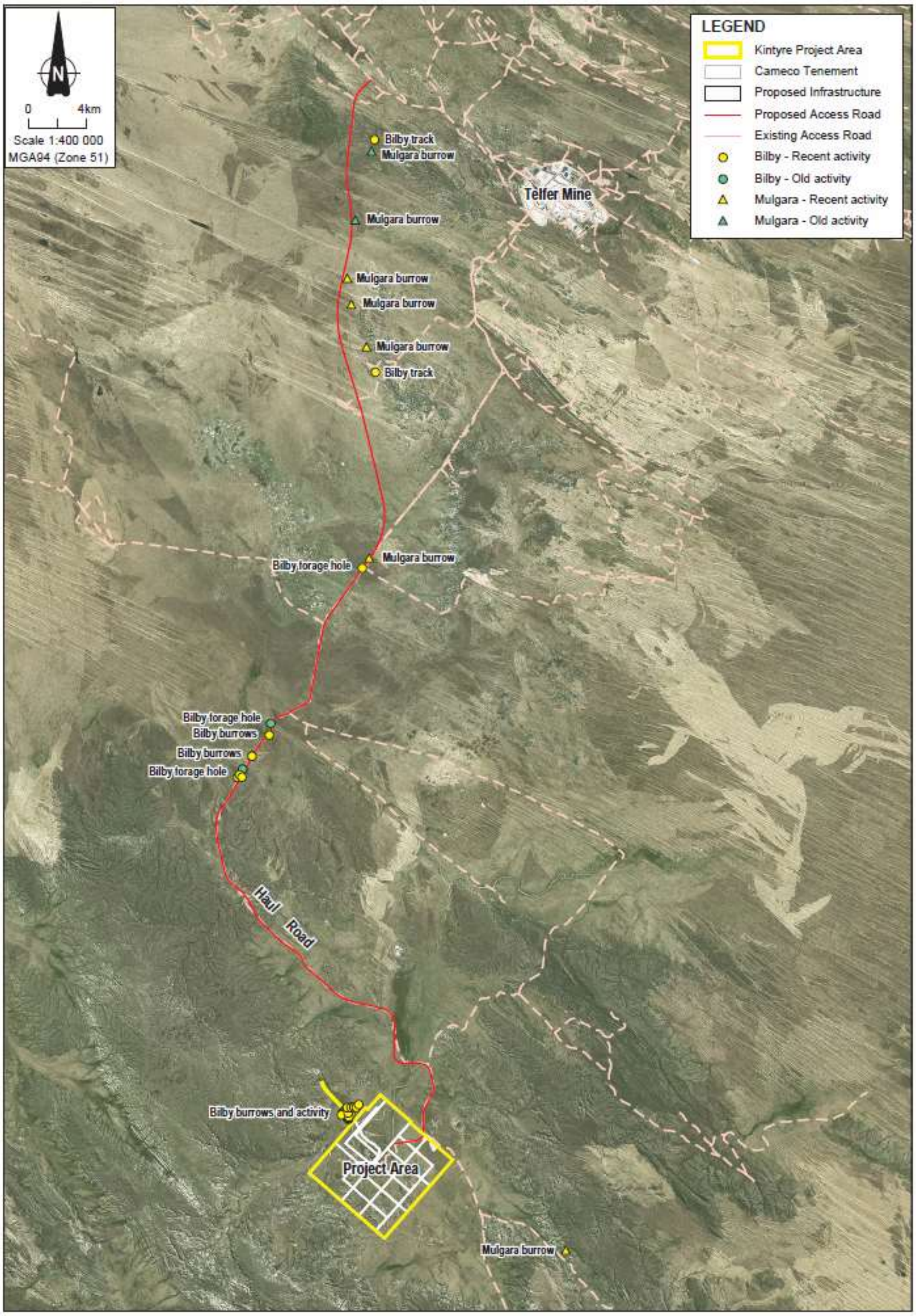

Figure 4-2 Significant Fauna Species Recorded Along the Access Road

4.2 Species Listed Under State and Federal Acts

4.2.1 Greater Bilby

(Vulnerable under the WC Act and the EPBC Act)

The species formerly utilised a wide range of habitat types across the continent, but has suffered substantial reduction in range (Burbidge, 2004). Extant populations are restricted to a variety of "tall shrublands, open woodland, hummock grasslands and sparse forblands" (Maxwell *et al*., 1996). Threats to the species include altered fire regimes and introduced grazers and predators. The species appears to remain widespread in the Great Sandy Desert and appears most common in acacia shrublands associated with palaeodrainage lines, where the soils are sandy loams (M. Bamford, *pers. obs*.).

The Bilby has been recorded adjacent to Project areas (Figure 4-1) and along the Kintyre to Telfer road (Figure 4-2).

4.2.2 Crest-tailed Mulgara and Brush-tailed Mulgara

The Crest-tailed Mulgara (Vulnerable under the WC and the EPBC Act)

Brush-tail Mulgara (Priority 4)

These species are found in mature (i.e. long un-burnt) spinifex grasslands on sandy and sandy-loam soils. Threats to the species may include habitat alteration through changing fire regimes and introduced grazers (e.g. rabbits and cattle) and increased predation by introduced predators (e.g. cats and foxes) (Maxwell *et al*., 1996).

It should be noted that the Brush-tailed Mulgara has only recently been distinguished from the Crest-tailed Mulgara and as such most records of Mulgara did not differentiate between the two species. While Mulgara have been recorded in the greater area of the Project (Figure 4-1) or along the access road (Figure 4-2), no individuals have been captured and as such confirmation of which species are present has not been obtained. Therefore on a precautionary basis the two species have been included together under scheduled and priority species. However, where the species in Western Australia has been confirmed, it has usually been the Priority 4 Brush-tailed Mulgara.

4.2.3 Northern Quoll

(Endangered under the WC Act and the EPBC Act)

A recent survey by Bamford Consulting Ecologists confirmed the presence of Northern Quoll at Desert Queen Baths, approximately 20km South East of the Project area. Before this discovery Northern Quolls were only recorded on the basis of material in an owl deposit. The bones, within the owl deposit, were deposited sometime between about 1975 and the late 1980s. It should be noted that there has been no evidence that the species is still living in the Project area.

The conservation status of this species has recently been upgraded because it declines dramatically when the introduced Cane Toad (*Bufo marinus*) invades an area. Given that Cane Toads are strongly restricted by air and soil aridity (Zug and Zug, 1979), they are unlikely to invade desert habitats in Australia. This does mean, however, that populations of the Northern Quoll that occur outside the potential range of the Cane Toad will become increasingly important as the Cane Toad spreads. If the Northern Quoll were to occur in the vicinity of the Project, impacts of the proposed Project are negligible as habitat will not be affected.

4.2.4 Orange Leaf-nosed Bat

(Vulnerable under the WC Act and the EPBC Act)

Orange Leaf-nosed Bats were recorded only on the basis of material in an owl deposit that was believed to be old (probably pre-1970). They have not been found during recent surveys that have included the use of ultra-sonic recording equipment). The Orange Leaf-nosed Bat has a requirement for deep caves or old mine shafts that provide warm, humid conditions (Armstrong 2001; Baudinette *et al*., 2000; Churchill *et al.*, 1988; Churchill, 1991; Jolly, 1988; Kulzer *et al.*, 1970). There may be caves in the nearby Coolbro Hills that provide such conditions. The only impact upon this species likely to occur is if personnel visit caves and disturb roosting bats.

The Orange Leaf-nosed bat is not expected to occur with the Project area. However, if sighted should be recorded and management plan amended to reflect presence.

4.2.5 Northern Marsupial Mole

(Rare under the WC Act and Endangered under the EPBC Act)

Spending most of its time underground in sand dunes, inter-dunal flats and sandy soils along river flats (Maxwell *et al.*, 1996), this blind species occasionally comes to the surface, particularly after rain (Maxwell *et al.,* 1996, Strahan 2004). Little is known about this species and its habits, making identification, management and mitigation of impacts extremely difficult.

This species has not been recorded and habitat is generally not suitable within the Project area, however, individuals have been recorded west of Telfer.

4.2.6 Great Desert Skink

(Vulnerable under the WC Act and the EPBC Act)

Although not recorded within the Project area, it occurs in sandy and gravelly habitats of the western desert regions (Cogger *et al*., 1993; Pearson *et al.*, 2001).

Threats to this species include altered fire regimes reducing available habitat and predation by cats and foxes. The Great Desert Skink is not expected to occur within the Project area.

However, if sighted should be recorded and management plan amended to reflect presence.

4.2.7 Peregrine Falcon

(Schedule 4 of WC Act)

Although the species was not recorded, the Project area may include suitable habitat, especially rocky hills for nesting (Johnstone and Storr, 1998). Impacts of the proposed Project negligible as this habitat will not be affected.

The Peregrine Falcon is not expected to occur with the Project area however, if sighted should be recorded and management plan amended to reflect presence.

4.2.8 Night Parrot

(Critically Endangered under the WC Act and Endangered under the EPBC Act)

Although not recorded during survey work, the Project area is within a region where occasional sightings are made. This is a very poorly understood species (Garnett and Crowley, 2000) and most sightings are either of birds coming to a waterhole to drink in the evening, or of birds foraging along tracks at night (Cameron, 1932; Garnett *et al*., 1993; Storr, 1960). Any sightings should be reported to DPaW.

The Night Parrot is not expected to be impacted by the Project, however, if sighted should be recorded and management plan amended to reflect presence.

4.2.9 Rainbow Bee-eater

(Migratory under the EPBC Act)

These were regularly recorded in the Project area. This species nests in burrows and often constructs nests in soft soil alongside tracks and roads (Boland, 2004; Forshaw & Cooper, 1987; Fry, 1984; Higgins, 1999; Lill, 1993). There is therefore some potential for disturbance of nesting sites, but this is a common and widespread species.

4.2.10 Princess Parrot

(Vulnerable under the EPBC Act)

Little is known about the habits of this species. Authors have speculated that changes to fire regimes may be impacting the quality of habitat thus affecting populations (Garnet and Crowley, 2000). In addition, it has been suggested that the introduction of herbivores such as sheep, cattle, camels and rabbits may be reducing the availability of habitat (Burbidge and McKenzie, 1989). Although not recorded within the Project area, this species may occur as an occasional visitor to the greater region.

If sighted, the Princess Parrot should be recorded and management plan amended to reflect presence.

4.2.11 Fork-tailed Swift

(Migratory under the EPBC Act)

Not recorded but may be an occasional visitor to the Project area. A largely aerial species (Higgins, 1999) it is unlikely to be affected by the Project activities.

4.2.12 Eastern Great Egret

(Migratory under the EPBC Act)

Although not recorded in the Project area, the species may be considered an occasional visitor as it is distributed across Australia, and often occurs in wetlands including coastal, marine and fresh water (Kushlan and Hancock, 2005; Marchant and Higgins, 1990; Martínez-Vilalta and Motis, 1992). The species may occur after rain, particularly along inundated creeks or in ephemeral pools.

The Eastern Great Egret is not expected to occur with the Project area however, if sighted should be recorded and management plan amended to reflect presence.

4.3 Priority Species

4.3.1 Ghost Bat

(Priority 4)

This cave-roosting bat is threatened by disturbance, loss of roost sites, habitat alteration (e.g. altered fire regimes, grazing by livestock and barb-wire fencing) and competition from introduced predators (e.g. feral cats and foxes) (Burbidge, 2004).

The Ghost Bat has not been recorded and is not expected to occur with the Project area however, if sighted should be recorded and management plan amended to reflect presence.

4.3.2 Spectacled Hare-Wallaby

(Priority 3)

Within Western Australia, this species is now restricted to a few small isolated patches in the Pilbara and Kimberley; threats may include altered fire regimes, and introduced grazers such as cattle and rabbits; and introduced predators such as foxes and feral cats (Burbidge, 2004). This species may also be vulnerable to road kill (Butler, 1987).

The Spectacled Hare-Wallaby has not been recorded and is not expected to occur with the Project area, however, if sighted should be recorded and management plan amended to reflect presence.

4.3.3 Western Pebble-mound Mouse

(Priority 4)

This species generally occurs on the lower slopes of rocky hills, where it uses small stones to build its distinctive mounds (Strahan, 1995). Possible threats to the species may be increased predation by introduced predators e.g. feral cats and foxes (Lee, 1995).

The Western Pebble-mound Mouse has not been recorded and is not expected to occur with the Project area however, if sighted should be recorded and management plan amended to reflect presence.

4.3.4 Lakeland Downs Mouse

(Priority 4)

Populations of the Lakeland Downs Mouse appear to fluctuate dramatically, probably in response to environmental conditions and food availability (Covacevich, 1995).

The Lakeland Downs Mouse has not been recorded and is not expected to occur with the Project area however, if sighted should be recorded and management plan amended to reflect presence.

4.3.5 Long-tailed Dunnart

(Priority 3)

The species appears to be a specialist of rocky habitats. Possible threats include habitat alteration due to introduced herbivores e.g. cattle and rabbits, inappropriate fire regimes and invasion by Buffel Grass; and predation by cats and foxes (Pavey, 2006).

The Long-tailed Dunnart has not been recorded in the Project area but may be present. If recorded, the management plan should be amended to reflect presence.

4.3.6 Bush Stone-curlew

(Priority 4)

In the Pilbara, the Bush Stone-curlew is often associated with woodlands and shrublands along ephemeral or permanent watercourses (M. Bamford *pers. obs*.). This species has been recorded within the greater Project area. Threats to the species include increased predation by foxes and habitat degradation from pastoralism (Garnett and Crowley, 2000).

The Bush Stone-curlew has been recorded in the Project area (Browne-Cooper and Bamford, 2010) but had not been recorded during extensive surveys in the 1980s (Hart Simpson and Associates, 1994b), so is probably an occasional visitor.

4.3.7 Australian Bustard

(Priority 4)

This species is associated with a variety of grassland, grassy woodland and shrubland habitats, with the main threats to its survival being a combination of habitat loss/degradation and predation by feral cats and foxes (Burbidge, 2004).

Regularly recorded throughout the Project area, this species is likely to be a regular visitor in and around the Project area.

4.3.8 Grey Falcon

(Priority 4)

This species appears to have a distribution centred around ephemeral or permanent drainage lines (Garnett and Crowley, 2000). Although the main threats to this species are not known, regional threats may include habitat degradation through grazing, which may have reduced prey abundance (Garnett and Crowley, 2000).

The Grey Falcon has been recorded close to the Kintyre Project area and is expected to be a regular visitor.

4.3.9 Woma

(Schedule 4 of the WC Act)

The southern “wheatbelt” population of this species is considered threatened, however the northern populations do not appear to be threatened (Maryan, 2002). This species utilises a variety of sand-plain habitats (Maryan, 2002) and has been recorded from near Telfer and also Jigalong community and is likely to occur within the Project area.

5 ROLES & RESPONSIBILITES

Table 5-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Fauna Management Plan.

Table 5-1: Roles and Responsibilities

Position	Responsibility
Environmental Manager	▪ Implementation and maintenance of the plan. ▪ Undertakes assessment and review of the effectiveness of this management plan.
Environmental Superintendent	▪ Formulate and implement fauna surveys, monitoring programs and liaise with stakeholders regarding feral animal control and fire management. ▪ Ensure all staff are aware of their obligations in relation to this plan. ▪ Deliver fauna education and induction awareness training to field personnel. ▪ Maintain site records of surveys and implement monitoring programs.
Operation Managers and Site Supervisors	▪ Ensure the plan is being adhered to by all staff and contractors. ▪ Participate in compliance audits and inspections.
All Cameco personnel, contractors and visitors	▪ Minimise impacts on native fauna from construction and mining activities. ▪ Report all incidents involving significant species.

6 ENVIRONMENTAL MANAGEMENT

6.1 Purpose

The purpose of this Plan is to outline available information on threatened and priority-listed species within Cameco's mining operations and to identify, assess and minimise potential environmental impacts on fauna populations within areas of operation.

The key environmental objectives are:

- Identify the potential direct and indirect impacts on threatened and priority-listed species, within the Project area;
- Identify strategies to minimise the potential impacts on threatened and Priority-listed species; and
- Implement targeted management strategies to help manage impacts on threatened and Priority-listed species such as Bilby (*Macrotis lagotis*), within and adjacent to the Project area.

6.2 Potential Impacts

6.2.1 Clearing and Ground Disturbance

Cameco plans to clear and construct the Kintyre Project area and upgrade the existing access road. While some of the Project area has been disturbed by past and present exploration activities, the clearing of some native vegetation will occur. This will affect fauna in the following ways:

- loss of habitat;
- loss of individuals through vegetation clearing;
- loss of individuals through collision with vehicles during clearing and operations;
- fragmentation of habitat affecting movements of less mobile species; and
- fauna becoming trapped in the wet tailings, or alighting on process water ponds.

6.2.2 Infrastructure Upgrade

Access to site is via the Kintyre – Telfer road that traverses a mixture of habitat types. Cameco plans to upgrade this road and construct a new section of road to the west of part of the existing road, and it is expected that fauna traversing the road will be vulnerable to collision with vehicles. The construction of new roads or upgrade of existing roads can fragment habitat by creating a barrier to wildlife movement. This fragmentation and habitat loss can lead to a decline in some fauna species, many of which then require active management (Zenger *et al*., 2005).

The detrimental effects associated with the construction of new roads may include:

- habitat loss – resulting from the clearing and construction of the road and its associated reserve;
- mortality due to road kill – collision with vehicles;
- increased feral predators – road kills may provide food for scavenging predators and the open nature of road verges may leave native fauna vulnerable to predation; and
- disorientation by light and noise – increases in traffic results in an increase in noise and light, particularly at night.

There have been a number of publications suggesting that habitat fragmentation (as a result of road construction) may have a detrimental effect on small mammal species such as bandicoots (Watson and Halley, 1999). It has been suggested that the greatest cause of adult mortality in populations of eastern barred bandicoots was collisions with vehicles (Dufty, 1989). Jones (2000) documented the sudden decline of a population of Eastern Quolls (*Dasyurus viverrinus*) and Tasmanian Devils (*Sarcophilus harrisii*) directly attributed to increased road mortality.

Jones (2000) attributed the high road mortality to an increase in traffic speed, facilitated by the upgrade of an existing road. This study was the first to document the direct relationship between roads and a sudden decline of native species.

6.2.3 Introduced Fauna

A number of introduced fauna species have been identified within and surrounding the Kintyre Project area including: Camels (*Camelus dromedarius*), Red Fox (*Vulpes vulpes*), Cats (*Felis catus*) and House Mouse (*Mus musculus*). In addition to these species there is the potential for other exotic species such as the Black Rat (*Rattus rattus*) and the Asian House Gecko (*Hemidactylus frenatus*) to become established. Introduced species have the potential to severely impact on fauna and fauna habitats in the following ways:

- Habitat degradation through over grazing (e.g. damage to vegetation composition and structure), removal of vegetation resulting in soil erosion and over use of standing water bodies.
- Direct predation, competition and displacement from habitat (the deleterious effects of introduced predator species are well documented with predation being one of the major causes of population decline for some fauna species (Burbidge, 2004).

Introduced predators can proliferate as a result of mining projects particularly if a high standard of housekeeping is not maintained. Introduced predator populations can increase if waste disposal sites are not correctly maintained as these can become a readily available food source. This can lead to an increase in predators and may result in an increase in predation on native species.

6.2.4 Dingoes

Dingoes were thought to have been introduced to the Australian mainland by Asian seafarers over 3,000 years ago. Dingoes are classified as unprotected native fauna under the *Wildlife Conservation Act 1950* and are controlled in agricultural and pastoral areas under the *Agriculture and Related Resources Protection Act 1976*.

In areas where dingoes have occurred in close proximity to human settlements there is often a problem with dingoes becoming habituated to humans and in some cases becoming aggressive. This is usually as a result of poor housekeeping and rubbish disposal, food not stored securely, easy access to water and people feeding dingoes.

Dingoes can also have an effect on populations of conservation significant fauna. Dingoes are recognised as having a role in the conservation of significant fauna as they are known to suppress the number of feral predators such as foxes.

6.2.5 Fire Management

Accidental fires arising from mining activities could have a detrimental effect on surrounding fauna and fauna habitats. Detrimental impacts include mortality of individuals and loss of habitat. Loss of habitat can result in fauna being exposed to adverse environmental conditions and predation. In addition to accidental fires, the traditional practice of burning carried out by local indigenous groups may also result in negative impacts if the burning is frequent and carried out without a full knowledge of traditional methods. Inappropriate or altered fire regimes have been identified as one of the main contributing factors in relation to the decline of some species (Maxwell *et al*., 1996).

6.2.6 Waste Control

Cameco will manage a minor landfill site for the disposal of inert and putrescible waste. This may impact on conservation significant fauna in the following ways:

- ingestion of waste material causing death;
- fauna entrapment within waste disposal site;
- contamination of surface waters; and
- aiding the increase in dingoes and feral predator species (Section 6.2.3).

6.2.7 Hydrocarbon and Chemicals

Hydrocarbons and chemicals will be transported to and from site and will also be used and stored on site. The potential impacts on significant fauna may arise from spills leading to:

- contamination of surface and ground waters;
- contamination and death of vegetation; and
- loss of habitat.

6.2.8 Tailings and Process Ponds

Fauna, particularly birds, may be attracted to water held in the stormwater ponds, on the surface of the Tailings Management Facility (TMF) and the tailings water recovery and evaporation pond. This could result in:

- fauna becoming stuck in the wet tailings;
- exposure to process chemicals; and
- exposure to above-background levels of radiation.

6.3 Environmental Objective and Performance Indicators

Table 6-1: Environmental Objectives and Performance Indicators

Environmental Objective	Performance Indicators
Maintain the geographic distribution and abundance of significant fauna species within the Project area.	• No significant or long term decline to the abundance and distribution of the conservation significant fauna.
Avoid or minimise adverse impacts on significant fauna species	• Design and plan Project activities so as not to impact on known areas supporting significant species.
Increase knowledge of significant species within the greater Project area.	• Participate in activities that increase knowledge of significant species within the region.
Contribute to land management activities in the East Pilbara region.	• Participate in land management activities that improve the habitat for significant species.

6.4 Environmental Aspects and Management Strategies

Table 6-2: Environmental Aspects and Management Strategies

Environmental Aspect	Management Strategy
Conservation Significant Fauna	• Prior to ground disturbances carry out pre-clearance survey for significant species. • If populations of significant species are identified within Project boundary (e.g. lay down areas or storage areas), alternative areas must be considered and evaluated where practicable. • 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. • Where practicable, a 100 m buffer zone will be established around active Bilby burrows within which project activities will be avoided. Where this is not possible (e.g. because Bilbies have moved close to, or into active project areas) Cameco personnel will be required to maintain a 25 m distance from active burrows, except for fauna monitoring purposes. • A site vegetation clearing permit will be completed and authorised by site Environmental Superintendent prior to ground disturbance. All sightings of significant species will be reported to site Environmental Superintendent. • Deceased significant species will be reported to DPaW and if the specimen is in good condition, liaise with district DPaW branch to see if specimen is required for research.

Environmental Aspect	Management Strategy
Clearing and Ground Disturbance	• Disturbance to native vegetation and land clearing will be minimised and undertaken in accordance with the Flora and Vegetation Management Plan. • If populations of significant species are identified within Project boundary (e.g. lay down areas or storage areas), alternative areas must be considered and evaluated where practicable. • 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. • A site vegetation clearing permit will be completed and authorised by site Environmental Superintendent prior to ground disturbance. • No unauthorised driving off tracks. • Vehicle speeds will be restricted to 40 km/hr around sensitive habitats.
Infrastructure Upgrade	• Disturbance to native vegetation and land clearing will be minimised and undertaken in accordance with the Flora and Vegetation Management Plan. • If populations of significant species are identified within Project boundary (e.g. active or recently active Bilby burrows), alternative routes will be considered and evaluated where practicable. • 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. • A site vegetation clearing permit will be completed and authorised by site Environmental Superintendent prior to ground disturbance. • No unauthorised driving off tracks. • Vehicle speeds will be restricted to 40 km/hr around sensitive habitats and area known to contain significant fauna. • Driving at night will be restricted to emergency travel only.

Environmental Aspect	Management Strategy
Introduced Fauna and Dingoes	• Site housekeeping will be maintained to a high standard. • Feeding of wildlife both introduced and native will be prohibited. • Cameco will educate the workforce to avoid interaction with both native and introduced fauna. • Waste disposal sites will be fenced to prevent introduced species from entering. • Where practicable, feral animal control programmes will be implemented in consultation with the DPaW.
Fire Management	• Implement the Fire Prevention and Management Plan including maintenance of fire breaks. • Hot work permits will be obtained prior to commencing any activity that may create/cause an ignition source. • Fire extinguishers will be readily available in all hot work areas. • Personnel will be trained in the use of fire extinguishers. • Liaise with DPaW and traditional owners to assist in the implementation of a landscape scale fire management programme, to create a mosaic of fire ages.
Waste Control	• Implement the Waste Management Plan. • Inert and putrescible waste will be disposed of in an authorised landfill on site. • The landfill will meet the requirements of the Environmental Protection (Rural Landfill) Regulations 2002. • Hazardous waste will be removed and disposed of by a licensed contractor.
Hydrocarbon and Chemicals	• Hydrocarbons and chemicals will be transported, stored and used in accordance with Australian standards and guidelines. • Spill kits will be made available on site and reflect the quantity of hazardous materials stored. • Hydrocarbon and chemical spills will be immediately cleaned up and reported, as per the Chemical and Fuel Storage Management Plan

Environmental Aspect	Management Strategy
Tailings and Process Ponds	• The tailings, process and stormwater ponds will be fenced. • A risk assessment will be undertaken to determine if netting is required on the TMF and TWERP to avoid birds alighting on the surface of these facilities. • Ponds will be inspected daily for signs of fauna entry. • Any trapped fauna will be rescued where it is safe to do so. Cameco will seek the advice of wildlife specialists / fauna rehabilitation centre if fauna are injured. • The process water and stormwater ponds will have a fauna egress ramp to enable fauna to exit the ponds.
Training	• Training on the identification and reporting of conservation-significant fauna species will be included in the Cameco site induction. • Ongoing awareness of significant species present will be conducted through environmental induction and environmental awareness sessions, posters and discussed regularly in toolbox meetings. • Training on vegetation clearing procedures will be included in the environmental induction.

7 DEMONSTRATING THE OUTCOME (MONITORING)

Monitoring of compliance will be carried out by completion of pre disturbance surveys and by internal audits conducted on a biannual basis. Impact on species will also be considered based on focused monitoring of known populations of significant species. In addition, compliance with this plan may also be monitored through external auditing.

7.1 Reporting

The Annual Environmental Report will provide detailed information on the effectiveness and implementation of this plan. In addition, the report will provide details on the status of conservation significant fauna recorded within the Project area.

7.2 Contingencies

Should pre-clearance surveys identify the presence of conservation significant fauna species within the Project area, specialist zoologist and DPaw will be consulted. This will enable appropriate contingency measures to be determined and implemented, if necessary.

7.3 Review and Revision

This plan will be reviewed following pre-clearance surveys, then every two years thereafter. In the event that conservation significant species are identified within the Project area prior to the completion of a two year period, the plan will immediately be revised in consultation with specialist zoologist and DPaW.

Table 7-1: Environmental Management Summary Table

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Clearing and Ground Disturbance	Minimal disturbance to significant species habitat	Internal auditing to monitor compliance with clearing permit conditions. Record number of incidents. All sightings of significant species will be recorded on the site Fauna Sighting Register.	Reporting in AER	Should pre disturbance surveys identify the presence of significant species DPaW will be consulted on alternative actions	Ground Disturbance Procedure
Infrastructure Upgrade	Minimal disturbance to significant species habitat. Nil deaths due to vehicle collision.	Number of significant species involved in vehicle collisions. Internal audits of infrastructure.	AER Notify DPaW if significant species killed on roads		Ground disturbance procedure
Introduced Fauna	No increase in introduced species presence	Maintain Fauna Sighting Register	Reporting in AER	Should the number of introduced species sighting increase over a period of 12 months then the DPaW and a specialist zoologist shall be consulted for advice on control measures.	

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Fire impacts on fauna	No accidental fires as a result of the Project	Internal auditing to monitor compliance with Hot Work Permits.	Any accidental or wildfires in area reporting in AER	Liaise with DPaWand traditional owners to assist in the implementation of a landscape scale fire management programme to create a mosaic of fire ages and protection of areas occupied by significant species (e.g. Bilbies)	Fire Prevention and Management Plan
Waste Control	All waste disposed of according to Waste Management Plan	Site audits	AER	Implement Waste Management Plan	Waste Management Plan and associated procedures
Hydrocarbons and Chemicals	No damage to existing environment from spills or leaks	Site Audits Number of incidents reported	AER	Implement Chemical and Fuel Storage Management Plan	Chemical and Fuel Storage Management Plan and associated procedures
Tailings and Process Ponds	No macrofauna will enter the TMF or process ponds.	Daily inspections of the TMF, TWRP, stormwater ponds and sediment ponds.	AER	Seek advice from wildlife specialist / fauna rehabilitation centre if fauna are injured.	Tailings Management Procedures

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Cameco

Cameco Australia Pty Ltd

Kintyre Uranium Project

Subterranean Fauna Management Plan

June 2013

Date	Revision	Description	Author	Approved
16/10/12	D1	Draft	ENVIRON	SW
14/6/13	2	Final	ENVIRON	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 5 km north of the Karlamilyi National Park in the Little Sandy Desert bio-region.

Subterranean fauna includes both terrestrial (troglofauna) and aquatic (stygofauna) species. Troglofauna occur in underground cavities, fissures and interstitial spaces above the water table whereas stygofauna inhabit groundwater environments.

This document outlines the potential impacts of the Project on subterranean fauna and the proposed management measures. Management of subterranean fauna has been identified as a key aspect for the Project during the risk assessment undertaken as part of the Environmental Review and Management Programme (ERMP).

The purpose of this management plan is to meet the legislative requirements and provide a framework for Cameco to responsibly meet any changing environmental obligations over the life of the Project.

2 RELEVANT LEGISLATION & STANDARDS

Legislation and standards applicable to this management plan include:

- *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*;
- *Environmental Protection Act 1986 (WA)*;
- *Rights in Water and Irrigation Act 1914 (WA)*;
- *Wildlife Conservation Act 1950 (WA)*;
- *Agriculture and Related Resources Protection Act 1976 (WA)*; and
- EPA Guidance Statement No. 54 (Sampling of Subterranean Fauna in Groundwater and Caves, 2003).
- EPA Guidance Statement No. 54A (Sampling Methods and Survey Consideration for Subterranean Fauna in Western Australia, 2007).

3 EXISTING ENVIRONMENT

3.1 Geology

The Kintyre deposit occurs in the Rudall region on the northern margin of the Rudall Metamorphic Complex, which consists of a basement complex of metamorphic sedimentary rocks. These rocks were carved by glaciers during the Permian Period, which formed large valleys that were infilled by sand silt and gravel as the glaciers receded. The Permian glacial valleys remain as active drainages, forming the catchment to the Yandagooge and Coolbro Creeks, as well as the Rudall River.

The uranium deposit is a vein type occurrence and the host rocks for the mineralisation are schists and metasediments (Yandagooge Formation). This formation is underlain by granitic gneiss, which is overlain by Coolbro Sandstone of the Yeena Group.

3.2 Hydrogeology

The main aquifer units in the Kintyre area are located in Permian sand, gravel and conglomerate deposits of the Paterson Formation, and fractured and weathered sandstone of the Coolbro Sandstone. Smaller local aquifers are present in Cenozoic deposits where saturated, and in secondary permeability features within basement rocks of the Rudall Metamorphic Complex. A summary of the main aquifer types are presented in Table 3-1.

Table 3-1: Summary of Aquifer types in the Kintyre area

Aquifer	Geological unit	Average thickness (m)	Bore yield (kL/day)	Aquifer potential	Lithology
Cenozoic	Alluvium	15	Minor	Minor	Unconsolidated localised sedimentary aquifers
Upper Paterson	Paterson Formation (upper unit)	50	100 to 1,500	Minor to Major	Glacio-lacustrine clay, siltstone and sand
Lower Paterson	Paterson Formation (lower unit)	100	100 to 1,700	Minor to Major	Fluvioglacial sand, gravel and basal conglomerate
Coolbro	Coolbro Sandstone	>1,000	200 to 800	Major where sheared	Sandstone
Rudall fractured rock	Rudall Metamorphic Complex	>1,000	<50 to 250	Minor	Schists, carbonates, quartzite

It is proposed that the mine pit will be approximately 1,500 m long by 1,000 m wide, with an approximate pit depth of 220 m. The water table lies at approximately 12 m to 15 m below ground surface. The cone of water table depressurisation is predicted to be a maximum of 220 m in the centre of the pit, decreasing away from the pit, with the limits of discernible drawdown impacts (nominally the 1 m drawdown contour) at the end of mining predicted to extend about 5 km from the pit. Although the proposed mine pit and cone of groundwater depression are considered small relative to the ranges of most subterranean species, mine development may potentially threaten the conservation status of highly restricted species of subterranean fauna, if such species only occur within the vicinity of the Project.

