

Kintyre Uranium Project
Environmental Scoping Document

for assessment under the
Western Australian
Environmental Protection Act 1986

and the Commonwealth
Environment Protection and Biodiversity Conservation Act 1999

Prepared for:
Cameco Australia Pty Ltd
Perth, Western Australia

Prepared by:
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Cameco

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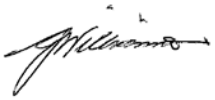
Signature:  Date: 09/08/2011

This document is issued to Cameco Australia Pty Ltd as an Environmental Scoping Document for assessment of the Kintyre Uranium Project under Part IV of the *Environmental Protection Act 1986* and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*. It should not be used for any other purpose.

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Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

Cameco Australia Pty Ltd (Cameco) is proposing to develop the Kintyre Uranium Project located approximately 1,200 km north northeast of Perth in the Shire of East Pilbara of Western Australia (WA).

On 20 September 2010 the Western Australian Environmental Protection Authority advertised the level of assessment for the Kintyre Uranium Project as an Environmental Review and Management Programme (ERMP) with a 14-week public review period. This level of assessment requires a proponent to prepare and release an environmental scoping document for public review for at least two weeks and to modify the document in response to submissions. This Environmental Scoping Document (ESD) has been prepared to enable key stakeholders and the public to comment on the proposed scope of works for the environmental impact assessment of the proposed Kintyre Uranium Project (the Project).

The Project will consist of an open-cut uranium mine, process plant and associated infrastructure. The Project will produce between 2.7 and 3.6 kilotonnes (kT) (six and eight million pounds[1]) per year uranium oxide concentrate (UOC) as U_3O_8 equivalent for transport via road from the mine site to the proposed Parkeston transport hub near Kalgoorlie, WA. Transport of UOC by road and/or rail from Parkeston to export ports in Adelaide South Australia or Darwin in the Northern Territory will be the subject of a separate environmental assessment. Indicative project characteristics are outlined in Table E1 below.

Table E1: Indicative Project Characteristics

Project Element	Description
Life of Project	Nominally 15 years (based on current geological modelling)
Timing (subject to approvals)	Commencement of construction after 2013 Commencement of operations after 2015
Size of orebody	28 – 36 kT (62 – 80 million pounds) uranium oxide (U_3O_8) with ore grade of 0.3 – 0.4% U_3O_8 Exploration drilling is ongoing to define the resource in compliance with Canadian Mineral Resource and Reporting Standards.
Mining method	Selective open pit mining
Major components	Open pits Permanent waste rock dump Temporary waste rock dump BOGUM dump ROM pad Process Plant

1 The standard unit of measurement in the uranium industry is pounds.

Table E1: Indicative Project Characteristics	
Project Element	**Description**
	Tailings Storage Facility (TSF) Mine workshop and administration buildings
Mining method	Rock blasting, with conventional excavator and truck
Mining rate	15 Mtpa – 24 Mtpa (140 Mt total)
Area of disturbance	Approximately 600 ha
Processing method	• Acid or alkaline tank leaching of beneficiated ore; and/or • Acid or alkaline tank leaching of whole ore; and/or • Acid or alkaline heap leaching.
Processing rate	0.5 to 3 Mtpa
Main reagents (acid processing option)	• Sulphuric acid • Peroxide • Lime
Main reagents (alkaline processing option)	• Sodium carbonate/bicarbonate • Caustic • Peroxide
Production rate	2.7 – 3.6 kT (6 - 8 million pounds) per year uranium oxide concentrate (UOC) as U_3O_8 equivalent.
Solid waste	Unmineralised waste rock. BOGUM – stored on BOGUM dump. May be used for backfilling open pit, or processing (should this become viable) prior to closure. Radioactive Waste Management Facility Tailings - discharged as slurry or as a dry filter cake to a TSF and capped on closure.
Water Supply Process water requirement Total project water requirement	Mine dewatering + process water supply borefield. Dependent on mill throughput and process. Estimated to be in the order of 0.6m^3/t of ore milled, or 2.4ML/day for throughput of 1.5Mtpa. Total project water requirements including process water, water for dust suppression and industrial requirements estimated to be less than a maximum of 5ML/ day.
Potable water	Dedicated borefield.

Table E1: Indicative Project Characteristics	
Project Element	**Description**
Power requirement	5 to 15 MW depending on processing rate. Owner operated diesel or gas fired power station; or Contract power supply through a Build Own and Operate agreement; or Reticulated power from Telfer Gold Mine.
Construction workforce	Up to 600 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; evaporation pond; Offices and warehouses; Landfill; and Airstrip.
Transport of product to export Port	Via road to Parkeston, Kalgoorlie, WA, then rail and/or road to the WA/SA border en-route to the export ports of Adelaide or Darwin.

Notes:
FIFO = Fly in, fly out
BOGUM = Below ore-grade uranium material
ROM = Run of Mine, ore stockpiled to feed the process plant

The Project Area lies in a transition zone between the Great Sandy Desert and the Little Sandy Desert in the Eastern Pilbara region of Western Australia. The area is an arid setting of exposed bedrock, low mesas and ephemeral watercourses. Most of the rainfall occurs during summer and autumn and is often related to cyclonic activity.

The Project Area lies within the Little Sandy Desert (LSD1 – Rudall Subregion) as classified by the Interim Biogeographical Regionalisation for Australia (IBRA) category (Thackway and Cresswell, 1995). The LSD1 sub region comprises sparse shrub-steppe over *Triodia basedowii* on stony hills, with River Gum communities and bunch grasslands on alluvial deposits in and associated with ranges (Kendrick, 2001).

The Project is located in a remote area on Vacant Crown Land and there are no commercial land uses active in the area. The local indigenous communities (Parnngurr 80 km southeast and Punmu 113 km northeast of the Project) use land in the area for traditional purposes

including hunting. Karlamilyi National Park (formerly Rudall River National Park) is located immediately south of the Project Area. The proposed mine is located outside of the Rudall River catchment. Access to the Project area is via the Telfer access road which is also used by the local indigenous communities, other exploration companies and visitors to Karlamilyi National Park.

Cameco has considered the key environmental factors, potential impacts of the Project and available information and has proposed a number of investigations in this ESD. The scope of works includes:

- Flora and vegetation surveys;
- Terrestrial fauna surveys including short-range endemic investigations;
- Subterranean fauna investigations;
- Surface water investigation;
- Groundwater investigation;
- Seepage investigations;
- Radiation assessments;
- Meteorology and ambient dust study;
- Greenhouse gas assessment;
- Geochemical characterisation of waste rock and tailings;
- Ethnographic and archaeological studies;
- Review of European heritage databases;
- Social impact assessment; and
- Transport risk study.

As part of the ERMP a number of management plans will be developed as part of the Environmental Management Programme (EMP). The ERMP will also include a Mine Closure and Rehabilitation Plan.

Cameco has developed a stakeholder consultation programme including consultation with local indigenous communities, government agencies and key interest groups. Consultation will include communities and municipalities along the transport route. The consultation programme has commenced and will continue throughout the approvals process and life of the Project.

The information presented in this document reflects Cameco's knowledge at the date of filing this document. The proposed Kintyre Uranium Project is in the planning phase and therefore details are not yet finalised. Geological exploration and work on process design and optimisation are ongoing. The full extent and preferred options for some project infrastructure are yet to be determined. Where information such as dates or rates are presented as a range in this document, the range includes the options that Cameco is investigating and what Cameco believes to be the upper limit at this time.

Invitation

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. The environmental impact assessment process is designed to be transparent and accountable, and includes specific points for public involvement, including opportunities for public review of environmental review documents. In releasing this document for public comment, the EPA advises that no decisions have been made to allow this proposal to be implemented.

Cameco Australia Pty Ltd proposes to develop the **Kintyre Uranium Deposit in the Eastern Pilbara region of Western Australia over an anticipated mine life of approximately 15 years, producing between 2.7 and 3.6 kilotonnes (6 and 8 million pounds) per year uranium oxide concentrate as U_3O_8 equivalent**. In accordance with the *Environmental Protection Act 1986*, an Environmental Scoping Document (ESD) has been prepared which describes this proposal and the environment and identifies the scope of studies and information required for the development of the Environmental Review (ERMP) document. The ESD is available for a public review period of **two** weeks from 28 March 2011, closing on 11 April 2011.

Comments from government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to government.

Where to get copies of this document

Printed and CD copies of this document may be obtained free of charge from Cameco Australia, Level 3, 1060 Hay Street, West Perth 6005. To obtain a copy please contact Chantelle Curtis by phone: +61 (8) 9216 7500 or at Kintyre.Enquiries@cameco.com.

The document/s may also be accessed through the proponent's website at www.cameco.com\australia\kintyre.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the Office of the EPA will be acknowledged. Electronic submissions will be acknowledged electronically. The proponent will be required to provide adequate responses to points raised in submissions. In preparing its assessment report for the Minister for the Environment, the Office of the EPA will consider the information in submissions, the proponent's responses and other relevant information. Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*, and may be quoted in full or in part in each report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may

help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues discussed in the ESD or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the ESD:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the ESD;
- if you discuss different sections of the ESD, keep them distinct and separate, so there is no confusion as to which section you are considering;
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name,
- address,
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: 11th April **2011.**

The EPA prefers submissions to be made electronically using one of the following:

- the submission form on the EPA's website: www.epa.wa.gov.au/submissions.asp;
- by email to submissions@epa.wa.gov.au.

Alternatively submissions can be

- posted to: Chairman, Environmental Protection Authority, Locked Bag 33, CLOISTERS SQUARE WA 6850, Attention: Ray Claudius; or
- delivered to the Environmental Protection Authority, Level 4, The Atrium, 168 St Georges Terrace, Perth, Attention: Ray Claudius; or
- faxed to (08) 6467 5562.

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1 Introduction

1.1 Overview

Cameco Australia Pty Ltd (Cameco) is proposing to develop the Kintyre Uranium Project located approximately 1,200 km north northeast of Perth in the Shire of East Pilbara of Western Australia (WA) (Figure 1).

The Kintyre Uranium Project (the Project) will consist of an open-cut uranium mine, process plant and associated infrastructure. The Project will produce between 2.7 and 3.6 kilotonnes (kT) (six and eight million pounds[1]) per year uranium oxide concentrate (UOC, also known as yellow cake) as U_3O_8 equivalent for transport via road from the mine site to the proposed Parkeston transport hub near Kalgoorlie, WA and then by road and/or rail from Parkeston, Kalgoorlie, to export ports in Adelaide, South Australia or Darwin in the Northern Territory. This environmental assessment covers all transport within Western Australia. Transport within South Australia and the Northern Territory will be the subject of separate environmental assessment and approvals processes.

1.2 Purpose of Document

The Kintyre Uranium Project requires environmental assessment under both State and Federal legislation.

In September 2010 assessment of the Kintyre Uranium Project commenced with submission of a Referral to the Western Australian Environmental Protection Authority (EPA) under the *Environmental Protection Act 1986* (EP Act) and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

On 20 September 2010 the WA EPA advertised the level of assessment for the Kintyre Uranium Protect as an Environmental Review and Management Programme (ERMP) with a 14-week public review period. This level of assessment requires a proponent to prepare and release an environmental scoping document for public review for at least two weeks and to modify the document in response to submissions.

On 5 October 2010 DSEWPC designated the Project a 'Controlled Action' requiring assessment under the EPBC Act. DSEWPC also determined that the Project would be assessed under the bilateral agreement between the Commonwealth and Western Australian State Government.

This Environmental Scoping Document (ESD) has been prepared to enable key stakeholders and the public to comment on the proposed scope of works for the environmental impact assessment of the proposed Kintyre Uranium Project.

1 The standard unit of measurement in the uranium industry is pounds.

1.3 Proponent

Cameco Corporation is a Canadian-based company and one of the world's largest uranium producers, accounting for about 16% of the world's production from mines in Canada, the United States and Kazakhstan.

Cameco Corporation (70%) and Mitsubishi Development (30%) acquired the Kintyre Uranium Project in 2008. Cameco Australia Pty Ltd is the Proponent for the Project.

Details for Cameco Australia Pty Ltd are:

ABN:	65 001 513 088
Office address:	Level 3, 1060 Hay Street, West Perth, WA 6005, Australia
Postal address:	PO Box 1958, West Perth, WA 6872, Australia
Telephone:	+61 (0)8 9216 7500
Facsimile:	+61 (0)8 9216 7555
Contact:	Mr Simon Williamson, Environmental Manager

1.4 Project History

The Kintyre, Whale and Pioneer deposits were discovered by CRA Exploration Pty Ltd in 1985 and a comprehensive drilling and metallurgical test programme was completed during the following four years. This work identified five main deposits (Kintyre, East Kintyre, Whale, East Whale, and Pioneer) which are collectively known as the Kintyre Uranium Project. The Project was put on care and maintenance in 1988 due to low uranium prices. In 1994 the WA State government excised the Project Area from the Rudall River National Park (now called Karlamilyi National Park) and the Kintyre Advancement Programme (KAP) was initiated by CRA in September 1995. A positive uranium outlook in 1996 lead to metallurgical testing of bulk samples and the Kintyre Uranium Project advanced to a full feasibility study.

The environmental approval process was triggered in June 1996, with the application to the Federal and State governments for Project designation. The Project assessment level was set at the State level as an ERMP and at the Federal level as an Environmental Impact Statement (EIS).

A drop in uranium prices and a change in government policy which led to a State-wide ban on uranium mining resulted in the Project being put on hold. In July 2008, the Canadian and Japanese mining companies Cameco Corporation and Mitsubishi Development purchased the Kintyre Uranium Project from Rio Tinto. In November of that year, the WA government formally lifted the State's ban on uranium mining.

2 The Project

2.1 Project Location

The Kintyre Uranium Project is located on the western edge of the Great Sandy Desert in the East Pilbara Shire of Western Australia. The Project is located approximately 270 km northeast of Newman which is the nearest town; approximately 80 km southeast of Nifty mining operations; and 90 km south of Telfer mining operations (Figure 2).

The Kintyre Project is located in a remote area on Vacant Crown Land. There are no commercial land uses active in the area. The local indigenous communities of Punmu (113 km northeast) and Parnngurr (80 km southeast) use land in the region for traditional purposes including hunting.

2.2 Proposal Summary and Key Characteristics

Kintyre is one of the largest uranium occurrences in Western Australia. It is estimated that the Kintyre Project may host potential mineral deposits ranging from 28 kT to 36 kT (62 to 80 million pounds) U_3O_8 in total, with an average ore grade between 0.3% and 0.4% U_3O_8. These estimates are conceptual in nature but based on data including 355 historical diamond drill holes totalling 70,279 metres. Exploration drilling is ongoing to define a resource at the Kintyre Project in compliance with Canadian mineral resource reporting standards.

Cameco proposes to develop the Kintyre Uranium Project, comprised of a uranium mine and associated treatment facilities (Figure 3). Ore would be mined by open cut techniques, sorted to separate uranium bearing ore from barren material, and then processed at an on-site leach and precipitation treatment plant to initially produce between 2.7 and 3.6 kT (six million and eight million pounds) per annum of uranium oxide for export. The UOC would be transported by road from the site to Parkeston and then by road and/or rail to Adelaide or Darwin ports. The anticipated life of the Project is nominally 15 years depending on mining and processing rates, with the potential to increase this should exploration confirm an increase in the size of the mineral resource.

There are five deposits; the Kintyre, Kintyre East, Whale, Whale East and Pioneer deposits, all of which will be mined via open pit mining as separate pits or multiple deposits as combined pits. The indicative key characteristics of the Project are summarised in Table 1. More detailed information on Project design will be provided within the ERMP documentation.

Table 1: Indicative Project Characteristics	
Project Element	**Description**
Life of Project	Nominally 15 years (based on current geological modelling)
Timing (subject to approvals)	Commencement of construction after 2013 Commencement of operations after 2015
Size of orebody	28 – 36 kT (62 – 80 million pounds) uranium oxide (U_3O_8) with ore grade of 0.3 – 0.4% U_3O_8 Exploration drilling is ongoing to define the resource in compliance with Canadian Mineral Resource and Reporting Standards.
Mining method	Selective open pit mining
Major components	Open pits Permanent waste rock dump Temporary waste rock dump BOGUM dump ROM pad Process Plant Tailings Storage Facility (TSF) Mine workshop and administration buildings.
Mining method	Rock blasting, with conventional excavator and truck.
Mining rate	15 Mtpa – 24 Mtpa (140 Mt total)
Area of disturbance	Approximately 600 ha
Processing method	• Acid or alkaline tank leaching of beneficiated ore; and/or • Acid or alkaline tank leaching of whole ore; and/or • Acid or alkaline heap leaching.
Processing rate	0.5 to 3 Mtpa
Main reagents (acid processing option)	• Sulphuric acid • Peroxide • Lime
Main reagents (alkaline processing option)	• Sodium carbonate/bicarbonate • Caustic • Peroxide

Table 1: Indicative Project Characteristics	
Project Element	**Description**
Production rate	2.7 – 3.6 kT (6 - 8 million pounds) per year uranium oxide concentrate (UOC) as U_3O_8 equivalent.
Solid waste	Unmineralised waste rock BOGUM – stored on BOGUM dump. May be used for backfilling open pit, or processing (should this become viable) prior to closure. Radioactive Waste Management Facility Tailings - discharged as slurry or as a dry filter cake to a TSF and capped on closure.
Water Supply Process water requirement Total project water requirement	Mine dewatering + process water supply borefield. Dependent on mill throughput and process. Estimated to be in the order of 0.6m^3/t of ore milled, or 2.4ML/day for throughput of 1.5Mtpa. Total project water requirements including process water, water for dust suppression and industrial requirements estimated to be less than a maximum of 5ML/ day.
Potable water	Dedicated borefield.
Power requirement	5 to 15 MW depending on processing rate. Owner operated diesel or gas fired power station; or Contract power supply through a Build Own and Operate agreement; or Reticulated power from Telfer Gold Mine.
Construction workforce	Up to 600 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; Evaporation pond; Offices and warehouses; Landfill; and Airstrip.

Table 1: Indicative Project Characteristics	
Project Element	**Description**
Transport of product to export Port	Via road to Parkeston, Kalgoorlie, WA, then rail and/or road to the WA/SA border en-route to the export ports of Adelaide or Darwin.

FIFO = Fly in, fly out

BOGUM = Below ore-grade uranium material

ROM = Run of Mine, ore stockpiled to feed the process plant

2.3 Mining

The five Kintyre deposits will be mined using open pit mining techniques. In preparation for mining, topsoil will initially be stockpiled or windrowed until it can be used in rehabilitation. This will be followed by removal of overburden.

Unmineralised waste rock will be stored in a permanent above-ground waste rock dump or returned as backfill to the pit once the orebody has been mined. The permanent waste rock dump would 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. Below ore-grade uranium material (BOGUM) will be stockpiled separately from benign waste rock and may be placed in the open pit, or processed (should this become viable) prior to closure.

Mining will be conducted using conventional excavator and truck methods. Mining rates for the open pits will be dependent on equipment selection and stockpiling strategy, and constrained by pit size, geotechnical conditions and hydrological conditions.

Ore will be trucked to a Run of Mine (ROM) ore stockpile that will be located adjacent to the primary crusher. The ROM will be of sufficient size to ensure sustainable plant feed. Low grade ore will be stockpiled for potential treatment in the later stages of the Project. It will also provide a buffer stockpile during any periods of production shortfall, or to blend with high grade ore feed which could be encountered occasionally during mining.

Ore stockpiles and the BOGUM stockpiles will be designed so that all potentially contaminated surface water runoff and seepage from these areas are captured and will be managed to reduce the risk of dust generation.

2.4 Dewatering

As the water table occurs at approximately 12 m to 15 m below ground level (mbgl) in the vicinity of the mineralisation, dewatering will be required to maintain dry pit conditions, and stable pit slopes. It is proposed to dewater the pit via production bores to achieve advance dewatering of the ore bodies, and to limit the levels of inflow to in-pit sumps.

Detailed hydrogeological studies and groundwater modelling to predict dewatering requirements will be undertaken as part of the ERMP. Water from dewatering of the orebody will be used in the process plant. In the event that supply of water exceeds demand

the excess water will be disposed of to a lined evaporation pond. No mine dewatering will be discharged off site with the possible exception of emergency conditions associated with extreme rainfall events.

2.5 Mineral Processing

The Project basis is for an annual production of approximately 2.7 to 3.6 kT (six to eight million pounds) of U_3O_8 over a mine life of nominally 15 years. Cameco is currently considering three potential options for processing of the ore:

- Acid or alkaline tank leaching of beneficiated ore; and/or
- Acid or alkaline tank leaching of whole ore; and/or
- Acid or alkaline heap leaching.

Cameco may implement all three of these options for processing different ore grades.

All processing routes incorporate leaching of the uranium from the ore using either acid or alkaline reagents, and conventional uranium extraction technology to produce a final UOC (U_3O_8) product.

As noted above, the optimum process flowsheet may ultimately involve a combination of all three processing options such as combining whole ore tank leaching of high grade ore with tank leaching of beneficiated medium grade ore and heap leaching of lower grade ore.

2.5.1 Tank Leaching of Beneficiated Ore

This option includes beneficiation of the ore before leaching, precipitation and recovery.

Beneficiation:

The beneficiation process may involve:

- Several stages of crushing;
- Radiometric sorting;
- Milling of combined coarse beneficiated products in a closed comminution circuit ; and

Leaching and Recovery

The key steps in the tank leaching process at atmosphere or under pressure and subsequent recovery processes would be as follows:

1. Thickening of the milled product;
2. Leaching of the thickened concentrate using sulphuric acid or sodium carbonate/bicarbonate and suitable oxidant;
3. Filtration and washing of the leach discharge thickener underflow;

4. Hydrometallurgical recovery/purification of uranium bearing solution;
5. Precipitation of uranium concentrate from the uranium bearing solution;
6. Thickening of the uranium concentrate precipitate;
7. Drying of the uranium concentrate which produces UO_x;
8. Packing the dried product into 205 L drums; and
9. Loading into sea containers for transport to port and ultimate export.

2.5.2 Tank Leaching of Whole Ore

This processing option excludes the beneficiation stages, so ore preparation only consists of a primary crusher and a closed comminution circuit. Downstream of the mill this process flowsheet is identical to tank leaching of beneficiated ore at either atmosphere or under pressure. The difference between the two process options is the higher leaching throughput and lower feed grade of whole ore.

The key steps will be:

- Primary crushing;
- Comminution and milling of primary crusher discharge in a closed comminution circuit;
- Thickening of the milled ore; and
- Leaching and product recovery as outlined for tank leaching of beneficiated ore.

2.5.3 Heap Leach of Whole Ore

This processing option is similar to tank leaching of whole ore but the leaching would be undertaken on crushed ore placed in engineered heaps on a structured facility designed to capture leachate generated by the acidic or alkaline solutions as they pass from the top of the heap to the recovery section of the heap leach. Ore preparation consists of crushing to suitable size and agglomeration and stacking to the prepared Heap Leach pad.

Recovery of the uranium oxide from the uranium bearing solution (pregnant liquor) from the heap leach is the same as for tank leaching of beneficiated ore.

2.6 Tailings Management

Tailings composition from the processing plant will depend on the processing route, and will primarily consist of the following:

- Acid Leach: Leach solids residue and uranium barren liquor neutralised with lime solution and treated for radionuclides with a barium solution (if required); or
- Alkali Leach: Leach solids residue treated for radionuclides with a barium solution (if required).

Barium may be added to the tails liquor in small quantities to precipitate out radium as a barium / radium / chloride complex. Investigations on tailings characteristics for both processes are currently underway and details on composition of the tailings including potential for radionuclides will be provided in the ERMP (Section 8.10).

Cameco is proposing to manage tailings from the processing plant by deposition of slurry tailings or dry filter cake tailings to an above ground tailings storage facility (TSF).

The TSF will meet current industry guidelines for best practice. The minimum design requirements for deposition of tailings to an above ground TSF may include but is not limited to:

- An above-ground TSF would be lined to control seepage and may include (from bottom up):
  - scarified and compacted in-situ foundation soils across the floor of the facility following removal of any top-soil resource;
  - a clay liner placed in layers and compacted across the floor and up the facility embankments;
  - a Leak Control and Recovery System (LCRS) with seepage collection pipework discharging to an external recovery pond above the clay liner;
  - a high density polyethylene (HDPE) liner; and
  - an above liner underdrainage collection system, similar to the LCRS, comprising of selectively graded sand with seepage collection pipework, discharging to an external recovery pond.
- The tailings would be deposited in a way that facilitates the collection of supernatant liquid and runoff at a single point on the TSF cell. The water would be pumped to the transfer pond for reuse in the process water circuit.

Details such as construction methods, permeability of the lining system, leak detection strategies and operating and closure strategies will be provided in the ERMP and Conceptual Mine Closure and Rehabilitation Plan (Section 8.15).

In-pit deposition of tailings has not been considered as an option as the current mine modelling indicates a single open pit will be mined.

2.7 Radiation Management

Issues concerning occupational, public and environmental protection from ionising radiation are addressed by a 'System of Dose Limitation' set out by the International Commission on Radiological Protection (ICRP) and further developed by such bodies as the International Atomic Energy Agency (IAEA). This international set of practical as well as philosophical guidelines and research data provides the basis for Australian Codes of Practice, which in turn provide the basis for State and Territory Acts and Regulations (Section 4.3). While day-

to-day regulation of radiation is a State or Territory responsibility, reference is made to both Australian and International bodies.

The system of dose limitation is briefly described as:

- Justification of a practice involving exposure to ionising radiation. That is in short that the benefits of the practice must outweigh the detriments.
- Optimisation of radiation protection. That is that measures to limit exposures should be optimised to produce a situation where doses are 'as low as reasonably achievable, social and economic factors being taken into account (the so-called ALARA Principle).
- Limitation, in which regardless of the first two principles, doses must be limited by dose limits appropriate to the circumstances (i.e. the dose limit for members of the public is 1 mSv per year, and the dose limit for radiation workers is 20 mSv per year).

It was considered until recently that if people were adequately protected by this system of dose limitation, other biota (plants and animals) would also be adequately protected. However, the ICRP has recently recommended that non-human species are the subject of a specific consideration to determine if they are indeed adequately protected.

In practice, the international, national and State recommendations, Acts and Regulations are applied to particular projects in the form of approved Radiation Management Plans. However prior to the documentation of these plans, there are several investigation steps that are necessary, including:

- pre-operational radiation baseline assessment;
- optimisation of engineering design to ensure radiation exposure is taken into account during design;
- analysis of the radiological consequences of alternative project components, to inform choices;
- characterisation of the preferred option in terms of its potential to expose employees, members of the public and non-human species;
- optimisation assessment of preferred option to reduce exposures to as low as reasonably achievable;
- consideration of closure concepts and end land-uses to ensure that optimal eventual closure options are not precluded by operational designs; and
- stakeholder and community engagement to ensure that views are considered and taken into account in the formulation of the radiation management plan.

Once these investigations have been completed, the outcomes are documented in the Radiation Management Plan, the principal elements of which are:

- demonstrated appropriate professional expertise in radiation protection, or access to a person with that expertise;
- a monitoring programme that is designed to characterise exposure to radiation, sufficient to allow dose estimates to be made;
- provision of appropriate equipment to carry out the monitoring programme, together with suitably trained operators, facilities and operational procedures;
- details of induction and training in radiation hazards of the workplace;
- a record keeping system that allows periodic and statutory reports to be assembled;
- a plan to deal with incidents, accidents and emergencies involving radiation exposure; and
- a means of reviewing the adequacy of the radiation management plan to ensure its effectiveness, currency and compliance with national and international recommendations and standards.

In practice, a specific radiation management plan is usually developed for each stage of a project, including:

- exploration;
- design and construction;
- operations; and
- closure (and long-term management).

A specialist radiological consultant has been engaged by Cameco and radiation baseline studies have commenced in the Project Area. The radiological consultant will also oversee the air dispersion modelling from a radiological perspective, undertake a radiation baseline assessment, and prepare a Radiation Management Plan which will include, a Safe Transport of Radioactive Materials Plan, Radioactive Waste Management Plan and BOGUM Management Plan (Section 8.6).

2.8 Waste Management

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

- inert waste such as excess fill and building rubble;
- organic debris;
- general refuse including scrap metal, cardboard and plastics; and
- industrial waste water;

- sewage.

Cameco will operate the Kintyre Project along the principles of the following waste management hierarchy:

1. Avoid;
2. Reduce;
3. Reuse;
4. Recycle;
5. Recover;
6. Treat; and
7. Dispose.

Waste designated for reuse, recycling, recovery or treatment will be stored in a temporary storage area prior to removal from site by a licensed waste contractor. The temporary salvage yard will be designed with appropriate surface drainage controls to avoid contamination of surface water and groundwater.

General waste for which disposal is the only option will be directed to an on-site landfill licensed under the Environmental Protection Act.

Hazardous substances will be transported, stored and handled in accordance with relevant Australian Standards or equivalent international standards. Cameco will ensure these substances are adequately bunded during storage to ensure any spills or leaks are captured and cleaned up.