3.3 Subterranean Fauna

The proposed disturbance footprint and surrounding Project area contains geology that is generally similar, however can be variable, both laterally and vertically on a scale of tens to hundreds of metres. Twenty three troglofauna species of 12 Orders, and 15 stygofauna species of seven higher level groups were recorded during an investigation into the subterranean fauna communities of the Kintyre Project area and surrounds. These represent a moderately rich troglofauna and a relatively sparse stygofauna community for the Pilbara region.

3.3.1 Troglofauna

The community composition and abundance of troglofauna that was found in the survey areas is unremarkable (Bennelongia, 2012). Pseudoscorpions, palpigrads, spiders, isopods, centipedes, millipedes, pauropods, symphylans, diplurans, silverfish, cockroaches and hemipterans are all commonly collected in the Pilbara (Biota, 2006; Bennelongia, 2009a,b). Notably, schizomids and coleopterans were absent from the area surveyed. Two species of troglofauna, the pauropods Pauropodidae sp. B26 (8 specimens from one bore) and the cockroach *Nocticola* sp. (a singleton), are currently known only from within the proposed mine pit at Kintyre.

3.3.2 Stygofauna

The stygofauna community composition within the Study Area is unremarkable, with all of the commonly collected higher order groups recorded, with the exception of ostracods (Bennelongia, 2012). Nine undescribed species were recorded in the Survey Area, but this may be expected in an area not previously sampled. Four of the species recorded within the area of predicted groundwater drawdown, from mining activities, are not known to occur elsewhere - the copepods *Nitocrella* sp. B04 (nr *obesa*), *Nitocrella* sp. B05, *Parastenocaris* sp. B07 and the syncarid *Atopobathynella* sp. Based on the ranges of related species, it is considered likely that *Nitocrella* sp. B05, *Parastenocaris* sp. B07, and *Atopobathynella* sp. (which were all collected in low abundance) have ranges extending beyond the zone of groundwater drawdown. The likely range of the more abundant *Nitocrella* sp. B04 (nr *obesa*) is unclear.

4 ROLES & RESPONSIBILITIES

Table 4-2 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Subterranean Fauna Management Plan.

Table 4-2: Roles and Responsibilities

Position	Responsibility
Environmental Manager	• Implementation and maintenance of the plan. • Undertakes assessment and review of the effectiveness of this management plan.
Environment Superintendent	• Formulate and implement flora and vegetation surveys, monitoring programs and liaise with stakeholders regarding feral animal control. • Ensure all staff are aware of their obligations in relation to this plan. • Deliver flora and vegetation education and induction awareness training to field personnel. • Maintain site records of surveys and implement monitoring programs.
Operation Managers and Site Supervisors	• Ensure the plan is being adhered to by all staff and contractors. • Participate in compliance audits and inspections.
All Cameco personnel, contractors and visitors	• Minimise impacts on native flora and vegetation from construction and mining activities. • Report all incidents involving significant species.

5 ENVIRONMENTAL MANAGEMENT

5.1 Purpose

The purpose of this Plan is to identify, assess and minimise potential environmental impacts of Cameco's mining operations on subterranean fauna populations within its areas of operation.

The overall environmental outcome is to maintain the abundance, diversity, geographic distribution and productivity of subterranean fauna.

The key objectives of this management plan are:

- Identify the potential direct and indirect impacts of mining on threatened and conservation significant species of subterranean fauna, within the Project area;
- Identify strategies to minimise the potential impacts on threatened/low abundance and conservation significant subterranean fauna, within the Project area;
- Identify and implement management strategies and monitoring to manage and measure impacts on threatened and conservation significant subterranean fauna, within the Project area.

5.2 Potential Impacts

5.2.1 Troglofauna

The conservation status of only two troglofauna species, *Pauropodidae* sp. B26 and *Nocticola* sp., is possibly threatened by mine development. Irrespective of whether the ranges of these are centred on the proposed mine pit, the threat to both will be small because the mine pit will occupy only 75 ha. There is only one troglofauna species which is a schizomid which occurs in north-western Australia with a known range as small as the proposed mine pit, in a Robe Valley mesa. Its range is delimited by the extent of the mesa (Biota, 2006; Harvey *et al*., 2008) whereas other schizomids in the same landscape have ranges up to 1,970 ha. The likelihood of either species recorded at Kintyre having a range this small is very low.

5.2.2 Stygofauna

The conservation status of four stygofauna species, *Nitocrella* sp. B04 (nr *obesa*), *Nitocrella* sp. B05, *Parastenocaris* sp. B07, and *Atopobathynella* sp., is possibly threatened by mine development. Based on the ranges of related species, it is considered likely that the three species collected in low abundance, *Nitocrella* sp. B05, *Parastenocaris* sp. B07, and *Atopobathynella* sp., have ranges extending beyond the zone of groundwater drawdown due to the extent of similar geology. Thus, the species are unlikely to be threatened by proposed mine development.

However, the range of *Nitocrella* sp. B04 (nr *obesa*) is unclear. Depending on the aquifer in which the species occurs, groundwater drawdown will not necessarily adversely impact this species. Species in deeper aquifers are likely to remain unaffected by small drawdowns in the upper aquifers.

5.3 Project Issues and Impacts

The following outlines the potential direct and indirect impacts from the project. Activities that have the potential to impact the conservation status of subterranean species are considered to be direct impacts, whilst activities that reduce the quality of subterranean fauna habitat are considered to be indirect impacts. Indirect impacts have been little studied in Australia (or elsewhere) but it is considered that these impacts are more likely to reduce population size than impact the conservation status of subterranean species.

5.4 Direct Impacts

Pit excavation

Removal of overburden and ore in the mining process has the potential to impact restricted troglofauna species. Based on the small size of the proposed mine pit (75 ha) in relation to the likely ranges of Pauropodidae sp. B26 and Nocticola sp. (inferred from ranges of related species), it is unlikely that this potential risk is significant.

Dewatering

Drawdown of aquifers for water supply and pit dewatering to prevent flooding of mine pits, has the potential to impact stygofauna species unless the underlying aquifers also provide habitat. All areas where drawdown is predicted to be greater than 2 m below natural levels were considered likely to result in reduction in stygofauna habitat.

5.5 Indirect Impacts

Dewatering below troglofauna habitat

The impact of a lowered water table on subterranean humidity and therefore the quality of troglofauna habitat is poorly studied, but it may impact troglofauna species in some cases. The extent to which the water table influence the humidity in the vadose zone is unclear. Pockets of residual water may remain trapped throughout dewatered areas and thereby reduce the impact of dewatering on troglofauna habitat (Bennelongia, 2012). Troglofauna may be able to avoid undesirable effects of a habitat drying out by moving laterally or vertically if suitable habitat exists is present.

Overburden stockpiles and Tailings Management Facility

Waste rock landforms, mineralised waste stockpiles and the lined tailings management facility (TMF) are likely to cause localised reduction in rainfall recharge and associated entry of dissolved organic matter and nutrients. The effects of reduced carbon and nutrient input are likely to be expressed over many years and may be greater for troglofauna than stygofauna because lateral movement of groundwater is likely to transport carbon and nutrients from beyond areas covered by stockpiles. Stockpiles are unlikely to significantly affect the conservation status of a species, although local population densities of species may decrease

Percussion from blasting

Impacts may occur to both stygofauna and troglofauna through the physical effect of explosions and through altering underground structure and transient increases in groundwater turbidity. Any effects of blasting are likely to dissipate rapidly with distance from the pit and are not considered to be a significant risk to troglofauna outside the proposed mine pits

Aquifer recharge with poor quality water

The quality of recharge water may decline during mining operations and post-closure as a result of rock break up and soil disturbance affecting subterranean communities. Runoff from mining areas which may be poor quality water, could also affect subterranean fauna habitats.

Contamination of groundwater

Spills or leaks from hydrocarbons or chemicals in the plant area, or any vehicles or equipment on the mine site may contaminate soil and groundwater affecting subterranean fauna communities.

Seepage from the TMF poses a potential pathway for radionuclide transportation into the groundwater. However, the design of the TMF with a double liner with leak detection and seepage collection system reduces this risk.

5.3 Environmental Objective and Performance Indicators

Table 5-3: Environmental Objective and Performance Indicators

Environmental Objective	Performance Indicators
Maintain the abundance and diversity of subterranean fauna species occurring within the Project area	• Subterranean fauna surveys indicate no significant or long term decline to the abundance and diversity of subterranean fauna species
Avoid or minimise adverse impacts on significant subterranean fauna species	• Groundwater monitoring results indicate no decline in groundwater quality within the Project area. • Groundwater monitoring results confirm modelled groundwater drawdown predictions. • Subterranean fauna surveys indicate no significant or long term decline to the abundance and diversity of subterranean fauna species.
Improved understanding of subterranean fauna species within the Pilbara region	• Participate in activities that improve the knowledge of subterranean fauna species. • Specimens collected from subterranean fauna sampling are lodged with the WA Museum.

5.4 Environmental Aspects and Management Strategies

Table 5-4: Environmental Aspects and Management Strategies

Environmental Aspect	Management Strategy
Pit excavation	• Ongoing periodic fauna sampling in existing bores
Dewatering and groundwater abstraction	• Groundwater abstraction rates and groundwater levels will be monitored in accordance with the Groundwater Management Plan to confirm predicted drawdown levels • Groundwater abstraction rates will be maintained at the minimum required for safe operation and for Project water supply • Groundwater quality monitoring will be undertaken in existing bores in accordance with the Groundwater management Plan • Ongoing periodic fauna sampling in existing bores
Contamination of groundwater	• Implement the Groundwater Management Plan • Implement the Chemical and Fuel Storage Management Plan • Implement spill response procedures in case of a spill
Radionuclide concentration	• Implement the Radiation Management Plan.
Overburden stockpiles	• Implement the Surface Water Management Plan
Poor quality of aquifer recharge.	• Implement the Chemical and Fuel Storage Management Plan • Implement the Surface Water Management Plan • Implement the Mine Closure and Rehabilitation Plan

6 DEMONSTRATING THE OUTCOME

6.1 Monitoring Programmes

During operations the monitoring programme will include the following monitoring:

- Groundwater quality monitoring will be undertaken as per Groundwater Management Plan to assess groundwater quality and potential impacts to the subterranean fauna;
- Cameco will undertake periodic ongoing sampling for subterranean fauna in existing bores;
- Groundwater drawdown and abstraction rates will be monitored in accordance with the Groundwater Management Plan.

6.2 Interpretation and Reporting of Results

Reporting of results obtained from the monitoring data will assess trends, patterns and discuss:

- any prolonged groundwater contamination or large spills;
- changes in subterranean fauna survey results;
- review hydrological data and drawdown rates; and
- review of groundwater abstraction rates.

6.2.1 Contingencies

If a significant change is recorded that can be attributed to the Project then the following will occur:

- If there is a saline water/oil/chemical spill, operations in that area would cease until the leak is halted and spill cleaned up (including removal of contaminated soil). Depending on the extent of contamination a survey to ensure all contaminated material has been removed, may be required;

- In the event the subterranean fauna survey identifies a species that may be localised the Project area, further sampling outside of the Project area may be undertaken to provide more certainty to the range of the species. Conservation measures may be taken in consultation with the Department of Environment and Conservation (DEC) and the WA Museum, which may include relocation of species at threat.

- If there is a prolonged drought then the rate of abstraction would be monitored to assess rates of change and dewatering activities may be altered accordingly to minimise impacts on subterranean fauna communities if practicable and safe to do so.

6.2.2 Review and Revision

This plan will be reviewed every two years. In the event that survey result identify rare or threaten populations of subterranean fauna then the plan may be revised sooner.

Table Error! No text of specified style in document.**-5: Environmental Management Summary Table**

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Pit excavation	Contain the effects of pit excavation on the subterranean fauna to the pit area.	Subterranean fauna surveys/assessment. Groundwater monitoring.	Subterranean fauna surveys/assessment reports. Reporting in AER (groundwater monitoring report).	None.	Groundwater Management Plan
Dewatering	Minimise the impact to stygofauna species	Groundwater monitoring and groundwater drawdown monitoring.	Reporting in AER (groundwater monitoring report).	Re-evaluate dewatering in the event of a drought, if practical and safe to do so.	Groundwater Management Plan
Rates of abstraction	Minimise the impact of abstraction on subterranean fauna.	Subterranean fauna surveys/assessment. Monitoring groundwater abstraction rates. Compliance with water licence conditions.	Subterranean fauna surveys/assessment reports. Reporting in AER (groundwater monitoring report).	Re-evaluate water abstraction in the event of a drought or water table dropping below planned hydrology assessments.	Groundwater Management Plan. Water licence conditions.

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Contamination of groundwater	Identify and implement controls to mitigate any potential contamination risk.	Groundwater monitoring	Reporting in AER (groundwater monitoring report).	Clean-up plan and Emergency Response Plan in the event of a major spill or seepage occurring.	Groundwater Management Plan. Chemical and Fuel Storage Management Plan Spill Response Procedure.
Radionuclide concentration	Ensure radionuclide concentrations are not above natural background levels in the groundwater.	Groundwater monitoring Monitoring of leak detection system in the TMF to ensure no seepage is occurring.	Reporting in AER.	Identify source in the case of elevated radionuclide concentrations and implement remedial measures. Repair any leaks in TMF and recover any released seepage.	Radiation Management Plan.
Overburden of stockpiles	Maintain the abundance and diversity of subterranean fauna.	Subterranean fauna surveys/assessment. Groundwater monitoring	Subterranean fauna surveys/assessment reports. Reporting in AER (groundwater monitoring report).	None	Surface water Management Plan. Groundwater Management Plan.
Percussion from blasting	Maintain the abundance and diversity of subterranean fauna.	Subterranean fauna surveys/assessment.	Subterranean fauna surveys/assessment reports.	None	

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Poor quality of aquifer recharge.	Divert clean water runoff away from the Project area.	Groundwater monitoring	Reporting in AER.	Ensure all potentially contaminated runoff reports to tailings water recovery pond, or other lined stormwater pond.	Groundwater Management Plan. Chemical and Fuel Storage Management Plan.

7 REFERENCES

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Cameco Australia Pty Ltd

Kintyre Uranium Project

Fibrous Minerals Management Plan

October 2012

Date	Revision	Description	Author	Approved
20/9/12	D1	Draft	LG	SW
16/10/12	2	Final	Cameco	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 10 km north of the Karlamilyi National Park (formerly Rudall River National Park) border.

This Fibrous Minerals Management Plan ('The Plan') has been developed in response to the positive identification of fibrous mineral fibres at the Kintyre Uranium deposit. The processes and procedures outlined in this Plan applies to all potential sources of exposure to fibrous minerals including activities involved in exploration, mining and processing.

The elements detailed within this Plan comply are in compliance with the requirements of the Code of Practice for the Management and Control of Asbestos in Workplaces [NOHSC:2018(2005)] and the Department of Mines and Petroleum (DMP) Guideline *Management of fibrous minerals in Western Australian mining operations 2010* at the time writing.

The purpose of this management plan is to meet the legislative requirements and provide a framework for Cameco to responsibly meet all environmental and occupational health obligations over the life of the Project.

2 RELEVANT LEGISLATION & STANDARDS

Legislation and standards applicable to this management plan include:

- *Mines Safety Inspection Act 1994 (WA);*
- Mines Safety and Inspection Regulations 1995 (WA);
- Department of Mines and Petroleum (DMP) Guideline *Management of fibrous minerals in Western Australian mining operations 2010;* and
- *Code of Practice for the Management and Control of Asbestos in Workplaces [NOHSC:2018(2005)].*

The overarching legislation is the *Mines Safety and Inspection Act 1994 (WA)* (the Act) which sets objectives to promote and improve occupational safety and health standards within the minerals industry. The Act sets out broad duties, and is supported by regulations, together with codes of practice and guidelines. The Guideline "Management of fibrous minerals in Western Australian mining operations" produced in 2010 is part of the Act.

The Mines Safety and Inspection Regulations 1995 (the Regulations) provide more specific requirements for a range of activities. Like the Act, regulations are enforceable and breaches may result in prosecution, fines, or directions to cease operations and undertake remedial action. Relevant Regulations include:

- Regulation 9.1 states (Terms Used):
  In this part, unless the contrary intention appears — *Contaminant* asbestos means crocidolite, chrysotile, grunerite (amosite), or the asbestiform of actinolite, tremolite or anthophyllite present in rock in or about the mine.
- Regulation 9.17 states (Suppression of dust — drilling operations):
  (1) If it is necessary for dry drilling to be carried out in a mine (whether underground or on the surface), each responsible person at the mine must ensure that the drilling machine used is fitted with an effective device that —
    (a) collects and contains the dust produced by drilling; or
    (b) discharges that dust through ducting to a position where it will not be breathed by any person or where it will be effectively suppressed or contained.
- Regulation 9.19 states (Use of dust collection and dust suppression appliances):
  (1) If dust collection or dust suppression appliances are provided at a mine, each responsible person at the mine must ensure that the appliances are —
    (a) fitted and operated in accordance with the manufacturer's or supplier's specifications; and
    (b) maintained in efficient operating condition.

(2) An employee at a mine who is engaged in any operation in which dust is produced must use any dust collection or dust suppression appliances provided at the mine for collecting or suppressing the dust.

3 EXISTING ENVIRONMENT

3.1 Geology of the mine site

The geology of the Kintyre area is dominated by an open, northwest-plunging synclinorium of Coolbro Sandstone overlying a basement of Rudall Metamorphic Complex exposed to the east and south. Coolbro Sandstone is exposed in unconformable contact with metamorphic rocks 300 m NW of the Kintyre discovery outcrop (Jackson and Andrew, 1990).

The metamorphic complex in the Project area is composed of various granitic to granodioritic, banded and augen gneiss units exposed in antiformal cores which are flanked and structurally overlain by isoclinally folded metasediments dominated by mica schists and quartzite. The younger meta-sedimentary suite includes a distinctive stratigraphic assemblage which is host to the uranium mineralisation. This assemblage is characterised by various graphite, chlorite and/or carbonate schists, carbonate (marble), variously ferruginous, garnetiferous and/or chloritic quartzite (metachert), and muscovite schist.

3.2 Mineralogy of fibre types present

In the process of exploration drilling at the mine site, geologists had observed in a small number of diamond drill cores what appeared to be thin layers (bands) of fibrous minerals. The company then contracted an occupational hygienist and analytical company with extensive experience in fibrous minerals including asbestos, to assist in identifying, or more correctly speciating, the fibrous minerals present.

Analysis was performed on the fibrous minerals using Scanning Electron Microscopy with Energy Dispersive Spectra which showed that the minerals present were chemically correct for asbestiform minerals and the fibres were of the dimensions of asbestiform minerals. The asbestiform fibres were part of the cummingtonite-grunerite asbestos series. These asbestiform minerals are known as amphibole forms of asbestos which are found in mafic and ultramafic rocks.

3.3 Association of Fibrous Material with the Ore Body

The asbestiform minerals were only found at depth (usually greater than 80 metres deep) in what is normally called “fresh” or “unoxidised” rocks. The asbestiform minerals were present close to the depth of rocks which will be mined for the uranium ore.

The exploration drilling using diamond core has been conducted with a small grid pattern so has provided reasonable confidence about the frequency and extent of the asbestiform minerals.

There is the possibility other asbestiform minerals may be found in the rocks to be mined. If there are any dolerite intrusions of the ore body then they can also have asbestiform minerals such as actinolite or ferroactinolite.

3.4 Preliminary Risk Assessment

The frequency and extent of the occurrence of asbestiform minerals is considered to be low risk compared with some other mining operations in Western Australia according to the experienced Western Australian mining occupational hygienist and supported by results of the analysis. However, a more thorough assessment can only be made after mining operations commence.

4 ROLES & RESPONSIBILITES

Table 1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Fibrous Minerals Management Plan.

Table 4-1: Roles and Responsibilities

Position	Responsibility
HSE Manager	• Implementation and maintenance of the plan. • Undertakes assessment and review of the effectiveness of this management plan.
Operation Managers and Site Supervisors	• Identify the potential occurrence of fibrous minerals at the workplace. • Assess the nature and degree of worker exposure. • Develop and implement controls to reduce such exposures. Where asbestiform minerals or other fibrous mineral hazard exists, Cameco will implement a Risk Based approach to manage the hazard. • Ensure the plan is being adhered to by all staff and contractors. • Participate in compliance audits and inspections. • Immediately quarantine workplaces contaminated with asbestos until the hazard has been dealt with. • Provide appropriate information, instructional training and supervision to all employees and contractors
All Cameco personnel, contractors and visitors	• Comply with work procedures and safety requirements. • Report any hazards related to the presence of suspected fibrous materials.

5 OCCUPATIONAL HEALTH MANAGEMENT

5.1 Purpose

The purpose of the Fibrous Minerals Management Plan is to detail the requirements to:

1. **Enable protection of all employees and contractors** by limiting exposure to fibrous minerals (particularly asbestiform minerals) to As Low As Reasonably Practicable (ALARP) and always below the Occupational Exposure Limit for fibrous minerals (see http://hsis.ascc.gov.au for current Australian requirements).
2. **Identify and log all potential sources of fibrous minerals exposure** in;
   a. exploration,
   b. mining,
   c. processing; and
   d. disposal of waste.
3. **Assess the risk** from exposure to fibrous minerals both in mining and processing.
4. **Implement controls** to reduce exposure to fibrous minerals to ALARP.
5. **Develop required work practices** where there exists a potential for exposure to fibrous minerals. This will be done by having Standard Work Procedures for each specific task or work group.
6. **Ensure compliance** with the *Mines Safety and Inspection Act 1994 (WA)* and the Mines Safety and Inspection Regulations 1995.
7. **Implement** the requirements and Department of Mines and Petroleum (DMP) Guideline *"Management of fibrous minerals in Western Australian mining operations 2010".*

5.2 Fibrous Minerals Management

Fibrous minerals management incorporates four phases:

5.2.1 Hazard Identification Phase

The asbestiform hazard will exist whenever the rocks containing the asbestiform minerals are handled. This would include; drilling through the asbestiform minerals, handling drill cores, cutting of drill cores, analysis of samples, blasting operations, loading trucks, crushing/grinding, potentially tails from the processing and final closure of the mine. As discussed in Section 3.2, the occurrence of fibrous materials was identified during examination of the drill core during exploration. Following the initial finding, a program of inspection of all core was implemented to identify and map all intersections. This information has subsequently been captured in the 3D geological block model of the open pit to assist pit geologists in identifying the fibrous material and planning for management during open pit mining.

Pit geologists will have an important role in identifying asbestiform minerals when mining operations commence. During mining, especially with grade control drilling, the on-going identification of asbestiform minerals by geologists will be conducted.

5.2.2 Evaluation and Risk Analysis Phase

The true risk from asbestos exposure can only be accurately assessed by personal air monitoring during operations.

During the Project exploration phase, measurement of exposure has already been conducted on the drillers, people cutting diamond core and geologists handling diamond core.

Airborne exposure to asbestiform minerals from these activities has been low to date (well below the Occupational Exposure Limit), and controls have already been introduced for activities which may generate airborne asbestos fibres).

Once mining commences, an asbestos monitoring program based on Similar Exposure Groups (SEGs) will be developed by a competent and qualified Occupational Hygienist to assess the risk to individuals in each of the workgroups at the mine. The amount of monitoring conducted will initially be extensive to enable a high level of confidence about actual exposures during normal operations. It is probable that over time, the amount of monitoring will reduce once a scientifically valid level of risk has been determined.

The monitoring of SEGs will be via a Risk Based approach. This approach is based on the principle that there will be more frequent monitoring of people at higher risk compared to those at lower risk. The Risk Based approach of monitoring will be on the basis of a random selection of people and days for monitoring.

In keeping with best-practice Occupational Hygiene techniques, it is envisaged that there will be campaign occupational hygiene monitoring (personal and positional where appropriate) when a new hazard has been identified or when new controls are introduced.

A Site Fibrous Mineral Action Level below the Occupational Exposure Limit will be used to assess whether a calculated exposure risk is at an acceptable level and when further controls need to be introduced.

Results of the personal air monitoring will be provided to the Department of Mines and Petroleum as part of their mandatory CONTAM monitoring program requirements.

5.2.3 Control Phase

As asbestiform minerals are a known human carcinogen, controls will be such that exposures will be kept As Low As Reasonably Practicable (known as ALARP), but always below the Occupational Exposure Limit. This is currently 0.1 respirable fibres per mL of air as a Time Weighted Average (based 8 hours exposure per day and 5 working days per week). An adjusted OEL in accordance will be determined for people working longer shifts.

The exposure risk determined from personal air monitoring will be the main driver for controls, but best practice will also be used to control exposures to asbestiform minerals.

Controls will be implemented on the basis of the hierarchy of controls; elimination, substitution, engineering, administration and personal protective equipment. Personal Protective Equipment will only be used as a control measure where the use of higher-level controls is not commensurate with the degree of risk for short times, while higher level controls are being designed or for longer duration tasks.

The controls for asbestiform minerals would be very similar to the controls necessary for the other hazardous dusts identified onsite such as uranium and crystalline silica and will include, but not be limited to the following:

1. **Designated Areas** will be developed as part of the controls for asbestiform minerals and will be appropriately sign posted to warn people they are entering a Designated Area and that certain procedures need to be followed at all times.
2. **Standard Work Procedures (SWPs)** will be produced as part of the control process for asbestiform mineral exposures (see Section 1.5.2 for relevant SWPs). SWPs will include, *at a minimum*, information on:
    a. Relevant Department;
    b. Relevant Work Activity;
    c. Basic Risk Assessment;
    d. For each job / task step;
        i. Identified Hazards and Potential Hazards;
        ii. Current Hazard Controls in place;
3. **People will be trained and competent** regarding the hazard, use of SWPs, the controls and why they are necessary and why they need to be followed at all times.

5.2.4 On-going Monitoring and Re-assessment

As discussed in Section 5.2.2 there will be an on-going Risk Based personal air monitoring program for asbestiform minerals. The results of this program will be assessed as they are received against both the Site Action Level and the Mineral Fibre OEL. A review of and re-assessment of controls would be conducted immediately if either levels are reached, otherwise a review will be conducted at least annually or more frequently in the early stages of operation.

5.3 Fibrous Minerals Management Hierarchy

5.3.1 Management Controls

Exposure to fibrous minerals will be maintained at an acceptable level by implementing the following key control measures and SWPs:

1. Identify the location of asbestiform minerals in the mining process as soon as possible.
2. Suppress dust and fibres at source using engineering and procedural dust-control techniques (e.g. dust suppression, enclosure or isolation of dust areas, local exhaust ventilation).
3. Immediately quarantine workplaces contaminated with asbestos until the hazard has been dealt with. Access to all areas containing fibres will be strictly controlled and monitored. Designated Areas will be established around the contamination area.
4. Implement focussed personal occupational air monitoring program to establish level of exposure risk during normal operation.
5. Implement regular surveillance of the ore mineralogy to identify the presence of fibrous minerals and ensure their disturbance is minimised.
6. Implement regular inspection of mined ore by geologists for the presence of fibrous minerals.
7. Provide appropriate information (including written SWPs), instructional training, and supervision to all employees and contractors.
8. Ensure the use of personal protective equipment will be secondary and complementary to engineering controls.
9. Conduct regular audits and air monitoring to confirm the effectiveness of engineering and procedural controls.

5.4 Work and Hygiene

The hierarchy of controls states that personal protective equipment (PPE) is the least preferred method of control, but it will be necessary for employees and contractors to wear some PPE in Designated Areas and will be necessary to perform decontamination when leaving Designated Areas.

5.4.1 Personal Protective Equipment

The wearing of protective clothing will be required for any operation where clothes could become contaminated with asbestiform minerals. The clothing will be supplied and will be a fabric that protects against fibre penetration and contamination.

Respiratory protection will be worn in Designated Areas where the risk has been determined to be significant. A disposable P2 respiratory mask will be the minimum requirement for exposures up to five times the exposure standard.

Personal protection equipment for other hazards such as airborne dust, noise and UV will also be worn.

5.4.2 Personal Decontamination

There will be a system in place for decontaminating clothing before leaving a Designated Area.

5.4.3 Equipment Decontamination

Equipment can also be contaminated with asbestiform minerals and such equipment will be decontaminated before leaving a Designated Area.

5.5 Asbestos Removal Work

As this is a new mine there will be no products used on the site that contains asbestos. The use of asbestos in any products has now been banned since 2003.

The only work which may be considered asbestos removal work is decontamination of people, equipment and workplaces from any asbestos due to handling the ore.

Processes to decontaminate people, equipment and workplaces will be similar to removing asbestos containing products.

5.6 Transport, Storage and Disposal of Fibrous Minerals

The whole lifecycle of the asbestiform minerals will be controlled at the mine site. Each part of the handling process will have controls that minimise dust generation. Dust from trucking ore will be controlled as will ore stockpiled for processing and material sent to the tailings storage facility.

Standard Work Procedures (SWPs) will apply to each part of the lifecycle of the ore and tailings. Positional monitoring will be used to confirm controls are effective.

5.7 Emergency Procedures (provision of emergency dust suppression)

In the event of an emergency, water will be sprayed to control dust emission. The spray will be sufficiently fine so as not to blow any dust into the air. Any run-off will be controlled and treated as asbestos contaminated.

5.8 Dust and fibre controls

Exploration drilling has been conducted using diamond core which requires the use of water with the drilling process. To date, the water has controlled the dust very well. Water run-off from diamond drilling has been collected in sumps which have been covered when drilling has finished.

During mining a number of different drilling operations will be required including blast hole and grade control drilling. Various techniques are available to control dust from these operations including the use of water in drilling and positive air pressure vacuum systems and the use of these or similar systems will be investigated during the design of the drilling programs.

5.9 Labelling and signage

Warning signs will be placed in all areas of the workplace where asbestiform minerals are present. They will be installed at all main entrances for such a site.

Warning signs will comply with the Australian Standard “AS 1319:1994 Safety signs for the occupational environment”. Signs will be similar to those below:

5.10 Designated Areas

There will be Designated Areas in the mine where people are potentially exposed to asbestiform minerals. These areas will be sign-posted to warn people they are entering such an area and they will have to follow SWPs. An example of sign is provided below:

The Mine Manager will maintain a Designated Area Register containing the following information for each person required to work in a Designated Area for more than ten shifts in a 12-month period.

1. Full Name;
2. Health Surveillance number;
3. Dates of training and retraining sessions; and
4. Approximate time spent in the designated area during each shift.

The register will be kept for 30 years.

5.11 Tailings

5.11.1 Details of The Design and Operation of the Tailings Dam

The tailings from the proposed development, consisting of acid leach wastes in the form of a slurry, would be disposed of to an above-ground paddock discharge tailings management facility (TMF) at a rate of around 600,000 tpa. The TMF would cover an area of around 50 ha, with an ultimate height of around 20 m.

In slurry discharge facilities the tailings material is about 50% by volume water. While water is removed through a central decant tower and the tailings could be become sufficiently dry for dust and potentially fibres to rise off the facility, Cameco has committed to maintaining a moist surface as part of radon gas management from the facility. This will also assist to minimise the potential for fibres to become airborne off the facility.

5.12 Mine Site Laboratory

Individuals working in laboratories that prepare samples of rock or ore for analysis will be informed of the potential for asbestos in the samples. This is particularly important where samples are to be crushed or milled as this can generate high concentrations of respirable fibres. This type of analysis needs to be conducted with local exhaust ventilation and areas decontaminated after analysis.

External laboratories will be notified of the potential for asbestiform minerals to be present in samples that are from parts of the deposit that might include these materials.

It is standard practice within the mining industry to wrap diamond core in cling wrap if suspected to contain asbestiform minerals. An asbestos label will be placed on these samples. If samples are drill chips or milled material this will also be labelled if it suspected to contain asbestiform minerals.

5.13 Environmental Considerations and Site Cleanup

It is likely there will be asbestiform minerals in the tailings from the processing of the ore. The TMF will have some asbestiform minerals present so controlling dust from the TMF will be required. The tailings are moist and this will significantly reduce the generation of dust and if new tailings are being added in a constant way, then the top layer will be moist and limit any dust generation. The final capping of the tailings will enclose the tailings and prevent dust being generated.

If there is any spilt ore or spillage of leaching liquids this will be to be collected and disposed of or reprocessed so that any asbestiform minerals will eventually go to a controlled area such as the TMF.

Any other area in the mine which contains waste with asbestiform minerals present will need to be capped with clean material.

5.14 Environmental Objectives and Performance Indicators

Table 5-1: Environmental Objectives and Performance Indicators

Environmental Objective	Performance Indicators
Limit the exposure of all employees and contractors to fibrous minerals (particularly asbestiform minerals)	Exposure of all employees and contractors to fibrous minerals is below the Occupational Exposure Limit for fibrous minerals
Ensure compliance with relevant legislation and standards for the storage and handling of chemicals and fuel.	No non-compliances with legislation and standards for the management of fibrous minerals.