Should there be any hazardous waste on site, this will be segregated from non-hazardous waste and managed in accordance with the relevant licence conditions issued under the *Environmental Protection Act 1986*, or appropriate Australian or international standards.

Industrial waste water will be stored in lined evaporation basins, with the waste sludge treated or disposed off site. Hydrocarbon contaminated water (from wash down bays and workshops) would be treated in oil/water separators and the hydrocarbon stream removed from site by licensed operators for disposal.

The sewage system will require approval under the Health (Treatment of Sewage and Disposal of Effluent and Liquid Wastes) Regulations. Cameco will ensure waste water is disposed of appropriately and in accordance with Department of Health (DoH) requirements.

2.9 Product Packaging and Transport

The uranium oxide concentrate (UOC) will be transported via road from the mine site to the proposed Parkeston transport hub (near Kalgoorlie), and then via rail or road transport to export ports at Adelaide or Darwin in accordance with Australian and international requirements. These requirements include the Code of Practice for the Safe Transport of

Radioactive Material (ARPANSA, 2008); Radiation Safety (Transport of Radioactive Substances) Regulations 2002, Australian Dangerous Goods Code 7th Edition, existing approved Australian Safeguards Non-Proliferation Office (ASNO), and Western Australian and South Australian Government regulations and the International Atomic Energy Agency's (IAEA) Regulations for the Safe Transport of Radioactive Material 2009.

Dried UOC product will be sealed in 205 L drums and loaded into shipping containers in compliance with the Code of Practice for the Safe Transport of Radioactive Material (ARPANSA, 2008).

This proposal includes the transport of the UOC within Western Australia via Parkeston to the Western Australian border via road and/or rail on-route to the Port of Adelaide or Darwin. The transport route currently being considered is road transport to Parkeston on the outskirts of Kalgoorlie, via Telfer, Port Hedland, Newman, Meekatharra, Mount Magnet, Leinster, Leonora and Menzies. Depending on the options available, transport from Kalgoorlie to Adelaide or Darwin would be via road or rail (Figure 4). Transfer to rail at the proposed Parkeston transfer facility is discussed in Section 2.10.5.

Should the Parkeston transport hub not be available by the time transport was to commence, the road transport route to South Australia would follow the proposed route to Kalgoorlie, then proceed through Kalgoorlie via the Goldfields Highway Eastern Bypass, then south via the Goldfields Highway to the Coolgardie-Esperance Highway and on to the Eyre Highway. The environmental assessment relating to the transport of the UOC beyond Western Australian borders will require approval by South Australian, Northern Territory and Federal regulatory agencies and the proposal is currently being discussed with the relevant State and Federal regulators.

2.10 Supporting Infrastructure

2.10.1 Power

The power supply to the accommodation village, construction camp, airstrip, processing plant, potable water supply bores and dewatering bores will be provided by either an on-site power station or reticulated power from Telfer Gold Mine. In the event that an on-site power station is established, energy efficiency, noise and air quality will be considered as part of its design. The power plant will be either an owner operated diesel or gas-fired power station or a contract power supply through a Build Own and Operate agreement.

2.10.2 Water

Process water will be provided by pit dewatering, and storm water runoff captured within the Project Area with any short-fall provided by an external borefield. Based on preliminary process water flowsheets, the process water requirement is estimated to be up in the order of 0.6m^3/t of ore milled. Therefore at a rate of 1.5Mtpa the processing water requirement would be 2.4ML/day. Other significant components of water demand include water for dust suppression and other industrial purposes. Cameco estimates a maximum of 5 ML/day may be required for the operation. While a secure water supply has not yet been demonstrated

for the Project, current hydrogeological investigations indicate that a suitable water supply is likely to be available nearby. The results of the hydrogeological studies and the predicted environmental impacts of operating the external borefield will be presented in the environmental assessment documentation.

Potable water for the Project will be abstracted from groundwater bores which will be located north-northwest of the processing plant. Cameco will comply with the Australian Drinking Water Guidelines 2004 and establish a drinking water quality monitoring and management plan. Cameco will also comply with the system compliance and reporting protocols recommended by the DoH.

The predicted impact of the proposed water supply on Aboriginal heritage sites within the project area will be included in the environmental assessment documentation. Cameco will consult with the Traditional Owners in relation to the water supply.

2.10.3 Access Roads

The main road access to and from the Project will be via the Telfer road (Figure 2). This road will be upgraded to enable transport of construction machinery and plant during Project development, and the transport of raw materials, supplies and UOC product during operations.

2.10.4 Accommodation and Personnel Transport

The existing Exploration Camp will be expanded and utilized as accommodation for a construction team that will build a new accommodation camp for a fly-in-fly-out (FIFO) workforce to be used during construction and operations. An air strip will be constructed for air transport of personnel from regional centres and Perth. Personnel will also be driven or flown in from local communities including, for example, Newman, Marble Bar, Nullagine, Port Hedland, Punmu and Parnngurr. The camps will be self-contained and include mess, ablution, recreational and medical facilities.

2.10.5 Parkeston Transport Hub

Cameco is currently proposing to use the proposed Parkeston Transport Hub northeast of Kalgoorlie for transfer of the UOC product from road to rail, for transport interstate to the export port. The Parkeston Transport Hub has been proposed by the WA Government to allow offloading and transfer of bulk freight between road and rail transport networks.

In the event the facility is not established by the time Kintyre has commenced production, Cameco would use road transport to the Port of Adelaide as outlined in Section 2.9.

2.10.6 Other Facilities

The Project will require haul roads, refuelling facilities, quarry or borrow pits, laydown and workshop areas, fire protection systems, waste management facilities, and office and

ablution facilities. The design and location of this supporting infrastructure will be developed during the pre-feasibility stage and be considered within the ERMP.

2.11 Workforce

It is anticipated the Project will require a construction workforce of up to 600 employees and an operational workforce of up to 250 employees with the majority on FIFO rosters. Employees and contractors will be sourced from regional centres and Perth and will be housed on-site in the accommodation village.

Cameco will also develop an indigenous training and employment programme to provide opportunities for members of the local indigenous communities to become involved.

2.12 Rehabilitation and Closure

Cameco will be required to consider the decommissioning, closure and rehabilitation of the Kintyre Uranium Project as part of the ERMP.

Decommissioning of the Project will be based on the following concepts:

- All remaining waste rock will be stored in 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 to commence.
- All BOGUM will be processed (should this become viable), placed in the open pit or otherwise covered prior to closure.
- The design for the closure of the TSF will ensure long-term stability of the structure and ensure minimal exposure and no release of material with elevated radiation levels or other contaminants.
- 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 with key stakeholders.

Some permanent changes to the landscape will remain due to the mined pits and waste rock dumps. Rehabilitation will be undertaken on areas of disturbance to minimise the impact of the changes in landscape. Rehabilitation of the Project will be based on the following concepts:

- the area of disturbance will be minimised by appropriate planning and design of the mine and associated infrastructure;
- rehabilitation will be progressive throughout operations;

- final landforms and surfaces will 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 will be made compatible with the surrounding landscape as far as practicable;
- consultation will be conducted with the Martu concerning rehabilitation;
- revegetation will be carried out using local species suited to the final landforms, to produce a stable, self-sustaining ecosystem and landform; and
- rehabilitation will be monitored and a comparison made with defined completion criteria so that remedial action can be implemented if necessary.

Post closure decommissioning objectives for radiation will be derived on the basis of achieving a safe, stable property that allows future utilisation of the area for traditional purposes or occasional access that is similar land use to the present.

3 Project Justification and Alternatives

3.1 Basis for Justifying Proposal

Cameco is one of the world's largest uranium producers accounting for 16% of world production from its mines in Canada, the US and Kazakhstan. Cameco has about 215 kT (475 million pounds) of proven and probable reserves and extensive resources. Cameco is also a leading provider of processing services required to produce fuel for nuclear power plants, and generates 1,000 MW of clean electricity through a partnership in North America's largest nuclear generating station located in Ontario, Canada.

According to the World Energy Outlook for 2010 (OECD/International Energy Agency), population growth and industrial development will lead to a near doubling of electricity consumption from 2008 to 2035. Most of this energy will be used by developing (non-OECD) countries as their populations increase and gross domestic products grow.

As the demand for energy increases, all stakeholders are becoming increasingly aware of the dangers and effects of air pollution from burning of fossil fuels, the implications for climate change, the finite life of fossil fuels, and the importance of low-emission sources of electricity.

Nuclear power can generate electricity with low air emissions and very low carbon dioxide (CO_2) or other greenhouse gas emissions. In a carbon-constrained world, nuclear energy will become an important part of the future energy mix.

As of 1 January 2011, there were 441 commercial nuclear power reactors operating in 30 countries. Sixteen of these countries use nuclear energy to meet most of their electricity demands. Countries around the world are increasing their capacity to generate nuclear power by refurbishing or upgrading nuclear reactors and building new ones.

China is expected to lead the world in the construction of nuclear power plants as electricity demand continues its rapid growth. India is also moving forward with ambitious growth plans to diversify its sources of energy and obtain a secure source of electricity. As at January 1, 2011:

- China was operating 13 reactors, building between 25 and 30 and planning more. Cameco expects a net increase of 54 reactors by 2020.
- India was operating 19 reactors and had several under construction. Cameco expects a net increase of 13 reactors by 2020.

This year the government of Canada signed a civil nuclear co-operation agreement with India to export nuclear technology, equipment and uranium to support India’s growing nuclear energy industry. Canada is the eighth nation to sign such an agreement with India since the Nuclear Suppliers Group lifted a 34-year ban on nuclear co-operation with India in 2008. Licensing arrangements for these exports still have to be negotiated by the two governments and discussions are ongoing.

Russia and South Korea continue to expand their nuclear generating capacity. Several non-nuclear countries, like United Arab Emirates, Turkey, Vietnam and Italy, are laying the groundwork to proceed with nuclear power development.

In the UK, government commitment to the future of nuclear energy is strong, driven by the need to limit CO_2 emissions, and by concerns about energy security as current reactors approach the end of their operating lives.

The US continues to make progress toward new nuclear development with pre-construction activities for new reactors underway in two states and one reactor under construction in another.

Demand for uranium is expected to be almost 1 million tonnes (2.3 billion pounds) of U_3O_8 over the next 10 years and so new mines are required to meet the demand. This estimate assumes utilities will build strategic inventories of about 73 kT (160 million pounds) U_3O_8 to support their reactor programs. During this period, it is expected that about 66% of uranium supply will come from existing primary production sources, mines that are currently in commercial operation and 16% will come from existing secondary supply sources. Most of these sources are finite and will not meet long-term needs. One of the largest current sources of secondary supply is uranium derived from Russian highly enriched uranium (HEU). All deliveries from this source are expected to be made by the end of 2013, when the Russian HEU commercial agreement expires. The US government also makes some of its inventories available to the market, although in much smaller quantities. The remaining 18% of world demand is expected to come from new sources of supply.

Over the long term, it is expected that the fundamentals for nuclear energy will remain positive as:

- demand is expected to continue to exceed worldwide production;
- secondary supplies are finite; and
- primary production is expected to increase to meet future demand

While the recent nuclear incident and radiation releases at the Fukushima nuclear power plant in Japan following the devastating earthquake and tsunami will likely cause nuclear nations to review existing plants and reconsider current expansion plans, Cameco anticipates demand for uranium to increase moderately over the next 10 years, with potential for more rapid growth toward the end of the period, as the construction of nuclear plants accelerates.

3.2 Alternatives Considered

3.2.1 Mining Methodology

Open pit mining is currently considered the preferred option due to the complex nature of the orebody. Initially, smaller pits may be excavated before forming a single open pit. The physical limits of the single pit are estimated as follows:

- Length: 1,100 to 1,500 m
- Width: 500 to 1,000 m
- Depth: 180 to 330 m.

Underground mining was also considered to offer potential economic advantages for mining of deeper mineralisation, where increasing stripping ratios erode the value of open pit extraction. However, due to the depth of the orebody proposed to be mined, underground mining is not currently considered feasible although it may be considered an option in the future as the depth of the orebody increases. Underground mining is not included in the project scope addressed in this ERMP.

In-situ recovery of uranium which involved pumping a complexing agent and oxidant into the orebody to leach the uranium and recover the pregnant liquor for processing was considered. However, this was not pursued because it was not feasible due to the nature of the orebody and the surrounding hydrogeology.

3.2.2 Waste Rock Disposal

Cameco has considered both in-pit disposal and above-ground disposal of waste rock. It is likely that management will be a combination of both. Unmineralised waste rock will be stored in a permanent above-ground waste rock dump or returned as backfill to the pit once the orebody has been mined. BOGUM will be stockpiled separately from benign waste rock and may be placed in the open pit, or processed (should this become viable) prior to closure.

3.2.3 Processing Options

A number of options for processing of the ore are being considered. These are tank leaching of beneficiated ore; tank leaching of whole ore; and heap leach of whole ore.

Cameco is also investigating using alkali or acid processing options for the leaching component of the circuit. At this point in time alkaline tank leaching appears as the preferred option. This option offers potential environmental advantages by using fewer inputs than the acid leach process.

These options will be further investigated as part of the Project pre-feasibility studies.

3.2.4 Plant and Infrastructure Locations

Tailings options that have been considered include storage of tailings in trenches excavated into clay sediments with the remainder of the tailings stored in-pit once a pit becomes available; storage of paste tailings in an above-ground facility; and storage of dry-stacked tailings in an above-ground facility.

The currently preferred option is the deposition of slurry tailings or dry filter cake tailings to an above ground tailings storage facility (TSF). In-pit disposal of tailings was initially considered, but has been removed as an option since the current mine modelling indicates a single open pit will be required, eliminating the potential for in pit tailings disposal.

The existing exploration camp is located to the north of the orebodies. The camp site is not suitable for the location of a permanent site and may ultimately be decommissioned prior to the operational phase. The accommodation village will be located south of the orebodies.

3.3 Customers

The uranium that Cameco produces will be used exclusively to produce fuel for the generation of electricity at nuclear power stations. Exports of uranium from Kintyre would be subject to the terms of Australia's international agreements and export controls including the safeguards and verification measures of the International Atomic Energy Agency pursuant to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT).

Uranium from Kintyre would be shipped outside the country for processing to nuclear fuel at permissible facilities of the customer's choice.

4 Applicable Legislation and Environmental Impact Assessment Process

The Kintyre Uranium Project will require environmental assessment under both State and Federal legislation. The assessment processes and applicable legislation and guidelines are outlined in the sections below.

4.1 Western Australian Environmental Assessment Process

The environmental assessment process under the Western Australian *Environmental Protection Act 1986* (WA EP Act) is commenced with referral of the project to the EPA. The referral document enables the EPA to determine if a proposal requires assessment under Part IV of the EP Act, and if so, what level of assessment is appropriate. The EPA determined that the Kintyre Uranium Project (the Project) will require assessment as an Environmental Review and Management Program (ERMP). This level of assessment was advertised by the EPA on 20 September 2010.

An ERMP level of assessment requires preparation of an Environmental Scoping Document (ESD) (this document) setting out the environmental factors raised by the proposal and the Proponent's intended studies. Once approved for release by the EPA, the ESD is made available for public review for a period of at least two weeks. Based on the submissions received, the Proponent is required to revise the ESD where appropriate, and the revised ESD is required to be approved by the EPA.

The Proponent will then prepare an environmental review document (the ERMP document) in accordance with the agreed scope documented in the ESD. When the EPA is satisfied that the ERMP document has addressed all of the environmental factors and studies identified in the ESD, the Proponent is required to release the ERMP for a public review period normally between 10 and 12 weeks. In the case of the Kintyre Uranium Project, the EPA has set a 14 week public review period.

Public submissions on the ERMP document that are received by the EPA are provided to the Proponent. The Proponent is required to prepare a summary of the issues raised and respond to these issues to the satisfaction of the EPA. The EPA will then assess the ERMP document, submissions received, Proponent's response to submissions, and obtain advice from any other persons it considers appropriate and submit its report and recommendations to the Minister of Environment. Any person may lodge an appeal with the Minister against the contents and/or recommendations of the EPA's report and recommendations. The Minister will then provide a decision on whether a proposal can be implemented and if so, the conditions attached to the project.

4.2 Federal Environmental Assessment Process

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) lists eight Matters of National Environmental Significance as follows:

- World Heritage properties;
- National Heritage places;
- Wetlands of International Importance (listed under the Ramsar Convention);
- listed threatened species and ecological communities;
- migratory species protected under international agreements;
- Commonwealth marine areas;
- the Great Barrier Reef Marine Park; and
- nuclear actions (including uranium mines).

As the Kintyre Uranium Project is a proposed uranium mine the Project required referral to DSEWPC under the EPBC Act and was designated a 'nuclear action'. The Project was referred to DSEWPC in September 2010.

A Bilateral Agreement exists between the Federal government and the WA EPA which accredits the State environmental assessment process, to ensure an integrated and coordinated approach to environmental assessment for actions requiring approval under both the Commonwealth EPBC Act and WA EP Act. This means that a project can be assessed concurrently by both agencies using the same documentation prepared to meet the requirements of both Acts with the assessment coordinated by the WA EPA.

The ERMP document will be prepared to meet both State and Federal environmental assessment requirements.

4.3 Other Approvals Required

In addition to environmental approvals required under Part IV of the *EP Act* and the *EPBC Act*, Cameco will be required to obtain the following approvals before operation of the Project commences.

Table 2: Other Approvals Required		
Legislation	**Approval**	**Agency / Department**
State Legislation		
Mining Act 1978	Mining Leases Miscellaneous Licences	Department of Mines and Petroleum (DMP)
	Mining Proposal	DMP
	Approval of closure and site rehabilitation plans	DMP, Radiological Council
Mines Safety and Inspection Act 1994 and Regulations 1995	Project Management Plan	DMP
	Radiation Management Plan	DMP
	Transport Management Plan (for transport of uranium oxide)	DMP
Radiation Safety Act 1975	Radiation Management Plan	Radiological Council
	Radioactive Waste Management Plan	Radiological Council
	Approval of a nominated Radiation Safety Officer to be holder of licence for mining and milling of radioactive ores	Radiological Council
	Registration of owners of premises	Radiological Council
	Approval of closure and site rehabilitation plans	Radiological Council
Radiation Safety (Transport of Radioactive Substances) Regulations 2002	Licence to transport radioactive substances	Radiological Council
	Radiation Protection Programme for transport	Radiological Council
Environmental Protection Act 1986 (Part IV)	Process for referral and assessment of projects subject to formal assessment under the EP Act.	DEC and EPA
Environmental Protection Act 1986 (Part V)	Works Approval	Department of Environment and Conservation (DEC)
	Prescribed Premises Licence	DEC
Dangerous Goods Safety Act 2004	Dangerous Goods Licence	DMP
Aboriginal Heritage Act 1972	Ministerial Consent under Section 18 (if required)	Department of Indigenous Affairs (DIA)

Table 2: Other Approvals Required		
Legislation	**Approval**	**Agency / Department**
Heritage of Western Australia Act (1990)	Conservation of sites	Heritage Council of WA
Rights in Water and Irrigation Act 1914	Licenses to take surface water or groundwater	Department of Water (DoW)
Planning and Development Act 2005	Planning Permit	DPI Shire of East Pilbara
	Building Permits	DPI Shire of East Pilbara
Main Roads Act (1930)	Applicable to the construction and maintenance of roads	Main Roads Department (MRD) Western Australia
Health Act 1911 and Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974	Sewerage treatment permit	Department of Health (DoH) Shire of East Pilbara
Commonwealth Legislation		
Native Title Act 1993	Land Access (Negotiation Notification Section 29 and State Deed; or Consultation Notification)	National Native Title Tribunal
Nuclear Non-Proliferation (Safeguards) Act 1987	Permit to possess nuclear material (Section 13)	Australian Safeguards and Non-Proliferations Office
	Permit to establish a uranium mining facility	Australian Safeguards and Non-Proliferations Office
Regulation 9 of Customs (Prohibited Exports) Regulations under the *Customs Act 1901*	Permit to export uranium ore concentrates	Department of Resources Energy and Tourism

Cameco has not yet obtained these approvals, which will be sought concurrent to, or following assessment of the Project under the *EP Act* and *EPBC Act*. Additional approvals and requirements under other legislation may be applicable during operations and on closure, such as approval of the final Decommissioning and Mine Closure Plan.

4.4 Radiation Management Legislation

Table 3 lists legislation in relation to radiation protection that is applicable in Western Australia and the Commonwealth.

Table 3: Radiation protection and radioactive substances legislation

Title	Administered by:
Western Australia	
Radiation Safety Act (1975)	Radiological Council
Radiation Safety (General) Regulations (1983)	Radiological Council
Radiation Safety (Qualifications) Regulations (1980)	Radiological Council
Radiation Safety (Transport of Radioactive Substances) Regulations (2002)	Radiological Council
Mines Safety and Inspection Act (1994)	Department of Mines and Petroleum (DMP)
Mines Safety and Inspection Regulations (1995)	DMP
Commonwealth [A]	
Nuclear Non-Proliferation (Safeguards) Act 1987	Australian Safeguards and Non-Proliferation Office (ASNO)
Australian Radiation Protection and Nuclear Safety Act 1998	Australian Radiation Protection and Nuclear Safety Agency (ARPANSA)
Environment Protection and Biodiversity Conservation Act 1999	DSEWPC
Nuclear Safeguards (Producers of Uranium Concentrates) Charge Act 1993	ASNO

Notes:
A: In South Australia there is a Radiation Protection Committee that coordinates application of these Acts and Regulations

4.5 Guidelines, Standards and Policies

Applicable environmental guidelines, standards and policies for the Kintyre Uranium Project will include, but not necessarily be limited to those presented in Table 4.

Table 4: Environmental Guidelines Standards and Policies

Title	Agency / Department
Western Australia	
EPA Position Statement No. 2 – Environmental Protection of Native Vegetation in Western Australia (2000a).	EPA
EPA Position Statement No. 3 – Terrestrial Biological Surveys as an Element of Biodiversity Protection in Western Australia (2002a)	EPA
EPA Position Statement No. 6 – Towards Sustainability (2004a)	EPA
EPA Position Statement No. 7 – Principles of Environmental Protection (2004b)	EPA
EPA Position Statement No. 9 – Environmental Offsets (2006a)	EPA
EPA Guidance Statement 6 - Rehabilitation of Terrestrial Ecosystems (2006b)	EPA
EPA Guidance Statement No. 8 (Draft) – Environmental Noise (2007a).	EPA
EPA Guidance Statement No. 12 – Minimising Greenhouse Gases (2002b)	EPA
EPA Guidance Statement No. 18 – Prevention of Air Quality Impacts from Land Development Sites (2000b)	EPA
EPA Guidance Statement No. 19 - Environmental Offsets – Biodiversity (2008)	EPA
EPA Guidance Statement No. 20 - Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia (2009a)	EPA
EPA Guidance Statement No. 41 – Assessment of Aboriginal Heritage (2004c)	EPA
EPA Guidance Statement No. 51 – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment (2004d)	EPA
EPA Guidance Statement No. 54 – Sampling of Subterranean Fauna in Groundwater and Caves (2003a)	EPA

Table 4: Environmental Guidelines Standards and Policies	
Title	**Agency / Department**
EPA Guidance Statement No. 54a (Draft) – Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia (2007b)	EPA
EPA Guidance Statement No. 56 – Terrestrial Fauna Surveys for Environmental Impact Assessment (2004e)	EPA
EPA Interim Industry Consultation Guide to Community Consultation (2003b)	EPA
DRAFT State Environmental (Ambient Air) Policy (2009b).	EPA
Western Australia State Greenhouse Strategy – Western Australia Greenhouse Task Force (2004b)	Department of Environment and Conservation (DEC)
Mining Operations Division Guidelines for Mining in Arid Environments, Department of Minerals and Energy (1996)	DMP
Commonwealth	
Australian Drinking Water Guidelines 2004	National Health and Medical Research Council (NHMRC)
ANZMEC and Minerals Council of Australia Strategic Framework for Mine Closure (2000).	ANZMEC and Minerals Council
Australian and New Zealand Environment Conservation Council (ANZECC) and Agriculture and Deposit Management Council of Australia and New Zealand (ARMCANZ) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000).	ANZECC and ARMCANZ
Australian and Torres Strait Islander Commission (ATSIC), Department of Indigenous Affairs (DIA) and Department of Premier and Cabinet Citizens and Civics Unit – Consulting Citizens: Engaging with Aboriginal Western Australians (2004).	ATSIC and DIA
Environment Protection and Heritage Council National Environmental Protection Measure (NEPM) for Ambient Air Quality (2003).	National Environment Protection Council NEPC)
Mine Rehabilitation, DITR, 2006	Department of Resources Energy and Tourism (DRET)
Mine Closure and Completion, DITR, 2006	DRET
Community Engagement and Development, DITR, 2006	DRET
Managing Acid and Metalliferous Drainage, DITR, 2007	DRET

Table 4: Environmental Guidelines Standards and Policies	
Title	**Agency / Department**
International	
Convention on Migratory Species (CMS) and United Nations Environment Programme (UNEP) Conservation of Migratory Species of Wild Animals (1983).	
International Migratory Bird Agreements (Japan-Australia Migratory Bird Agreement [JAMBA], 1974; China-Australia Migratory Bird Agreement [CAMBA], 1986; and Republic of Korea Migratory Bird Agreement [ROKAMBA], 2006).	

Applicable guidance on radiation management is outlined in Table 5.

Table 5: Radiation Guidelines	
Title	**Agency / Department**
Western Australia	
Department of Mines and Petroleum (2010). Managing Naturally-Occurring Radioactive Material in Mining and Mineral Processing – Guidelines: NORM-1 Applying the system of radiation protection to mining operations NORM-2.1 Preparation of a radiation management plan – exploration NORM-2.2 Preparation of a radiation management plan – mining and processing NORM-3.1 Monitoring – pre-operational monitoring requirements NORM-3.2 Monitoring – operational monitoring requirements NORM-3.3 Monitoring – air monitoring strategies NORM-3.4 Monitoring – airborne radioactivity sampling NORM-3.5 Monitoring – measurement of particle size NORM-4.1 Controlling – dust control strategies NORM-4.2 Controlling – management of radioactive waste NORM-4.3 Controlling – transport NORM-5 Dose assessment NORM-6 Reporting requirements NORM-7 Boswell – assessment and reporting database	DMP

Table 5: Radiation Guidelines	
Title	**Agency / Department**
Department of Industry and Resources, Approved Procedure for Dose Assessment RSG05 (1997)	DMP
Commonwealth	
Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) Radiation Protection Series: RPS 2: Code of Practice for the Safe Transport of Radioactive Material (2008) RPS 2.1: Safety Guide for the Safe Transport of Radioactive Material (2008) RPS 5: Code of Practice and Safety Guide for Portable Density/Moisture Gauges Containing Radioactive Sources (2004) RPS 6: National Directory for Radiation Protection (NDRP) (2010) PRS 7: Recommendations for Intervention in Emergency Situations Involving Radiation Exposure (2004) RPS 9: Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (2005) RPS 11: Code of Practice for the Security of Radioactive Sources (2007) RPS 13: Code of Practice and Safety Guide for Safe Use of Fixed Radiation Gauges (2007) RPS 16: Safety Guide for the Management of Naturally Occurring Radioactive Material (NORM) (2008)	ARPANSA
National Standard for Limiting Occupational Exposure to Ionising Radiation (1995 Reprinted by ARPANSA 2002 as Radiation Protection Series 1)	National Health and Medical Research Council and National Occupational Health (NHMRC) and Safety Commission (NOHSC)
International	
ICRP 108 Environmental Protection: the Concept and Use of Reference Animals and Plants, Ann. ICRP 38 (4-6) ICRP 107 Nuclear Decay Data for Dosimetric Calculations, Ann. ICRP 38(3), 2008. ICRP 104 Scope of Radiological Protection Control Measures, Ann. ICRP 37(5), 2007. ICRP 103 The 2007 Recommendations of the International Commission on Radiological Protection,	International Commission on Radiological Protection (ICRP)

Table 5: Radiation Guidelines	
Title	**Agency / Department**
Ann. ICRP 37(2-4), 2007. ICRP SG5 Analysis of the Criteria Used by the International Commission on Radiological Protection to Justify the Setting of Numerical Protection Level Values, Ann. ICRP 36(4), 2006. ICRP 101 The Optimisation of Radiological Protection: Broadening the Process, Ann. ICRP 36(3), 2006. ICRP 101 Assessing Dose of the Representative Person for the Purpose of Radiation Protection of the Public, Ann. ICRP 36(3), 2006. ICRP 100 Human Alimentary Tract Model for Radiological Protection ICRP 99 Low Dose Extrapolation of Radiation Related Cancer Risk ICRP 92 Relative Biological Effectiveness (RBE), Quality Factor (Q), and Radiation Weighting Factor (wF) ICRP 91 A Framework for Assessing the Impact of Ionising Radiation on Non-Human Species ICRP 89 Basic Anatomical and Physiological Data for Use in Radiological Protection: Reference Values Supporting Guide for the Practical Application of the ICRP Guidance 3 Human Respiratory Tract Model ICRP 83 Risk Estimation for Multifactorial Diseases ICRP 82 Protection of the Public in Situations of Prolonged Radiation Exposure ICRP 78 Individual Monitoring for Internal Exposure of Workers ICRP 77 Radiological Protection Policy for the Disposal of Radioactive Waste	
ICRP 76 Protection from Exposures: Application to Selected Radiation Sources ICRP 75 General Principles for the Radiation Protection of Workers ICRP 74 Conversion Coefficients for use in Radiological protection against External Radiation ICRP 72 Age-dependent Doses to the Members of the Public from Intake of Radionuclides: Part 5 – Compilation of Ingestion and Inhalation Coefficients ICRP 71 Age-dependent Doses to the Members of the	ICRP