6 DEMONSTRATING THE OUTCOME (MONITORING)

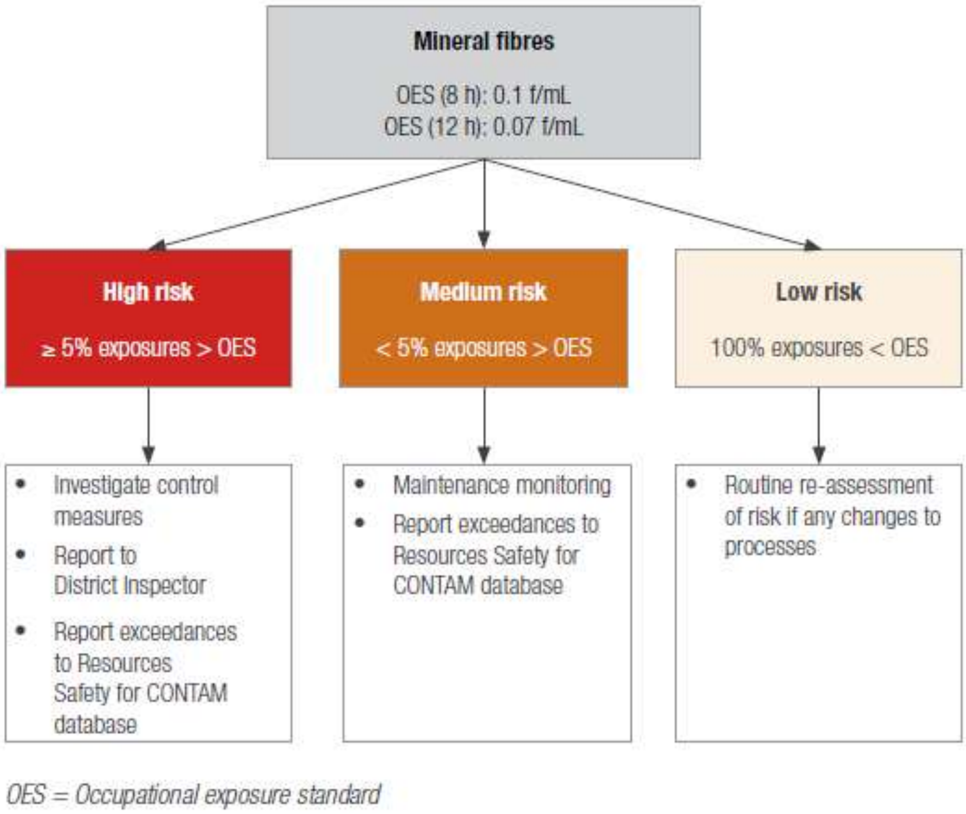

Figure 6-1: Risk assessment for mineral fibres

Source: DMP (2010), p40.

6.1 Asbestos Exposure Assessment

6.1.1 Airborne Asbestos Monitoring

An Asbestos Air Monitoring Program will be implemented using a Risk Based approach. SEGs will be established and initially a baseline conducted followed by on-going monitoring on a random basis. In the higher risk SEGs there will be more extensive monitoring.

As shown in Figure 1, the ongoing program of controls and reporting will depend on the results of personnel and positional monitoring.

6.1.2 Airborne Asbestos Action Levels

An Action Level of half the Occupational Exposure Limit will be used for personal monitoring to activate an assessment of the cause of the Action Level being exceeded. This may result in changes to controls.

6.1.3 Plan and timeframe for receiving and assessing monitoring results

It is important any monitoring samples are analysed promptly and accurately. Samples will be sent from site within 5 days of being collected and the NATA Accredited laboratory will be asked to provide results in 5 days.

The results, with some interpretation, will be provided to the individuals monitored by letter as soon as possible after receiving the results. In all instances, a contact for further information if required will be provided on the letter.

Any results that are approaching the Action Level will activate a re-assessment to determine the cause of the exposure and whether controls are adequate.

The District Inspector will be informed in writing promptly of any results that exceed the Occupational Exposure Limit.

6.2 Training

6.2.1 Employee Information and Training

All employees and contractors will have specific information and training regarding asbestiform minerals before starting work at the mine.

Training shall be delivered by persons with sufficient expertise and competency.

The level of information and training for people who work in Designated Areas will be greater than those in non-Designated Areas (namely, training would be commensurate with the expected exposure risk).

Refresher training will be completed at least annually. The training program will cover as a minimum:

- The type(s) and likelihood of occurrence of fibrous minerals at the mine.
- The nature and scope of operations involving potential exposure to fibrous minerals.
- The potential health effects of exposure to fibrous minerals, including the added risk of lung cancer due to the combination of cigarette smoking and asbestos exposure.
- Required medical examinations.
- The proper use and maintenance of respirators, and their limitations; and
- Required work practices, including the use of available engineering controls and other protective measures (e.g. personal hygiene, no smoking).

6.2.2 Training Records

Training records and information will be retained in accordance with the Cameco's information management and records retention requirements. Records and information to be kept include:

- Details of training and information provided;
- Attendance records with employee details completed;
- Evaluation sheets (if completed);
- Assessment sheets (if completed);
- Presenters name; and
- Session date and time.

6.2.3 Contractor Training

All contractors will be treated as if they were employees in terms of information and training which includes asbestiform minerals. If a contractor has to go into a Designated Area they will be provided the same information and training program on asbestiform minerals as employees.

Contractors will be required to follow SWPs for the site.

6.3 Reporting

6.3.1 Reporting to Regulatory Authorities

It is a regulatory requirement that the Cameco Mine Manager notifies the District Inspector from DMP in writing when contaminant asbestos is found at a mine. Cameco has already notified the DMP of the presence of asbestiform minerals at the mine site. Further written advice will be sought from DMP on the requirement for notifying of subsequent asbestiform minerals found at the site.

If personal air monitoring shows an exceedance of the Occupational Exposure Limit, then the District Inspector and DMP Resources Safety will be notified in writing of the exceedance within 30 days of the result being received.

All survey and monitoring results will be reported annually.

6.4 Incident Procedures (Exposure Reporting)

As discussed above any exposures above the Occupational Exposure Limit will be reported to the District Inspector of Mines.

If pit geologists become aware of large amounts of asbestiform minerals in parts of the deposit a decision will be made by the Mine Manager as to whether this ore will be processed or sent to a dedicated disposal area.

Where an exposure above the Action Level (Section 5.5.2) occurs this will be considered an Incident and be reported and assessed as an Incident.

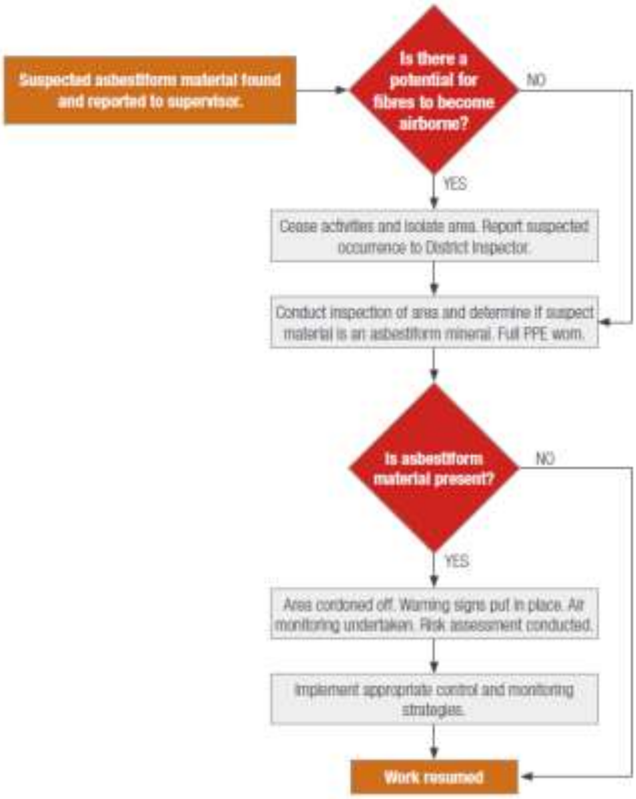

Figure 6-2: Incident response for uncovered fibrous minerals

Source: Department of Mines and Petroleum Guideline 'Management of fibrous minerals in Western Australian mining operations, 2010', p39.

6.5 Commitments

Following the completion of the design of mining operations, processing and tailings management and prior to the commencement of mining Cameco commits to completing the following.

1. **Development and Implementation of initial SWPs**. Initial SWPs identified include:
    a. Exploration
    b. Mining (SWPs for each of grade control, drill and blast, shot-firing, loading and hauling, and anybody outside of cabs while in the pit)
    c. Crushing and grinding
    d. Maintenance work on plant and equipment
    e. Laboratory
    f. Tailings
2. **Implementation of the Site Designated Area Register.**
3. **Review of SWP requirements** following baseline monitoring.

Table 6-1: Environmental Management Summary Table

Environmental Issue	Environmental Outcome (Management Objective)	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies	Related Procedures
Exposure to fibrous minerals	Enable protection of all employees and contractors by limiting exposure to fibrous minerals (particularly asbestiform minerals) to As Low As Reasonably Practicable (ALARP) and always below the Occupational Exposure Limit for fibrous minerals. Ensure compliance with the *Mines Safety and Inspection Act 1994 (WA)* and the *Mines Safety and Inspection Regulations 1995 (WA)*.	An Asbestos Air Monitoring Program will be implemented using a Risk Based approach. Audits of compliance to State and Commonwealth legislation, guidelines and Australian Standards will be undertaken regularly to maintain appropriate standards of fibrou8s minerals management.	Cameco Mine Manager will notify the District Inspector from DMP in writing if contaminant asbestos is found at the mine. Any exposures above the Occupational Exposure Limit will be reported in writing to the District Inspector of Mines and DMP Resources Safety within 30 days of the result being received. Summary of all monitoring results audits and outcomes will be detailed in the AER.	An Action Level of half the Occupational Exposure Limit will be used for personal monitoring to activate an assessment of the cause of the Action Level being exceeded.	Kintyre Project Dust Management Plan. Kintyre Project Emergency Response Plan.

7. REFERENCES

Department of Mines and Petroleum (DMP) (2010. Guideline *Management of fibrous minerals in Western Australian mining operations 2010.*

National Occupational Health and Safety (2005). Code of Practice for the Management and Control of Asbestos in Workplaces [NOHSC:2018(2005)].

Cameco Australia Pty Ltd

Kintyre Uranium Project

Greenhouse Gas Management Plan

June 2013

Date	Revision	Description	Author	Approved
20/9/12	D1	Draft	Tetra Tech	SW
16/10/12	2	Draft	Tetra Tech	SW
14/6/13	3	Final	ENVIRON	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project, located just north of the Karlamilyi National Park, Western Australia. The Kintyre Project is situated approximately 260 km northeast of Newman, 90 km south of the Telfer Mining Centre and lies 10 km north of the Karlamilyi National Park in the Little Sandy Desert bio-region.

The Kintyre Project would require the consumption of energy, primarily in the form of diesel consumption for the production of electricity and for the mining fleet. This consumption would generate emissions that have been associated with climate change, in the form of greenhouse gases.

The purpose of this Greenhouse Gas Management Plan is to meet the legislative requirements and provide a framework for Cameco to minimise greenhouse gas emissions over the life of the Kintyre Project.

2 GREENHOUSE GAS SCIENCE

2.1 Greenhouse Gases

Greenhouse gases include gases such as water vapour, carbon dioxide, methane, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) that absorb and re-emit infra-red radiation (heat), which warm the Earth's surface and contribute to climate change. The greenhouse effect, which is synonymous with climate change and global warming, has been defined as 'any change in climate over time, whether due to natural variability or as a result of human activity' (IPCC, 2007).

The impact of greenhouse gas emissions on the atmosphere is the combined effect of the radiative properties of the gases (that is, their ability to absorb solar and infra-red radiation) and the time that it takes for those gases to be removed from the atmosphere by natural processes. In order to compare the relative effects of different gases over a particular time period, Global Warming Potentials (GWP) are used, referenced in units of carbon dioxide equivalents (CO_2-e); carbon dioxide is used as the base reference, and has a GWP of 1. There are six major groups of greenhouse gases, which are listed in Table 2-1. The table also shows the GWP for each of the gases, calculated over a 100-year time scale. The table indicates, for example, that an emission of 1 kg of methane has the same global warming potential as an emission of 21 kg of carbon dioxide; that is, if 1 kg of carbon dioxide is emitted together with 1 kg of methane, the total emission would be valued at 22 kg of CO_2-e.

Table 2-1: Greenhouse gas categories and indicative global warming potentials[1]

Greenhouse gas	GWP range
Carbon dioxide	1
Methane	21
Nitrous oxide	310
Hydrofluorocarbons (HFC)	150–11,700
Hydrofluoroethers (HFE)	100–500
Perfluorocarbons (PFC)	6,500–23,900

[1] Sourced from National Greenhouse Accounts Factors 2011.

2.2 Climate Change

Climate change is a change in the average pattern of weather over a long period of time. Greenhouse gases play an important role in determining climate and causing climate change. Information on climate change and how it affects Australia's climate is available on the government's website www.climatechangeinaustralia.gov.au.

The information presented in this report is drawn from international climate change research including conclusions from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), research completed within the Australian Climate Change Science Program by CSIRO and the Australian Bureau of Meteorology in partnership with the Australian Greenhouse Office. The document also gives projections of future changes to Australia's climate and provides information on how to apply the projections in impact studies and in risk assessments.

Some of the most recent commentary is provided within the CSIRO and Bureau of Meteorology State of the Climate 2012 report which states that:

- Australian annual average daily mean temperatures have increased by 0.9 °C since 1910.
- Global average mean sea level for 2011 was 210 mm above the level in 1880.
- Sea surface temperatures have increased by about 0.8 °C since 1910.
- The main cause of the observed increase in carbon dioxide concentration in the atmosphere is the combustion of fossil fuels since the industrial revolution.
- Australian average temperatures are projected to rise by 1.0 to 5.0 °C by 2070 when compared with the climate of recent decades.

The northwest of Western Australia has experienced an increasing trend in rainfall and surface temperatures, particularly since the middle of the 20th century. Predictions of future climate change are dependent on the selected emission scenario modelled. However, in general the predictions indicate little change in precipitation in the far north with gradually decreasing precipitation moving south. Overall temperatures are expected to increase across Australia with greatest increases observed in inland Australia.

Cameco has taken the above findings into consideration in the design of the Project accounting for a possible increasing trend in annual rainfall and extreme weather events.

3 RELEVANT LEGISLATION AND STANDARDS

3.1 Federal Legislation

The primary Australian mechanism for reducing the potential for climate change is based on the Clean Energy Legislative Package which passed into law in November 2011. The package ties together a number of related greenhouse gas abatement and management programmes and introduces a price on carbon designed to promote reductions in greenhouse gas emissions from industry. The carbon price, initially $23 per tonne of CO_2-e emitted (as calculated using the NGER Technical Guidelines methodology), will apply to all enterprises that emit over 25,000 t of CO_2-e per annum, with the money raised being used to provide compensation for households against price rises associated with the carbon price, and for investment into renewable and low-carbon energy sources and greenhouse gas emissions abatement initiatives.

The NGER framework was legislated in 2007 and contains mandatory reporting provisions for companies who, as a corporation, emit over 50,000 t of CO_2-e per annum or demand over 200 terajoules (TJ) of energy or for individual facilities where these emit over 25,000 t of CO_2-e per annum or have an energy demand of greater than 100 TJ, calculated using the associated Technical Guidelines methodology. Aside from supporting the carbon pricing legislation, information from the NGERs reporting is also used in the National Greenhouse Accounts to meet Australia's greenhouse gas reporting obligations under the United Nations Framework Convention on Climate Change (UNFCCC) and to track progress against Australia's target under the Kyoto Protocol.

The *Energy Efficiency Opportunities Act 2006* was developed to improve the method of identifying and evaluating energy efficiency opportunities. Participation in the EEO program is mandatory for corporations that use more than 0.5 petajoules (PJ) of energy per year. The Act requires reporting organisations to submit five year plans that set out proposals for assessing their energy usage and to identify, evaluate and report on cost effective energy saving opportunities.

In terms of greenhouse gas abatement programs facilitated by the Federal Government, the two primary systems are the Renewable Energy Target (RET) scheme, which commenced in 2001, and the Carbon Farming Initiative (CFI). The Australian Government amended the legislation associated with the related RET scheme in mid-2010. This scheme, designed to ensure that 20 percent of Australia's electricity supply is generated from renewable energy sources by 2020, was split into the Large-scale Renewable Energy Scheme (LRET) and the Small-scale Renewable Energy Scheme (SRES) in order to provide greater certainty for people or enterprises developing renewable energy systems.

The CFI allows farmers and land managers to generate carbon credits through increasing the amount of carbon stored in soils and trees on a given area of land that can then be traded to other businesses wanting to offset their own greenhouse gas emissions.

3.2 Western Australian Legislation

The Western Australian Government had developed a range of measures and policies via its Greenhouse Strategy (2004) and Making Decisions for the Future: Climate Change Statement (2007) which were designed to develop a foundation for a carbon pricing scheme in lieu of a national carbon price or trading scheme, and so are of questionable relevance now that the carbon pricing scheme has been legislated. A Climate Change Adaption and Mitigation Strategy is currently being developed to ensure that Western Australian action on climate change targets those areas where a carbon price may not be sufficient to achieve efficient abatement.

4 ROLES & RESPONSIBILITES

Table 4-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Greenhouse Gas Management Plan.

Table 4-1: Roles and Responsibilities

Position	Responsibility
Site Manager	▪ Ensure reporting requirements for the entire Project are met
Environmental Manager	▪ Implementation and maintenance of the plan ▪ Undertakes assessment and review of the effectiveness of this management plan
Operation Managers and Site Supervisors	▪ Ensure the plan is being adhered to by all staff and contractors ▪ Participate in compliance audits and inspections
All Cameco personnel, contractors and visitors	▪ Adhere to energy efficiency initiatives

5 ENVIRONMENTAL MANAGEMENT

5.1 Purpose

The purpose of this Greenhouse Gas Management Plan is to meet the legislative requirements and provide a framework for Cameco to minimise greenhouse gas emissions over the life of the Kintyre Project.

The key environmental objectives are:

- Minimise greenhouse gas emissions where practicable for mining and operating activities.
- Ensure compliance with the National Greenhouse and Energy Reporting System and the *Energy Efficiency Opportunities Act 2006*.

5.2 Greenhouse Gas Emissions

A description of the assessment methodology and an estimate of the likely emissions associated with the Project are provided in the Kintyre Greenhouse Gas Assessment (Tetratech, 2012) and summarised below.

For the purpose of this Greenhouse Gas Assessment, emissions were broken down by scope in accordance with various international standards for emissions reporting. For the purpose of understanding the potential NGERs liability, emissions were also broken down into NGER-reportable (and thus carbon price-exposed) emissions. Figure 5-1 shows the relationship between the three emission scopes as defined in the GHG Protocol and used in NGERS reporting. Scope 1 GHG emissions are those emissions from sources owned and controlled by the organisation. Scope 2 emissions are those from purchasing energy (heat or electricity). Scope 3 emissions are all other indirect emissions that occur in the value chain of the reporting company, including upstream and downstream activities.

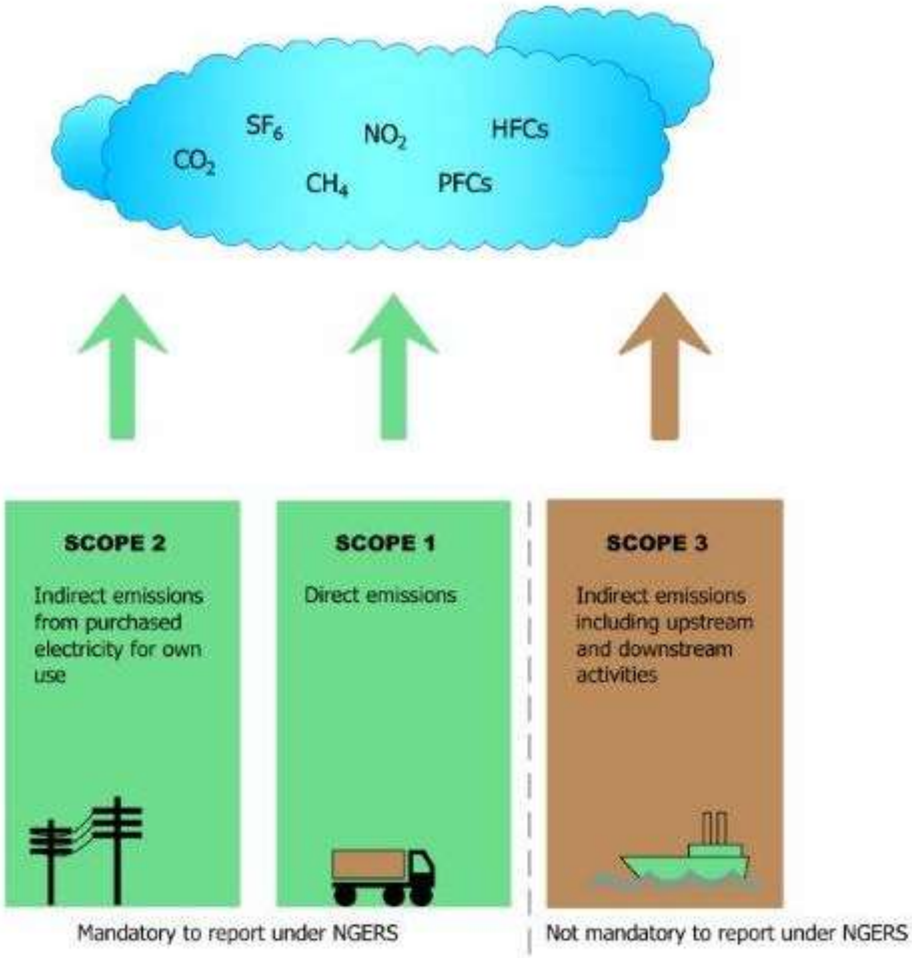

Figure 5-1 GHG emission scopes and sources across the value chain

Reporting of Scope 3 emissions by an organisation is voluntary under all of the standards relevant to this assessment (ISO 14064:1-2006, GHG Protocol, NGER Measurement Determination). Cameco has elected to report certain scope 3 emissions which are considered to be of primary interest to the Project stakeholders. In making the decision to include or exclude a certain Scope 3 emission source in the inventory, the criteria presented in Table 2, as specified within WRI and WBCSD (2011), have been taken into account.

Table 5-1: Criteria for the inclusion of Scope 3 emissions

Criterion	Description
Size	They contribute significantly to the Project's total anticipated downstream or upstream GHG emissions
Influence	There are potential emissions reductions that could be undertaken or influenced by the Company
Risk	They contribute to the Company's risk exposure (e.g. climate change related risks such as financial, regulatory, supply chain, product and technology, compliance/litigation, reputational and physical risks)
Stakeholders	They are deemed critical by key stakeholders (e.g. customers, suppliers, investors or civil society)
Outsourcing	They are outsourced activities previously performed in-house or activities outsourced by the Company that are typically performed in-house by other companies in the same industrial sector
Other	They meet additional criteria developed by the Company or the industry sector to which the Project belongs

5.2.1 Scope 1 and 2 emission sources

Table 5.2 contains a summary of emission sources associated with the Kintyre Project. Point source GHG emissions from these activities are considered as occurring within Cameco's operational boundary and are therefore categorised as Scope 1 or Scope 2 emissions and need to be reported by Cameco.

Table 5-2: Scope 1 and 2 emissions sources

Scope	Source
1	Diesel consumption by mobile fleet
	Stationary energy (electricity) generation
	Explosives
	Metallurgical emissions
	Emissions associated with land-use change (clearing)
2	Nil (electricity will be generated on-site)

5.2.2 Scope 3 emission sources

The major scope 3 emission sources to be reported for the Project are identified in Table 5.3, together with the criteria determining inclusion or exclusion of each of these emission sources in the inventory.

Table 5-3: Scope 3 emissions sources

Scope	Source	Size	Influence	Risk	Stakeholders	Outsourcing	Other	Include?
3	Product transport diesel (to Australian export port)	Y	Y	N	N	N	N	Y
	Product transport diesel (Bulk sea freight to end user)	N	N	N	N	N	N	N
	Workforce transport	Y	Y	N	N	N	Y	Y
	Further processing of Product	Y	N	Y	Y	N	N	Y
	End use of Product	Y	N	Y	Y	N	N	Y
	Raw materials generation energy	N	N	N	N	N	N	N

5.2.3 Uranium Life Cycle Emissions

Studies of nuclear fuel life cycle greenhouse gas emissions have shown that the generation of nuclear electricity produces about 65 g of CO_2-e per KWh of electricity generation (Sovacool 2008; Lenzen 2008). This emissions intensity is about 10 to 15 times less than that of other fossil fuel electricity generation and at the higher end of the range of renewable electricity generation emission intensities.

An extensive analysis of the life cycle greenhouse gas emissions of electricity-generating technologies has been undertaken (Sovacool 2008; Lenzen 2008). These studies indicated the following factors have the greatest influence on life cycle greenhouse gas emissions:

- the grade of the uranium ore mined
- the method of enrichment
- the conversion rate of the nuclear fuel cycle (i.e. the amount of fuel recycling)
- the source (fossil, renewable or nuclear) of electricity used for the enrichment phase and the overall greenhouse gas intensity of the electricity mix in the countries where fuel cycle activities are undertaken.

A high-level assessment of the life cycle greenhouse gas emissions associated with the proposed development was undertaken using available literature to estimate emissions associated with uranium production, use and disposal.

Approximately 9.05 kg of UOC is required to produce 1 kg of nuclear fuel-grade UO_2 (World Nuclear Association 2008), sufficient to generate approximately 360,000 kWh of electricity. Given the nuclear life cycle information presented above, the life cycle greenhouse gas emissions for the UOC produced by the proposed Kintyre development would be around 2.6 t of CO_2-e per kilogram of UOC, with the proposed development accounting for 0.3 t of this.

The actual generation of electricity using uranium generates no GHG emissions however would offset emissions that would otherwise occur should the same amount of electricity be generated using traditional fossil fuel energy mixes.

5.2.4 Emissions Estimate

The Scope 1 and 3 emissions estimates presented in the previous section are summarised in Table 5.4. Table 5.5 outlines the NGER-reportable emissions associated with the Project.

Table 5-4: Project GHG emissions summary

Energy demand	**Greenhouse gas emission ($t\ CO_2$-e per annum)**
Scope 1	
Electricity generation†	33,000
Mobile fleet †	41,000
Explosives †	1,700
Metallurgical emissions †	31,000
Clearing (700 ha)*	32,700
Rehabilitation offsets (520 ha)*	-24,300
Sub-total[1]	115,100
Scope 2 †	
	0
Scope 3	
Transport (diesel)	1,000
Workforce transport (Aviation Avtur)	2,000
Sub total	3,000
Total	118,100

† Mandatory to report under the NGER Act

* Calculated over life of project (ie. 12 years). Actual annual emissions will vary based on the rate of clearing per year.

5.3 Environmental Objective and Performance Indicators

Table 5-5: Environmental Objectives and Performance Indicators

Environmental Objective	Performance Indicators
Minimise greenhouse gas emissions where practicable for mining and operating activities	Greenhouse Gas Management Plan developed, implemented and periodically reviewed
Ensure compliance with the National Greenhouse and Energy Reporting System and the *Energy Efficiency Opportunities Act 2006*.	All required reporting is completed

5.4 Environmental Aspects and Management Strategies

With regards to the reduction of greenhouse gas emissions from an operation, management measures can be typically categorised as either demand-side, relating to measures that reduce the on-site demand for energy, and supply-side, relating to measures that reduce the greenhouse gas emissions associated with meeting the site demands. Table 5-6 outlines the management measures that will be undertaken to reduce emissions both demand-side and supply-side.

Table 5-6: Environmental Aspects and Management Strategies

Environmental Aspect	Management Strategy
Greenhouse Gas Emissions – Demand-side	• Optimisation of the proposed mining fleet size (number of trucks versus size of trucks) in order to best meet the targets of the mine plan and optimise diesel demand. • Optimisation of mine blasting regimes to reduce the energy required to crush the resultant ore. • Incorporation of energy efficiency measures for the accommodation and administration facilities. • Undertake monitoring to support the required reporting • Undertake emissions reporting as required by the appropriate legislation (National Greenhouse and Energy Reporting System and the *Energy Efficiency Opportunities Act 2006*). • Remove or reduce direct emissions or energy consumption resulting in direct greenhouse gas emissions where practicable. • Train all staff and contractors and make energy efficiency promotional material available on site. • Implement recycling facilities and divert waste streams from landfill where practicable.
Greenhouse Gas Emissions – Supply-side	• Use of solar hot water systems and solar photovoltaic systems for the site administration and accommodation facilities. • Use of solar photovoltaic power systems for powering the remote groundwater wells and associated pumping stations.

6 DEMONSTRATING THE OUTCOME

6.1 Reporting

The reporting requirements associated with carbon emissions for the Kintyre Project align with legislative requirements, i.e., the NGER Act and EEO Act. In addition, the Annual Environmental Report will provide detailed information on the effectiveness and implementation of this plan including greenhouse gas emissions relative to productivity over time.

6.2 Review and Revision

The suitability and success of greenhouse gas management measures detailed in this plan will be monitored against the associated performance indicators by the Environmental Manager. Site environment inspections will include monitoring to ensure appropriate management measures and reporting are being undertaken.

Audits of compliance to State and Commonwealth legislation, guidelines and standards will be undertaken regularly to maintain appropriate standards of greenhouse gas management and reporting. A summary of all audits and outcomes would be detailed in the Annual Environmental Report.

This Plan will be maintained as a live document and will be reviewed on an annual basis, or as necessary, taking into account the results of monitoring and audits undertaken during the year. Significant process changes that will or may result in a change in the nature of greenhouse gas emissions, or present greater or lesser opportunities for management of emissions will be assessed and a determination made regarding the need for an interim update of this plan. Annual reviews will address matters such as the overall design and effectiveness of the plan, progress in environmental performance, incorporation of current leading practice and any changes in relevant legislation.

Table 6-1: Environmental Management Summary Table

Environmental Issue	Environmental Outcome (Management Objective)	Management Measures	Demonstrating The Outcome (Monitoring)	Reporting	Contingencies
Greenhouse Gas Emissions	Minimise greenhouse gas emissions where practicable for mining and operating activities. Ensure compliance with the National Greenhouse and Energy Reporting System and the *Energy Efficiency Opportunities Act 2006*.	Optimise: • mining fleet size • mine blasting regimes; • metallurgical process. Incorporate energy efficiency measures across the Project; Train all staff and contractors in how to reduce energy consumption; Implement recycling in accordance with the Waste Management Plan; Incorporate renewable energy measures (solar hot water systems, solar photovoltaic systems) where practical.	Undertake monitoring to support the required reporting.	National Greenhouse and Energy Reporting System and the *Energy Efficiency Opportunities Act 2006*.	Provide additional monitoring equipment and update monitoring and reporting procedures as required.

7 REFERENCES

CSIRO and the Australian Bureau of Meteorology (2012). State of the Climate 2012.

Government of Western Australia (2007). Making Decisions for the Future: Climate Change Statement.

Government of Western Australia (2004). Western Australian Greenhouse Strategy. Prepared by the Western Australian Greenhouse Task Force.

Intergovernmental Panel on Climate Change (IPCC) (2007). Fourth Assessment Report: Climate Change.

Tetratech (2012a). Kintyre Greenhouse Gas Assessment. September 2012.

Cameco

Cameco Australia Pty Ltd

Kintyre Uranium Project

Noise Management Plan

June 2013

Date	Revision	Description	Author	Approved
15/8/12	D1	Draft	ENVIRON	SW
16/10/12	2	Final	ENVIRON	SW
14/6/13	3	Final	ENVIRON	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project (the Project), situated approximately 260 km north-east of Newman, 90 km south of the Telfer Mining Centre and 10 km north of the Karlamilyi National Park.

This Noise Management Plan (the Plan) outlines measures that will be implemented to minimise noise impacts during construction and operation of the Project. Management of noise is required to protect the amenity of nearby residents from noise impacts resulting from activities associated with the Project by ensuring the noise levels meet statutory requirements and acceptable standards.

The purpose of this management plan is to both meet the legislative requirements and provide a framework for Cameco to responsibly meet any changing environmental obligations over the life of the Project.

2 RELEVANT LEGISLATION & STANDARDS

Legislation and standards applicable to this management plan include:

- *Environmental Protection Act 1986 (WA)*;
- *Environmental Protection (Noise) Regulations 1997 (WA).*

The assigned noise levels in the *Environmental Protection (Noise) Regulations 1997* do not apply to construction activities carried out between 0700 and 1900 hours on any day except Sunday and public holidays provided:

- work is carried out in accordance with section 6 of the Australian Standard 2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites;* and
- the equipment used is the quietest reasonably available.

As mining and processing at the Kintyre Project would be a 24 hours per day operation, noise received at neighbouring noise sensitive premises from the mining and processing plant needs to comply with the assigned L_{A10} noise level of 35 dB(A) for the night period.

Table 2-1 outlines all the assigned noise levels that apply at all the Project sensitive premises.

Table 2-1: Noise Limits at Surrounding Noise Sensitive Premises

Time of Day	Applicable L_{A10} Assigned Level (dB)
0700 to 1900 hours Monday to Saturday	45
0900 to 1900 hours Sunday and public holidays	40
1900 to 2200 all days	40
2200 hours on any day to 0700 hours Monday to Saturday	35

3 EXISTING ENVIRONMENT

The closest noise sensitive premises to the proposed Kintyre Project mining operations, other than the accommodation village associated with the Project, are Nifty Mine (80 km), Parnngurr Community (80 km), Telfer Mine (90 km) and Punmu Community (113 km).