Table 5: Radiation Guidelines

Title	Agency / Department
Public from Intake of Radionuclides: Part 4 Inhalation Dose Coefficients ICRP 70 Basic Anatomical & Physiological Data for use in Radiological Protection: The Skeleton A report of a Task Group of Committee 2 of the International Commission in Radiological Protection ICRP 69 Age-dependent Doses to Members of the Public from Intake of Radionuclides: Part 3 ICRP 68 Dose Coefficients for Intakes of Radionuclides by Workers A report of a Task Group of Committee 2 of the International Commission on Radiological protection Replacement of ICRP Publication 61 ICRP 67 Age-dependent Doses to Members of the Public from Intake of Radionuclides: Part 2 Ingestion Dose Coefficients A Report of a Task Group of Committee 2 of the International Commission on Radiological Protection ICRP 66 Human Respiratory Tract model for Radiological Protection ICRP 65 Protection Against Radon-222 at Home and at Work ICRP 64 Protection from Potential Exposure: A Conceptual Framework A Report of a Task Group of Committee 4 of the International Commission on Radiological Protection ICRP 60 1990 Recommendations of the International Commission on Radiological Protection	
International Basic Safety Standards for Protection Against Ionizing Radiation and for the Safety of Radiation Sources IAEA Safety Series No. 115 Principles of Radioactive Waste Management Safety Fundamentals IAEA Safety Series No. 111-F Compliance Assurance for the Safe Transport of Radioactive Material IAEA Safety Series No. 112 Extension of the Principles of Radiation Protection to Sources of Potential Exposure IAEA Safety Series No. 104 Evaluating the Reliability of Predictions Made Using Environmental Transfer Models IAEA Safety Series No. 100 Radiation Monitoring in the Mining and Milling of Radioactive Ores (Jointly Sponsored by IAEA, ILO and WHO) IAEA Safety Series No. 95	International Atomic Energy Agency (IAEA)

Table 5: Radiation Guidelines	
Title	**Agency / Department**
The Application of the Principles for Limiting Releases of Radioactive Effluents in the Case of the Mining and Milling of Radioactive Ores IAEA Safety Series No. 90 Radiation Protection of Workers in the Mining and Milling of Radioactive Ores 1983 Edition Code of Practice and Technical Addendum, Sponsored by IAEA, ILO, WHO IAEA Safety Series No. 26 Regulations for the Safe Transport of Radioactive Material 2005 Edition (No. TS-R-1)	

5 The Environment

5.1 Regional Setting

The Kintyre Project Area lies in a transition zone between the Great Sandy Desert and the Little Sandy Desert in the Eastern Pilbara region of Western Australia. The area is an arid setting of exposed bedrock, low mesas and ephemeral watercourses. Most of the rainfall occurs during summer and autumn and is often related to cyclonic activity.

The Kintyre deposits are located in the Paterson Province that also hosts the Telfer Gold Mine and the Nifty Copper Mine. The Kintyre Project's uranium deposits are located in the Yandagooge Supergroup of the early Proterozoic basement, the Rudall Metamorphic Complex. These metamorphics are unconformably overlain by the Coolbro Sandstone of the mid Proterozoic Yeneena Group. The Yandagooge Formation occurs between the basement gneisses and the overlying Coolbro Sandstone.

The Project Area lies within the Little Sandy Desert (LSD1 – Rudall Subregion) as classified by the Interim Biogeographical Regionalisation for Australia (IBRA) category (Thackway and Cresswell, 1995). The LSD1 sub region comprises sparse shrub-steppe over *Triodia basedowii* on stony hills, with River Gum communities and bunch grasslands on alluvial deposits in and associated with ranges (Kendrick, 2001).

The Kintyre Project is located in a remote area on Vacant Crown Land. There are no commercial land uses active in the area. The local indigenous communities use land in the area for traditional purposes including hunting.

Karlamilyi National Park is located immediately south of the Project Area (Figure 2) and is an example of a relatively undisturbed desert ecosystem. The Park is rarely visited by tourists due to its remoteness and poor road access.

5.2 Climate

The Kintyre Project Area has an arid climate with hot summers and warm dry winters. Since the inception of the Kintyre Uranium Project, a series of meteorological monitoring programs have been undertaken within the region in order to define the existing environmental characteristics of the Project Area.

The meteorological monitoring programs were initially carried out between 1987 and 1992, when the Project was put into care and maintenance. Monitoring recommenced in 1996 with the advancement of a full feasibility study and ended in 1998 as the Project was put into care and maintenance once again.

A summary of the key meteorological features described by Dames and Moore (1990, 1998) following assessment of the monitoring data is presented below:

- The 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.

- The 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 reported for the monitoring periods was 18.5 m/s in February 1997.
- The annual average temperature measured at Kintyre 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; 251 mm was recorded over the 23 month period between July 1988 and May 1990, while 485 mm was recorded over the 18 month period from June 1996 to November 1997. However, the highest monthly rainfalls tend to occur in the summer months, indicative of the influence of cyclonic conditions in the region.
- Higher measurements of relative humidity and lower measurements of barometric pressure also tend to coincide with wetter summer months, which experience some cyclonic effects. Lower humidity and higher pressures are more common during the drier winter months.

In 2010 Cameco installed and commissioned a meteorological monitoring station with the capacity to measure:

- wind speed;
- wind direction and standard deviation of wind direction;
- temperature;
- solar radiation;
- relative humidity;
- barometric pressure;
- rainfall; and
- evaporation;

In addition to the meteorological monitoring station, one continuous Beta Attenuation Meter (BAM) PM_{10} (i.e. particulate matter with an effective aerodynamic diameter of less than 10 µm) and a number of deposition gauges were installed. In addition, two Environmental Radon Daughter Monitors and two air pumps for sampling total suspended particulates for alpha radiation analysis are also being installed. The location of the meteorological and dust monitoring sites are shown on Figure 5.

5.3 Geology

The Kintyre deposits are located in the Paterson Province that also hosts the Telfer Gold Mine and the Nifty Copper Mine. The uranium mineralisation is hosted within the Yandagooge Formation which occurs between the basement gneisses and the overlying Coolbro Sandstone.

The Yandagooge Formation comprises a sequence of folded biotite graphite schist, chert banded chlorite garnet magnetite schist, dolomitic carbonates and quartz muscovite schist. This sequence generally dips to the north at about 50 degrees in a series of recumbent folds with east-northeast trending axial planes and axial planar cleavage. The uranium mineralisation occurs as pitchblende veins in the chert banded chlorite garnet magnetite schist. The Project currently includes five main deposits have been identified in the Kintyre area; Kintyre, Kintyre East, Whale, Whale East and Pioneer.

Glaciers of Permian age incised the Proterozoic metamorphics and glacial sediments of the Paterson Formation were deposited in U-shaped valleys up to 100 m deep. The thickness of the Permian sediments is quite variable in the area, the thickest section being 70 m over the Whale deposit. The Permian sediments are typically silts and clays with a basal layer of coarse sand and gravel.

Most of the bedrock exposed in the hills around Kintyre comprises the Yandagooge formation. The flat areas between the hills are largely underlain by a few metres of red sand and then Paterson Formation sediments.

The primary uranium mineralisation does not outcrop at Kintyre, with the shallowest pitchblende mineralisation being approximately 30 m below surface. However on Kintyre Hill there are a few showings of bright yellow secondary uranium minerals near the old winze site.

5.3.1 Geochemistry

A geochemical characterisation of waste rock and soil samples was undertaken for the Kintyre Project by Graeme Campbell & Associates in 1997. The main aim of the study was to identify rock types that had the potential to acidify through oxidation of sulphide minerals, and assess rock types that may be enriched in elements of potential concern to water quality and revegetation. The test work focused on the acid-base chemistry, salinity and multi-element composition of a range of waste rock and soil samples.

Waste rock from the Kintyre and East Kintyre deposits are mildly alkaline with a low salt content and classified as non-acid forming (NAF). The rock samples also had element concentrations below or close to, those typically recorded for unmineralised soil and rock (Graeme Campbell & Associates, 1997).

Waste rock from the Whale and East Whale deposits were mildly alkaline with low salt content with the exception of the glacial clays and grits with a moderate salt content (0.34 – 0.60 mS/cm). The waste rock samples were classified as NAF with the exception of two of the quartz-chlorite-graphite-schist which is classified as potentially acid forming (PAF) (low-

capacity) due to sulphide-sulphur concentrations near 1%. Provisional estimates indicate that the quartz-chlorite-graphite-schist may comprise 20% to 30% of the total volume of waste rock produced from mining of the Whale and East Whale deposits. The rock samples typically had element concentrations below or close to, those recorded for unmineralised soils and rocks. The two samples of the quartz-chlorite-graphite-schist classified as PAF (low-capacity) were moderately enriched in selenium and the sample of glacial conglomerate was moderately enriched in bismuth (Graeme Campbell & Associates, 1997).

5.3.1.1 Fibrous Materials

During laboratory analysis of ore samples taken during exploration, respirable fibrous materials were identified. Further analysis identified thin layers of cummingtonite / grunerite asbestos present in the ore body adjacent to the mineralised zone. A comprehensive program of personal air sampling was undertaken to determine the occupational risk. The program results concluded that the dust suppression practices in place during exploration to manage the radiation contamination pathways, including the use of diamond drilling and wet core cutting were responsible for reducing the levels of airborne asbestos to levels significantly below the occupational limit.

During the exploration phase, Cameco has recorded the locations and depths of all recorded intersections of the zones of fibrous material.

During mining, a number of strategies will be implemented to ensure that levels of airborne fibrous materials remain significantly below occupational levels. These will include procedures for the identification of the zones of fibrous material during blasting and mining, strategic mining, handling and burial within the waste rock dump to encapsulate the fibrous rock and in the design of the processing plant.

Cameco considers that with these measures in place, levels of airborne asbestos will remain significantly below the occupational limit.

5.4 Landforms and Soils

The Paterson Province within which the Kintyre Project is located is a large area of rocky hills between the Little and Great Sandy Deserts. Dunefields are a typical landform of the Sandy Deserts with rocky hills also being common.

The area lies within part of the upper reaches of the Yandagooge Creek catchment area, which forms a broad valley bounded by rocky flat-topped hills. These hills consist of the Broadhurst Range to the east, the Throssell Range to the west, and the Watrara Range to the south. Isolated hills, surrounded by an apron of scree, survive as erosional remnants within the main valley.

The main course of Yandagooge Creek meanders through a broad valley formed by alluvial and aeolian deposits. There is a sharp boundary between the valley and the ranges, and a distinct change in drainage pattern, with dendritic tributaries draining the ranges. Small permanent or semi-permanent pools occur outside the Kintyre area in places along major

creeks. To the north of the area, the Yandagooge Creek exits the ranges and becomes Coolbro Creek, which dissipates into the sand ridges of the Great Sandy Desert.

The surface elevation ranges from about 375 m Australian Height Datum (AHD) in the main valley, to about 500 m AHD in the ranges. Remnants of glacial action in the form of striated pavements and U-shaped valleys are preserved in places within, and along the margins of the ranges.

Soil samples from the Project area had a generally neutral pH, low salt content and element concentrations below or close to, those recorded for unmineralised soils and rocks (Graeme Campbell & Associates, 1997).

A soil survey was conducted in 1996 to identify and map soils in the Kintyre area (Dames & Moore, 1997). Seven soil units were identified within the soils study area as presented in Table 6.

Table 6: Soil Units in the Kintyre Area

Unit	Title	Description	Pattern on Air photograph
1	Flat sandy plains	Red, deep sand (>2m thick).	Featureless with scattered trees.
2	Stony hills and scree slopes	Rock fragments in sandy loam matrix, overlying weathered rock at 0.5 to 1m depth.	Light coloured vegetation concentrated in defined drainage lines.
3	Claypan areas and old drainage lines	Red sandy loam and silty sand sometimes with superficial layer of sand.	Mottled with small light-coloured claypans and darker patches of vegetation.
4	Patches of aeolian sand and minor sand dunes	Red sand.	Similar to Unit 1, but slightly paler, and vegetation more evenly scattered.
5	Levee banks and alluvium marginal to major drainage lines	Red, loose sand.	Sinuous and linear zones, heavily vegetated, large trees.
6	Alluvium along active drainage lines	Sand with gravel bars and lenses.	Light-coloured with lines and Islands of large trees.
7	Rock outcrops	Small scattered patches of Unit 2 soils.	Rock structure visible.

Soil units 1, 4, 5 and 6 are permeable sands which will allow rapid infiltration and have poor water holding characteristics. These soils have low cohesion soil structure and hence are susceptible to erosion by water or wind. All can be readily excavated by backhoe and are easy to handle.

Soil unit 2 consists of colluvial soils on steeper slopes. They generally have slow infiltration and fair water holding characteristics. This unit is subject to erosion due to its topographic position on steep slopes. It is difficult to excavate due to the high content of rock fragments within the unit.

Soil unit 3 is less permeable than units 1, 4, 5 and 6 and infiltration is therefore slow. Ponding at the surface is likely after heavy rains, leading to the formation of superficial clay pans. This unit is resistant to erosion unless broken up by vehicle traffic. Excavation of soil unit 3 would require more effort than for units 1, 4, 5 and 6 as it is more cohesive.

Soil unit 7 is essentially bare rock with poor infiltration and water holding characteristics. It is highly resistant to erosion and cannot be excavated without preliminary blasting.

In terms of rehabilitation suitability, soil units 1, 3, 4 and 5 would be suitable for use in rehabilitation even though they are of predominantly sandy texture. Soil units 2, 6 and 7 would be unsuitable for use in rehabilitation activities (Dames & Moore, 1997).

5.5 Surface Water

The Kintyre Project Area lies within River Basin 025 (Sandy Desert Basin) of the internal drainage division of Australia (Western Plateau Drainage Division No. 12). Locally the Kintyre area lies within two tributaries of the Yandagooge Creek referred to as the South Branch and the West Branch (Figure 6). The Yandagooge Creek System catchment is separated from the Rudall River System catchment by low hills. The tributaries converge north of the old airstrip (Figure 3) and continue to flow in a northerly direction into Coolbro Creek. Coolbro Creek flows easterly towards the Great Sandy Desert where the surface drainage dissipates into the sandy environment. There is no defined drainage system beyond the discharge to the dune system. During major flood events surface water discharge is likely to accumulate in the interdunal areas and flow along the northwest – southeast trending dune system. During Cyclone Fay in 2004 major overland flows occurred in this area with the predominant flow towards Lake Waukarlycarly to the north of the Project area.

Surface water monitoring was undertaken by Canning Resources from 1988 to 1992 to determine the hydrological characteristics of the Yandagooge Creek. The monitoring programme involved the measurement and collection of stream flow, water quality and rainfall data. Results from the monitoring programme are summarised below.

Rainfall data were recorded for 12 flow events over a four-year period from 1988 to 1992. Rainfall events generally occurred between the months of December and June, although there was a large variation in the number, intensity and spatial distribution of events experienced from year to year. Stream flow levels were recorded using automatic water level loggers and a peak stage indicator for the twelve flow events in the South and West Branches of Yandagooge Creek. Peak water levels indicate that the maximum depth of flow is generally up to three times greater in the West Branch compared to the South Branch.

Runoff generated in the area is thought to be facilitated by the abundance of sandstone and quartzite outcrops. The coarse, sandy bed of the creek produces little runoff and encourages recharge of the superficial groundwater aquifer.

Monitoring undertaken by Canning Resources demonstrated that the West Branch experienced significantly larger flow events than the South Branch and was consistent for all events monitored. The difference in runoff is attributed to the differing area, topography and soil types influencing the runoff characteristics of each catchment. However, the times of concentration, (i.e. the time it takes for surface runoff from the extreme edges of the catchment to reach the monitoring stations), of the two catchments were found to be very similar.

Stream monitoring stations will be installed to record stream height and water quality to further refine catchment surface hydrology.

Applicable environmental values for surface water in the Kintyre area as defined by the ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality are likely to be:

- aquatic ecosystems;
- aesthetics and recreation; and
- cultural and spiritual values (if there is a link with surface water features).

Environmental values will be determined based on surface water monitoring results and consultation with the local indigenous communities.

5.6 Groundwater

Hydrogeological studies in the Kintyre area were undertaken from 1987 to 1990. A report was prepared in 1993 that consolidated and summarised the groundwater monitoring programme and findings from the 1987 to 1990 studies (Dames & Moore, 1993). The following discussion has been drawn from the reports from the previous studies.

The hydrostratigraphy of the area occurs in the following five formations in vertical succession:

- Alluvium deposits of Quaternary age;
- Paterson Formation (Upper Unit) of Permian age;
- Paterson Formation (Lower Unit) of Permian age;
- Coolbro Sandstone of the Yeneena Group of Proterozoic age; and
- Basement Schists of the Rudall Metamorphic Complex of Proterozoic age.

The aquifers in the area which produce the greatest quantity and best quality of water are the Lower Unit of the Paterson Formation and the Proterozoic Coolbro Sandstone. The hydrogeology for units of different geological ages is discussed below.

- Quaternary Deposits

  The Quaternary alluvium deposits form a minor aquifer which may provide moderate amounts of good quality groundwater in saturated zones. Saturated zones occur primarily in large drainage zones and are important recharge sources during runoff events in areas where intersection of sheared Proterozoic rocks or coarse grained Permian sediments occurs. This aquifer is not considered significant as a water resource as most of the alluvial and colluvial deposits occur above the water table and are not saturated.

- Permian Sediments

  The Paterson Formation (Upper Unit) forms an aquitard and is composed of a sequence of fine grained glaciolacustrine clay and silt sediments with minor sand aquifers present. This aquitard can provide limited amounts of moderate quality groundwater at shallow depths.

  The Paterson Formation (Lower Unit) forms an aquifer also of Permian age and is composed of a sequence of coarse glaciofluvial sand interbedded with gravel and basal conglomerate. This formation north of the Kintyre deposit forms a thick confined aquifer and can provide moderate reserves of sub-potable groundwater.

- Proterozoic Formations

  The geological structure of the Proterozoic rocks is complex but is generally dominated by a series of northwest-trending folds, faults and shear zones. These structures have little or no intergranular permeability and their groundwater yielding capabilities and aquifer characteristics are dependent on secondary structures such as faults, fractures and vugs.

  The Coolbro Sandstone is composed of quartzite and sandstone and is the most important aquifer. This aquifer provides a major source of potable/process quality water where shear zones are intersected at depth. Basement Schists form an aquitard composed of schists, carbonates and quartzite. This aquitard is relatively impermeable and only provides minor amounts of poor quality groundwater. A number of such shear zones in the Coolbro Sandstone have been explored during previous groundwater investigation programmes and have been confirmed as high permeability zones.

The depth to the water table is approximately 12 to 15 m below the ground surface of the flat sand plain areas and may be shallower near current drainage zones. Regional groundwater flow is towards the north and northeast into the Canning Basin, and vertical groundwater gradients depend largely on topography and geological structure.

Aquifers in the area are recharged primarily through drainage zones by runoff associated with monsoonal rain events. Groundwater discharge zones are not common in the area, with the exception of some larger rock pools in the Coolbro Sandstone, which are sustained over dry periods by groundwater discharge along shear zones. Further investigation into the

interaction between groundwater and surface water are proposed as part of the groundwater investigations (Section 8.4).

Groundwater quality in the area is variable but generally fresh to moderately saline. The best water quality, with a Total Dissolved Solids (TDS) concentration of less than 1,000 mg/L, is found in the sheared Coolbro Sandstone and basal Permian sediments 5 km to 10 km north of the Kintyre deposit in the immediate area of the larger drainage zones. In the remaining Proterozoic and Permian rocks the TDS concentration generally ranges between 3,000 mg/L and 10,000 mg/L.

The chemistry of the groundwater is dominated by sodium and chloride with significant concentrations of sulphate, alkalinity and hardness. Concentrations of common cations and anions generally fluctuate only slightly in response to rainfall. Groundwater quality analyses indicated the following ranges in parameters (excluding analysis of the potable water bore) (MWH, 2010).

- pH 7.5 – 9.5
- Conductivity 3,300 µS/cm – 15,000 µS/cm
- TDS (calculated) 2,000 mg/L – 9,300 mg/L
- Soluble iron, <0.02 mg/L – 0.66 mg/L
- Sodium 650 mg/L – 3,900 mg/L
- Potassium 29 mg/L – 310 mg/L
- Calcium 2 mg/L – 190 mg/L
- Magnesium 30 mg/L – 410 mg/L
- Chloride 540 mg/L – 4,500 mg/L
- Carbonate <1 mg/L – 100 mg/L
- Bicarbonate 280 mg/L – 710 mg/L
- Sulphate 370 mg/L – 2,400 mg/L
- Nitrate <0.2 mg/L – 13 mg/L.

Radionuclide activity and concentrations show more fluctuation across the area and are strongly affected by the presence of the uranium mineralisation. Gross alpha activity ranges from below the minimum detection level to 2873 mBq/L and gross beta activity ranges from below the minimum detection level to 6784 mBq/L.

Applicable environmental values for groundwater in the Kintyre area as defined by the ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality are likely to be:

- aquatic ecosystems (if there is a link with surface water features);
- drinking water (dependent on water quality);
- industrial water; and

- cultural and spiritual values (if there is a link with surface water features).

The groundwater investigations will provide the necessary information to determine appropriate environmental values. Where two or more environmental values apply to a water body, the more conservative, or stringent of the associated guidelines will be selected as the water quality objectives. From this Cameco will develop monitoring and assessment programme in accordance with the ANZECC/ARMCANZ (2000) guidelines and determine appropriate management responses to maintain water quality objectives (Section 8.4).

5.7 Flora and Vegetation

Cameco commissioned flora and vegetation surveys of the Kintyre leases in April / May 2010 (Bennett Environmental Consulting, 2010). Prior to this comprehensive flora, vegetation and rehabilitation studies were undertaken in the Kintyre area between 1986 and 1992 (Hart, Simpson and Associates, 1994a) and June / July 2007 (Bennett Environmental Consulting, 2007) by Canning Resources.

The 2007 vegetation survey was limited to the proposed drill area as it was defined at that time and the areas proposed for the village and associated infrastructure. Prior to the 2007 survey there had been good rainfall but in 2009 a fire had burnt through a large extent of the area. Following a meeting between Bennett Environmental Consulting, representatives of the Department of Environment and Conservation and Cameco the 2010 survey was designed to cover the entire Kintyre Project leases and to meet the requirements of a Level 2 survey under the Environmental Protection Authority Guidance No. 51 (2004a) for terrestrial flora and vegetation surveys. Prior to the 2010 survey there had been very little rainfall. Further survey work of the Project area and access road is proposed for May 2011 following a high rainfall period (Section 8.1).

The Project Area is located in the Little Sandy Desert (LSD1 – Rudall Subregion) as classified by IBRA (Thackway and Cresswell, 1995). The LSD1 sub region comprises sparse shrub-steppe over *Triodia basedowii* (hard spinifex) on stony hills, with River Gum communities and bunch grasslands on alluvial deposits in and associated with ranges (Kendrick, 2001).

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.

A comparison was made between the vegetation units recorded 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. Quadrats have now been placed in each of the units mapped by Hart Simpson & Associates. The vegetation map for the Project is included as Figure 7.

The key vegetation units within the Project area as described by Hart Simpson & Associates 1997) are:

- F4: Mixed low shrubs over the hard spinifex *Triodia basedowii*
- F1: *Acacia ancistrocarpa* and *A. ligulata* over the hard spinifex *Triodia basedowii*
- A: Hard spinifex *Triodia wiseana*
- J: Sand dunes
- H: Sennas over grass
- G: Sparse shrubs over the hard spinifex *Triodia basedowii*

A total of 48 vascular plant families, 149 genera and 323 taxa (species, subspecies and varieties) were recorded during the 2010 survey. Poaceae (grass family) and Fabaceae (pea family) were the dominant families with 32 and 16 genera, and 60 and 59 taxa respectively. The other dominant family was Malvaceae with 10 genera and 38 taxa.

As part of the environmental impact assessment for the current Project, vegetation and flora studies been undertaken in all areas proposed to be disturbed. No major issues have been identified previously in respect to flora and vegetation at the site and none are anticipated from the 2010 work. The results of this most current study will be reported in the ERMP for the Project.

5.7.1 Significant Flora

One Priority 3 taxon, *Comesperma pallidum*, was recorded in 2007 in the area proposed for exploration drilling, but none were located during the 2010 survey. A number of Priority

flora[1] have previously been recorded in the area including:

- Priority 2 – *Acacia auripila*
- Priority 2 – *Goodenia hartiana*
- Priority 2 – *Thysanotus* sp. Desert East of Newman (RP Hart 964)
- Priority 4 – *Acacia balsamea*
- Priority 4 – *Ptilotus mollis*

5.7.2 Weeds

Five introduced taxa were recorded in the Kintyre area during the 2007 and 2010 surveys (Bennett Environmental Consulting 2007, 2010), none of which are Declared Weeds (Department of Agriculture and Food, 2010) or listed as Weeds of National Significance:

- Buffel Grass (*Cenchrus ciliaris*), which is a perennial tussock grass. This grass was deliberately and widely disseminated as a pasture plant, and is now common throughout the Pilbara and desert areas. It is common along the rivers and drainage lines of the site and around any disturbed areas where there is water runoff.
- The small shrub known as Kapok Bush (*Aerva javanica*), was found on Kintyre Hill which had been ripped after the original exploration phase.
- Beggars Ticks (*Bidens bipinnata*) was recorded on the bank of the southern arm of the creek, at several of the locations sampled. This weed is regionally widespread.
- The melon (*Cucumis melo* subsp. *agrestis*) was also recorded from several locations. It occurs as scattered plants and was not observed as a dense mass.
- *Citrullus lanatus* was recorded in damp soil close to creeks. Where it occurred it formed dense areas over the ground with several round fruits up to 150 mm wide.

1 Definition of Priority Flora under the *Wildlife Conservation Act* 1950
Priority One - Poorly Known: taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat or the plants are under threat. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

Priority Two - Poorly Known: taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

Priority Three - Poorly Known: taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

Priority Four - Rare: taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.

5.7.3 Groundwater Dependent Vegetation

A few vegetation units which are possibly groundwater dependent occur within the vicinity of the Project area. These are:

- C: Minor drainage line with Woodland of *Corymbia opaca*;
- D: River channels with Woodland of *Eucalyptus camaldulensis*;
- E: Chenopod Dwarf Scrub on low lying areas adjacent to claypans;
- L: Open Grassland of *Xerochloa laniflora* and *Dactyloctenium radulans* on claypans;
- R: Low Open Forest of *Acacia aneura* subsp. *macrocarpa* on lower slope above creek;
- O: Low Open Woodland of *Eucalyptus odontocarpa* on lower slope above creek; and
- *Q:* Low Shrubland of *Eremophila tietkensii* at the base of hills within the White Quartzite Scree Complex.

The presence of groundwater dependent vegetation communities will be investigated in further detail and reported in the ERMP.

5.8 Fauna

Cameco commissioned a targeted fauna survey in August 2010 (Bamford Consulting Ecologists, 2010). Prior to this the fauna of the Kintyre Project area and surrounds were extensively surveyed by Hart Simpson & Associates and Bamford Consulting Ecologists on behalf of Canning Resources.

Historic surveys were undertaken between April 1986 and November 1988 over a number of seasons and varied annual conditions at a total of 39 sites covering all of the habitats present in the Kintyre area. A summary and compilation of the fauna surveys undertaken during these periods was prepared in 1994 (Hart Simpson & Associates, 1994b). This involved a survey equivalent to level 2 intensity survey (*sensu*. EPA Guidance Statement 56, EPA 2004) (Bamford Consulting Ecologists, 2010).

Bamford Consulting Ecologists was commissioned to carry out a review of the existing information on the fauna of the area and to revise and update the species lists presented in the earlier reports in terms of taxonomy and changes in conservation legislation (Bamford Consulting Ecologists, 2007a). As part of this review, an extended site inspection was undertaken in October 2007 with particular emphasis on searching for signs of significant species within the Project Area (Bamford Consulting Ecologists, 2007b).

Following discussions between Bamford Consulting Ecologists, the Department of Environment and Conservation and Cameco in March 2010, a targeted species approach was accepted as an appropriate means to provide additional information and supplement the abovementioned survey for the Kintyre Project. Subsequently a field survey was conducted in August 2010 by Bamford Consulting Ecologists with the assistance of Martu trackers. The purpose of this survey was to search for significant fauna in and around the Kintyre area. Identifications and analysis of data collected from this survey are still being undertaken, but preliminary information on significant fauna recorded is presented below.