The Project area lies within a broad valley bounded by rocky flat-topped hills of the Broadhurst Ranges to the East, Watrara Ranges to the south and Throssell Ranges to the west. The proposed Kintyre accommodation village will be separated from the active mining and processing areas by low hills. Although not required under regulations, the accommodation village was also taken into consideration during noise assessments.

4 ROLES & RESPONSIBILITES

Table 4-1 provides provisional roles and responsibilities for personnel responsible for the implementation of the Kintyre Noise Management Plan.

Table 4-1: Roles and Responsibilities

Position	Responsibility
Environmental Manager	• Implementation and maintenance of the plan. • Undertakes assessment and review of the effectiveness of this management plan.
Environment Superintendent	• Formulate and implement noise monitoring programs and liaise with stakeholders regarding any complaints. • Ensure all staff are aware of their obligations in relation to this plan. • Maintain site records of complaint register and implement monitoring programs.
Operation Managers and Site Supervisors	• Ensure the plan is being adhered to by all staff and contractors. • Participate in compliance audits and inspections.
All Cameco personnel, contractors and visitors	• Report all incidents involving significant noise emissions.

5 ENVIRONMENTAL MANAGEMENT

5.1 Potential Noise Impacts

During construction and operation of the Project, activities which may contribute to noise impacts could include:

- earthmoving;
- construction of infrastructure;
- power generation;
- processing plant;
- airfield; and
- transport of Uranium oxide concentrate (UOC).

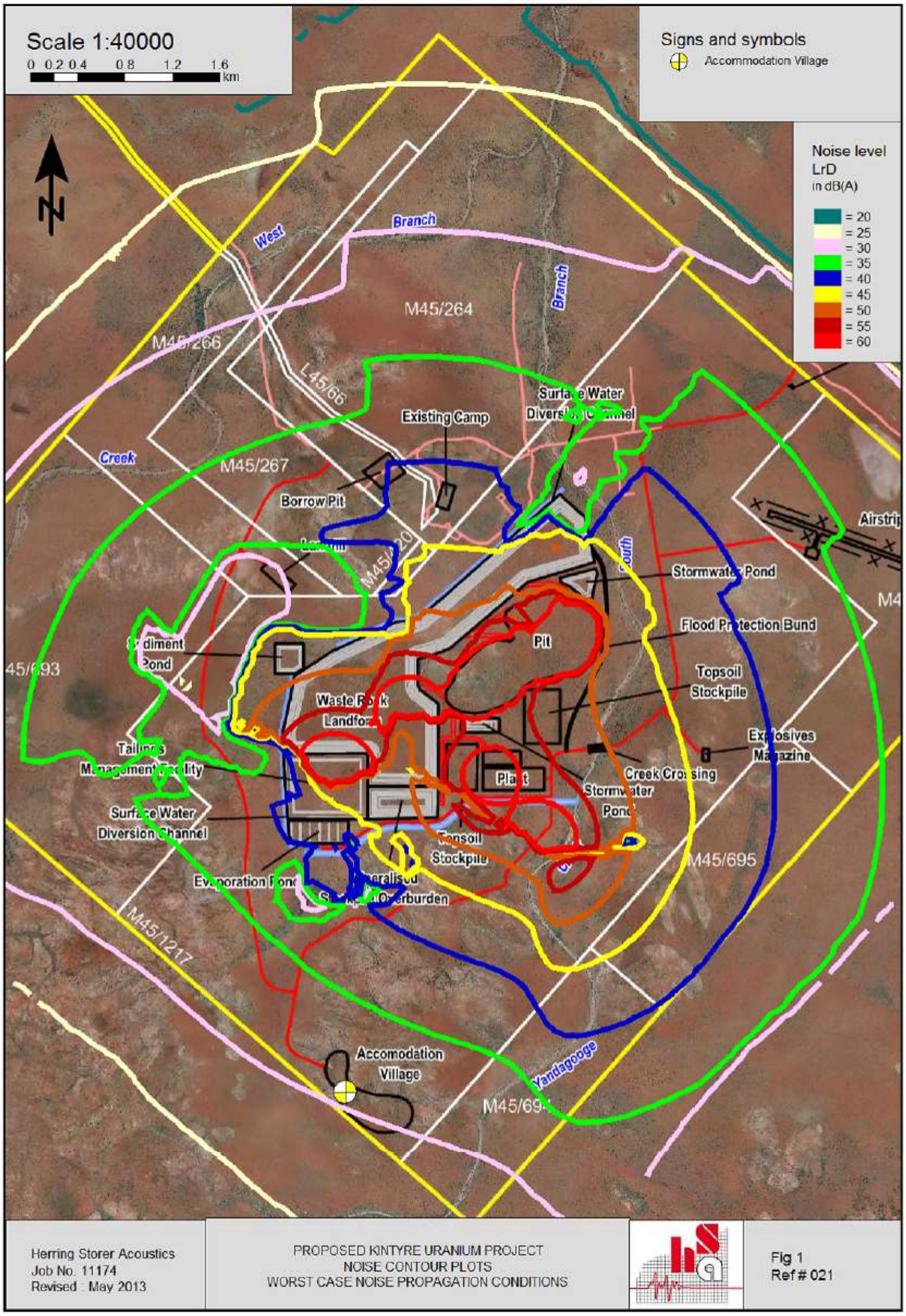
Single point calculations and noise contour calculations were undertaken for the mining and processing operations, to show the level of noise distribution. Noise levels at the settlements of Nifty, Parnngurr, Telfer and Punmu were predicted to be 0 dB(A) and hence no further analysis was carried out for these locations.

At different times of day the applicable assigned levels required to be complied with under the Noise Regulations are presented in Table 5-1. Even though the accommodation village is not required to comply with the assigned noise levels, predicted noise levels at the accommodation village are well below the assigned noise levels, indicating the amenity of personnel at the camp will be protected (Figure 5-1).

Table 5-1: Assessment of noise level emissions

Receptor	Assessable Noise Level dB(A)	Applicable Times of Day	Applicable L_{A10} Assigned Level (dB)
Accommodation village	28	Day time	45
		Day time (Sunday / Public Holiday)	40
		Evening	40
		Night time	35

Figure 5-1 Worst case noise impacts



As the Project is expected to comply with environmental protection noise requirements potential impacts are predicted to be minor, but may include:

- occupational noise impacts;
- impacts to native fauna; and
- loss of amenity.

5.2 Environmental Outcome

Even though the accommodation village is not required to comply with the assigned noise levels, predicted noise levels at the accommodation village are well below the assigned noise levels, indicating the amenity of personnel at the camp will be protected.

As such, environmental noise management will primarily comprise actions to ensure the noise generated from the Project remains within the assigned noise levels. The will be achieved through:

- physical separation of operational areas and the accommodation camp;
- verification that machinery and vehicles supplied are within specified sound power levels;
- machinery and vehicles to be operated in compliance with specifications, noise regulations and guidelines;
- regular maintenance of machinery and vehicles; and
- complaint lodging and response procedure.

5.3 Environmental Objectives and Performance Indicators

Table 5-2: Environmental Objectives and Performance Indicators

Environmental Objective	**Performance Indicators**
Noise emissions from the Project do not adversely affect the health, welfare and amenity of people and land uses	• Noise emissions comply with the assigned noise levels that apply at all the Project sensitive premises

5.4 Demonstrating the Outcomes

Management strategies have been developed and are detailed in Table 5-3.

Table 5-3: Noise Management Strategies

Aspect	**Management Strategy**
Construction	Construction activities will be carried out between 0700 and 1900 hours on any day except Sunday and public holidays Construction undertaken outside of these times will comply with the assigned noise levels in *the Environmental Protection (Noise) Regulations 1997*
Accommodation camp	The accommodation camp will be separated from the active mining and processing areas by low hills. No further noise reduction measures considered necessary.
Machinery and vehicles	Low noise machinery and vehicles will be specified where practicable. The sound power levels of machinery and equipment will be verified.
	Machinery and vehicles will be operated in accordance with manufacturers guidelines.
Maintenance	Machinery and vehicles will be maintained and serviced regularly to ensure optimal operation. Equipment in unsatisfactory condition will be tagged out for repair or replacement.
Complaints	Any complainants will be contacted to determine the nature of the noise nuisance. The cause of the noise impact will be investigated. Appropriate measures will be implemented to remove the nuisance if it is caused by operation of the Project. Feedback will be provided to the complainant regarding the cause, and remedial measures implemented.

5.5 Reporting

A noise complaint register will be maintained on site. Details of noise complaints and mitigation measures resulting from investigation of the complaints will be included in Annual Environmental Reporting.

5.6 Contingencies

Should sound power levels of ordered equipment, machinery and vehicles not meet order specifications the goods will be returned to the supplier.

In the case where equipment is not performing as specified, the equipment will be tagged out for repair or replacement.

Should repeated valid noise complaints be lodged, complaints will be investigated to assess the need for completion of a noise assessment that will be undertaken by a qualified sub-consultant. In this case a report will be prepared to address potential noise exceedances and will include practical and feasible mitigation measures that may be adopted.

Table 5-4: Demonstrating the Outcome (Monitoring)

Environmental Issue	Environmental Outcome	Demonstrating the Outcome	Reporting	Contingencies
Noise impacts	Noise levels meet statutory requirements and acceptable standards	No noise complaints	AER	Complaints investigated to assess the need for completion of a noise assessment by a qualified sub-consultant. If deemed necessary a report will be prepared to address potential noise exceedances and will include practical and feasible mitigation measures that may be adopted

6 REFERENCES

Environmental Protection Authority (2007). *Draft Guidance for Noise Assessment of Environmental Factors No. 8* – Environmental Noise. May 2007.

Cameco Australia Pty Ltd

Kintyre Uranium Project

Cultural Heritage Management Plan

June 2013

Date	Revision	Description	Author	Approved
20/10/12	D1	Draft	Cameco	SW
13/6/13	2	Final	Cameco	SW

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1 INTRODUCTION

Cameco Australia Pty Ltd (Cameco) proposes to develop the Kintyre Uranium Project, located just north of the Karlamilyi National Park, Western Australia. The Kintyre Project is situated approximately 260 km northeast of Newman, 90 km south of the Telfer Mining Centre and lies 10 km north of the Karlamilyi National Park in the Little Sandy Desert bio-region.

The Project is located within the traditional lands of the Aboriginal people referred to as the Martu. The Martu, who traditionally lived by hunting and gathering, were one of the last groups of Aboriginal people in Australia to encounter European settlers in the mid-twentieth century.

In September 2002, the Federal Court of Australia granted the Martu people Native Title rights to their traditional land. This determination stated that the Martu held Native Title to their traditional land and had the right to negotiate about future acts that would impact on these Native Title rights.

The determination covers the northern section of the Project area with the balance being subject to a further Native Title claim by the Martu that is registered but has not been finally determined. The Native Title claim area that has yet to be determined includes the Karlamilyi National Park.

Cameco respects the cultural rights and responsibilities of the Martu people and acknowledges that the Martu people have a traditional responsibility (under Martu traditional law and custom) to protect Aboriginal sites of significance to the Martu people.

During 2011 and 2012, Cameco met with Martu and Western Desert Lands Aboriginal Corporation (WDLAC) to negotiate the Kintyre Mining Development Agreement. This document includes requirements for cultural heritage management and consultation.

The purpose of this management plan is to document the consultation and decisions between Cameco and Martu and set out the processes for the protection of cultural heritage during exploration, development and mining of the Kintyre Project. At all times the requirements of Cultural Heritage Management Plan Rules, Schedule 6 of the Kintyre Mining Development Agreement (Indigenous Land Use Agreement) applies. This document is a summary of that document and is subservient to it.

2 RELEVANT LEGISLATION AND STANDARDS

The State legislation, the *Aboriginal Heritage Act 1972* (WA) (AHA) is the primary Act that applies to the protection of indigenous heritage within the Project area.

A number of policy documents are also relevant to the protection of indigenous heritage within the Project area:

- EPA Guidance Statement No.41. (Assessment of Aboriginal Heritage);
- Department of Indigenous Affairs (DIA) guidelines regarding Section 18 and Risk Assessment.

The *Aboriginal Heritage Act 1972 (WA)* provides protection for all places and objects in Western Australia that are important to the indigenous people of Australia. Proponents are required to apply for clearance from the Minister for Indigenous Affairs under Section 18 of the Act if disturbance to an Aboriginal heritage site by a project cannot be avoided. A report on the Aboriginal heritage surveys undertaken is also required to be submitted to the Aboriginal Cultural Material Committee (ACMC).

The EPA Guidance statement provides guidance for the assessment of Aboriginal Heritage as part of environmental impact assessments (EPA, 2004a). This guidance considers Aboriginal heritage as a relevant environmental factor "*in circumstances where the heritage values are linked directly to the physical and biological attributes of the environment, and when the protection and management of those attributes are threatened as a result of a proposed development*." The guidance indicates that the proponent should demonstrate that the relevant Aboriginal heritage issues have been identified and the proponent has considered how to minimise any adverse impact by the proposal on heritage values. The guidance provides a list of actions to be considered including undertaking an Aboriginal heritage survey, consultation with appropriate Aboriginal people, and, if necessary, an archaeological survey.

A number of Federal Acts are also relevant,

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Cth) (ATSIPA);
- *Native Title Act 1993* (Cth) (NTA).

3 EXISTING ENVIRONMENT

3.1 Cultural Heritage Landscape

Historically, there were two groups associated with the Project area; the Ngurlipartu and the Warnman (Tonkinson, 2012). These two language groups are now part of the Aboriginal group identified within the area who describes themselves as the Martu people. The closest Aboriginal communities are located at Parnngurr (80km south east) and Punmu (113km north east). The majority of the residents at these two communities identify themselves as Martu people. Martu people with links to the Kintyre Project area live at both Parnngurr and Punmu as well as other communities and regional towns, including Marble bar, Nullagine, Jigalong, Port Hedland and Newman.

The links between specific ethnographic heritage sites within the Project area and the broader regional cultural heritage values were considered by Professor Tonkinson (Tonkinson, 2012). He states that the area to the "*north and west of the Yandagooge Creek across to the Oakover River is quite poor in food and water resources, and would rarely have been visited traditionally*" (Tonkinson, 2012).

Tonkinson and others also provide background information relating to the importance of the broader Yandagooge Creek area in relation to Aboriginal mythology and rituals. However, this information is considered culturally sensitive and is not reported here. This Martu knowledge has been bought to the table in discussions with Cameco and measures to protect places and values have been agreed.

Archaeological evidence indicates Aboriginal habitation of the Project area has been associated with the wet season creeks and that few finds were made in the upland or relict floodplain areas (Veth, 1999).

In relation to the regional significance of the archaeological material located to date Veth noted "*None of the material recorded during the survey, either individually or considered together, is unique at a regional or national level*." (Veth, 1999).

In summary there is evidence that the Project area was inhabited historically, albeit the area was perhaps not as rich in resources as other areas.

3.2 Historical Work

A number of Aboriginal heritage surveys have been undertaken in the Project area dating back 30 years. They include:

- Regional survey by the WA Museum Department of Aboriginal Sites (WA Museum, 1980).
- Archaeological survey undertaken by Professor P. Veth in 1999 (Veth, 1999).
- Ethnographic survey undertaken by N. Green in November 2006 (Anthropos, 2006).

- Aboriginal Heritage surveys undertaken by N. Green and employees of Anthropos Australia in December 2008 and January 2009 (Green, 2008 and Green, 2009) for a section18 application.
- Archaeological survey undertaken by J. Mattner in 2011 (Mattner, 2011) for a section 18 application.
- Ethnographic survey undertaken by D. DeGand in 2011 (DeGand, 2011) for a section 18 application.
- Regional Heritage Assessment completed by Professor R Tonkinson in 2012 (Tonkinson, 2012).

The original Project owners conducted project-wide ethnographic and archaeological surveys which were the surveys conducted by Veth (Veth 1999) and Green (Green 2006). These surveys were arranged through the Western Desert Land Aboriginal Corporation (WDLAC) and involved participation by relevant Martu Traditional Owners. The survey reports have been submitted to the DIA.

Cameco has subsequently conducted additional archaeological and ethnographic surveys over specific parts of the Project area and the findings and recommendations of these later reports have remained consistent with the findings of the original reports by Veth and Green. In particular, Cameco has conducted ethnographic and archaeological surveys over sections of Yandagooge Creek prior to installing vehicle crossings and water monitoring stations.

3.3 Recent Work

Since acquiring the Project in 2008, Cameco has engaged with Martu and WDLAC. On the heritage front, a number of surveys have been conducted to clear areas for exploration related activity or to support S18 applications.

A comprehensive programme of consultation was also held to determine the heritage landscape and the implications for the proposed mining project. These consultations resulted in the development of a document called the Cultural Heritage Management Plan Rules (CHMPR). This document summarised the cultural heritage landscape and sets out a series of rules to protect the cultural values of the area. The following discussion is a simplified summary of that document.

4 HERITAGE MANAGEMENT

4.1 Ethnographic Sites

The main ethnographic features of the Kintyre landscape were recorded by Green in 2006. A further new place was listed and Cameco and WDLAC agree that Project Area has been comprehensively surveyed by competent anthropologists. The Ethnographic sites overlapping the project area are shown on Figure 4-1.

Cameco has agreed to the following measures to protect sites.

- All ethnographic Aboriginal Sites within the Project Area have been identified in the reports listed above and no further ethnographic surveys are required within the Project Area,

- Martu and Cameco have agreed a set of management rules for each site (these are summarised in the Table below),

- Prior to the commencement of mining, Cameco and WDLAC will review the Rules and prepare a detailed implementation plan.

Table 4-1: Management measures agreed for recording ethnographic sites

Management measures	Ethnographic Sites				
	Pinpi Pool	**Claypan**	**Yandagooge Creek**	**Split Rock**	**Stone Outcrop**
Impact of Proposed Mining Operations on site	No physical impact on the site. No predicted impact on water quality. The Rules require no ground disturbance within 300m of the centre of the Pool.	No physical impact on the site. The Rules require that the proposed airstrip is to be no closer than 300m from the southern boundary of the site.	The Project is within the current registered boundary of the Creek. Martu have agreed to support an application to the Aboriginal Cultural Material Committee to amend the boundary of the site to reduce it to better reflect the cultural boundary of the site. The boundaries of the existing and proposed Site are shown on Figure 4-2. Some components of the project Cameco will occur within the boundaries of the new site. Martu have agreed in principle to Cameco lodging a S18 application to permit the proposed work. Cameco has agreed to consult Martu over the location of the works. Cameco has agreed to engage Martu Heritage Monitors anytime ground	The open pit is located close to the Site and the parties acknowledge that Project activities including dust fly rock and vibration may impact the site and that the proximity of the open pit and waste rock dumps will impact the visual amenity of the Site. The Rules establish a buffer zone and requirements for working around the site.	No physical impact on the site. The Rules require no material is to be removed from the site.

			disturbing work is being conducted within the site.		
Access	Access for environmental monitoring and any other compliance related activities with the accompaniment of the Heritage Monitoring Team is approved. Cameco in consultation with Martu, may develop a plan for passive recreation including walking within the Site and the buffer area.	Access for environmental monitoring and any other compliance related activities with the accompaniment of the Heritage Monitoring Team is approved. Cameco may, with agreement of the Martu maintain or upgrade the existing track within the Site.	Within the new site Martu will agree to ground disturbing activities related to the construction and maintenance of proposed creek crossings. Access for environmental monitoring and any other compliance related activities with the accompaniment of the Heritage Monitoring Team is approved. Cameco in consultation with Martu, may develop a plan for passive recreation including walking within the Site.	Cameco will prevent site personnel access to the site other than for activities required by to implement the management plans.	
Signage	Cameco will install signage in a form approved by Martu to inform site personnel of the cultural significance of the site and to prevent unknowing disturbance of the site.	Cameco will install signage in a form approved by Martu to inform site personnel of the cultural significance of the site and to prevent unknowing disturbance of the site.	Cameco will install signage in a form approved by Martu to inform site personnel of the cultural significance of the site and to prevent unknowing disturbance of the site.	Cameco will install signage in a form approved by Martu to inform site personnel of the cultural significance of the site and to prevent unknowing disturbance of the site. Cameco will also install a ring of closely spaced posts to demarcate the site.	Cameco will install signage in a form approved by Martu to inform site personnel of the cultural significance of the site and to prevent unknowing disturbance of the site.
Ongoing Access	Cameco will ensure that	Cameco will ensure that		Subject to reasonable	

	Martu people continue to have access to and use of the Site and buffer area.	Martu people continue to have access to and use of the Site and buffer area.		limitations regarding safety and security, Cameco will ensure that Martu people continue to have access to and use of the Site.	
Other	No physical material is to be removed from within the Site or buffer. Cameco will not move the access track into the site from its current position.			Prior to the commencement of mining Cameco will carry out investigations to assess the risk to the site from mining related activities and modify the proposed activities to minimise or mitigate the proposed impact.	

Note: This information presented in this Table is a summary of the Cultural Heritage Management Plan Rules, Schedule 6 of the Kintyre Mining Development Agreement (MDA) and should not be relied as the only source. Land Managers should refer directly to Schedule 6 of the MDA.

4.2 Archaeological Sites

The Kintyre Project Area has also been the subject of a number of archaeological surveys.

Cameco and Martu agree that parts of the Project Area have been comprehensively surveyed by competent archaeologists. This includes areas covered by surveys conducted by Veth, 1999, and Bhaskar and Lafrentz.

Within the Veth Survey Area, Veth has identified a number of sites and areas he describes as Management Areas.

While it has been agreed that it is likely that all major archaeological sites have been identified and only limited archaeological inspections are required, Cameco has agreed to undertake archaeological surveys prior to any new ground disturbing activities within the Management Area and on areas outside of the areas previously surveyed by Veth and, Bhaskar and Lafrentz.

Areas that have been the subject of archaeological surveys are shown on Figure 4-3.

Cameco has also agreed to engage monitors to observe all new ground disturbing activities within the Veth Survey Area.

4.3 Cultural Awareness Training

Cameco will provide reasonable cultural awareness training to all staff, contractors and consultants who are engaged in activities on Martu land, including Cameco senior managers who are likely to have a significant relationship with Martu people.

Cameco will develop the scope of the training in collaboration with WDLAC and Martu.

4.4 Consultation

In the MDA, Cameco and WDLAC have agreed to establish a committee for the purposes of regular communication. This committee is called the Relationships Committee. This Committee will oversee the implementation of the CHMP Rules.

4.5 Heritage Management Objective and Performance Indicators

Table 4-2: Heritage management objectives and performance indicators

Management Objective	Performance Indicators
Implement the CHMP Rules as agreed with Martu.	All tasks implemented. Review conducted by Relationship Committee confirms compliance.
No unauthorised impact on Aboriginal heritage sites.	No incidents recorded in relation to breaches of the Rules or unauthorised disturbance of a cultural heritage site.

4.6 Environmental Aspects and Management Strategies

Table 4-3: Environmental aspects and management strategies

Environmental Aspect	Management Strategy
Management of recorded Aboriginal Cultural heritage sites.	• Develop the detailed processes and methodologies for the implementation of the CHMP Rules (Schedule 6 Of the MDA) • Implement the CHMP Rules • Conduct annual Cultural Heritage Awareness training for all site staff • Ensure all site staff are aware of Cultural “No Go” zones across the Project Area
Protection of any new or unrecorded sites	• Implement the Ground Disturbance Permit Form • Implement the CHMP Rules if further surveys are required

5 DEMONSTRATING THE OUTCOME

5.1 Assessment

Prior to the commencement of mining Cameco will construct the protective measures including protective posts and signage agreed in the CHMP Rules and review the implementation of these measures with the Relationships Committee.

5.2 Auditing

Cameco will conduct an annual review of the implementation of the CHMP Rules and the status of the areas to be protected by the Rules.

5.3 Reporting

Cameco will provide an annual report on heritage management and the implementation of the CHMP Rules to the Relationships Committee.

5.4 Review and Revision

This Plan will be maintained as a live document and will be reviewed on an annual basis, or as necessary, taking into account the results of monitoring and audits undertaken during the year and considering any proposed significant changes to the Project footprint. Annual reviews will also address matters such as the overall effectiveness of the plan, progress in performance, incorporation of current leading practice and any changes in relevant legislation.

Figure 5-1 Kintyre Project Area and Ethnographic Sites

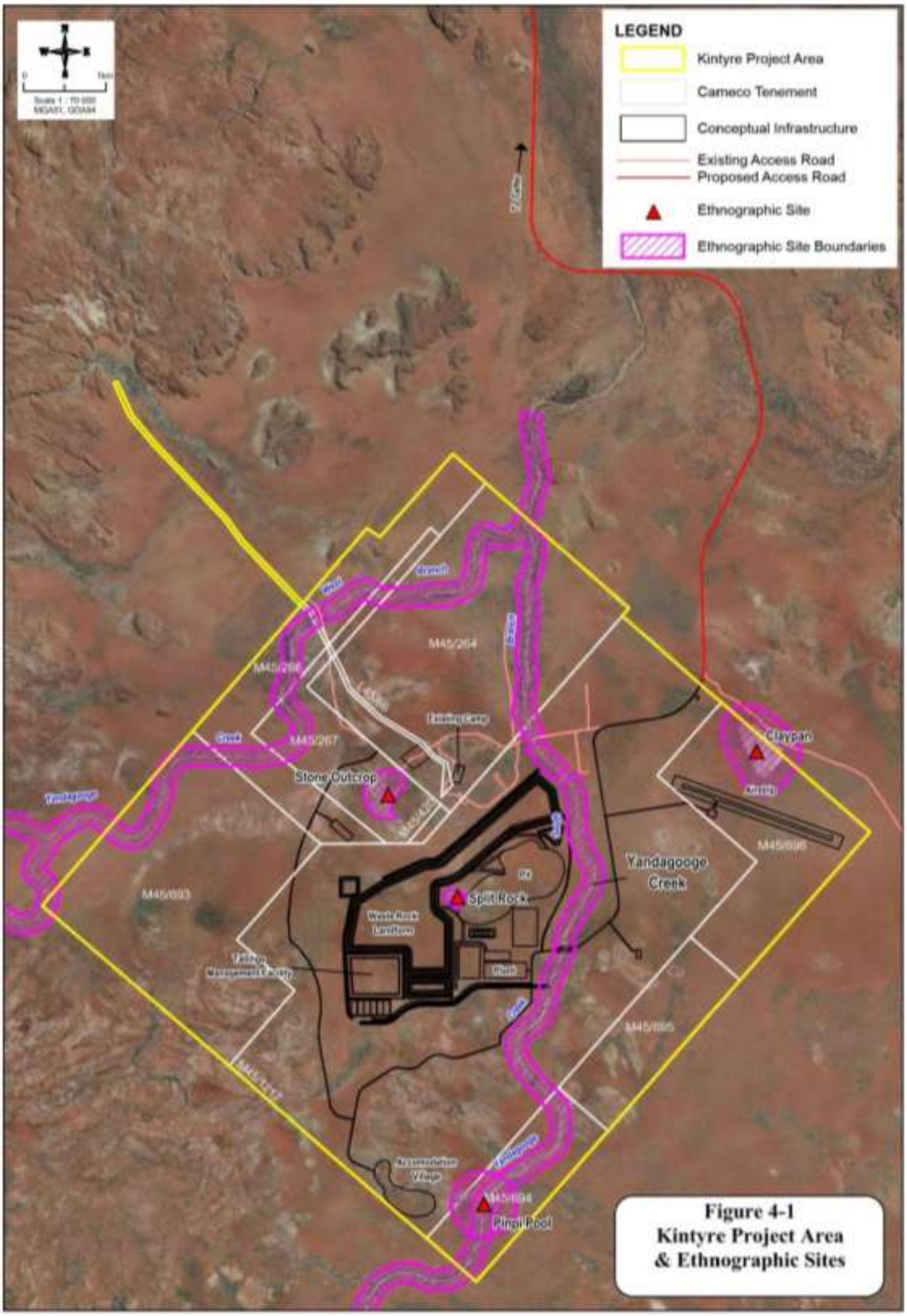


Figure 5-2 Yandagooge Creek Site Boundaries

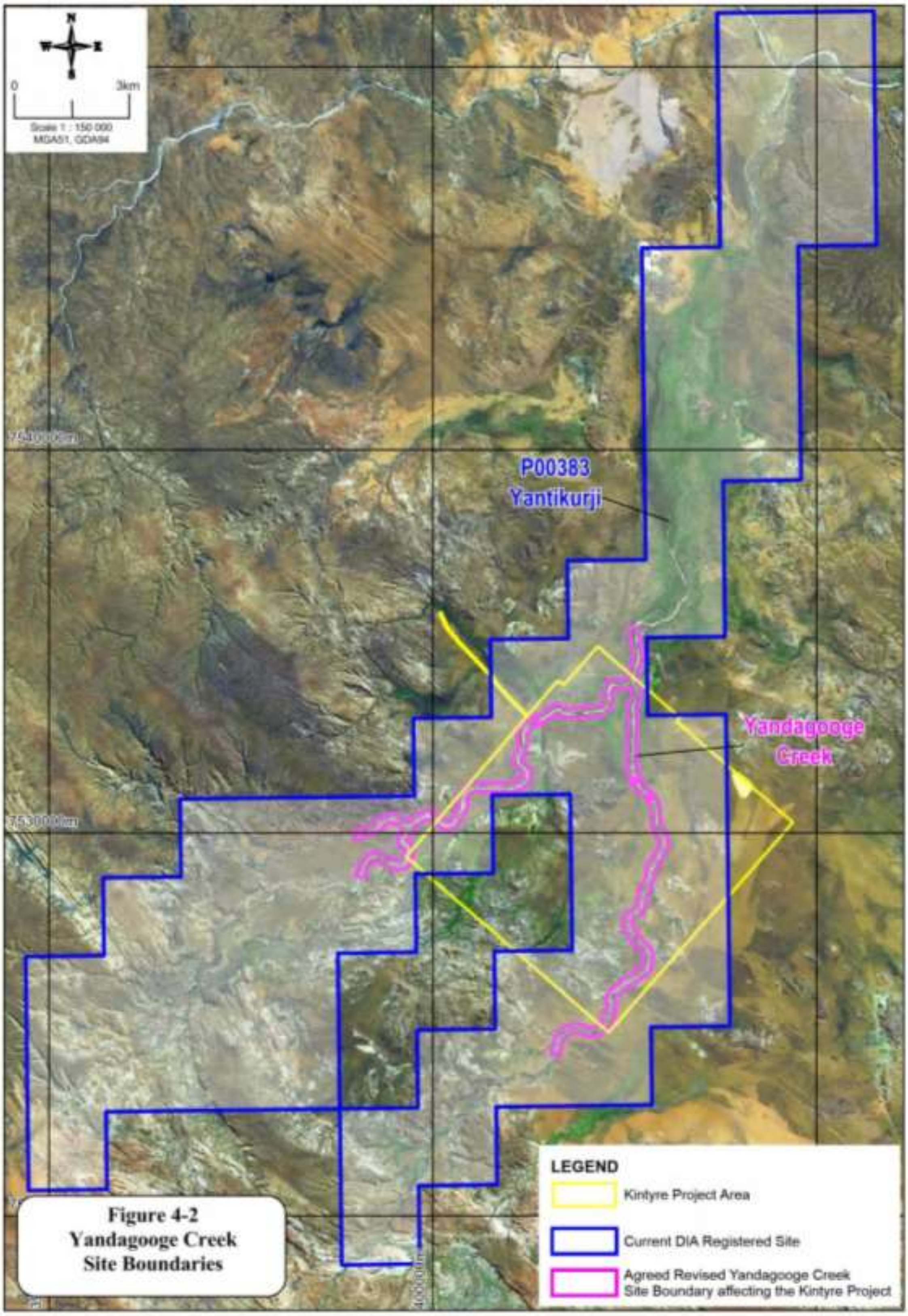
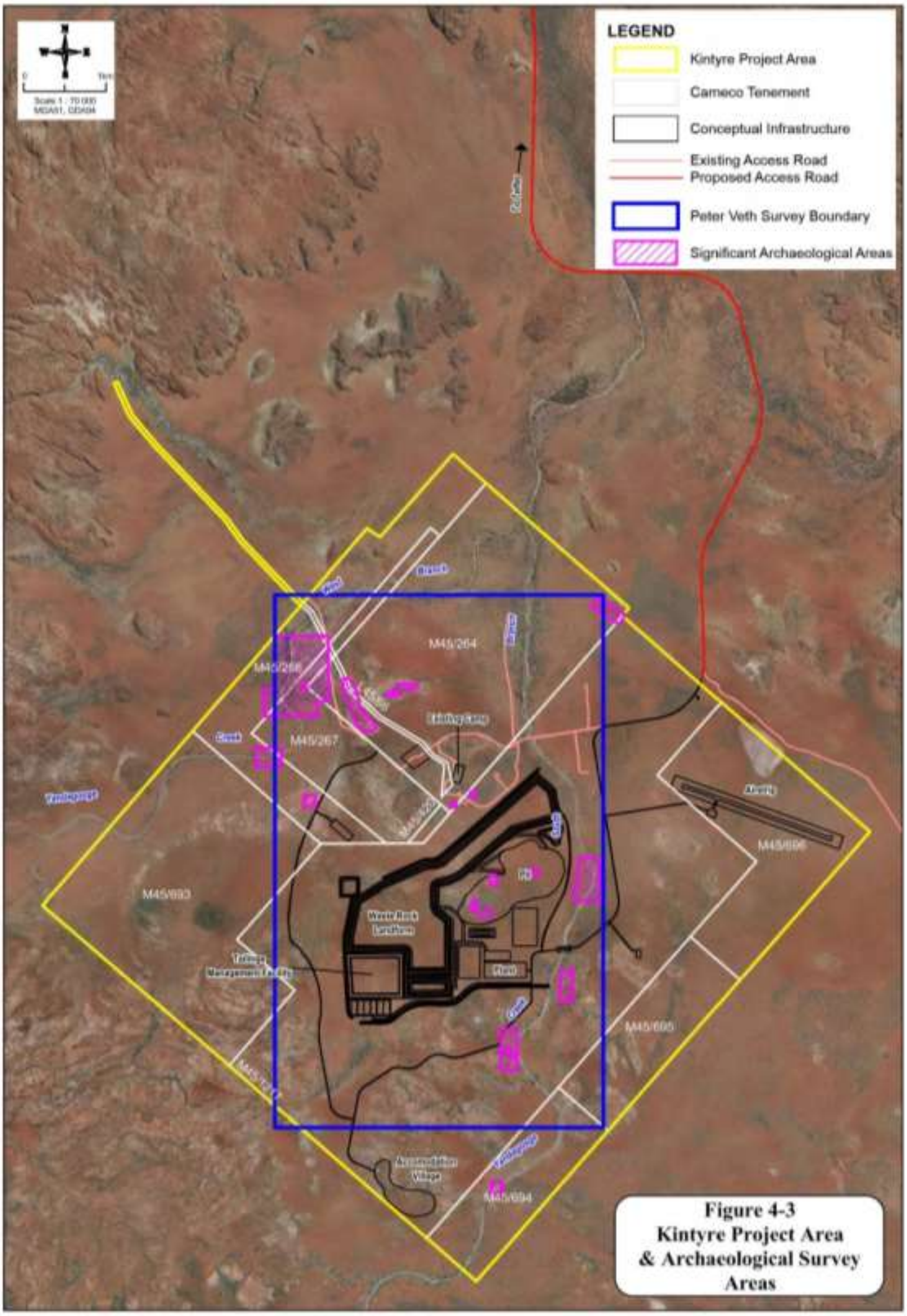


Figure 5-3 Kintyre Project Area and Archaeological Survey Areas



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Cameco Australia Pty Ltd

Kintyre Uranium Project

Mosquito Management Plan

October 2012

Date	Revision	Description	Author	Approved
15/8/12	D1	Draft	Bennelongia	SW
16/10/12	2	Final	ENVIRON	SW

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1. INTRODUCTION

Cameco Australia Pty Ltd proposes to develop a uranium mine at Kintyre, which is located 60 km south of Telfer and 260 km north-east of Newman at the western edge of the Great Sandy Desert in the East Pilbara region of Western Australia. In mid-2009, Cameco established a small permanent camp to facilitate mineral exploration and environmental surveys of the area.

The purpose of this document is to assist in minimising risks posed by mosquitoes to the Project workforce and to that end the document:

- proposes a framework to avoid, minimise and manage risks posed by mosquitoes at the camp;
- presents a generic management framework which can be applied, through timely review and revision, to the construction and operational phases of the proposed Kintyre Uranium Mine; and
- presents the results of initial assessments of mosquito occurrence and potential breeding sites in the vicinity of the camp.

2. RELEVANT LEGISLATION & STANDARDS

The Western Australian *Health Act 1911* includes provisions for the drafting of regulations and by-laws relating to pest or disease vector management under the following sections:

- Part IV Sanitary Provisions;
- Part VII Nuisances and Offensive Trades; and
- Part IX Infectious Diseases.

The *Health Act 1911 (WA)*, and subsidiary legislation gives the following powers relating to mosquito management to local shires:

- the preparation and implementation of management programs to control pest mosquitoes and disease vectors;
- ensuring that appropriate mosquito management is planned and implemented by land owners, including monitoring, community education and the adoption of mosquito avoidance strategies; and
- in partnership with the Western Australian Department of Health Mosquito Borne Disease Control Unit, control and manage outbreaks of mosquito borne diseases.

As outlined in their Policy Statement number 1, the Conservation Commission:

- opposes in principle any mosquito control in wetlands of high conservation value;
- supports planning and design initiatives which minimise mosquito impacts on residential areas (e.g. buffer zones);
- where control is necessary, advocates the preferential use of controls which target mosquitoes and have minimal impact on natural environmental values; and
- generally considers fogging (the application of fine aerosol insecticide sprays) to be an unacceptable method of mosquito control.

3. EXISTING ENVIRONMENT

3.1 Mosquitoes as Pests

There are well over 200 species of mosquitoes in Australia (EPA 2000; Lindsay 2009), of which at least 90 occur in Western Australia. Of these, only a small proportion are both commonly abundant and represent significant pests because of their capacity to transmit human diseases or cause a nuisance by biting.

All species of mosquitoes lay their eggs in areas where there is water, usually in natural and constructed wetlands, rain water tanks, pot plant saucers, tree hollows, gutters or debris that retains water. The eggs can hatch within a few days and there are four larval stages before a pupa forms. It takes only 7 days for some species to progress through the larval stages to the emergence of adult flying mosquitoes. After emerging, adults mate. Males feed on plant material and never bite, but females require a rich source of protein such as blood to fuel egg development. Most species do not preferentially feed on humans. Some rely on cold blooded prey; others feed preferentially off a wide variety of warm blooded animals. Adult male mosquitoes usually stay close to the breeding area but females may disperse over several kilometres to obtain a feed of blood. They home in on the animal or human source of blood by detecting exhaled carbon dioxide.

The number of eggs mosquitoes lay in a single batch varies between about 20 and a few hundred, depending on the species. After laying a batch of eggs, female mosquitoes repeat the cycle of feeding on blood, brooding and then laying eggs. Some species have only one generation per year, but most brood their eggs over much shorter periods and complete a cycle of blood ingestion and egg laying every few days. It is the repeated feeding on blood by female mosquitoes that provides the critical pathway for the transmission of diseases between host organisms. The mosquito proboscis contains very fine tubes, or stylets, that are inserted into the skin when the female bites. Blood is sucked up one stylet and saliva is injected down the other. When pathogens are ingested in a blood meal, they are incubated within the female mosquito for a period of about 10 days and then may be transmitted to new hosts through the saliva. Adult female mosquitoes must live about two weeks after their first blood meal to become disease vectors.

Mosquitoes are vectors for three types of pathogenic organisms:

- filarial worms such as nematodes that may cause diseases such as lymphatic filariasis;
- plasmodia or protozoans, which may cause malaria among other diseases; and
- arboviruses, which are responsible for dengue fever, Ross River virus and Australian encephalitis.

The mosquito-borne diseases of greatest concern in north-western Australia are the following arboviruses, for which no specific cures or vaccines are available:

- Ross River (RR) and Barmah Forest (BF) virus belong to a group of diseases referred to as epidemic polyarthritis. The occurrence of these diseases is widespread in Australia. These diseases often result in chronic, debilitating arthritic symptoms and feeling of unwellness, especially among adults. In Western Australia, there is considerable focus on the occurrence of epidemic polyarthritis diseases because of the significant number of people contracting the diseases (mostly RR) in the south-west. However, the exposure rate is much higher in the north-west.
- Australian encephalitis (AE) was first isolated in 1951 from the Murray Valley region and is often referred to as Murray Valley encephalitis. Kunjin virus is closely related. In Western Australia, AE is restricted to the northern part of the State. It is a potentially fatal disease that can also cause permanent brain damage. The exposure rate is high in some outback communities.

In addition to being disease vectors, mosquitoes can cause a significant nuisance and impact on amenity values, through their persistent biting. Mosquito bites may also become infected.

The mosquito management framework in this document is aimed at minimising exposure to RR, BH and AE and to reducing the level of nuisance mosquito biting.

3.2 Factors affecting mosquito occurrence and disease risk

There are several factors determining the abundance of mosquitoes, of which water is the most important. The threat of disease is dependent on whether the mosquito is a competent vector and the level of human exposure, which can be viewed as the frequency of mosquito bites. Manipulating mosquito abundance and the level of human exposure are usually the most cost-effective ways of managing mosquitoes and associated disease. Mosquito competence is most directly related to the prevalence of disease among alternative vertebrate hosts (such as wallabies) and is beyond the scope of this framework.

Access to water is crucial to mosquito breeding. In the absence of water, mosquito breeding does not occur and few adults will be found. Providing water within a development site in artificial pools is likely to create breeding mosquito populations. Possible water sources are sewage treatment ponds, poorly maintained swimming pools, inundated wheel ruts, water tanks and any open containers stored on-site. Minimising the available water within a development site will reduce mosquito nuisance and disease risk. In some cases, such as swimming pools and sewerage ponds, managing standing water in such a way as to reduce its attractiveness to mosquitoes is a more appropriate option than eliminating the water source.

Natural wetlands can be major breeding areas for mosquitoes. Tidal salt marshes are a well-recognised source of mosquitoes but inland saline and freshwater wetlands (including river pools) can also be important mosquito breeding areas. In most cases, mosquito larvae in saline and freshwater wetlands persist amongst dense vegetation that provides shelter from predators, or in small ephemeral pools on the wetland margins where few predatory species occur. The distance of natural wetlands and watercourses from developments has a significant impact on the potential for mosquitoes to impact humans. Mosquitoes readily travel 2-3 km from a waterbody to food sources. If the distance is greater, few mosquitoes from the waterbody will bite people despite records showing that a few mosquitoes of some species will travel 20 km.

The risk of contracting mosquito-borne disease (and of mosquito nuisance) will be reduced by any mechanism that reduces mosquito populations, whether it acts on larvae or adult mosquitoes. Mosquito control can be achieved through biological control by introducing approved microbes or fish into wetlands to reduce larval populations. Control of both larvae and adults can be achieved chemically. However, the application of chemical controls, which have indiscriminate effects, may also negatively impact non-pest species and communities, some of which may prey on mosquitoes.

Adopting of low risk behaviours is another way of reducing the risk of contracting mosquito-borne disease. This includes the use of protective clothing and insect repellents plus the avoidance of unscreened outdoor areas, particularly during high risk periods associated with warm wet conditions and twilight hours when many species are most active. The provision of awareness programs to promote understanding and the adoption of low risk behaviours is an important part of managing the impacts of mosquitoes.

4. ROLES & RESPONSIBILITIES

The implementation of this plan is primarily the responsibility of the Project Health and Safety Officer. It is also the responsibility of all senior staff at the Camp to support a culture of compliance with the initiatives outlined in this plan, and the responsibility of all employee and contract personnel at the Project to ensure their cooperation with the management framework.

5. ENVIRONMENTAL MANAGEMENT

5.1 Management Objectives

The broad objectives of this plan are to:

- minimise the risk of staff contracting mosquito borne diseases to the Project;
- maintain the level of nuisance biting from mosquitoes at the Project within an acceptable level;
- provide a framework for the effective management of mosquitoes at the existing camp that can also be applied to expanded mining operations at Kintyre;
- minimise the impact of mosquito controls on the natural environment; and
- comply with legislative and regulatory requirements relating to mosquito control.

This plan does not provide a detailed management framework for the control of problem mosquitoes. It does, however, provide advice on who to contact for specialist advice if workers contract mosquito borne diseases or there is a perceived need for substantial reduction of mosquito populations.

5.2 Management Approach

This plan does not attempt to eliminate mosquitoes at the Project. Instead it adopts an adaptive management approach, based on the general monitoring and evaluation framework that was developed by the World Union (International Union for the Conservation of Nature, IUCN) (Hockings et al 2006) and is outlined in the Australian and New Zealand Standard ISO 14001 series Environmental Management Systems (Australian/New Zealand Standard 2004). Monitoring and evaluation is a process of “learning by doing” in a systematic and purposeful way (Stem 2005). In the case of mosquito management at the Project, measured mosquito populations will be compared with predicted populations. Information on the level of disease risk and the nuisance level of mosquitoes (as measured by staff complaints) will also be considered. This creates a decision matrix that will trigger implementation of preparatory and reactive management actions appropriate to the varying levels of disease risk and biting nuisance. An ongoing review of management effectiveness will inform the refinement of management strategies.

5.3 Management Strategies

Reducing disease risk and nuisance from mosquitoes may be achieved through reducing the number of mosquitoes or reducing human exposure to mosquitoes.

Reducing mosquito numbers involves either the manipulation of natural habitats to reduce the area of successful mosquito breeding habitat or the application of chemicals to reduce numbers of adult mosquitoes. Chemical controls may act on either immature stages or adults. In very general terms, when breeding habitats are well defined and not overly extensive in relation to the area of residential dwellings, mosquito control is achieved either by habitat manipulation or chemicals aimed at immature stages. When breeding habitat is widespread and extensive in relation to the residential area, control is achieved by fogging adult mosquitoes.

Reducing exposure can be achieved by excluding mosquitoes from buildings and staying indoors, or by planning outdoor activities during times of low mosquito activity, wearing protective clothing and using mosquito repellents.

A major component of any mosquito management plan is awareness of weather-related variation in the level of mosquito risk, which is usually achieved through monitoring of breeding sites. It can also be achieved through monitoring of potential breeding habitat (e.g. noting occurrence of large tidal or cyclonic flood events) or keeping records of adult mosquito activity.

This mosquito management plan recommends initial focus on preparatory and pre-emptive measures in order to minimise the requirement for chemical control and the manipulation of natural habitats. The management framework proposed in this plan incorporates the following management strategies:

- physical aspects of development design and on-site management;
- workforce management, communication and training; and
- the use of monitoring to trigger the implementation of biological and chemical controls.

5.4 Development design and site management

5.4.1 Development design and site management objectives

The objectives of the design and site management strategy at Kintyre for mosquito control are to:

- minimise the provision of unnatural mosquito breeding and resting habitats at the Project;
- minimise mosquito use of the Project infrastructure that unavoidably provides mosquito habitat; and
- where practicable, incorporate mosquito control design considerations when planning the development of the expanded mine site at Kintyre.

5.4.2 Development design and site management implementation strategy

The management initiatives outlined in Table 5-1 will be implemented to achieve the objectives outlined in section 0 above.

Table 5-1: Development design and site management initiatives

Management Initiative	Timing
D1 Building and Infrastructure Standards	
the Project buildings will incorporate the following standards: • Air conditioning in all accommodation, recreation and office buildings; • Windows that can be opened to have mosquito effective screening; • Where practicable and in line with cyclone engineering standards, self-closing screen doors will be fitted; • Mosquito proof cowls on toilet vent stacks. Mosquito access to pipes, stored water and buried sewage treatment tanks will be prevented by the installation of mosquito mesh, or where appropriate, surface oil films. Permanent pools of water e.g. wash down facilities, bore sumps and any surface waste water disposal facilities will be characterised by: • Ponds with smooth steep sides and no aquatic or close perimeter vegetation; • Retention capacities that prevent overflow into unmanaged ditches; • Easy access to facilitate maintenance; and • Mechanisms to prevent the pooling of water at waste water disposal sites.	Remediation to reach the listed standards will be progressive. Results of the mosquito survey in June 2011 indicate that Camp infrastructure currently does not incorporate all of these standards and a list of remedial actions likely to reduce the incidence of biting mosquitoes is provided in Appendix A.
D2 Infrastructure inspection and maintenance program	
Site management will implement a building and Camp infrastructure monitoring and maintenance program incorporating the following components: • Regular inspections of buildings and infrastructure in order to ascertain their state of repair, and identify maintenance and remediation requirements to ensure effective elimination of mosquito access into buildings and artificial breeding areas. Particular attention will focus on the building and infrastructure standards outlined in management initiative D1 above, plus guttering, surface water drainage and the potentials for water to pool beneath buildings, and any other potential artificial breeding areas; • The encouragement of the Project personnel to report damaged or failed mosquito protective measures associated with building and infrastructure design; • Prioritisation and implementation of necessary maintenance and remediation works identified during inspections and by Camp personnel. • Documentation of inspection dates and damage reports, descriptions of damage and failed infrastructure, dates and descriptions of repairs and remediation actions.	Inspection will be conducted prior to the predicted wet season in November and within 5 days of the commencement of heavy winter rains. Repeat inspections will be conducted every two months during wet periods. At least temporary but effective repairs to prevent mosquito access into buildings and artificial breeding habitats to be implemented as soon as possible and during warm wet periods, within 3 days of an inspection or damage report, with permanent repairs initiated (e.g. parts ordered) within 7 days of an inspection or receipt of a damage report.

<table>
<tr><th>Management Initiative</th><th>Timing</th></tr>
<tr><td></td><td>The maintenance log will be ongoing.</td></tr>
<tr><td colspan="2">D3 Rubbish and stored materials</td></tr>
<tr><td>One of the following approaches will be adopted for managing rubbish and stored materials:
• Either ensure that all rubbish and stored materials with the capacity to trap standing water are placed under cover, or
• Prior to rubbish disposal, minimise the potential for standing water by e.g. puncturing or crushing containers, and during periods of rain, inspect all rubbish and stored materials within 3 km of the Project to eliminate standing water focusing on tyres, drums and any other containers. Any standing water should be eliminated; e.g. drained by tipping the water out.</td><td>The management option to store rubbish and materials under cover is ongoing.

Inspections of exposed rubbish and stored materials should be conducted within 5 days of significant rainfall and subsequently every week until the rainy period has ceased.</td></tr>
<tr><td colspan="2">D4 Vehicle use</td></tr>
<tr><td>Vehicles, vehicle wash down equipment and access roads and tracks will incorporate the following standards:
• All vehicles will be fitted with air conditioning and/or have screened cabins where practicable.
• Vehicle and equipment wash down facilities will be designed to minimise the potential for water pooling for periods greater than 5 days. Water that pools for longer than 5 days will be monitored for mosquito larvae and where necessary treated with a biological or chemical larvicide (refer to Table 5-5 for additional information about larval monitoring and treatment).
• Access roads and maintenance areas within 3 km of the Project will be maintained to facilitate surface water runoff and wherever possible, prevent pooling for periods greater than 5 days. Where access permits, wheel ruts that pool water will be filled or monitored for mosquito larvae and treated with a larvicide when appropriate.</td><td>The implementation of vehicle design standards will be ongoing.

Wash down facility inspections will be conducted every week when standing water persists.

Maintenance of access roads and maintenance areas to minimise depressions and wheel ruts will be ongoing.</td></tr>
<tr><td colspan="2">D5 The Design of Future Expansions of Camp and Mine Development</td></tr>
<tr><td>Infrastructure at Kintyre will give consideration to, and where practicable incorporate the following design characteristics in order to minimise the exposure of site personnel to biting mosquitoes:
• Incorporate the design standards outlined in management action D1 above;
• Where possible, site accommodation, plus offices workshops and other infrastructure requiring the prolonged presence of personnel, to be located in areas upwind and as far as possible away from natural mosquito breeding areas and as far as practicable from waste water disposal areas;
• Either minimise the presence of dense vegetation in the vicinity of waste water disposal and other ponds plus areas used extensively by site personnel, or apply a residual surface spray with the active ingredient of bifenthrin to strategically planted vegetation just beyond cleared buffers immediately surrounding waste disposal and building</td><td>During the design phase of future planned expansions</td></tr>
</table>

Management Initiative	Timing
infrastructure (Refer to Table 5-5 for additional information about bifenthrin); • Where practicable, locate surface water pools in exposed locations downwind from accommodation, office and other major workplace locations to both promote wind induced surface water disturbance, and minimise wind driven dispersal towards sensitive accommodation and workplace areas. • Design waste water treatment ponds to avoid the growth of reeds and other shoreline plants and design waste water discharge facilities to avoid surface water pooling.	

5.4.3 Development design and site management performance indicators

To assist in reviewing the effectiveness of this plan and its implementation in controlling mosquitoes at Kintyre, performance against the design and site management performance criteria outlined in Table 5-2 will be assessed on an annual basis.

Table 5-2: Development design and site management performance indicators

Indicator No.	Performance indicator	Measure	Management Target
I	Elimination of artificial mosquito breeding habitats (provision of standing water for a period of 7 or more days) at, or within 3 km of, the Project.	Number of avoidable mosquito breeding habitats remaining	zero
II	Implementation of repair and maintenance required following the identification of mosquito protection infrastructure damage or failure	% incidents where effective (permanent or temporary) repair is implemented within 24 hours of a damage report and permanent repair is initiated (e.g. parts ordered) within 7 days of a damage report.	100%
III	Incorporation of mosquito pest minimisation building and infrastructure design attributes into future Kintyre camp and mine site expansions.	% of design attributes listed in this plan incorporated in future Kintyre expansions	100%

5.5 Communication, Training and Personnel Management

5.5.1 Communication, training and personnel management objectives

The objectives of the communication, training and personnel management strategy in relation to mosquito control at the Project are to ensure that:

- all personnel are aware of:
  - health risks associated with mosquito bites and their personal role in minimising the risk of introducing mosquito borne diseases to the Project;
  - protective clothing requirements during periods of high mosquito risk;
  - their responsibilities to notify the Project Health and Safety Officer of any infrastructure maintenance requirements;
- personnel involved in maintaining infrastructure which unavoidably provides mosquito breeding habitat; e.g. waste water disposal facilities and wash down bays, have a thorough understanding of management requirements to minimise mosquito use of these habitats; and
- liaison with health professionals is maintained.

5.5.2 Communication, training and personnel management strategy

To achieve the objectives outlined in section 0 above, the management initiatives outlined in Table 5-3 will be implemented.

Table 5-3: Development design and site management initiatives

Management initiative	Timing
C1 Provision of protective clothing and repellent	
Company staff deployed at the Project will be provided with protective clothing suitable for mosquito protection consisting of long sleeved shirts and long trousers made of durable close weave mosquito bite-proof fabrics, plus optional face nets to be worn over protective head gear. Insect repellent containing diethyl toluamide (DEET) or picaridin will be made available to personnel based at the Project.	Ongoing
C2 Personnel awareness and induction	
All the Project personnel will attend an induction that addresses the following topics: • health risks associated with mosquitoes; • early symptoms of mosquito borne diseases and responsibilities to notify the Project Health and Safety Officer of any such symptoms (Appendix B); • how to minimise the risk of mosquito bites both at the Project and off-site by wearing protective clothing and repellent, minimising the time spend outdoors, especially during dawn and dusk and avoiding high risk areas such as swamps and marshes; • company requirements for protective clothing consisting of long sleeved shirts and long trousers made of mosquito bite proof fabrics as well as company advice to use repellent at all times when outdoors during high mosquito risk periods (declared by the Project Health and Safety Officer – refer to Table 5-5); • responsibilities to notify the Project Health and Safety Officer of any maintenance requirements associated with mosquito	Inductions to be delivered prior to deployment or on arrive at the Project.

Management initiative	Timing
control design initiatives; and • responsibilities to notify the Project Health and Safety Officer of problem levels of biting mosquitoes at the Project. Personnel involved in the management of the Project infrastructure which unavoidably provides mosquito habitat; e.g. waste water disposal areas and bore sumps will be inducted on mosquito monitoring and management frameworks relating to that infrastructure.	
C3 Information updates	
the Project personnel will be informed when high risk mosquito periods are declared based on monitored mosquito levels, high rainfall events, and/or the recorded presence of a mosquito borne disease within 100 km of the Project. Personnel will be reminded of the importance of adopting low risk behaviours and the use of protective clothing and repellents during high risk periods.	During wet periods, personnel will be informed of mosquito risk levels within 24 hours of mosquito monitoring results or other trigger levels being known.
C4 Health professional liaison	
Liaison with Local Government Health Officers at the Shire of East Pilbara (Ph. 08 9175 8000) will be maintained in order to: • monitor reports and warnings relating to mosquito borne diseases in the east Pilbara region; • maintain up-to-date information relating to mosquito control techniques; • maintain up to date information relating to State Government, Western Australian University, local Shire and other broadly coordinated mosquito monitoring and control programs; • obtain professional advice in the event that a mosquito borne disease is identified at, or close to the Project; and • advise authorities of the occurrence of mosquito borne disease symptoms reported by any Camp personnel. Additional expert advice can be obtained from the Western Australian Department of Health, Mosquito Borne Disease Unit (Ph. 08 9285 5500).	Liaison is to be ongoing with a minimum of fortnightly monitoring of health warnings. The East Pilbara Shire will be informed immediately that a suspected mosquito borne disease is identified at the Project. Expert advice will be obtained as required.

5.5.3 Communication, training and personnel management performance indicators

To assist in reviewing the effectiveness of this plan and its implementation in controlling mosquitoes at the Project, performance against the communication, training and personnel management criteria outlined in Table 5-4 will be assessed on an annual basis.

Table 5-4: Communication, training and personnel management performance indicators

Indicator No.	Performance indicator	Measure	Management Target
IV	the Project personnel inducted on the topic of mosquito management prior to deployment, or on arrival at the Project.	% of the Project personnel	100%
V	Occurrence of a mosquito borne disease at the Project	Number of disease occurrences	zero

5.6 Monitoring and Direct Mosquito Control

5.6.1 Monitoring and direct mosquito control objectives

The objectives of implementing a mosquito monitoring program at the Project are to:

- identify when high mosquito risk periods occur;
- identify when to most effectively apply biological and chemical mosquito controls within the Project;
- identify when it is appropriate to seek technical advice from Shire Health officers or the Western Australian Department of Health Mosquito Borne Disease Unit regarding the likely effectiveness and potential requirement for broad scale application of insecticides beyond the Project; and
- ensure the safe and targeted application of biological and chemical controls when required.

5.6.2 Monitoring and direct mosquito control strategy

To achieve the objectives outlined in section 0 above, the management initiatives outlined in Table 5-5 will be implemented. The application of biological and chemical controls will be triggered primarily by the results of monitoring adult and larval mosquito populations (see sections M3 and M4 in Table 5-5 for interim thresholds for management action), but monitored meteorological conditions, camp personnel complaints and levels of disease risk will also inform decisions regarding the appropriateness for the application of biological or chemical controls.

Chemical controls include the use of personal repellents, the application of surface water films, and the use of insecticides that directly target larval or adult mosquitoes. Although the broad scale application of insecticides receives the most publicity and may appear to provide a simple answer to mosquito management, this is not necessarily the case. The Western Australian Department of Health recommends that the broad scale application of insecticides in the natural environment be reserved for circumstances in which vector control is required in high disease risk areas and mosquitoes are occurring at high nuisance levels that persist following the unsuccessful application of other mosquito control measures. The requirements for accurate timing of chemical applications and delivery of required concentrations at different target water depths makes the use of chemical control of larvae technically difficult, although in many respects it is the most desirable control method. These ‘chemical’ treatments include biological control agents.

Biological control options have the advantages of:

- no potential for the development of resistant strains; and
- little or no impacts on the broader environment.

The Western Australian Department of Health advises that the biological control option *Bacillus sphaericus “…. is ideal for using in polluted waters such as sewerage treatment lagoons*” (Douglas 2009), this management plan recommends the use of biological control agents in preference to larval insecticides at ponds which unavoidably provide mosquito breeding habitats. However, because of the number of environmental variables, every site is different and what works during one season may not be as effective during the next. For this reason, the application of any biological or chemical control needs to be continually reviewed and adjusted based on the results of monitoring programs.

Chemical and biological control products are available from several suppliers, of which Garrads at http://www.garrards.com.au/index.php?option=com_content&view=article&id=74&Itemid=31 is based in Western Australia, provides a wide range of products and provides full material data safety sheets or MSDS labelling outlining requirements for safe transport, storage and application.

This management plan focuses on the application of control measures within the Project and associated Camp infrastructure. In cases where large numbers of mosquitoes persist following the application of control measures within the Camp, or when the disease risk is very high and the broad scale application of chemical or biological control may be appropriate in surrounding areas, technical advice should be sought from the Shire of East Pilbara Environmental Health Officer on Ph. 08 9175 8000, or the Western Australian Department of Health Mosquito Borne Disease Unit on 08 9285 5500.

Table 5-5: Development design and site management initiatives

Management initiative	**Timing**
M1 Meteorological monitoring	
Forecast rain should be monitored and used to trigger the following preparatory management actions: • checking stocks and when necessary ordering repellents and other chemical and biological control agents, dry ice for	Monitoring of weather forecasts and weather conditions at Kintyre to be ongoing.

<table>
<tr><th>Management initiative</th><th>Timing</th></tr>
<tr><td>

mosquito traps, sample vials, and alcohol for preserving specimens;
building and infrastructure inspections and maintenance, (refer to initiative D2 in Table 5-3).

Continued monitoring of rainfall, temperatures and wind records from the existing weather station at Kintyre will assist in interpreting adult and larval monitoring results.
Rainfall provides an important trigger to commence the following monitoring and control initiatives outlined below:

Adult mosquito monitoring (management initiativeM3 below);
Larval monitoring (management initiative M4 below).

</td><td>
Larval monitoring should commence 5 days after heavy rain.
Adult mosquito monitoring should commence 10 days to 2 weeks after heavy rain.
</td></tr>
<tr><th colspan="2">M2 Monitoring personnel discomfort and health risks</th></tr>
<tr><td>
the Project personnel will be encouraged to assist in managing mosquitoes by providing information as to where and when mosquito pests are most prevalent. Reports of this nature will be logged, monitored, and used to assist in determining the level of mosquito nuisance and to target locations for adult monitoring and control.
Western Australian Health Department and Local Government Health Officer warnings of mosquito borne disease risks in the East Pilbara need to be monitored (refer to management initiative C4 above). A high risk of disease introduction to the Project should trigger the declaration of a high mosquito risk period by the Kintyre Health and Safety Officer, with reminders issued to personnel of the importance of wearing protective clothing, using repellent and where possible avoiding locations where biting mosquitoes are most active.
A report of mosquito borne disease symptoms from a member of the workforce at, or recently departed from, the Project should trigger the following management actions:

notification of the Shire Health Officer or the Western Australian Department of Health Mosquito Borne Disease Unit;
adult and larval mosquito monitoring and the application of biological and/or chemical controls within the Project and associated infrastructure where required;
In consultation with the Shire Environmental Health Officer or the Western Australian Department of Health Mosquito Borne Disease Unit, consideration could be given to the requirement for, and likely effectiveness of the broad scale application of insecticides in areas surrounding the Project to minimise the risk of spreading the disease.

</td><td>
The monitoring of:

Camp personnel reports of pest levels of mosquitoes; and
Camp personnel reports of disease symptoms;

will be ongoing.
Department of Health disease risk warnings will be monitored on an ongoing basis, at least every 2 weeks.
Any report of disease symptoms by Camp personnel will be reported to the Shire Environmental Health Officer or to the Western Australian Department of Health Mosquito Borne Disease Unit, immediately.
</td></tr>
</table>

Management initiative	Timing
M3 Adult mosquito monitoring	
Two CO_2 mosquito traps will be set up on calm nights; at sites within the Camp. The same sites should be used repeatedly so that comparisons can be made. Additional locations may be identified based on personnel advice and concerns. All mosquitoes trapped between dusk and dawn will be frozen and counted. Samples will then be stored in a labelled, sealed vial between soft tissue paper layered with salt to prevent mould. Stored samples from CO_2 mosquito traps will be stored for a minimum of 2 years so that they can be forwarded to an entomologist for more detailed identification and abundance analyses if required. Meteorological conditions on trapping nights will need to be recorded along with mosquito counts. Mosquito counts of 50 per trap per night usually indicate that adult mosquitoes are at a pest level. However, some mosquito species are more vicious bitters than others and unless monitoring trap samples are to be forwarded to an entomologist for identification, counts of between 30 and 50 should be interpreted in the context of reports from Camp personnel to determine the pest level. Counts of around 20 mosquitoes are associated with moderate nuisance at the Project to some people. Counts of 50, or less than 50 if considered a pest level, will trigger the following actions: • the declaration of a high mosquito risk period by the Project Health and Safety Officer, with reminders issued to personnel of the importance of wearing protective clothing, using repellent and where possible avoiding locations where biting mosquitoes are most active; • the application of a residual surface spray with the active ingredient bifenthrin (marketed under a variety of brand names) in areas within the camp and workshops identified as mosquito resting sites; e.g. under indoor and outdoor furniture, under window sills and within any dense vegetation located within or immediately adjacent to the camp site. The provision of strategically located vegetation, specifically for the purpose of applying a bifenthrin surface spray provides an effective control strategy; e.g. when vegetation is located beyond cleared buffers which immediately surround Camp accommodation and waste water disposal ponds, or between the Camp and known breeding habitats. Bifenthrin sprays remain active for periods of up to 2 months, but cannot be used on infrastructure or vegetation over water bodies and wetlands because they are not specific to mosquitoes and are therefore lethal to natural aquatic wildlife. • an assessment regarding the need for fogging or the application of an adulticide in the form of a small droplet mist within the Project and workshop areas. Adulticide sprays are non-specific and are therefore toxic to the majority of aquatic life and some are also toxic to birds and may cause respiratory irritation in humans. Their use, while appropriate when mosquito numbers are high and there is a significant disease risk, should therefore be limited. Advice regarding	Mosquito traps should be set on a minimum of a fortnightly basis during and immediately after wet periods, and every 2 months during dry periods Counts of trapped mosquitoes will be completed within 2 days of trapping and if triggered, high mosquito risk periods declared within 24 hours of monitoring results being available. If the active period since previously applying a residual bifenthrin spray has expired, and monitoring results indicate the requirement for surface treatments, a repeat surface spraying will be applied preferably within 2 days of monitoring results being available, and as soon as calm conditions occur. If monitoring results indicate that fogging within the Camp is required, this will be undertaken as soon as practicable after the monitoring results are available to coincide with calm conditions and the most active period for the problem mosquito species at the site.