Further survey work of the Project area and access road is proposed for May 2011 following a high rainfall period (Section 8.2.1).

5.8.1 Terrestrial Fauna

Hart Simpson and Associates recorded 92 bird species during the surveys mentioned above (Hart Simpson and Associates, 1994b) and an additional 27 species are known to be found in the general area. Bamford Consulting Ecologists (2007b) observed the Barn Owl and Tawny Frogmouth, previously included on the basis of the literature only. Other species considered vagrants also occur such as some waterbirds. Some birds of conservation significance have been recorded or may occur in the area.

Hart Simpson and Associates (1994b) recorded 66 reptile species, and an additional 23 species are known from the general area. Bamford Consulting Ecologists (2007b) identified an additional two species not recorded by Hart, Simpson and Associates, including the blind snake *Ramphohtyphlops hamatus* and Rosen's Snake *Suta fasciata*. This high number of species indicates that there is a very rich reptile fauna in the Kintyre area and reflects both habitat diversity within the area and the desert location. The Kintyre area is in a region transitional between the Pilbara and the sandy deserts, so the reptile fauna includes species typical of one or other of these regions, as well as more widespread species. None of the reptile species recorded is of listed conservation significance, although some of the species are on the edge of their natural range.

Hart Simpson and Associates (1994b) presents information on the mammal assemblage of the Kintyre area from observations and from the analysis of the recent and sub-fossil remains in an owl deposit. A total of 25 species were observed within the Project area. Another five species were known to have been present recently but not actually observed, and 12 species were represented only as sub-fossil remains that can be presumed to be locally extinct. There are also another nine species that are expected to occur in the area but were not observed during the surveys nor were represented in the owl deposit. Bamford Consulting Ecologists (2007b) observed evidence of the Lesser Stick-nest Rat, which was not previously recorded. This species is extinct, which may be why it was excluded from previous reports, but evidence of old nests in small caves was found at several locations (Bamford Consulting Ecologists 2007b). It is noted that the remains are historic and such findings are common throughout the Murchison (Bamford *pers. comm.*). Seven of the observed species are introduced including the fox and feral cat. Of the 51 mammal species known to occur in the area, including those that are locally extinct, 21 (41%) are of conservation significance.

5.8.1.1 Fauna of Conservation Significance

Using the *EPBC Act* on-line Protected Matters Search tool, the following threatened fauna species were listed as potentially occurring in the Kintyre area (search conducted 2 August 2010). Evidence of these species in the vicinity of the Kintyre Project is also presented in Table 7.

Table 7: Significant Fauna listed under the *EPBC Act* that may occur in the Project Area

Species	Conservation Status	Notes
Dasycercus cristicauda (Mulgara)	Vulnerable	One active burrow and several inactive burrows of *D. cristicauda* or *D. blythi* recorded by Bamford Consulting Ecologists (2010) outside of the Project Area, east of the Rudall River Road.
Dasyurus hallucatus (Northern Quoll)	Endangered	Recorded by Hart Simpson & Associates (1994b) in owl pellets. Scats found by Bamford Consulting Ecologists (2007b).
Macrotis lagotis (Greater Bilby)	Vulnerable	Fresh burrows recorded and an individual photographed on sensor camera by Bamford Consulting Ecologists (2010) outside of the Project Area near North Bore.
Notoryctes caurinus (Northern Marsupial Mole)	Endangered	Not recorded and no evidence found despite extensive searching.
Rhinonicteris aurantia Pilbara Leaf-nosed Bat	Vulnerable	Recorded by Hart Simpson & Associates (1994b). No caves suitable for roosting within the Project area, may be an occasional visitor to the site (Bamford Consulting Ecologists, 2007b).
Liopholis kintorei (Great Desert Skink)	Vulnerable	Not recorded and no evidence found despite extensive searching.
Merops ornatus (Rainbow Bee-eater)	Migratory	Recorded by Hart Simpson & Associates (1994b) and Bamford Consulting Ecologists (2007b).
Ardea alba (Great Egret)	Migratory	Not recorded and expected only as vagrant as little suitable habitat.
Ardea ibis (Cattle Egret)	Migratory	Not recorded and expected only as vagrant as little suitable habitat.
Apus pacificus (Fork-tailed Swift)	Migratory	Not recorded.
Charadrius veredus (Oriental Plover)	Migratory	Not recorded and expected only as vagrant as little suitable habitat.

In addition, the following fauna species of conservation significance protected under the Western Australian *Wildlife Conservation Act* 1950 have been recorded or could occur in the vicinity of the Kintyre Project.

Table 8: Significant Fauna listed under the *Wildlife Conservation Act* that may occur in the Project Area

Species	Conservation Status	Notes
Lerista macropisthopus remota	Priority 2	Not recorded but habitat present within Project Area.
Falco hypoleucos (Grey Falcon)	Priority 4	Recorded by Hart, Simpson and Associates (1994b) and Bamford Consulting Ecologists (2007b) outside Project area.
Ardeotis australis (Australian Bustard)	Priority 4	Recorded by Hart, Simpson and Associates (1994b) and Bamford Consulting Ecologists (2007b).
Burhinus grallarius (Bush Stonecurlew)	Priority 4	Bird heard by Bamford Consulting Ecologists (2010) in Project area.
Macroderma gigas (Ghost Bat)	Priority 4	No caves suitable for this species present in the Project Area, but individuals may visit the site (Bamford Consulting Ecologists, 2007b).
Lagorchestes conspicillatus leichardti (Spectacled Hare-Wallaby)	Priority 3	Not observed by Bamford Consulting Ecologists (2007b). Habitat may be suitable but the species is probably locally extinct.
Pseudomys chapmani (Western Pebble-mound Mouse)	Priority 4	No active mounds in the Project Area (Hart, Simpson & Assoc (1994b).

In addition scats and tracks of a rock-wallaby were recorded. This may have been Rothschild's Rock Wallaby (*Petrogale rothschildi*), which is not considered significant, or the Black-flanked Rock Wallaby (*Petrogale lateralis lateralis*) which is listed under the *EPBC Act* as Vulnerable.

5.8.2 Aquatic Fauna

The Kintyre area lies close to two seasonal watercourses, Yandagooge Creek and Coolbro Creek, however there are no permanent water sources within or adjacent to the Project Area. Some pools may persist along the creeks for extended periods following heavy rain, but do not necessarily reappear at the same sites. All of the pools dry out completely without substantial rainfall.

Several water bodies were present in Yandagooge Creek upstream of the Project area and in valleys of smaller drainage lines in the adjoining hills following cyclonic activity in 1988. Sampling was undertaken on the aquatic invertebrates in these more permanent pools by Davis & Whittle (1988). The survey produced a wide variety of aquatic invertebrates dominated by insects and small crustaceans. Two species of molluscs were also recorded. Most species were short-lived with eggs that survive the drying out of the pools. Some flying species, which may fly long distances to colonise the temporary waterbodies, were also recorded. Nutrient levels showed that the pools were mildly eutrophic, most likely due to the flushing of nutrients from catchments which had been dry for some time and the subsequent drying out of the pools.

The taxonomy of the species identified in Davis & Whittle (1988) will be compared with the findings from a recently published study "A Biodiversity Survey of the Pilbara Region of WA, 2002 – 2007 by Pinder *et al.* (2010). In general terms Pinder *et al.* (2010) found that biodiversity was high in wetlands in the Pilbara region but most species were widespread throughout the Pilbara. If a review of Davis & Whittle (1988) supports this finding then no further work on aquatic fauna is proposed. If not, then Cameco will undertake a biodiversity survey of local semi-permanent pools subject to granting of access by the local indigenous stakeholders.

5.8.3 Short Range Endemic Species

Bamford Consulting Ecologists (2007b) undertook an opportunistic search of the Project Area for potentially significant invertebrates such as millipedes, land snails and scorpions, and no specimens were found. The conditions during the survey were probably too dry to find active millipedes and snails. It is likely that land snails are absent from the Project Area due to lack of suitable habitat. Scorpions are undoubtedly present and inactive burrows were found, but no specimens were collected.

In general, the Project Area lacked the sort of mesic refugia, such as deep gorges or persistent waterholes that can be expected to support populations of short range endemic invertebrates (Bamford Consulting Ecologists, 2007b).

Further investigations into short range endemic species were undertaken as part of the 2010 investigations. At least two scorpion species and one species of mygalomorph spider were collected and will be lodged with the WA Museum for identification. Samples of leaf-litter were also collected and will be searched for invertebrates such as pseudoscorpions. No land snails were found despite recent heavy rainfall that resulted in there being some pools of water present and in moist soil near the surface.

5.8.4 Subterranean Fauna

As part of the environmental impact assessment for the Kintyre Project, a subterranean fauna study is underway including both stygofauna and troglofauna sampling. Bores suitable for sampling stygofauna were drilled by February 2010 and subsequent rounds of sampling were undertaken in May 2010, July 2010 and September. The troglofauna traps

have been set with the first round of sampling undertaken in May 2010 by Bennelongia. Additional sampling will be undertaken as part of the investigations for the ERMP.

The timing of the initial stygofauna sampling round was not ideal as the bores had not been established for the recommended time and therefore colonisation of the bores by subterranean fauna had only just begun. However, sampling was commenced at this time to capture seasonal variations. Identification and analysis of the second round of stygofauna sampling is currently underway.

5.9 Threatened and Priority Ecological Communities

None of the vegetation units recorded for the survey area are listed by the Department of Environment and Conservation (DEC) as Threatened or Priority Ecological Communities. Three communities listed by Kendrick (2001) of conservation significance for the Rudall River area were recorded on the Kintyre leases. These are:

- Shrubland, mulga scrub which has the Beard Vegetation Code 39. This unit was found in the south eastern area of the lease but in an area not proposed for any development. It was small in area and occurred on a sandy slope above a creek;
- *Triodia wiseana* Grass Steppe on stony hills which has the Beard Vegetation Code 157. Quadrat KIN01 is representative of this community as may be quadrat KIN100 but the latter includes low shrubs. Both of these quadrats are within the Project area and the location of this community will be considered during Project design and addressed in the ERMP; and
- Mixed Shrub Steppe between sandhills with *Triodia schinzii* which has the Beard Vegetation Code of 136. Although there are several areas where *Triodia schinzii* was the dominant grass there was only one quadrat KIN111 where it occurred between sand hills. This quadrat is located outside of the proposed area of development. (Bennett Environmental Consulting, 2010).

The botanical and zoological specialist consultants will undertake an assessment of the conservation significance of ecological communities recorded in the Project Area as part of the investigations for the ERMP.

5.10 Radiological Environment

5.10.1 Physical radiological environment

A baseline radiological survey was undertaken by Canning Resources in 1996. The data collected are currently being supplemented by a new baseline data acquisition project. The data being collected include:

- Direct gamma exposure rate:
  - hand-held, energy-compensated dose-rate meters at many sites;
  - thermo-luminescent dosimeters (TLDs) at fixed locations in both potentially disturbed areas and areas unlikely to be disturbed; and

  - surface dose-rates calculated from aerial radiometric survey data.
- Selected radionuclides in surface soils:
  - samples taken to 40 cm below ground surface (bgs);
  - samples taken at sites where direct gamma (TLD) readings were obtained;
  - radionuclides analysed (Bq/g): Th-234, Ra-226, Pb-210, Ra228, Th-228, K-40; and
  - radioactive metals (µg/g): U, Th.
- Concentration of long-lived alpha-emitting radionuclides in air:
  - samples collected by air-flow samplers; and
  - long-lived alpha concentration determined by alpha counting.
- Concentration of radon (Rn-222):
  - track-etch detectors placed at fixed locations 1 m above ground surface (ags).
- Concentration of radon decay products in air:
  - 'grab sampling' and determination by modified Rolle method; and
  - continuous air sampling by Environmental Radon Detection Monitors (ERDMs).
- Meteorological conditions (for use in dispersion modelling):
  - wind speed;
  - wind direction;
  - standard deviation of wind direction;
  - temperature;
  - relative humidity;
  - barometric pressure;
  - rainfall; and
  - evaporation rate.
- Radionuclide concentration in water:
  - The local creeks flow very occasionally, but if they do, water samples will be screened by gross alpha & beta counting. If screening indicates an elevated alpha/beta count, the samples will be analysed for selected radionuclides.
  - Groundwater samples will be screened by gross alpha & beta counting. If screening indicates an elevated alpha/beta count, the samples will be analysed for selected radionuclides.

- Radon emanation rate:
    - Once materials become available to test (such as tailings) the radon emanation rate will be determined.

5.10.2 Biological radiological environment

The International Commission on Radiological Protection (ICRP) recently introduced the requirement to assess radiation exposure of non-human species (animals and plants). The concept is an extension of the existing system of radiation protection, but recognises that in some circumstances, protection of humans may not necessarily afford protection to other species. The concept was born out of studies relating largely to the nuclear power industry in the northern hemisphere.

The situation in uranium mining and processing is somewhat different in that uranium is only mildly radioactive and is of low concentration in most ore bodies (typically in the order of less than one percent on average at Australian deposits). Thus there is little prospect of irradiating biota at high dose-rates or total doses. Nevertheless, Cameco will undertake an assessment of potential exposure of non-human species.

The assessment of non-human species' exposure to radiation is a three-tiered approach. The first tier assessment is largely a desk-top study designed to identify at the broad scale whether or not there may be vulnerable species in the environs of an anthropogenic source of radiation exposure such as a uranium mine. The ICRP has assembled a set of 'Reference Animals' and 'Reference Plants'. While none of these are particularly relevant to Australia's flora and fauna, they nevertheless can be used at the tier one level of assessment. Conceptually, the assessment takes the form described briefly below:

- Determine potential radionuclide source terms at the proposed mine, and characterise their likely chemical and physical behaviour in the environment of the geographic region of the mine;
- Map pathways leading from the mine site to the wider environment (usually referred to as the aquatic pathways and the atmospheric pathways). Characterise these pathways in terms of their ability to transport radionuclides in the wider environment (note that in arid zones, many aquatic pathways either do not exist or are truncated).
- Understand trophic relationships between plants and animals specific to the local flora and fauna species found within the realms of the identified pathways (i.e. fauna should be range-restricted rather than transitory).
- Select an animal or plant that is likely to be a radionuclide receptor as a result of its place in the environment, and (for animals) their foraging or predatory habits.
- Calculate radiation exposure rates to the selected plant or animal, using conservative assumptions and reference values found in ICRP guidance material.
- Compare the calculated exposures to 'Derived Consideration Reference Levels' (DCRL) provided by the ICRP.

- Decide whether or not the tier one assessment provides sufficient evidence to confidently state that no non-human species is likely to suffer unacceptable effects of exposure at the calculated dose and dose rate.