Management initiative	Timing
the selection of an appropriate fogging spray to address specific requirements can be obtained from chemical suppliers. Their application should target the active period for the problem mosquito species. The persistence of adult mosquitoes at levels equivalent to 50 of more per trap per night following the application of control measures within the Camp could be used to trigger the forwarding of trap samples to an entomologist to assist in identifying natural problem breeding areas with a view to liaising with the Shire Environmental Health Officer, or Western Australian Department of Health Mosquito Borne Disease Control Unit regarding the potential requirement for, and likely effectiveness of applying insecticides beyond Camp boundaries.	
M4 Larval mosquito monitoring	
Mosquito larvae will be monitored at: • the waste water disposal area, wash down pools and the sump at Turkey Nest bore; and • natural potential breeding habitats located based on mosquito species identifications and known preferred habitats, Camp personnel reports, or on observed inundation patterns. Larval samples will be collected using a soup ladle from a variety of water depths and where present, from a variety of shade and sunny areas, plus vegetated and open water areas. Samples with mosquito larvae will be stored in labelled vials using 70% alcohol or methylated spirits for a minimum period of 2 years and used for detailed species identification if required. Larval concentrations are not easily determined because of the use of non-standard sampling and the patchy distribution of larvae. However, when well controlled, mosquito larvae should not be located in numbers where several larvae (>2) are repeatedly collected within a single bailer scoop. Any such larval concentrations indicate that significant adult emergence is imminent. When recorded at natural breeding locations within 3 km of the Project, high larval concentrations (>5 per bailer sample) should trigger: • the declaration of a high mosquito risk period by the Project Health and Safety Officer, with reminders issued to personnel of the importance of wearing protective clothing, using repellent and where possible avoiding locations where biting mosquitoes are most active; and • contact with Shire Environmental Health Officers or the Western Australian Department of Health Mosquito Borne Disease Control Unit to discuss the appropriateness, likely success and mechanism to approve the application of insecticides in adjacent natural areas. High larval concentrations recorded in waste water disposal or other Camp infrastructure where water pools, should trigger the application of biological or chemical controls at these sites taking note of the following guidance: - Larval samples with significant numbers of mosquito larvae should be inspected to determine the proportion of mosquitoes at the larval and at the pupa stages. The basic difference	Larval sampling at pooled waste water disposal areas and any other pooled water associated with Camp infrastructure will be conducted on a weekly basis. Larval sampling at natural habitat sites will be conducted on an as needs basis when inundated and adult mosquito pest levels persist at the Camp. The determination of larval to pupae ratios will be completed within 2 days of larval sampling if significant numbers of larvae are found. If the time since previously applying biological or chemical larvicide has expired and monitoring results indicate the requirement for repeat applications, this will be undertaken as soon as practicable and calm after the monitoring results are available; in the case of Bs within 2 days; and for other control agents, at a time to coincide with the most vulnerable lifecycle stage identified in the product information. Follow up monitoring to determine the effectiveness of control measures should be conducted within 3 days of their application

Management initiative	Timing
between larval stages and pupae is illustrated in Appendix C. This information is critical in determining which treatment or treatments will be most effective, and will assist in determining the critical period for treatment application. The biological control agent *Bacillus sphaericus*, or Bs, is marketed under the brand name of Vectolex (not the closely related but non-biological control agent called Vectobac). The effectiveness of Bs relies on its ingestion by mosquito larvae. Pupae do not feed and therefore the application of Bs alone will not prevent the emergence of mosquitoes which have already reached the pupae stage. (This is also the case with some chemical controls). Larval samples of high abundance and with a high ratio of pupae require treatment with both Bs to control early larval stages, and an insecticide which controls adult mosquitoes. Bs can be applied at any time to control early larval stages and because it is likely to remain active for about three weeks or longer, it also has the potential to control subsequent larval cohorts. Residual bifenthrin spray on vegetation strategically located just beyond a cleared buffer immediately surrounding infrastructure ponds will assist in controlling newly emerged mosquitoes. The effectiveness of biological and chemical controls is not guaranteed and follow up monitoring after their application is recommended. If monitoring results indicate that treatments have not been effective, product labels should be checked, expert advice sought from suppliers or the Shire Environmental Health Officer, and where product information indicates it is appropriate, they should be repeated or an alternative treatment tried. The environmental impacts of chemical control agents for larvae which contain the active ingredient s-methoprene, are lower than the environmental impacts caused by organophosphate insecticides. However, s-methoprene larvicides are generally less effective in water with high nutrient content such as sewerage disposal ponds. The repeated use of the same chemical control agent should be avoided because of its potential to result in the development of resistant mosquito strains. The effectiveness of all treatments should be documented and used to inform future mosquito management.	

5.6.3 Monitoring and direct mosquito performance indicators

To assist in reviewing the effectiveness of this plan and its implementation in controlling mosquitoes at the Project, performance against the mosquito monitoring criteria outlined in Table 5-6 will be assessed on an annual basis.

Table 5-6: Monitoring and direct mosquito control performance indicators

Indicator No.	Performance indicator	Measure	Management Target
VI	Implementation of adult and larval mosquito monitoring programs as outlined in Table 5-5.	Number of instances when adult and larval mosquito monitoring protocols not implemented	zero

5.7 Review and Revision

It is recommended that the mosquito management program and this management plan be reviewed on an annual basis. The annual review would require that documentation be maintained relating to monitoring results, the application and effectiveness of mosquito treatments and all associated costs, plus the consideration of achievements against the performance criteria listed in this management plan.

The review should identify where improvements can be made based on knowledge gained during the year. Any such improvements in process and understanding should be included in a revised management plan.

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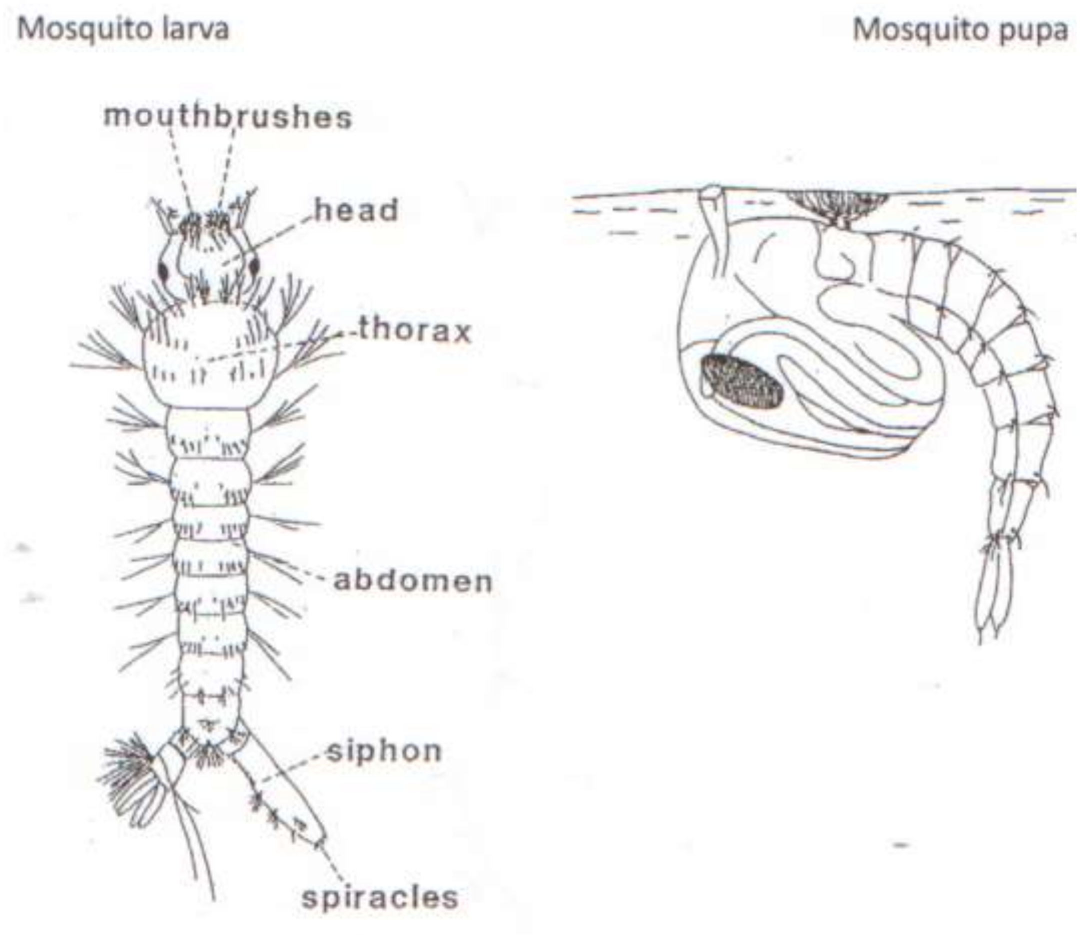
APPENDIX A - EARLY SYMPTOMS OF MOSQUITO BORNE DISEASES

Ross River and Barmah Forest Viruses	Murray valley Encephalitis and Kunjin Virus
Flu-like illness Tiredness Headache Muscle pains Enlarged glands Sore throat Fever Depression Tingling or numbness of extremities Rash – normally not itchy Joint pain – often in small symmetrical joints like fingers, knees and elbows. Pain can be acute with associated swelling and redness.	Headache Fever Nausea Vomiting Neck stiffness Disorientation dizziness

APPENDIX B. GENERAL CHARACTERISTICS DISTINGUISHING MOSQUITO LARVAE AND PUPAE.



Sourced from Russell R. C. (2009) Mosquito Biology and Ecology. In 'Mosquito Management Manual'. (ED. Department of Health) pp.2 – 16 (Government of Western Australia: Perth).

Kintyre Uranium Project
Conceptual Mine Closure Plan

Prepared for:
Cameco Australia
Perth WA

Prepared by:
ENVIRON Australia Pty Ltd

Date:
May 2013

Project Number:
AS140161

ENVIRON

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Executive Summary

A Conceptual Mine Closure Plan (CMCP) has been prepared to provide direction to Cameco Australia, the State Government and the Community on Cameco's post mining land use aspirations for the Kintyre Uranium Project (Project), which may affect the attainment of mine rehabilitation and closure outcomes.

Conceptual Mine Closure is also required as part of the Mining Proposal approval under the WA Mining Act 1978. The CMCP is prepared in accordance with the Western Australian Department of Mines and Petroleum (DMP) 'Guidelines for Preparing Mine Closure Plans, June 2011' and will be submitted to the DMP as part of the pre-mining approvals process.

Following closure, the site objective for the project area is:

"Rehabilitated with the goal of achieving a safe, stable property that allows future utilisation of the area for traditional purposes or occasional access that is similar to the existing (pre-mining) land use".

Rehabilitation would be undertaken on areas of disturbance to minimise the impact, based on the following concepts:

- The area of disturbance would be minimised by appropriate planning and design of the mine and associated infrastructure.
- Rehabilitation would be progressive throughout operations.
- Final landforms and surfaces would be made physically stable by controlling drainage, slopes and the nature of the final surface cover.
- The appearance, shapes and heights of the final landforms would be made compatible with the surrounding landscape as far as practicable.
- Revegetation would be carried out using local species suited to the final landforms, to produce a stable, self-sustaining ecosystem and landform
- Rehabilitation would be monitored and a comparison made with defined completion criteria so that remedial action can be implemented if necessary.

Some permanent changes to the landscape would remain due to the mined pit, the integrated waste landform (IWL), incorporating the waste rock landform and tailings management facility (TMF). Decommissioning of the Project will be based on the following concepts:

- Waste rock will remain as a permanent above surface waste rock landform. The permanent waste rock landform will be designed to blend in with the landscape as far as practicable, and will be constructed early in the mine life to allow for early rehabilitation.
- The design for the final integrated tailings management facility (TMF) will ensure long-term stability of the structure and ensure no exposure or release of material with elevated radiation levels.
- Management of the post closure Pit Lake to minimise any long term environmental impact on the surrounding environment.

- Groundwater production and monitoring bores will be closed and rehabilitated after they are no longer required and the Project closure completion criteria have been achieved. Relevant stakeholders will be consulted prior to the closure of the bores to ensure that they are not required for any other purpose.
- All plant and associated infrastructure (such as mine camp and airport) will be demolished and removed at the conclusion of operations, subject to negotiations by key stakeholders.

Cameco will undertake monitoring and maintenance throughout the life of the mine. Baseline monitoring and data collection will be undertaken in the planning phase in preparation for the ERMP as well as an approved monitoring plan for construction and operation. A post closure preliminary monitoring plan has been developed as part of the CMCP. Parameters and frequency are all indicated at this stage of the process and will be re-evaluated closer to closure. The expected monitoring period post closure is expected to be around 10 years however this will vary depending on monitoring result demonstrating baseline or acceptable values at the time of closure.

Glossary

AER	Annual Environmental Report
ALARA	As Low As Reasonably Achievable
BAT	Best Available Technology
BOGUM	Below ore-grade uranium material
CCL	Compacted Clay Liner
CMCP	Conceptual Mine Closure Plan
DMP	Department of Mines and Petroleum
EPA	Environmental Protection Authority
ERMP	Environmental Review and Management Program
FIFO	Fly in Fly Out
GCL	Geosythetic Clay Liner
IWL	Integrated Waste Landform
km	Kilometre
ktpa	Kilotonnes per annum
LLDPE	Linear low density polyethylene
m	Metre
MCP	Mine Closure Plan
ML/d	Megalitres per day
Mtpa	Metric tonnes per annum
MW	Megawatts
PAF	Potentially Acid Forming
ROM	Run of Mine, ore stockpiled to feed the process plant
TMF	Tailings Management Facility
UOC	Uranium Oxide Concentrate
U_3O	Triuranium octoxide
WRL	Waste Rock Landform

1 Introduction

1.1 Purpose and Scope

The Conceptual Mine Closure Plan (CMCP) has been prepared to provide direction to Cameco Australia, the State Government and the Community on Cameco's post mining land use aspirations for the Kintyre Uranium Project (Project), which may affect the attainment of mine rehabilitation and closure outcomes. A Conceptual Mine Closure and Rehabilitation Plan is also required as part of the Mining Proposal approval under the WA *Mining Act 1978*. The CMCP is developed to capture all the significant risks and identify issues that need addressing prior to closure in order to minimise overall costs and impacts come closure. The benefits of a risk-based mine closure process include:

- Early identification of potential risks to successful closure.
- Stimulate discussion amongst stakeholders who may want to contribute to closure planning and outcomes.
- Reduced uncertainty in closure impacts and costs.
- Continual improvement in industry rehabilitation standards (e.g. cover design, and management of contaminated drainage, erosion and seepage).

The CMCP is preliminary in nature and, accordingly does not provide detailed prescriptions of how the rehabilitation and closure outcomes will be achieved. The CMCP is a 'live' document that will evolve with the project as new information is gathered.

The CMCP is prepared in accordance with the Western Australian Department of Mines and Petroleum (DMP) 'Guidelines for Preparing Mine Closure Plans, June 2011' and will be submitted to the DMP as part of the pre-mining approvals process.

The objectives of the CMCP are to:

- Describe Cameco's vision for the post mining environment in the project area.
- Identify key environmental and social risk associated with planned or unplanned closure of the Project.
- Describe how closure risks will be avoided or managed.
- Development of acceptable and realistic criteria to measure performance.
- Develop orderly, timely and cost-effective closure outcomes.
- Reduce the need for long term monitoring and maintenance by establishing effective physical and chemical stability.

1.2 Proponent

The Kintyre Uranium Project is a joint venture between Cameco Corporation (70%) and Mitsubishi Development (30%). Cameco Australia Pty Ltd is the Proponent for the Project. Details for Cameco Australia Pty Ltd are:

ABN:	65 001 513 088
Office address:	24 Hasler Rd, Osborne Park, WA 6017, Australia

Postal address: PO Box 748, BC Osborne Park, WA 6916, Australia

Telephone: +61 (0)8 9318 6600

Facsimile: +61 (0)8 9318 6606

Contact: Mr Simon Williamson, Environmental Manager

Cameco is one of the world's largest uranium producers with uranium assets on three continents, including Australia. Cameco's head office is located in Saskatoon, Saskatchewan, Canada.

1.3 Project Overview

A joint-venture consortium (hereafter Consortium) comprising Cameco Australia Pty Ltd (hereafter Cameco) (70%) and Mitsubishi Development Pty Ltd (Mitsubishi) (30%) proposes to develop an open pit mine and associated processing facilities at Kintyre in the Shire of East Pilbara of Western Australia, approximately 1,200 km north-east of Perth on the edge of the Great Sandy Desert. The proposed Kintyre Uranium Project (the Project) would produce up to approximately 4,400 tonnes of U_3O_8 based uranium oxide concentrate (UOC) per annum (peak annual rate). The open pit mine would consist of a single open pit mine encompassing a number of discrete ore zones. The open pit would ultimately extend approximately 1,000 m north-to-south, 1,500 m east-to-west and would be excavated to a depth of around 220 m. Up to 30 million tonnes (Mt) of overburden and ore would be mined per annum using a combination of selective and bulk open pit mining techniques. Run-of mine (ROM) ore would be stockpiled and subsequently treated in the proposed metallurgical plant, with non-mineralised overburden stored in a permanent above-ground Waste Rock Landform (WRL). Below ore-grade uranium overburden (mineralised overburden) would be stockpiled separately from the non-mineralised overburden and may be blended with high grade ore to ensure a consistent ore grade for processing.

The metallurgical plant would leach uranium from ore using acid reagents and conventional uranium extraction technologies to produce UOC for containerised export via the port of Adelaide. All tailings generated during the metallurgical processing of the ore would be dewatered and directed to an above-ground Tailings Management Facility (TMF).

The mining and miscellaneous tenements that form the Project area are listed in Table 1.

Table 1. Project Tenements.

Lease	Holder	Area (Ha)	Status
M45/264	Cameco / MDP	766	Granted
M45/266	Cameco / MDP	341	Granted
M45/267	Cameco / MDP	226	Granted
M45/1217	Cameco / MDP	2352	Granted
M45/420	Cameco / MDP	8	Granted

M45/693	Cameco / MDP	693	Granted
M45/694	Cameco / MDP	195	Granted
M45/695	Cameco / MDP	195	Granted
M45/696	Cameco / MDP	390	Granted
L45/66	Cameco / MDP	34	Granted

Additional tenements for the water supply borefield and the site access road will be applied for in the future.

Detail of the conceptual site layout is provided in Figure 1.

Table 21: Indicative Project Characteristics

Project Element	Description
Life of Project	Nominally 12 years (including construction, production and closure)
Mining method	Continuous open pit mining using a combination of selective and bulk excavation methods based on conventional drilling and blasting methods with excavator and truck material movement.
Major components	Open pit Integrated Waste Landform incorporating a permanent waste rock landform, mineralised waste, stockpile and tailings management facility ROM pad Process Plant Mine workshop and administration buildings.
Mining rate	Up to 30 Mtpa.
Project Footprint (Tenement Area)	Approximately 5,200 ha.
Area of disturbance	Approximately 700 ha
Waste rock management (WRL)	Approximately 142 Mt of non-mineralised overburden (defined as material containing an average 10 ppm U3O8) would be generated during the extraction of ore from the pit. This would be stored either within permanent WRLs or backfilled to the western side of the pit following completion of mining activities in this area. Some (about 6 Mt) would be used as a construction material for the TMF embankments. Approximately 6 Mt of mineralised overburden (defined as material containing an average of 500 ppm U3O8) would be stored on an engineered pad for potential processing or otherwise covered with non-mineralised overburden at mine closure.
Tailings Management	7 Mt of tailings solids to be stored in an above-ground TMF
Processing method	Acid tank leaching of beneficiated ore

Table 21: Indicative Project Characteristics	
Project Element	**Description**
Processing rate	Up to 1.3 Mtpa through the primary crusher and radiometric sorters and up to 0.6 Mtpa through the milling circuit and metallurgical plant.
Production rate	Up to 4,400 tpa of uranium oxide concentrate (UOC) as U_3O_8 equivalent
Solid waste	Three main mining and processing materials would be stored within the footprint of the Integrated Waste Landform • Non-mineralised waste rock. • Mineralised waste – stored on an engineered stockpile adjacent to the WRL and may be processed (should this become viable) prior to closure. • Tailings - discharged as slurry to a TMF and capped on closure.
Process water requirement Borefield Water requirement	Mine dewatering, dust suppressant, and process water supply borefield Dependent on mill throughput and process. Estimated to be in order of 3.1 ML/ day
Potable water	Dedicated borefield
Power requirement	5 to 15 MW depending on processing rate. Owner operated diesel generation plant; or Contract power supply through a Build Own and Operate agreement
Construction workforce	Up to 400 employees on FIFO roster housed at an on-site accommodation village.
Operational workforce	Up to 250 employees on FIFO roster housed at an on-site accommodation village.
Other infrastructure	Roads including 90 km access road from Telfer Core storage facility; Explosive powder magazine Accommodation village Bulk fuel storage facilities Stormwater drainage and environmental pond systems Offices and warehouses Airstrip

1.4 Project Setting

The Kintyre Project Area is located between the Great Sandy Desert and the Little Sandy Desert in the Eastern Pilbara region of Western Australia. The area has been subject to extensive erosion with areas of exposed bedrock, low mesas, ephemeral watercourses and dunefields. The Project area is characterised by the flat floodplains of the Yandagooge Creek, flat Aeolian sand dune areas, isolated outcropping ridges within the floodplain areas and hilly range areas with flat mesas that abut the edge of the Yandagooge Creek Floodplain.

In relation to road access, the East Pilbara region is a remote region punctuated by mining operations and remote Aboriginal communities. In general terms, road access is limited. A developed road runs east-west across the northern part of the region from Marble Bar to Telfer, while the Talawana Track runs east-west across the south. A number of Aboriginal communities occur within the region. Parnngurr, home to up to 100 people, is on the Talawana Track south of the National Park. Two other communities, Punmu and Kunawarritji occur in the North. Punmu is located within the National Park and Kunawarritji is located further east.

The north-south track between Telfer and the Talawana Track serves as the only north-south access in the region. This track runs south from Telfer, past the Kintyre turnoff, through the Karlamilyi National Park to the Talawana Track.

Telfer mine, historically a residential town, it is now a fly-in-fly-out operation and along with the Woodie Woodie Mine further west, are responsible for the establishment of the all-weather road from Marble Bar to Telfer.

2 Identification of Closure Obligations

Below is a brief description of corporate, regulatory and industry standard mine closure obligations. A register of all legally binding obligations and commitments and/or legal obligations applicable under State and Federal legislation is provided in Appendix A (Mine Closure Obligations Register). Appendix A will be updated when the DMP sets the tenement conditions.

2.1 Cameco Corporate Requirements

Cameco's preferred approach to decommissioning a mine site is to plan and undertake decommissioning and reclamation activities, where appropriate, during the operating life of the facility (progressive decommissioning).

2.2 Statutory Requirements

Closure and rehabilitation of the Project must, as a minimum, satisfy general requirements set out in the following legislation:

- Environmental Protection Act 1986
- Contaminated Sites Act 2003
- Mining Act 1978
- Mines Safety and Inspection Act 1994
- Dangerous Goods Safety Act 2004
- Radiation Safety Act 1975
- Radiation Safety (Transport of Radioactive Substances) Regulations 2002.

As of 1 July 2011, the Western Australian Department of Mines and Petroleum (DMP) under the provisions of the Mining Act 1978 requires all new Mining Proposal applications to contain a Mine Closure Plan (MCP) that was prepared in accordance with the DMP's 'Guidelines for Preparing Mine Closure Plans, June 2011' (jointly released by the DMP and the Environmental Protection Authority (EPA)). The EPA requires that the guidelines are used to prepare a MCP as part of its formal environmental impact assessment process.

It is understood that the current Kintyre Project mine life is medium term (10-25 years) and therefore as per the Guidelines for Preparing Mine Closure Plans (June 2011), the following level of detail will be required at this stage of planning for the MCP:

Table 2: Indication of Required Level of Closure Detail

Closure tasks	Task Detail Required	Comment
Post-mining land use	Well advanced in detail	Refer to Section 6
Identification and management of key environmental issues	Completed	Refer to Sections 7,10 and 11 as well as Appendix B, C and D
Closure outcomes	Well advanced in detail	Refer to Sections 6 and 8
Closure costing	Increased accuracy. Closure costing are only	Refer to Section 9

Table 2: Indication of Required Level of Closure Detail		
Closure tasks	**Task Detail Required**	**Comment**
	submitted if requested by the DMP	
Closure implementation and monitoring plans	Well advanced in details	Refer to Sections 4, 10 and 11 as well as Appendix C

Other key points on the level of detail required include:

- Mine closure plans must be site-specific. Generic “off-the-shelf” closure plans will not be acceptable.
- Closure planning should be risk-based taking into account results of materials characterisation, data on the local environmental and climatic conditions, and consideration of potential impacts through contaminant pathways and environmental receptors.
- Consultation should take place between proponents and stakeholders which include acknowledging and responding to stakeholder’s concerns. Information from consultation is central to closure planning and risk management.
- Post-mining land uses should be identified and agreed upon through consultation before approval of new projects.
- Characterisation of materials needs to be carried out prior to project approval to a sufficient level of detail to develop a workable closure plan.
- Closure plans should demonstrate that appropriate systems for closure performance monitoring, maintenance, record keeping and management are in place.
- The level of detail required for the closure plan, as indicated by the Guidelines needs to be a balance between conceptual and detailed design and outcomes. It is more appropriate to include more detail where possible, with the understanding that closure plans change over time based on changes to mine planning and processing.

2.3 Government and Industry Standards

The methods by which closure and rehabilitation outcomes may be achieved and the standards by which closure planning, design and implementation will be assessed are described in a range of guidelines and related publications, including:

- Mine Closure Guideline for Mineral Operations in Western Australia (Chamber of Minerals and Energy WA Inc, 2000).
- Strategic Framework for Mine Closure (Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia, 2000).
- Mine Closure and Completion, Leading Practice Sustainable Development Program for the Mining Industry (Department of Industry Tourism and Resources, 2006a).
- Mine Rehabilitation, Leading Practice Sustainable Development Program for the Mining Industry (Department of Industry Tourism and Resources, 2006b).

- Guidance Statement No 6 – Rehabilitation of Terrestrial Ecosystems (EPA, 2006).
- Planning for Integrated Mine Closure: Toolkit (International Council on Mining & Metals, 2008).
- Guideline 18: Rehabilitation requirements for mining projects (Queensland Department of Environment and Resource Management, 2008).
- Environmental Assessment Guideline No 4 -Towards Outcome Based Conditions (EPA, 2009).
- Guidelines for Preparing Mine Closure Plans (EPA/DMP, June 2011).

This CMCP has been prepared in accordance with the Guidelines.

3 Key Mine Components

Figure 1 illustrates the conceptual site lay out of the main components associated with the mine development which are as follows:

- Mine pit
- Integrated Waste Landform, incorporating the waste rock dump, the mineralised waste rock stockpile and the Tailings Management Facility.
- ROM Pad
- Processing Plant

Other associated infrastructure includes:

- Access road to the site from the Telfer Road
- Airstrip (The facility would also include a fuel storage facility, a small terminal and motor vehicle parking area)
- Accommodation village for a fly-in-fly-out (FIFO) workforce to be used during construction and operations
- Borrow pits
- Buildings, including offices, mess building, laundry, workshops and warehouses
- Bulk Low-level Radioactive Waste Facility
- Class I/II landfill for inert and putrescible waste
- Steam generation plant
- Electricity supply network
- Haul roads
- Magazine Storage Facility
- Pit dewatering infrastructure to maintain dry pit conditions and stable pit slopes
- Potable water supply borefield
- Potable water treatment facilities
- Process water supply borefield located in the vicinity of the ore body
- Process bleed-water Evaporation Pond (PBEP) (a lined evaporation pond for the disposal of process bleed-water excess to demand)
- Reagent storage facilities
- Refuelling facilities
- Security Check Point Gate House
- Sewage management facilities
- Sediment pond
- Stormwater ponds X3
- Surface water diversion channels

3.1 Mine Pit

The five Kintyre ore zones are mined using a single open pit mine encompassing various individual ore zones. The mine will use a combination of selective and bulk open pit mining techniques and a conventional excavator and truck fleet. A mining rate of up to 30 Mtpa (depending on equipment selection and stockpiling strategy, as well as geotechnical and hydrological conditions) would result in approximately 152 Mt of overburden and up to 6 Mt of ore being mined over the life of the mine.

All material from the open pit is classified as one of three categories (ore, mineralised overburden or non-mineralised overburden) depending on the U_3O_8 content (Triuranium octoxide). Ore includes material above the economic cut-off grade of 1,530 ppm of U_3O_8. Up to 1.2 Mtpa of ore will be hauled to a ROM stockpile located adjacent to a primary crusher, which is sized to ensure a consistent and sustainable feed to the metallurgical plant.

Mineralised overburden (around 6 Mt) will be stockpiled separately and may be used to blend with high grade ore or processed during periods of production shortfall. If not processed, mineralised overburden would be encapsulated to minimise radon emanation and mitigate the potential for hazardous stormwater runoff.

Of the 148 Mt of Non-mineralised overburden expected to be produced, around 6 Mt would be used in the construction of the TMF, approximately 23 Mt would be backfilled in the western end of the open pit, and the remainder, approximately 119 Mt stored in a permanent above-ground WRL, designed as far as practicable to blend in with the surrounding natural landscape.

The key features of the proposed mining operation are provided in Table 3 below.

Table 3: Indicative Features of the Proposed Mining Operation

Element	Description
Mining method	Open pit
Maximum mining rate (Mtpa)	30
Length of pit (m)	1,500
Width of pit (m)	1,000
Maximum pit depth (m)	220
Number of drill rigs	6
Number of excavators	3
Number of haul trucks	Up to 15
Maximum water demand (ML/d)	1.4 (primarily for dust suppression)
Maximum electricity demand (MW)	2
Average electricity consumption (MWh/a)	17,000
Average diesel demand (ML/a)	12

3.2 Processing

A metallurgical plant suitable for the production of up to around 4,400 tpa of U_3O_8 would be established to treat ore extracted from the open pit using an acid leaching process followed by conventional uranium extraction processes to produce a final uranium oxide concentrate (UOC) product for export.

The key features of the proposed metallurgical plant are detailed in Table 4 below.

Table 4: Indicative Characteristics Of Proposed Metallurgical Operation

Element	Description
Processing method	acid leaching followed by solid-liquid separation, evaporation, direct precipitation and calcination
ROM ore to crusher (Mtpa)	Up to 1.2
Radioactive sorter rejects to WRL (ktpa)	600
Ore to metallurgical plant (ktpa)	600
Maximum water demand (ML/d)	1.5
Maximum electricity demand (MW)	4
Average electricity consumption (MWh/a)	35,000

Infrastructure associated with the constructed and operation of the metallurgical plant would include:

- Access roads including a crossing over the Yandagooge Creek
- Warehouse and reagent storage facilities
- Maintenance workshops
- Sand-blasting and painting facilities for the removal of surface contamination prior to the removal of plant and equipment from site
- Security and emergency response facilities
- A vehicle wash down facility
- Metallurgical administration, change room and laundry facilities.

3.3 Tailings Management Facility

A single cell tailings management facility has been designed to meet the total required capacity. The plan area of the lined portion of the facility is approximately 38 ha (ultimate configuration). The ultimate TMF dam would have a nominal final height of around 20 m. The TMF has been designed with leak collection and recovery systems and tailings underdrain systems.

A Best Available Technology (BAT) approach has been adopted for tailings containment and closure designs which would also provide radiation protection as low as reasonably achievable (ALARA). To this end, the TMF would be designed to minimise the potential for seepage through:

- A double geomembrane liner system with leak detection between the liners
- A leachate collection system above the liner.
- A series of lined evaporation ponds adjacent to the tailings facility for containment and evaporation of excess tailings and stormwater from the facility

The tailings closure design will be based primarily on the following general objectives:

- The cover will be designed to be effective for 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years.
- Target limit for radon flux from the cover surface to <20 pCi/m2s [0.74 Becquerel per square meter per second (Bq/m2s)], or as required to meet applicable ALARA air quality limits.
- Limit infiltration of moisture into, and release of contaminated liquid from the tailings to mitigate environmental effects to downstream receptors.

Table 5: Indicative Features Of The Proposed TMF

Element	Description
Storage method	Single fully lined impoundment cell constructed with a compacted earth and rock fill.
Total tailings disposed of (Mt)	7
Annual rate of deposition (tpa)	600,000
Area of tailings cell (ha)	38
Average solids concentration (%)	50

3.4 Waste Rock Landform

The non-mineralised overburden mined during recovery of ore from the pit would be transported to a WRL and is shown in Figure 1. Some mineralised overburden mined during extraction of the ore would be stockpiled separately within the final footprint of the WRL, nominally at the southern end of the WRL, in an area that would be engineered to manage any potential rainfall infiltration and leachate.

Non-mineralised overburden would be end-dumped from haul trucks onto the prepared foundation in a series of lifts, each of around 10 m, with a final 4.5 m lift prior to closure. The lowest (base) lift would be battered from the natural angle of repose (around 37 degrees) to around 18 degrees to promote stability, while subsequent lifts would be left at angle of repose. Benches would be maintained between lifts for the management of stormwater run-off and to enhance stability, providing an overall slope angle of around 30 degrees (excluding the base lift).

Approximately 142 Mt of non-mineralised overburden (defined as material containing an average 10 ppm U3O8) would be generated during the extraction of ore from the pit. This would be used as a construction material for the TMF embankments (about 6 Mt) with the remainder stored within the permanent WRL or backfilled to the western side of the pit following completion of mining activities in this area.

Approximately 6 Mt of mineralised overburden (defined as material containing an average of 530 ppm U3O8) will be stored in a stockpile on an engineered pad for potential processing or otherwise covered with non-mineralised overburden at mine closure.

Table 6: Indicative Characteristics Of The Proposed Waste Rock Landform

Element	Description
Final height (m)	45 (to blend in with the surrounding natural landscape)
Number of lifts	4.5
Height of lifts (m)	10
Face angle of base lift (degrees)	18
Face angle of upper lifts (degrees)	37
Final footprint (ha)	200

A desktop study of the ‘Geochemical Characterisation of Ore and Waste Rock Samples’ undertaken by CSA Global Pty in 2011 determined that there are no geochemical concerns foreseen for all of the waste-rock types to be produced from the proposed mining of the Kintyre Project area. Although no laboratory test results were available for this review, a stoichiometric comparison of acid producing versus acid-neutralising capacities of the rocks showed that the waste-rock materials should be neutral-to-alkaline with a low salt content, so that drainage waters and leachates produced from the waste dumps should be neutral-to-alkaline and of fresh quality (refer to the ERMP).

The ‘Geochemical Characterisation of the Cameco Kintyre Uranium Project-Prefeasibility Study’ prepared by Tetra Tech in May 2012 determined that “several metals of concern were identified (Pb, Zn, U, and Al) that showed an increase in kinetic test effluents and/or exceeded Australian Drinking Water Standards, most metals were either present in quantities below the analytical detection limit, or were well below Australian Drinking Water Guidelines”.

4 Collection and Analysis of Closure Data

The following lists the key physical and biological information required for mine closure implementation which includes establishment of baseline data and establishment of the mine closure footprint. This data is to be checked against the Closure Tasks Register (Appendix C).

4.1 Baseline Data

Study / Parameter	Relevance	Available	
		Document	Y/N
Topography	Baseline topography to demonstrate that post mining landforms will be compatible with pre-mining environment.	ERMP	Y
Soil Chemistry and Radiochemistry	Baseline soil surveys to demonstrate that post mining landforms will be compatible with pre-mining environment.	ERMP. Geochemical Characterisation of Ore and Waste Rock Samples' undertaken by CSA Global Pty in 2011 Geochemical Characterisation of the Cameco Kintyre Uranium Project-Prefeasibility Study' prepared by Tetra Tech in May 2012.	Y
Groundwater	To assess groundwater flow in proximity to waste storages including evidence of effectiveness of perimeter barriers and evidence of integrity of tailings containment system.	ERMP Kintyre Groundwater Investigation Program, MWH, February 2010.	Y
Flora & Fauna	Obtain baseline data on known flora and fauna in the region to identify species to plant and be attracted back to the area post closure.	ERMP Flora and Vegetation, Kintyre Lease, Bennett Environmental Consulting.	Y
Water Resources	Identify drainage patterns for post closure drainage alignment.	ERMP	Y

4.2 Ongoing Data Collection

Study / Parameter	Relevance	Available	
		Document	Y/N
Climate conditions	Ascertain climatic conditions, patterns and trend to assist in rehabilitation planning. Wind speed and direction, rainfall and temperature all monitored.	In 2010 Cameco installed and commissioned a meteorological monitoring station.	Y
Waste Rock disposal	Characterising, mapping and monitoring of waste rock.	Commence during operation.	N
Soil	Ascertain the availability and volumes of	Commence during Definitive	N

Study / Parameter	Relevance	Available	
		Document	Y/N
	key materials required for rehabilitation such as competent wast rock, subsoil, top soil and low permeability clay.	Feasibility Stage and throughout operations.	
Weed Occurrence	Monitor weed infestation to assess health and minimise spread to assist in returning ecosystems to pre operation health.	Establish annual weed surveys and mitigation programs. Reported in the AER.	N
Rehabilitation Reporting	Assess the success of rehabilitation program. Identify successful and unsuccessful techniques.	Reviewed and reported in AER.	N
Ground Disturbance	Demonstrate compliance with the approval conditions. Assess total area of disturbance to assess closure costs.	Reviewed and reported in AER.	N
Groundwater elevation	Assess groundwater flow in proximity to waste storage including evidence of effectiveness to perimeter barriers of tailing containment system.	Quarterly groundwater monitoring. Reported in the Quarterly Environmental Reports.	N
Groundwater Quality	Use to verify the performance of waste facility and identify any contamination issues early to minimise clean up costs.	Quarterly groundwater monitoring. Reported in the Quarterly Environmental Reports.	N
Tailing quantities and density	Check the capacity of mine voids to contain waste.	Daily log of tailing discharge. Annual event based testing of in situ tailing density.	N

5 Stakeholder Consultation

5.1 Overview of Stakeholder

Key stakeholders that will need to be consulted or considered in closure planning have been identified during the scoping and approvals process and are listed in Table 7. Consultation with these and other community and government stakeholders will be ongoing throughout the approvals process, project development, construction, operation and closure.

Table 7: Key Stakeholders

Category	Group
Government	Western Australian Department of Mines and Petroleum Western Australia Environmental Protection Authority Shire of East Pilbara Commonwealth Department of Resources, Energy and Tourism Commonwealth Department of Sustainability, Environment, Water, Populations and Communities
Aboriginal Groups	Western Desert Lands Aboriginal Corporation (WDLAC)
Non Government Organisation	Cameco/WDLAC Kintyre Relationships Committee
Community Groups	Martu Community through WDLAC
Industry and Business	Other mining and exploration companies in the East Pilbara district

5.2 Consultation Process

Cameco recognises that stakeholder consultation is a key component of the mine closure planning process. Early engagement with stakeholders enables Cameco to better understand and manage community expectation and the potential risk associated with closure.

Cameco has developed a stakeholder consultation programme including consultation with local indigenous communities, government agencies and key interest groups (listed in Table 7). The methods and materials used during consultation have been tailored to the intended recipient so that communications are culturally appropriate, informative, and promote constructive discussion.

The purpose of the stakeholder consultation programme will be to identify closure land use expectations with the Kintyre Project from stakeholders as well as presentation of proposed land use options. Consultation will continue to be an integral part of project development, construction, operation, closure and beyond.

The stakeholder consultation programme will include formal and informal meetings with key stakeholders, site visits, fact sheets, presentations and workshops and follow the following principles:

- Identification of stakeholders and interested parties as part of the closure process.
- Effective consultation is an inclusive process which encompasses all parties and should occur throughout the life of the mine.
- A targeted communication strategy should reflect the needs of the stakeholder groups and interested parties.
- Adequate resources should be allocated to ensure the effectiveness of the consultation process.
- Wherever practical, work with communities to manage the potential impacts of mine closure.

5.3 Stakeholder Program

Cameco would commit to the following specific methods to keep communities and stakeholders informed on mine closure and rehabilitation issues (in addition to any reporting obligations to government), much of which is included in the operational stakeholder program:

- Establishment of a Stakeholder Consultation Register (Appendix D)
- The establishment of a Community Relations Manager
- An annual briefing to key stakeholders
- A quarterly briefing of representatives of the Traditional Owners via the Relationships Committee
- A Community Issues Procedure to ensure prompt and documented responses to all issues (including those related to closure) raised with Cameco, available for government review
- An annual report posted on Cameco web site on operational, environmental and social performance – such report to be externally audited every three years
- Regular provision of information to the local and regional press and media.

6 Post-Mining Land Use and Closure Objectives

Cameco has developed a number of objectives for the Kintyre Uranium Project which align with Cameco's four measures of success:

To achieve:

1 A safe, healthy and rewarding workplace.
2 A clean environment.
3 Supportive communities.
4 Outstanding financial performance.

The objectives for the Project from approvals to closure and beyond are to:

- Enhance the safety and environmental performance of the operation
- Maximise the value of the deposit for the nation, stakeholders and community
- Maintain employment source in East Pilbara of Western Australia
- Enhance the current opportunities, lifestyle and amenities for the local and regional communities
- Enhance the relationship and communication with traditional claimant groups
- Design, construct, operate and decommission an expanded operation that minimises the impact on the environment, and maximises the benefits to the community.

6.1 Proposed Land Use

It is Cameco's goal that all structures and disturbed areas in the Kintyre Project Area are to be reclaimed. Evidence of the mining activity that will occur at Kintyre during the construction and operation of the mine cannot be completely obscured or eliminated. However, Cameco's reclamation goals include the eventual establishment of planted and self-sustaining vegetation to host wildlife in its natural form.

All clean waste rock stockpiles and surface disturbances will be stabilised for the long term to prevent any potential erosion problems. Surface water and groundwater flows will be managed with the goal of minimising contaminant transport outside of the Kintyre Project Area development footprint. The pit is to be partially backfilled with non-mineralised waste rock and filled with water and used as a lake for the region although water in the pit lake may be seasonal and will become saline

Further input on post mining land use will be undertaken in consultation with key stakeholders.

6.2 Closure Goals and Objectives

Following closure, the site objective for the project area is:

"Rehabilitated with the goal of achieving a safe, stable property that allows future utilisation of the area for traditional purposes or occasional access that is similar to the existing (pre-mining) land use".

Rehabilitation would be undertaken on areas of disturbance to minimise the impact, based on the following concepts:

- The area of disturbance would be minimised by appropriate planning and design of the mine and associated infrastructure.
- Rehabilitation would be progressive throughout operations.
- Final landforms and surfaces would be made physically stable by controlling drainage, slopes and the nature of the final surface cover.
- The appearance shapes and heights of the final landforms would be made compatible with the surrounding landscape as far as practicable.
- Revegetation would be carried out using local species suited to the final landforms, to produce a stable, self-sustaining ecosystem and landform.
- Rehabilitation would be monitored and a comparison made with defined completion criteria so that remedial action can be implemented if necessary.

Some permanent changes to the landscape would remain due to the mined pit and the integrated waste landform. Decommissioning of the Project will be based on the following concepts:

- The majority of the waste rock will remain as a permanent above surface waste rock dump. The permanent waste rock dump will be designed to blend in with the landscape as far as practicable, and will be constructed early in the mine life to allow early rehabilitation.
- The design for the final IWL-TMF will ensure long-term stability of the structure and ensure no exposure or release of material with elevated radiation levels.
- Management of the pit lake to minimise any long term environmental impact on the surrounding environment.
- Groundwater production and monitoring bores will be closed and rehabilitated after they are no longer required and the Project closure completion criteria have been achieved. Relevant stakeholders will be consulted prior to the closure of the bores to ensure that they are not required for any other purpose.
- All plant and associated infrastructure (such as mine camp and airport) will be demolished and removed at the conclusion of operations, subject to negotiations by key stakeholders.

7 Identification and Management of Closure Issues

Identifications and management of mine closure is to be undertaken progressively throughout the operation's life cycle. As the CMCP is a 'live' document and is at the conceptual stage the amount of detail will increase and refocus on specific issues through the mine life cycle. In order for mine closure planning to be successful, Cameco will ensure management needs are integrated early into planning rather than being attended to at the end of mine life. The initial ground work, even at the exploration phase, can impact on the effectiveness and success of closure planning.

A risk assessment was undertaken of the key risks associated with closure. The inherent and residual risks were assessed using a consequence and likelihood risk matrix to develop a comparative risk register (Appendix B).The following risks were identified:

Open Pit
Closure Objective: "Management of the post closure pit lake to minimise any long term environmental impact on the surrounding environment."
Issues: • Contamination of the pit water. • Poor geotechnical stability. • Acid and metalliferous drainage. • Pit becomes saline from evaporation.
Controls: *Pre Closure:* • Third party assurance and sign off on pit design and construction. • Integrity testing throughout the life of the mine. *Closure and Post Closure:* • Surface and groundwater monitoring. • Revegetation around the pit to assist in pit stabilisation.
Monitoring: • Surface and groundwater monitoring during and post mining operation to determine any contamination issues associated with the pit. • Assessment of rehabilitation success through annual flora and fauna surveys.

- Quarterly radiation monitoring (gradually stepped down if results are consistently favourable).

Integrated Waste Landform - Waste Rock Landform (IWL-WRL)

Closure Objective:

"All waste rock (inclusive of the Integrated Waste Landform and the Open Pit Flood Protection Bund) would remain as permanent above surface structures. The permanent landforms would be designed to blend in with the landscape as far as practicable, and would be constructed early in the mine life to allow early rehabilitation of the external surfaces. The design would ensure the long-term erosional stability of the structure".

Issues:

- Poor geotechnical stability.
- Seepage and runoff of metalliferous and/or other potential contaminates in the drainage.
- Lack of top soil for rehabilitation.
- Unsuccessful rehabilitation prolonging the closure process.

Controls:

Pre Closure:

- Third party assurance and sign off on waste rock dumps design and construction.
- Review of sequence planning.
- Development of local seedling and nursery. Prioritise species that have had high success rate throughout construction and operation.
- Storage of top soil from excavation and land development work during the construction and operation phase into the designated top soil stockpiles.
- Ongoing rehabilitation trials throughout mining operation.

Closure and Post Closure:

- Undertake post closure rehabilitation/revegetation.

Monitoring:

- Surface and groundwater monitoring during and post mining operation to determine any contamination issues associated with the pit.
- Assessment of rehabilitation success through annual flora and fauna surveys.
- Quarterly radiation monitoring (gradually stepped down if results are consistently favourable).

Integrated Waste Landform-Tailing Management Facility (IWL-TMF)
Closure Objective: "The IWL-TMF is planned to be capped and rehabilitated to achieve a safe and stable property that allows future utilisation of the area for traditional purposes or occasional access that is similar to the existing (pre-mining) land use. The designs would ensure the long-term erosional stability of the structures. Specifically the facilities would be designed such that the release of contained materials, if any, would only be measurable within geologically significant time periods".
Issues: • Poor geotechnical stability. • Seepage and runoff of metalliferous and/or other potential contaminates in the drainage. • Lack of top soil for rehabilitation. • Unsuccessful rehabilitation prolonging the closure process.
Controls: *Pre Closure:* • TMF designed from the outset such that it can be effectively closed. Designs would ensure the long-term erosional stability of the structures. Specifically the facilities would be designed such that the release of contained materials, if any, would only be measurable within geologically significant time periods. • Undertake long term erosion modelling of the IWL to demonstrate sustainability. • Third party assurance and sign off on TMF design and construction. • Storage of top soil from excavation and land development work during the construction and operation phase into the designated top soil stockpiles. • Undertake a safety assessment to determine the long-term risk to the public and environment from the TMF, to include a systematic approach to understand the long term behaviour of the system under normal and unusual weather conditions and the outcomes that can be achieved in the long term post mine closure. *Closure and Post Closure:* • Construct a cover system for the tailings deposited in the TMF facility. The cover system will be designed to limit surface water infiltration into the tailings mass, radon emissions from the tailings mass, and to be sufficiently durable to withstand the climate, including extreme precipitation events. • The post-closure surface water management system will be designed to prevent ponded water on the surface of the TMF and safely pass peak flows from the extreme design

Integrated Waste Landform-Tailing Management Facility (IWL-TMF)
rainfall event. • Development of local seedling and nursery. Prioritise species that have had high success rate throughout construction and operation. • The preliminary cover design will consists of a layer of waste rock over the tailings surface to create a minimum 0.5 percent grade (post-settlement) to the TMF outslopes for positive drainage. The regrading layer will consist of a minimum 1 m layer of waste rock. The thickness of this layer was set at 1 m to provide a stable surface for construction of the radon barrier. The actual constructed thickness will vary to account for long-term settlement of the tailings and to form the minimum desired surface grades to the TMF outslopes for positive drainage of surface water. The vegetative cover/radon barrier will consist of 2 m of native on-site soils classified as silty sand, clayey silt, silty clay, and sandy silty gravel. On top of the vegetative/radon barrier will be an erosion barrier consisting of 100 mm of crushed rock mulch for protection.
Monitoring: • Surface and groundwater monitoring during and post mining operation to determine any contamination issues associated with the TMF and if any seepage is occurring. • Assessment of rehabilitation success through annual flora and fauna surveys. • Quarterly radiation monitoring (gradually stepped down if results are consistently favourable).

Process bleed-water and tailings water Evaporation Pond
Closure Objective: "The Evaporation Pond will be decontaminated, backfilled, capped and rehabilitated to safe and stable landform that allows future utilisation of the area for traditional purposes or occasional access that is similar to the existing (pre-mining) land use".
Issues: • Poor geotechnical stability. • Seepage and runoff of metalliferous and/or other potential contaminates in the drainage. • Lack of top soil for rehabilitation. • Unsuccessful rehabilitation prolonging the closure process.
Controls: *Pre Closure:* • Ponds designed from the outset such that they can be effectively closed.

Process bleed-water and tailings water Evaporation Pond

- Third party assurance and sign off on Ponds design and construction.
- Any contained fluid will be allowed to evaporate.
- Development of local seedling and nursery. Prioritise species that have had high success rate throughout construction and operation.
- Storage of top soil from excavation and land development work during the construction and operation phase into the designated top soil stockpiles.

Closure and Post Closure:

- Any residues remaining on the top HDPE liner will be collected and placed on the lined TMF area.
- The top HDPE liner and geonet between the top HDPE liner and the bottom HDPE liner will be removed, including the Leak Collection and Removal System (LCRS). The top HDPE liner and geonet will either be sent to an approved off-site recycler or will be placed on the lined TMF area. Drain rock from the LRCS sump will be placed on the lined TMF area.
- The bottom HDPE liner will be inspected for visual signs of liner damage, liner defects, or impact by leakage through the liner system. If there is no evidence of past leakage, the HDPE liner and the GCL will be removed for appropriate disposal.
- Where inspection reveals presence of one (1) or more holes or tears or defective seams, the HDPE liner and GCL will be removed and the underlying surface inspected for visual signs of impact. Sampling and analysis of the underlying material will be performed as required, to determine whether the potential impact poses a threat to groundwater quality. If required, soil remediation will be conducted to prevent groundwater impact;
- The HDPE liner will either be sent to an approved off-site recycler or it will be placed in the Waste Management Area. If the liner cannot be recycled, it will also be placed in the lined TMF area; and
- The former Evaporation Pond will either be filled and encapsulated with waste rock or converted to a treatment basin for possible on-going seepage from the TMF overdrain and then filled encapsulated with waste rock. Future studies will include predictions of post-closure seepage rates from the TMF overdrain system.

Monitoring:

- Surface and groundwater monitoring during and post mining operation to determine any contamination issues associated with the pond.
- Assessment of rehabilitation success through annual flora and fauna surveys.
- Quarterly radiation monitoring (gradually stepped down if results are consistently favourable).

Metallurgical plant, surface infrastructure and drains
Closure Objective: “All plant and associated infrastructure (such as Accommodation Village and airport) would be demolished and removed at the conclusion of operations, subject to negotiations with key stakeholders and meeting relevant surface contamination criteria. All materials that do not meet the surface contamination criteria would be sand blasted prior to transport off-site, or buried in an appropriate facility on-site”.
Issues: • Waste and distance of disposal sites. • Radiation contamination. • Lack of top soil for rehabilitation. • Unsuccessful rehabilitation prolonging the closure process.
Controls: *Pre Closure:* • Selection criteria to include plant and infrastructure that has recycling or degradability capabilities. • Undertake detailed surveys to categorise the facility and equipment in terms of their level of decontaminated required prior to closure. • Specific criteria will be developed for (1) unrestricted release of equipment/materials from the site (2) restricted release of equipment/materials and (3) retention of equipment/materials within the site with provisions for future permanent disposal options. • Development of local seedling and nursery. Prioritise species that have had high success rate throughout construction and operation. • Storage of top soil from excavation and land development work during the construction and operation phase into the designated top soil stockpiles. *Closure and Post Closure:* • Segregation of contaminated equipment, structures and materials from those which are less contaminated or not contaminated, in order to reduce radiation hazards to employees in subsequent handling and also to reduce the quantity of waste requiring final disposal. • As far as possible contamination will be removed from plant surfaces, equipment and pipe-work prior to demolition.

Metallurgical plant, surface infrastructure and drains
Monitoring: • Assessment of rehabilitation success through annual flora and fauna surveys.

Bulk Low-Level Radioactive Waste Facility
Closure Objective: "The Bulk Low-Level Radioactive Waste Facility will be decontaminated, backfilled, capped and rehabilitated to safe and stable landform that allows future utilisation of the area for traditional purposes or occasional access that is similar to the existing (pre-mining) land use".
Issues: • Poor geotechnical stability. • Seepage and runoff of metalliferous and/or other potential contaminates in the drainage. • Lack of top soil for rehabilitation. • Unsuccessful rehabilitation prolonging the closure process.
Controls: *Pre Closure:* • Bulk Low-Level Radioactive Waste Facility designed from the outset such that they can be effectively closed. • Third party assurance and sign off on Bulk Low-Level Radioactive Waste Facility design and construction. • Development of local seedling and nursery. Prioritise species that have had high success rate throughout construction and operation. • Storage of top soil from excavation and land development work during the construction and operation phase into the designated top soil stockpiles. *Closure and Post Closure:* • Closure will be as per the WRL controls.
Monitoring: • Surface and groundwater monitoring during and post mining operation to determine any contamination issues associated with the pond. • Assessment of rehabilitation success through annual flora and fauna surveys.

Bulk Low-Level Radioactive Waste Facility
• Quarterly radiation monitoring (gradually stepped down if results are consistently favourable).

8 Development of Completion Criteria

The completion criteria presented in Table 8 are the progressive targets for various ages of the project. The criteria are based on the estimated 15 year life span of the mine.

Table 8: Provisional Completion Criteria and indicators

Factor	Closure Objective	Indicator	Progressive Completion Criteria	Measurement
Soils	At least 10 cm of topsoil and 90 cm of subsoil to spread over the affected area. All contaminated soil is identified and remediated and any compacted soil is relieved.	Success of vegetation growth. Soil and groundwater sampling.	Ensure top soil and sub soil stock piles are monitored and maintained. Contaminated sites are identified and remediated where practical.	Contamination assessments. Top soil and sub soil stock
Flora and Fauna	Rehabilitated areas will be revegetated to the extent that they display similar species diversity to pre mining conditions. Response of vegetation to environmental stressors (such as drought and fire) will approach that of vegetation in agreed control sites.	Species diversity Vegetation density Weed occurrence Vegetation health	50% of pre-mining taxa have been re-established for the decommissioned mine areas five years into the operation. Vegetation density similar to pre mining density in same location, or to agreed analog location. Weed occurrence (types and frequency) similar to pre-mining density in same location, or to agreed analog location.	Biennial surveys (quadrats) Annual weed surveys Seeding of early colonising native species in rehabilitation areas prior to wet season.
Landform Stability	Rehabilitated areas show no evidence of significant erosion following intense storm events. Backfilled areas compacted and graded to reduce ponding.	Frequency and size of rills and gullies Quantity of sediment collected in settling ponds and other drainage structures.	Suitable surface stability measures such as a Landform Function Analysis indicate increasing stability. No erosion features deep enough to present landform stability and containment risks.	Annual and event based erosion surveys (transects).

Table 8: Provisional Completion Criteria and indicators

Factor	Closure Objective	Indicator	Progressive Completion Criteria	Measurement
		Persistent ponding		
Soil Quality	Contamination status of soils in mined areas does not differ to pre-mining status Soils are compatible with agreed post-mining land uses.	Concentrations of trace elements, radionuclides and total salts. Bulk density and plant available water.	Mean concentration of radionuclides, metals and salts in upper 1 metre of soil does not exceed pre-mining mean plus 1 standard deviation from the mean.	Analysis of soil characterization at frequency and locations in sampling plan to be agreed with DEC and DMP
Landform and Drainage	The post-mining landform will be similar to the surrounding terrain. The direction and rate of surface water flows will not be materially different to pre-mining flows.	Scale and form of postmining Landforms Location and hydrological attributes of drainage features.	Mineralised materials contained to designated and appropriately designed areas.	Ground based topographic surveys Lidar data (for regional scale topographic and drainage information).
Surface Water	Turbidity and chemical characteristics of runoff from rehabilitated areas are similar to runoff from agreed analog sites.	Suspended solids, EC, pH and trace elements in unfiltered runoff samples.	Surface water quality similar to pre mining conditions or other analogue location.	Event based monitoring at agreed monitoring locations.
Fauna	Natural re-colonisation of disturbed areas by vertebrate and invertebrate fauna. No evidence of accumulation of trace elements or radionuclides in invertebrates.	Biomass and diversity of soil meso and macrofauna Concentrations of trace elements and radionuclides in invertebrate fauna	Demonstrable increase in biomass and diversity of soil meso and macrofauna overtime.	Six-monthly sampling and annual review of soil invertebrates
Radiation	Post-mining radiation levels will be compatible with agreed post-mining land uses. Mine closure plans prepared under the Mining Act are	Post-closure radiation levels in environmental media.	Annual radiation dose to members of the public does not exceed 1mS/yr	Ground-based radiation surveys.

Table 8: Provisional Completion Criteria and indicators

Factor	Closure Objective	Indicator	Progressive Completion Criteria	Measurement
	also required to be approved by the Radiological Council if radiation is considered an issue at the site.			

9 Financial Provision for Closure

Cameco has prepared a preliminary closure cost estimate for the operation. A probabilistic approach has been applied to best determine closure costs based on the early stage of the project. This approach examines the likelihood of the event occurring and resulting in expenditure, the range of costs associated with the event and the period of time in which expenditure is required.

In developing the project costing, estimated areas, volumes and costs have been determined through the mining studies that have been undertaken and input from various closure studies and methods including the Department of Primary Industry (NSW DPI) rehabilitation and closure cost spreadsheet. The costs to undertake activities include project management fees that would be associated with closure.

The closure costing estimate will be reviewed when the closure plan is updated. Changes in activities and understanding of landform and mine structures will further refine the closure estimate as the mine progresses.

As stated in the DMP/EPA Guidelines for Preparing Mine Closure Plans (May, 2011), the closure cost estimate will be provided to the Department of Mines and Petroleum upon request.

The operation is divided into areas and activities that require specific activities to achieve the closure objective. These areas/activities include:

- Mine Pits
- Waste Rock Landform
- ROM Pad
- Processing Plant
- Tailings Management Facility
- Access road from the site to Telfer Road
- Airstrip
- Accommodation village
- Borrow Pits
- Other Buildings
- Bulk Low-level Radioactive Waste Facility
- Evaporation Pond
- Class I/II landfill for inert and putrescible waste.
- Diesel Powered Power Station
- Electricity supply network
- Haul and site Roads
- Magazine Storage Facility
- Mineralised Overburden Storage Area

- Potable water supply borefield
- Potable water treatment facilities
- Refuelling facilities
- Security Check Point Gate House
- Sediment Pond
- Stormwater Ponds X3
- Surface water diversion channels
- Repair of Storm Events
- Soil contamination
- Monitoring.

10 Closure Implementation

The sections below provide key strategies pertinent to the implementation of the mine closure plan. The strategies were developed from key risk and issues identified relating to mine closure (refer to Section 7 and Appendix B). Actions/tasks derived from the strategies are outlined in Appendix C – Closure Tasks Register.

Table 9: Mine Closure Plan Implementation Strategy

Phase	Strategy	Description
Planning	Mine Closure considered in the design stage:	Design of key domains such as TMF, Waste Rock Landform and Pits are designed so that from the onset they can be effectively closed to post closure criteria. Key focus includes segregation of saline and non saline materials, lining integrity and post closure design.
	Undertake all baseline monitoring prior to construction:	Essential to establish pre-existing conditions to assist on post mining planning, setting objectives and target and as sign off on mine closure completion.
	Encourage local stakeholder participation:	Seek the views and input of local stakeholders to develop meaningful completion criteria. Invite local participation in surveillance activities aimed at testing the effectiveness of mine rehabilitation practices.
Construction	Third Party Assurance of construction:	Ensure completed structures such as the TMF, WRL and Pits are reviewed, have third party assurance and are signed off. This measure can ensure that the structures remain in place for the life of the mine and mitigate the potential for leaching or seepage to occur (contamination issue).
	Minimisation of disturbance:	Temporary disturbance to be located on mine path to the extent practicable; use of existing disturbed areas for access roads and lay down areas. Rehabilitation to be carried out progressively.
	Appropriate storage of hazardous materials:	Ensure that fuels, reagents and process liquids are stored and transferred in accordance with best practice. Carry out routine checks to ensure integrity of containment systems. Conduct periodic contamination assessments.
Operation	Monitoring	Ensure monitoring is undertaken periodically throughout the life of the mine (including weeds and rehabilitation).
	Appropriate storage of hazardous materials:	Ensure that fuels, reagents and process liquids are stored and transferred in accordance with best practice. Carry out routine checks to ensure integrity of containment systems. Conduct periodic contamination assessments.
	Segregation of materials:	Careful segregation of saline and less saline materials and mineralised/ non-mineralised wastes.
	Progressive rehabilitation:	Rehabilitation of disturbed areas from construction that are no longer required (i.e. laydown areas, access track etc.).
	Seedling and top soil	Ensure top soil is collected and stored from

Table 9: Mine Closure Plan Implementation Strategy

Phase	Strategy	Description
	culmination:	excavation works into the designated top soil stockpiles and site nursery germinates and development of seedlings for rehabilitation.
Closure	Monitoring	Continued monitoring of key closure elements.

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11 Closure Monitoring and Maintenance

Cameco will undertake monitoring and maintenance throughout the life of the mine. Baseline monitoring and data collection will be undertaken in the planning phase in preparation for the ERMP as well as an approved monitoring plan for construction and operation which will cover the following key elements/factors:

- Flora and fauna
- Hydrogeology assessment
- Soil quality
- Groundwater condition and quality
- Landform stability
- Air quality and background radiation levels
- Meteorology monitoring
- Topography
- Surface water conditions
- Weed occurrence
- Rehabilitation progress.

Table 10 outlines a preliminary schedule for post mine monitoring. Parameters and frequency are all indicated at this stage of the process and will be re-evaluated closer to closure. The expected monitoring period post closure is expected to be around 10 years however this will vary depending on monitoring result demonstrating baseline or acceptable values at the time of closure. In addition issues that may arise during operation may change the monitoring plan.

Table 10: Preliminary Monitoring Plan

Element / Factor	Monitoring Parameters	Monitoring Frequency
Fauna	Fauna surveys of diversity, fauna habitat, comparisons to baseline values data Concentration of trace elements and radionuclide’s in invertebrates fauna.	Biennial fauna survey’s (every two years)
Flora and vegetation (including spread of weeds).	Flora surveys of diversity, vegetation density, weed occurrence, vegetation health, and comparisons to baseline values data.	Biennial fauna survey’s (every two years) Annual weeds survey’s
Soil quality	Soil sampling on concentrations of trace elements, radionuclide’s and salt total. Remediation assessment (i.e. hydrocarbons).	Minimum every three yearly.

Table 10: Preliminary Monitoring Plan

Element / Factor	Monitoring Parameters	Monitoring Frequency
	Assessment of top soil coverage and availability.	
Groundwater condition and quality	Sampling of groundwater quality, levels and comparison to baseline data (quality and levels)	Annual monitoring.
Landform stability	Assessment of closure landforms such as TMF, Waste Rock Dum and the pit. Frequency and size of rills and gullies.	Annual and event based surveys.
Air quality and background radiation levels	Sampling for background radiation level at potential radiation prone areas. Assessment of dust particulate in the atmosphere from rehabilitated areas.	Initial annual monitoring however this may be revised depending on results. Event based.
Surface water conditions	Sampling of down gradient surface water quality and compare to baseline values.	Annual sampling.
Rehabilitation Progress	Walkover inspection for the stakeholder and the general public.	Biennial (every two years).

12 Management of Information and Data

Cameco has established a Project directory on its in house database. This is a corporate system and is maintained and backed up appropriately.

The Project directory is currently organised based on Project aspects.

The two key studies completed at this time, the Kintyre Pre-feasibility Study and the ERMP also include bibliographies listing all of the technical investigations and field work undertaken to inform both Studies.

As the Project develops the background studies and data will be collated on a domain basis to provide for better management of data relevant to each mine feature.

Evidence of the establishment of the structure will be provided in the next version of the closure plan prior to the commencement of construction.

13 Limitations

ENVIRON Australia prepared this report in accordance with the scope of work as outlined in our proposal to Cameco dated November 2011 and in accordance with our understanding and interpretation of current regulatory standards.

A representative program of sampling and laboratory analyses was undertaken as part of this investigation, based on past and present known uses of the site. While every care has been taken, concentrations of contaminants measured may not be representative of conditions between the locations sampled and investigated. We cannot therefore preclude the presence of materials that may be hazardous.

Site conditions may change over time. This report is based on conditions encountered at the site at the time of the report and ENVIRON disclaims responsibility for any changes that may have occurred after this time.

The conclusions presented in this report represent ENVIRON's professional judgement based on information made available during the course of this assignment and are true and correct to the best of ENVIRON's knowledge as at the date of the assessment.

ENVIRON did not independently verify all of the written or oral information provided to ENVIRON during the course of this investigation. While ENVIRON has no reason to doubt the accuracy of the information provided to it, the report is complete and accurate only to the extent that the information provided to ENVIRON was itself complete and accurate.

This report does not purport to give legal advice. This advice can only be given by qualified legal advisors.

13.1 User Reliance

This report has been prepared exclusively for Cameco and may not be relied upon by any other person or entity without ENVIRON's express written permission.

Figures

Appendix A

Closure Obligations Register

Relevant DMP Tenement Conditions		
Tenement No.	Condition No.	Closure Conditions.

Appendix B

Closure Risk Assessment

Site:	**Kintyre Uranium Mine, Western Australia**									
Date:	**14 September 2012**									
Risk Principles	**Environmental - Mine Closure Risks**									
RISK IDENTIFICATION				**Inherent Risk (without controls)**			**Actual Risk (with controls)**			
Domain	**Element**	**Issue**	**Potential Impact(s)**	**Likelihood**	**Consequence**	**Inherent Risk Level**	**Proposed Controls** *(Preventative, Contingency, Monitoring)*	**Likelihood**	**Consequence**	**Residual Risk Level (Actual)**
Overall	Social	Shut down of mining operation.	Negative socio economic impact to region due to loss of jobs and infrastructure maintenance, however this will be minimal due to the site's fly-in-fly nature.	Likely	Minor	**M**	None	**Likely**	**Minor**	**M**
Overall	All	Unexpected closure	Lack of financial provisions to undertake required closure tasks.	Possible	Moderate	**M**	Cameco has prepared a preliminary closure cost estimate for the operation and a Mining Rehabilitation Fund will be set by the DMP to recover any closure costs. Additionally immediate review of the pre-existing Mine Closure Plan to include a detailed Decommissioning Plan will be required by DMP and/or the EPA, within three months of notification to DMP or at such other time as specified in writing by DMP.	**Unlikely**	**Moderate**	**L**
Overall	All	Temporary closure		Possible	Moderate	**M**	Care and Maintenance Plan will be prepared, based on the pre-existing Mine Closure Plan, and submitted to DMP within three months of its notification to DMP or at such other time as specified in writing by DMP	**Unlikely**	**Moderate**	**L**
Mine Pits	Fauna	Drawdown impacts of groundwater as a result of pit dewatering.	Superficial formations in the groundwater system and potential affects on revegetation works, in particular vegetation whose roots go deep into the groundwater.	Possible	Minor	**L**	Undertake groundwater monitoring, in particular areas with potential risk to vegetation root zones. Identify flora/vegetation that rely on groundwater and whether their roots can reach the groundwater.	**Unlikely**	**Minor**	**L**
Mine Pits	Water	Collapse/slumping of pit walls.	Potential public safety risk as well as potential uncontrolled contaminated water runoff into nearby water courses.	Possible	Major	**H**	Third party sign off on design and construction. Undertake integrity testing and contingency planning as well as revegetation to assist in pit stabilisation.	**Unlikely**	**Major**	**M**

Site:	**Kintyre Uranium Mine, Western Australia**									
Date:	**14 September 2012**									
Risk Principles	**Environmental - Mine Closure Risks**									
RISK IDENTIFICATION				**Inherent Risk (without controls)**			**Actual Risk (with controls)**			
Domain	**Element**	**Issue**	**Potential Impact(s)**	**Likelihood**	**Consequence**	**Inherent Risk Level**	**Proposed Controls** *(Preventative, Contingency, Monitoring)*	**Likelihood**	**Consequence**	**Residual Risk Level (Actual)**
Mine Pits	Water	Lack of geochemical characterisation or poor design, implementation and maintenance resulting in acid, metalliferous and other potential contaminates in drainage. However background studies have indicated that waste-rock materials should be neutral-to-alkaline with a low salt content, so that drainage waters and leachates produced from the waste dumps should be neutral-to-alkaline and of fresh quality.	Serious contamination of surface water and groundwater which depending on the extent can be an enduring/long term contamination source. High remediation and rehabilitation costs, community backlash as well as potential legal consequences	Possible	Moderate	M	Third party sign off on design and construction. Undertake integrity testing and contingency planning. Ongoing geological contamination analysis.	Unlikely	Moderate	L
Mine Pits	Water	Pit lake' adopted for closure option.	Saline pit water forming from long term evaporation posing a potential issue to wildlife using the pit as a water source.	Likely	Moderate	H	Rock characterisations undertaken and ongoing monitoring post mine closure.	Possible	Moderate	M
Mine Pits	Water	Pit lake' adopted for closure option.	Poor surface water quality of pit void posing potential human and wildlife issue.	Almost Certain	Major	VH	Rock characterisations undertaken and ongoing monitoring post mine closure.	Possible	Moderate	M

Site:	**Kintyre Uranium Mine, Western Australia**									
Date:	**14 September 2012**									
Risk Principles	**Environmental - Mine Closure Risks**									
RISK IDENTIFICATION				**Inherent Risk (without controls)**			**Actual Risk (with controls)**			
Domain	**Element**	**Issue**	**Potential Impact(s)**	**Likelihood**	**Consequence**	**Inherent Risk Level**	**Proposed Controls** *(Preventative, Contingency, Monitoring)*	**Likelihood**	**Consequence**	**Residual Risk Level (Actual)**
Waste Rock Landform	Water	Lack of geochemical characterisation or poor design, implementation and maintenance resulting in acid, metalliferous and other potential contaminates in drainage. However background studies have indicated that waste-rock materials should be neutral-to-alkaline with a low salt content, so that drainage waters and leachates produced from the waste dumps should be neutral-to-alkaline and of fresh quality.	Serious contamination surface water and ground water which depending on the extent can be an enduring/long term contamination source. High remediation and rehabilitation, community backlash as well as potential legal consequences	Possible	Moderate	M	All waste rock (inclusive of the Waste Rock Landform and the Open Pit Flood Protection Bund) would remain as a permanent above surface structures. The permanent landforms would be designed to blend in with the landscape as far as practicable, and would be constructed early in the mine life to allow early rehabilitation of the external surfaces. The design would ensure the long-term erosion stability of the structure.	**Unlikely**	**Moderate**	**L**
Waste Rock Landform	Water	The drainage pattern formed by the reconstructed landforms could be different to the pre-disturbance drainage pattern and this could have adverse impacts on vegetation due to interruption of drainage.	Decline of flora and vegetation species in the region.	Possible	Moderate	M	Re-profile the tailings into the required landforms. Natural drainage patterns will be re-established where possible by re-profiling the land to create a landform as close as possible to the surrounding undisturbed landforms	**Unlikely**	**Minor**	**L**
Waste Rock Landform	Land	Runoff/leaching from waste rock dumps	Runoff/leaching may contain a high saline content causing erosion (gully, tunnel, top soil) which can have long term effects on rehabilitation aspiration/ability for fauna to grow, a high level of dust particles as well as landform instability.	Possible	Moderate	M	Surface water drainage systems would be designed to capture and manage heavy rainfall events. Undertake post closure rehabilitation/revegetation and monitor success of rehabilitation.	**Unlikely**	**Moderate**	**L**
Waste Rock Landform	Land	Lack of top soil and availability of local seedlings for capping of the waste rock dumps.	Prolonging the rehabilitation process, ongoing dust and visual issues.	Likely	Moderate	H	Excavated top soil to be stored in a designated area for rehabilitation works. Ongoing rehabilitation trials throughout mining operation.	**Possible**	**Moderate**	**M**

Site:	Kintyre Uranium Mine, Western Australia										
Date:	14 September 2012										
Risk Principles	Environmental - Mine Closure Risks										
RISK IDENTIFICATION				Inherent Risk (without controls)			Actual Risk (with controls)				
Domain	Element	Issue	Potential Impact(s)	Likelihood	Consequence	Inherent Risk Level	Proposed Controls *(Preventative, Contingency, Monitoring)*	Likelihood	Consequence	Residual Risk Level (Actual)	
ROM Pad	Land	Compaction of soil.	Poor rehabilitation success rate and consequently prolonged closure timeline.	Possible	Minor	L	Rip compacted areas when rehabilitation commences.	**Unlikely**	**Minor**	**L**	
ROM Pad	Land	Left over / spilled residue and concentrate on land base.	Ground contamination, health hazard (concentrate dust emissions and uranium), poor revegetation success and surface water runoff contamination.	Possible	Moderate	M	Clear up of residue to waste rock dump or TMF post closure of operations.	**Unlikely**	**Moderate**	**L**	
Processing Plant	Waste	Decommission on plant assets and associated infrastructure.	Processing Uranium oxide can be a contamination issue meaning that difficult to on sell the plant for reuse or scrap metal.	Likely	Moderate	H	Investigation into decommissioning the plant and available options of plant.	**Possible**	**Moderate**	**M**	
Tailings Management Facility (TMF)	Water	Seepage from the TMF	Extensive and prolonged surface water and groundwater contamination. Requirement to pump (and possibly treat) for extended period of time post closure	Likely	Severe	VH	Liner system designed, constructed, and installed to limit migration of wastes out of the impoundment to the adjacent subsurface soil, groundwater, or surface water at any time during the active life (including post-closure). Stormwater controls in the active disposal area to safely convey stormwater from the top of the deposit to limit ponding and associated infiltration. Liner and over drain system will collect seepage flows at the base of the facility and convey to an external lined pond while limiting hydraulic head on the liner.	**Unlikely**	**Major**	**M**	
Tailings Management Facility (TMF)	Land	Lack of top soil and availability of local seedlings for capping of the TMF	Prolonging the rehabilitation process. Erosion issues as a result of runoff and dust issues.	Likely	Moderate	H	Excavated top soil to be stored in a designated area for rehabilitation works.	**Possible**	**Moderate**	**M**	
Tailings Management Facility (TMF)	Water	Cannot achieve post-closure groundwater levels.	Requirement to pump (and possibly treat) for extended period of time post closure. Unable to relinquish leases or reduce bond.	Possible	Major	H	Third party sign off on design and construction. Undertake integrity testing and contingency planning as well as ongoing post-closure monitoring.	**Possible**	**Moderate**	**M**	

Site:	**Kintyre Uranium Mine, Western Australia**
Date:	**14 September 2012**
Risk Principles	**Environmental - Mine Closure Risks**

RISK IDENTIFICATION				Inherent Risk (without controls)			Actual Risk (with controls)			
Domain	**Element**	**Issue**	**Potential Impact(s)**	**Likelihood**	**Consequence**	**Inherent Risk Level**	**Proposed Controls** *(Preventative, Contingency, Monitoring)*	**Likelihood**	**Consequence**	**Residual Risk Level (Actual)**
Tailings Management Facility (TMF)	Air	Potential for low level radiation levels. Therefore, there is the potential for the formation of radiation 'hot spots' where NORM is concentrated.	Detrimental long term health effect to humans and wildlife.	Possible	Severe	H	Monitoring to be undertaken during operation and post operation. Survey to be undertaken prior to non mineralised cover.	**Unlikely**	**Major**	**M**
Tailings Management Facility (TMF)	Water	The drainage pattern formed by the reconstructed landforms could be different to the pre-disturbance drainage pattern and this could have adverse impacts on vegetation due to interruption of drainage.	Decline of flora and vegetation species in the region.	Possible	Moderate	M	Re-profile the tailings into the required landforms. Natural drainage patterns will be re-established where possible by re-profiling the land to create a landform as close as possible to the surrounding undisturbed landforms	**Possible**	**Minor**	**L**
Access road from the site to Telfer Road.	Land	Ongoing compaction of soil.	Prolonging the rehabilitation process, ongoing dust and visual issues.	Likely	Minor	M	Rip compacted areas when rehabilitation commences.	**Unlikely**	**Minor**	**L**
Airstrip and infrastructure	Land	Spills and leaks from workshop, fuel storage areas and fuel loading areas.	Soil and groundwater contamination requiring clean up.	Possible	Minor	L	EMP, clean up SOPs and storage requirements to be implemented	**Possible**	**Minor**	**L**
Airstrip and infrastructure	Land	Compaction of soil.	Prolonging the rehabilitation process, ongoing dust and visual issues.	Likely	Minor	M	Rip compacted areas when rehabilitation commences.	**Unlikely**	**Minor**	**L**
Accommodation Village	Land	Compaction of soil.	Prolonging the rehabilitation process, ongoing dust and visual issues.	Likely	Minor	M	Rip compacted areas when rehabilitation commences.	**Unlikely**	**Minor**	**L**

Site:	**Kintyre Uranium Mine, Western Australia**									
Date:	**14 September 2012**									
Risk Principles	**Environmental - Mine Closure Risks**									
RISK IDENTIFICATION				**Inherent Risk (without controls)**			**Actual Risk (with controls)**			
Domain	**Element**	**Issue**	**Potential Impact(s)**	**Likelihood**	**Consequence**	**Inherent Risk Level**	**Proposed Controls** *(Preventative, Contingency, Monitoring)*	**Likelihood**	**Consequence**	**Residual Risk Level (Actual)**
Borrow Pits	Land	Remaining borrow pits.	Hole in the ground posing a risk to wildlife and humans as well as ongoing erosion due to high rainfall if not rehabilitation or contouring is undertaken.	Likely	Minor	**M**	• Borrow pits will be progressively rehabilitated unless the pit is to remain open to provide material for road maintenance, in which case access will be retained to the active face by battering down edges and ripping ensuring the site is made safe. • Borrow pits will be deep ripped deep ripped to enable rip lines to hold up after heavy rainfall. • Ripping to be done along contour, not up and down slope which leads to enhanced erosion.	**Unlikely**	**Minor**	**L**
Buildings, including offices, mess building, laundry, workshops and warehouses.	Land	Compaction of soil.	Prolonging the rehabilitation process, ongoing dust and visual issues.	Likely	Minor	**M**	Rip compacted areas when rehabilitation commences.	**Unlikely**	**Minor**	**L**
Bulk Low-level Radioactive Waste Facility.	Air	Stockpile of radioactive waste.	Hazardous radioactive levels generated from the stockpile posing a human and wildlife risk.	Likely	Major	**H**	The Bulk Low-Level Radioactive Waste Facility would be covered with non-mineralised overburden post assessment.	**Unlikely**	**Major**	**M**
Bulk Low-level Radioactive Waste Facility.	Water	The drainage pattern formed by the reconstructed landforms could be different to the pre-disturbancedrainage pattern and this could have adverse impacts on vegetation due to interruption of drainage.	Decline of flora and vegetation species in the region.	Possible	Moderate	**M**	Re-profile the waste rock landform into the required landforms. Natural drainage patterns will be re-established where possible by re-profiling the land to create a landform as close as possible to the surrounding undisturbed landforms	**Unlikely**	**Minor**	**L**
Bulk Low-level Radioactive Waste Facility.	Land	Lack of top soil and availability of local seedlings for capping of the waste rock dumps.	Prolonging the rehabilitation process, ongoing dust and visual issues.	Likely	Moderate	**H**	Excavated top soil to be stored in a designated area for rehabilitation works.	**Possible**	**Moderate**	**M**

Site:	Kintyre Uranium Mine, Western Australia
Date:	14 September 2012
Risk Principles	Environmental - Mine Closure Risks

RISK IDENTIFICATION				Inherent Risk (without controls)			Actual Risk (with controls)			
Domain	Element	Issue	Potential Impact(s)	Likelihood	Consequence	Inherent Risk Level	Proposed Controls *(Preventative, Contingency, Monitoring)*	Likelihood	Consequence	Residual Risk Level (Actual)
Class I/II landfill	Air	Methane gas produced as the putrescible materials begins to break down in the landfill	Such emissions can lead to important detrimental environmental and human effect and may cause an explosion. However the remoteness and openness of site would deem any effects to be unlikely.	Unlikely	Major	M	Accommodation camp is located away from the landfill so it does not pose a risk if it is kept post closure.	**Rare**	**Moderate**	L
Class I/II landfill	Water	Seepage from the landfill.	Extensive and prolonged surface water and groundwater contamination	Likely	Major	H	Third party sign off on design and construction. Undertake integrity testing and contingency planning. Cap landfill at closure to industry standard. Post closure monitoring	**Unlikely**	**Major**	M
Class I/II landfill	Ground	Capping of the landfill	Lack of top soil and availability of local seedlings may result in aesthetically poor rehabilitated of the landfill and consequently prolonging the rehabilitation process.	Likely	Moderate	H	Excavated top soil to be stored in a designated area for rehabilitation works.	**Possible**	**Moderate**	M

Site:	**Kintyre Uranium Mine, Western Australia**
Date:	**14 September 2012**
Risk Principles	**Environmental - Mine Closure Risks**

RISK IDENTIFICATION				**Inherent Risk (without controls)**			**Actual Risk (with controls)**			
Domain	**Element**	**Issue**	**Potential Impact(s)**	**Likelihood**	**Consequence**	**Inherent Risk Level**	**Proposed Controls** *(Preventative, Contingency, Monitoring)*	**Likelihood**	**Consequence**	**Residual Risk Level (Actual)**
Diesel Powered Power Station	Ground	Leaks and spills from long term storage and generation of diesel power.	Soil and groundwater contamination requiring clean up.	Likely	Minor	**M**	• Design and construct hydrocarbon storage in accordance with AS1940 or other approved standard. • Ensure necessary approvals are obtained for hazardous goods storage (e.g. Dangerous Goods Licence if >100 kL diesel is required to be stored on site). • Locate hydrocarbon storage areas at a safe distance from environmentally sensitive areas such as water courses. • Bund hydrocarbon storage and vehicle maintenance areas. • Clean up of any spills and the remediate contaminated areas in accordance with the Spill Response procedure. • All soil contaminated by fuels or oil spills will removed to the Project Area for temporary storage, prior to the removal to an approved disposal location. • Collect and store waste oil in suitable drums within a bunded area prior to them being taken off site for disposal at an approved facility.	**Possible**	**Minor**	**L**
Electricity supply network.		Decommission of electricity supply network.	Potential waste issue	Likely	Minor	**M**	Electricity supply network to be disposed of in the landfill or in the Bulk Low-level Radioactive Waste Facility	**Unlikely**	**Minor**	**L**
Haul Roads	Ground	High salinity content in haul roads from long term water cart use containing a high TDS concentration.	Dust emissions, increased soil erosion potential and prolonged rehabilitation process.	Possible	Minor	**L**	Rip compacted areas and rehabilitate haul roads if required.	**Unlikely**	**Minor**	**L**

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Date:	**14 September 2012**										
Risk Principles	**Environmental - Mine Closure Risks**										
RISK IDENTIFICATION				**Inherent Risk (without controls)**			**Actual Risk (with controls)**				
Domain	**Element**	**Issue**	**Potential Impact(s)**	**Likelihood**	**Consequence**	**Inherent Risk Level**	**Proposed Controls** *(Preventative, Contingency, Monitoring)*	**Likelihood**	**Consequence**	**Residual Risk Level (Actual)**	
Magazine Storage Facility.	Ground	Spill and leaks of hazardous substances	Soil and groundwater contamination requiring clean up.	Unlikely	Moderate	L	Bunding of the Magazine Storage Facility, clean up of any spills and the remediate contaminated areas in accordance with the Spill Response procedure, implement handling and transport SOPs for the Magazine Storage Facility.	**Unlikely**	**Minor**	**L**	
Mineralised Overburden Storage Area.	Ground	Seepage from the former storage area.	Extensive and prolonged surface water and groundwater contamination. Requirement to pump (and possibly treat) for extended period of time post closure	Possible	Moderate	M	Undertake post closure rehabilitation/revegetation and monitor success of rehabilitation.	**Unlikely**	**Moderate**	**L**	
Pit dewatering infrastructure.	Waste	Disposal of pumping equipment.	Potential contamination of equipment from uranium causing difficulty with disposal.	Unlikely	Minor	L	None	**Unlikely**	**Minor**	**L**	
Potable water supply bore field.	Groundwater	Contamination of groundwater from boreholes during operation or disused	Contamination of groundwater	Possible	Moderate	M	The decommissioning of the water bores would be conducted in accordance with the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2003) Minimum Construction Requirements for Water Bores in Australia. This will include: • Operational wells to be capped and cemented between casing and wall of hole to prevent surface water entering well. • Unsuccessful or disused bores to be sealed and filled to prevent groundwater pollution	**Unlikely**	**Minor**	**L**	
Potable water treatment facilities	Waste	Decommission of treatment facility.	Large amounts of waste that is difficult to recycle, reuse or dispose of due to remoteness of the area.	Likely	Minor	M	Disposal in the TMF or waste rock dump	**Unlikely**	**Minor**	**L**	

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Domain	**Element**	**Issue**	**Potential Impact(s)**	**Likelihood**	**Consequence**	**Inherent Risk Level**	**Proposed Controls** *(Preventative, Contingency, Monitoring)*	**Likelihood**	**Consequence**	**Residual Risk Level (Actual)**
Bore fields	Water	Abandonment of boreholes	Unsealed, abandoned bores are a potential hazard to fauna, and public health and safety. Abandoned bores are also a hazard to the preservation of the quantity and quality of the groundwater resource.	Possible	Minor	L	All abandoned bore holes to be decommissioned to industry standards.	**Unlikely**	**Minor**	**L**
Process Bleed-water Evaporation Pond (PBEP)	Water	Contaminated water from the process plant.	Medium term contamination issue for wildlife and a human health risk. Potential overflow issue during high rainfall periods.	Likely	Moderate	H	Solids accumulated during operations in the PBEP and TWRP would be removed and placed in the TMF prior to its closure. Pump waste water into the TMF.	**Unlikely**	**Moderate**	**L**
Process Bleed-water Evaporation Pond (PBEP)	Waste	Liners for the PBEP potentially contaminated with radioactive material.	Human health risk and waste disposal issue.	Likely	Minor	M	The liners at the base of PBEP would be removed and placed into the Bulk Low-Level Radioactive Waste Facility.	**Unlikely**	**Minor**	**L**
Reagent storage facilities	Land	Leaks and spill from the storage of hazardous substances	Soil and ground water contamination	Possible	Minor	L	• Ensure necessary approvals are obtained for hazardous goods storage. • Clean up of any spills and the remediate contaminated areas in accordance with the Spill Response procedure. • All soil contaminated by fuels or oil spills will removed to the Project Area for temporary storage, prior to the removal to an approved disposal location.	**Unlikely**	**Minor**	**L**
Security Check point gate	Waste	Removal of infrastructure.	Waste that is difficult to recycle, reuse or dispose of due to remoteness of the area.	Likely	Low	L	Disposal of waste into the TMF.	**Unlikely**	**Low**	**VL**
Sewage management facilities	Waste	Removal of infrastructure.	Disposal of infrastructure costs.	Likely	Minor	M	Disposal offsite if possible. Alternatively is off site is not economically viable waste can be disposed of in the TMF.	**Unlikely**	**Minor**	**L**
Sewage management facilities	Waste	Non processed sewage residue from processing.	Contamination of soil and surface water and disposal presenting a health risk.	Unlikely	Minor	L	Clean up of contaminated areas and dispose in the TMF.	**Unlikely**	**Minor**	**L**

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RISK IDENTIFICATION				**Inherent Risk (without controls)**			**Actual Risk (with controls)**			
Domain	**Element**	**Issue**	**Potential Impact(s)**	**Likelihood**	**Consequence**	**Inherent Risk Level**	**Proposed Controls** *(Preventative, Contingency, Monitoring)*	**Likelihood**	**Consequence**	**Residual Risk Level (Actual)**
Sediment Pond	Land	Evaporation of the sediment pond	Saline soil and runoff of sediment during high rainfall.	Possible	Minor	L	Backfill once rehabilitation has taken place.	**Unlikely**	**Minor**	**L**
Stormwater Ponds X3.	Ground	Evaporation of stormwater ponds	Saline soil preventing rehabilitation. The dam could form a potential hazard to fauna and public health and safety.	Possible	Minor	L	Backfill once rehabilitation has taken place.	**Unlikely**	**Minor**	**L**

CONSEQUENCE DESCRIPTOR TABLE

Low	Minor	Moderate	Major	Severe
		Environment		
No discernible impact or measurable impairment – for example, not exceeding published guideline values for “normal” or “background” levels. Internally reported. Environmentally liability or remediation cost: < AUS $5,000	Minor effects on biological or physical environment. Minor short-medium term damage to a localised area or that ceases once the event is over. Environmental liability or remediation cost: AUS $5,000 - $50,000	Measurable impairment on biological or physical environment but not affecting ecosystem function. Short-medium term impacts, where the ecosystem will recover quickly and without intervention. Environmental liability or remediation cost: AUS $50,000 - $500,000	Serious environmental effects with some impairment of ecosystem function. Relatively widespread medium-long term impacts requiring remediation, where ecosystem will recover over time once clean-up has been completed. Environmental liability or remediation cost: AUS $500,000 - $5M	Very serious environmental effects with significant impairment of ecosystem function. Long term, widespread effects. Remediation required. Environmental liability or remediation cost: > > AUS $5 Million

RISK MATRIX and LIKELIHOOD DESCRIPTOR TABLE

sourced from PR295 Hazard & Risk Assessment

Likelihood	Description
5. Almost Certain	The event is expected to occur in most circumstances
4. Likely	The event will probably occur in most circumstances
3. Possible	The event should occur at some time
2. Unlikely	The event could occur at some time
1. Rare	The event may occur in exceptional circumstances

				Consequences		
		1	2	3	4	5
	Likelihood	Low	Minor	Moderate	Major	Severe
5	Almost Certain	**L(15)**	**H(10)**	**H(6)**	**VH(3)**	**VH(1)**
4	Likely	**L(19)**	**M(14)**	**H(9)**	**H(5)**	**VH(2)**
3	Possible	**L(22)**	**L(18)**	**M(13)**	**H(8)**	**H(4)**
2	Unlikely	**VL(24)**	**L(21)**	**L(17)**	**M(12)**	**H(7)**
1	Rare	**VL(25)**	**VL(23)**	**L(20)**	**L(16)**	**M(11)**

Appendix C

Closure Task Register

Domain	Pit	Waste Rock Dump	PREP & TWRP	Process Plant	Bulk Low-Level Radioactive Waste Facility	Water bores	Accommodation & infrastructure	Access roads	Responsibly	Current Status
Actions										
Planning Stage										
Undertake Closure Risk Assessment.	X	X	X	X	X	X	X	X	**E**	Completed and included in Appendix B of the Conceptual Mine Closure Plan.
Document and maintain database register/bibliography.	X	X	X	X	X	X	X	X	**E**	To be completed. Appendix A (Closure Obligations Register) will be updated when the DMP sets the tenement conditions.
Document and maintain legal register.	X	X	X	X	X	X	X	X	**E**	Completed and included in Appendix A of the Conceptual Mine Closure Plan.
Domain's design to incorporate closure practices as such that they can be effectively closed to post closure criteria.	X	X	X	X	X	X	X	X	**M**	Completed and included in Appendix B (Closure Risk Assessment) of the CMCP. Also refer to ERMP.

Domain	Pit	Waste Rock Dump	PREP & TWRP	Process Plant	Bulk Low-Level Radioactive Waste Facility	Water bores	Accommodation & infrastructure	Access roads	Responsibly	Current Status
Complete Baseline Studies - Surface and Ground water.	X	X	X	X	X	X	X		**E**	Completed. Refer to Section 11 (Closure Monitoring and Maintenance) of the CMCP. Baseline monitoring and data collection is currently been Baseline monitoring and data collection will be undertaken in the planning phase in preparation for the ERMP as well as an approved monitoring plan for construction and operation undertaken as part of the preparation for the ERMP as well as ongoing monitoring during the construction and operation of the Project.
Complete Baseline Studies - Background radiation levels.	X	X	X	X	X	X	X		**E**	Completed and included in the ERMP.
Complete Baseline Studies - Flora and Fauna.	X	X	X	X	X	X	X	X	**E**	Completed and included in the ERMP.
Complete Baseline Studies - Soil	X	X	X	X	X	X	X	X	**E**	Completed and included in the ERMP.
Complete Baseline Studies - Meteorological data.	X	X	X	X	X	X	X		**E**	Completed and included in the ERMP.
Complete Baseline Studies - geology characteristics.	X	X	X	X	X	X	X		**G**	Completed and included in the ERMP.

Domain	Pit	Waste Rock Dump	PREP & TWRP	Process Plant	Bulk Low-Level Radioactive Waste Facility	Water bores	Accommodation & infrastructure	Access roads	Responsibly	Current Status
Document seed list and identify areas for collection.	X	X	X	X	X	X	X	X	**E**	
Preliminary Drainage Design.	X	X	X	X	X	X	X	X	**M**	Completed and included in the ERMP.
Preliminary Closure Cost Estimates.	X	X	X	X	X	X	X	X	**E**	Completed. Refer to Section 9 (Financial Provision for Closure).
Stakeholder Consultation on post closure land use.	X	X	X	X	X	X	X	X	**E**	To be completed. The MCP will be publically reviewed and provisions will be made for comment to the DMP by the public as part of the ERMP public review process.
Construction										
Construct nursery and seedlings collection.	X	X	X	X	X	X	X	X	**E**	To be completed
Establish top soil area.	X	X	X	X	X	X	X	X	**P**	To be completed. Two top soil stockpiles have being allocated in the planning.
Ascertain the availability and volumes of key materials required for rehabilitation such as competent wast rock, subsoil, top soil and low permeability clay.	X	X	X	X	X	X	X	X	**E**	To be completed
Annual Surveys of disturbed and rehabilitated areas.									**E**	To be completed

Domain	Pit	Waste Rock Dump	PREP & TWRP	Process Plant	Bulk Low-Level Radioactive Waste Facility	Water bores	Accommodation & infrastructure	Access roads	Responsibly	Current Status
Third party assurance and sign off on construction to meet design specification.	X	X	X	X	X	X	X		**E**	To be completed
Operation (years 1-2)										
Progressively rehabilitation of disturbed areas from construction that are no longer required (i.e. laydown areas, access track etc.).	X	X	X	X	X	X	X	X	**E**	To be completed
Annual Surveys of disturbed and rehabilitated areas.	X	X	X	X	X	X	X	X	**E**	To be completed
Review top soil quantities and availability	X	X	X	X	X	X	X	X	**E**	To be completed
Operation (years 3-11)										
Review Mine Closure Plan and cost estimates and submit to the DMP for approval every three years.	X	X	X	X	X	X	X	X	**E**	To be completed
Monitor mining sequence plan and revise if required.	X	X	X		X				**M**	To be completed
Annual Surveys of disturbed and rehabilitated areas.	X	X	X	X	X	X	X	X	**E**	To be completed

Domain	Pit	Waste Rock Dump	PREP & TWRP	Process Plant	Bulk Low-Level Radioactive Waste Facility	Water bores	Accommodation & infrastructure	Access roads	Responsibly	Current Status
Pre Closure Operation (years 11-15 prior to closure)										
Review closure cost estimates.	X	X	X	X	X	X	X	X	**C**	To be completed
Stakeholder Consultation on post closure land use.	X	X	X	X	X	X	X	X	**C**	To be completed
Undertake contamination risk assessment.	X	X	X	X	X	X	X	X	**E**	To be completed
Finalise closure design.	X	X	X		X				**E**	To be completed
Ensure availability of required top soil.	X	X	X	X	X	X	X	X	**E**	To be completed
Prepare assets list.				X	X	X	X		**C**	To be completed
Closure (years 15+)										
Decommission and Decontaminate Equipment.			X	X	X	X	X		**Pr**	To be completed
Remove all metal wastes.				X			X		**C**	To be completed
Commence capping and rehabilitation.		X	X		X				**P**	To be completed
Undertake rehabilitation.	X	X	X	X	X	X	X	X	**E**	To be completed
Commence rehabilitation monitoring program/plan.	X	X	X	X	X	X	X	X	**E**	To be completed

Responsibility

Domain	Pit	Waste Rock Dump	PREP & TWRP	Process Plant	Bulk Low-Level Radioactive Waste Facility	Water bores	Accommodation & infrastructure	Access roads	Responsibly	Current Status

Environmental Department	E
Mining Department	M
Geology Department	G
Corporate	C
Processing Department	Pr
Projects	P

Appendix D

Stakeholder Consultation Register

Stakeholder Consultation Register					
Date	**Description of Consultation**	**Stakeholders**	**Stakeholder comments/issue**	**Proponent Response and/or resolution**	**Stakeholder response**