If this (tier one) assessment provides the confidence mentioned in the last bullet point, there is no useful purpose served by undertaking a tier two assessment. If uncertainty remains, a tier two assessment may be indicated.

A tier two assessment is a more in-depth study, but retains the general approach outlined above, with the exception that the conservative assumptions used at tier one may need to be revisited and made more representative of actual values in the given environment and the given non-human reference species selected.

In the event that even a tier two assessment leaves sufficient uncertainty, a tier three assessment may be indicated. It is at tier three that investigations into the radiobiology of specific species may need to be undertaken to reduce uncertainty or replace the assumptions made at tiers one and two.

The radiation exposure rate range in which there is a very low probability of effects (including mortality, morbidity or genetic/reproductive effects) is between 0.1 and 1 mGy per day. Below this dose range there is no evidence of effects. The average global natural background exposure rate is about 0.01 mGy per day or less. In other words, the mining and processing of uranium at Kintyre would have to increase the exposure rate by a factor of between 10 and 100 for there to be a (low) probability of effects. Without having undertaken the assessment, experience would indicate that this scenario is highly unlikely. For example, an assessment of environmental dose rate near the Ranger uranium mine shows an incremental exposure rate (i.e. that in addition to natural background dose rate) of 0.000185 mSv per day (i.e. a factor of more than 1,000 below the band that includes a low probability of effects) (Australian Uranium Association, 2009). Similarly, workers at Australian uranium mines are usually exposed to less than a few milli-Sieverts per year: far less than 0.1 to 1 mSv per day.

Note that in the assessments discussed above, only at the tier three stage might it be necessary to collect and analyse plant and animal specimens for radionuclide determination. Cameco will undertake the tier one assessment at the desk top, and will not include a plant and animal collection programme for radionuclide determination unless the assessment indicates its necessity.

5.10.3 Human radiological environment

The concept of a ‘critical group’ has evolved over time. The original concept was useful as a tool in that in some circumstances it is possible to identify a small, homogenous, group of individuals living in proximity to a source of radioactive materials (such as a uranium mine) that was likely to receive the highest radiation exposure from that source and any others in the vicinity. The group could be identified by plotting pathways of exposure between the source and the group, and modelling the rates of delivery of radionuclides along the pathways to the group. Conventional dosimetry was then used, together with several

'lifestyle' factors to calculate the average effective dose to individuals in the group. By definition, if the critical group is likely to receive the highest radiation exposure, all other people must receive less exposure. If, furthermore, the exposure (or annual effective dose) to individuals in the critical group could be demonstrated (by modelling or measurement) to be a small fraction of the relevant annual dose limit (1 mSv/a), then again by definition, all other members of the public would receive an even smaller fraction of the annual dose limit.

In many cases, the assessed (often modelled) dose to the critical group can be directly or indirectly measured by taking samples of water, air and biota along pathways or even at the location of the critical group itself.

The situation in places where the existing and future populations of an area are low or a considerable distance from the source, and pathways are either non-existent, curtailed or very long, makes it problematic to use the concept of a critical group as a tool to demonstrate good radiation protection principles. Instead, the concept of an 'hypothetical critical group' has been used. As the name implies, this group is not composed of real people, and can be placed anywhere in the environment that is likely to receive the greatest exposure resulting from a source of radioactive materials, such as a uranium mine and processing plant. Just as with a real critical group, measurements of samples along pathways to the hypothetical group location (or at it) can confirm modelled exposures.

As no members of the public reside within 80 km of the Kintyre Project Area, Cameco propose to use the concept of an Hypothetical Critical Group in its assessment of potential radiation exposures to members of the public arising from the Kintyre Project.

Concern is sometimes expressed about ingestion of radionuclides in 'bush tucker' arising as a result of uranium mining and processing. For example, mussels found in creeks near the Ranger uranium mine have been shown to be 'bio-accumulators' of radium. Similarly, plants growing on areas of land at Ranger that are irrigated with excess water from evaporation ponds may bio-accumulate radionuclides from the irrigation water (Allison & Simpson, 1989; Willett *et al.,* 1993).

While these processes may be real, the question is what risk these processes pose to people and to the species themselves. For people to be exposed, radionuclides would have to leave the uranium mine and processing facilities by a pathway, and would have to accumulate in plants or animals that people eat. This implies that people in the vicinity would collect or hunt foods that had accumulated these radionuclides. Furthermore, for the risk (dose) to be significant, hunting and gathering would have to make a significant contribution to an on-going diet.

The most likely pathway of significance at Kintyre is the atmospheric pathway, along which dust and radon decay products may travel. Most radon decay products are short-lived and are unlikely therefore to accumulate in any significant concentration in plants or animals, leaving dust as the most likely carrier of radionuclides. Accumulation of radionuclides in dust by plants and animals is likely to be minor, given that the material is unlikely to be soluble, and is therefore unlikely to be bio-available to any great extent.

For animals to accumulate significant quantities of radionuclides resulting from operations at Kintyre, they would have to have a limited range as transient, migratory and vagrant species would not derive significant amounts of radionuclides during brief foraging episodes.

Pathway analysis and estimation of exposures to an Hypothetical Critical Group will form part of the Radiation Assessment for the Project (Section 8.6).

5.10.4 Transport and Radiation

Concern is sometimes expressed over the potential for radiation exposure of communities and the environment along the transport route. The transport of radioactive material is covered by the Code of Practice for the Safe Transport of Radioactive Material (2008). It requires that the dried UOC product will be sealed in 205 L drums and loaded into shipping containers in compliance with the Code of Practice for the Safe Transport of Radioactive Material (ARPANSA, 2008).

Based on the proposed production of 6,000,000 to 8,000,000lbs (approximately 2,700 to 3,600 tonnes) the product would be transported in approximately 54 to 70 truck movements per year. Typical radiation levels recorded from a trailer load of UOC are summarised in Table 9. Given the public exposure limit of 1mSv/yr, someone would have to be in contact with the trailer for 83 hours over the period of a year to receive a dose equivalent with the limit. If an individual was located 10m from the trailer for a year the maximum exposure would be 0.8 mSv, which is less than the annual limit.

Table 9: Typical Radiation Levels from Trailer of Uranium Oxide Concentrate (UOC)

Distance from Trailer with UOC	Gamma Dose (µSv/hr)	Estimate of Error (+/-)
In contact	12	2
1 metre	2.8	0.5
5 metres	0.7	0.3
10 metres	0.1	0.1

These comparisons demonstrate the limited risk to the public along the transport route where exposure time is likely to be less than an hour per year at minimum distances of a few metres.

5.11 Air Quality

The Kintyre Project is located within an arid environment between the Great Sandy Desert and the Little Sandy Desert. A network of six dust deposition gauges was established at the Kintyre site in May 1996. These gauges were designed to collect data to provide information on the existing dust deposition rates of the Kintyre region in order to define baseline deposition rates to assess the potential impacts of an increase in dust deposition as a result of the Project.

Dust samples were collected from the gauges on a monthly basis for the period June 1996 to November 1997 and were analysed for total soluble and insoluble solids. Samples were also analysed for radionuclides and total uranium in May 1997 and a single sample for particle/fibre identification. The results of the dust deposition monitoring program were presented in Dames and Moore (1998) and are summarised below.

One gauge was located northeast of the proposed operations, at the site of the meteorological station (KDG1) (Figure 5). A second gauge was located upwind (south) of the proposed mine site (KDG2) and the remaining four gauges were located downwind of the proposed operations under the predominant south-easterly winds, within the northwest quadrat (KDG3-6).

The results of the monitoring program indicate that the Kintyre region experiences naturally high dust deposition rates (Dames and Moore, 1998). The average monthly dust deposition rates measured at each monitoring station exceed the New South Wales Department of Environment and Climate Change (NSW DECC) dust deposition criteria of 4 g/m^2/month, with the exception of KDG1 which recorded 3.97 g/m^2/month.

The lowest monthly deposition rates were recorded during summer, when winds were predominately from the east-southeast quadrant. Higher deposition rates were consistently recorded throughout the winter, spring and autumn months, when winds were predominantly from the south-east quadrant. Wind speed however, did not seem to influence seasonal dust deposition rates as it remained relatively constant throughout the year.

The analysis of dust samples collected for radionuclides and total uranium suggests that the passive dust samples collected at Kintyre contain relatively low levels of radioactivity (Dames and Moore, 1998). The majority of total uranium and gamma emitter concentrations measured at each gauge station were below detection limits. The highest gamma emitted concentrations were Lead-210, which ranged from below detection limits to 0.21+/-0.09 Bq/filter (Dames and Moore, 1998).

The particle composition analysis of the single sample (from KDG6) collected during May 1997 identified nine primary elements including copper, chloride, sulphur, silica, sodium, potassium, aluminium, iron and phosphorus. The highest percentage of particles identified (22%) contained copper, chloride, sulphur and silica. The analysis also identified three respirable fibres of varying dimensions.

As only one round of samples were analysed for radioactivity, particle composition and fibre identification the subsequent results can only be considered as an indication of the existing characteristics of the deposited dust at the Kintyre site. Dames and Moore (1998) recommended additional analysis to substantiate the results presented.

Review of the dust monitoring program identified a series of issues associated with the collection of monthly deposition samples that resulted in a number of invalid samples. These issues were predominantly related to poor communication and inaccessibility to monitoring sites due to poor weather conditions.

Further dust deposition sampling is currently underway to characterise the existing dust levels in the Kintyre area (Section 8.7).

5.12 Noise

The Project Area is located in a remote area of the Eastern Pilbara. The nearest settlements are:

- Telfer mining operations 90 km north;
- Nifty mining operations 80 km northwest;
- Punmu indigenous community 113 km northeast; and
- Parnngurr (Cotton Creek) community 80 km southeast.

There is currently no economic land use in the area and the nearest pastoral leases are Balfour Downs, approximately 80 km west southwest of the Project Area and Wandanya approximately 80 km northwest of the Project Area. The nearest town is Newman approximately 260 km southwest of the Project. Whilst no noise assessments have been undertaken, it is expected that background noise levels at the Project area would be representative of remote rural areas.

5.13 Conservation Areas

5.13.1 Karlamilyi National Park

The Karlamilyi National Park (formerly Rudall River National Park) was proclaimed an "A" Class Reserve on 13 April 1977 for the purposes of conserving the arid river system and environment of the Rudall River. The Rudall River has its head waters in a low, dissected plateau and flows to the northeast through sand dune country into Lake Dora. It is also classified as a Priority 1 Wild River (DoW, 2009). The designated Park boundary did not follow any ecological or geomorphic features and originally included the Kintyre Project Area.

The Karlamilyi National Park represents a transition zone between the Little Sandy Desert and the Great Sandy Desert. It is in an area comprised of exposed bedrock, sandy plains and ephemeral watercourses in a desert setting. The National Park has limited, difficult road access and no public facilities. Currently visitor numbers are low and depending on any future upgrades access to the National Park will be improved.

In 1991 a submission was presented to the Director General, Department of Minerals and Energy regarding excising an area from the Karlamilyi National Park which included the Kintyre deposits. In April 1994 the Western Australian State Government approved the excision and compensatory land was added along the western boundary of the National Park. The excision measured 151 km^2 and the compensatory land measured 154 km^2. At the same time the area of the National Park was recalculated using current surveying methods to 1,283,406 ha (12,835 km^2).

5.13.2 Register of the National Estate

The Register of the National Estate is a list of natural, Indigenous and historic heritage places throughout Australia. The Rudall River National Park was listed on the Register in 1978 (Place ID number 10054) as it is noted as being "significant for maintaining ongoing geomorphic and ecological processes within a tropical desert environment. It contains an entire landscape sequence which includes extensive dune fields, table lands, an entire river/creek system, alluvial formations, saline lakes and palaeodrainage lines." The boundary of the place identified on the Register of the National Estate follows the old Rudall River National Park boundary which is different from the current Karlamilyi National Park boundary. The Kintyre Project area therefore occurs within an area listed on the Register of the National Estate.

The Register of the National Estate was originally established under the *Australian Heritage Commission Act 1975*. In 2004, responsibility for maintaining the Register shifted to the Australian Heritage Council, under the *Australian Heritage Council Act 2003* (AHC Act). On 1 January 2004, a new national heritage system was established under the EPBC Act. This led to the introduction of the National Heritage List, which was designed to recognise and protect places of outstanding heritage to the nation, and the Commonwealth Heritage List.

Many places in the Register of the National Estate are already included in other statutory lists, such as the state heritage lists, or local government heritage registers. As a result, those places receive protection under the relevant federal, state or territory legislation, or under council bylaws. In the case of places of National or Commonwealth significance that are in the Register, some of these places are already included in the National Heritage List or the Commonwealth Heritage List, and therefore receive protection under the EPBC Act. The Rudall River National Park (1978 boundary) is not listed on the National Heritage List and there is currently no provision in the *EPBC Act* for Register of the National Estate places to be transferred to the National Heritage List or the Commonwealth Heritage List. The majority of the National Estate site 10054 is protected within the Karlamilyi National Park under the *Conservation and Land Management Act 1984*. However, this does not include the Kintyre Project Area.

5.14 Social Environment

The Kintyre Project Area is located in a remote area of the Shire of East Pilbara, approximately 260 km northeast of Newman (Figure 1) the nearest town with public facilities such as fuel and accommodation. Current access to the Project Area via road is from Marble Bar 420 km northwest, and Telfer. The mining centres of Telfer and Nifty are located approximately 90 km north and 80 km northwest of the Project area respectively (Figure 2).

There are two local indigenous communities in the area; the Punmu community near Lake Dora approximately 113 km northeast of the Project; and the Cotton Creek (Parnngurr) community approximately 80 km southeast of the Project, both within the Karlamilyi National Park.

The Shire of East Pilbara is the largest Shire in Western Australia comprising an area of over 371,696 km^2. Total population of the region based on Council Records is 10,500 and the major industries in the Shire are mining, pastoral and tourism (Shire of East Pilbara webpage: www.eastpilbara.wa.gov.au).

Australian Bureau of Statistics 2006 census data indicate the resident population of the Shire of East Pilbara was 6,544 with majority of the population classified as living very remote. Of the total population in the Shire of East Pilbara 21.8% were classified as indigenous persons compared with 2.3% in Australia. The median age of persons in the Shire of East Pilbara was 30 years, compared with 37 years for persons in Australia (www.abs.gov.au).

In the Shire of East Pilbara the unemployment rate was 3.7% compared in 2006 with 5.2% for Australia. The median weekly household income was $1,990 in 2006, compared with $1,171 in Australia (www.abs.gov.au).

The transport route for UOC will cross through the following towns and municipalities (Figure 4):

- Port Hedland — Town of Port Hedland
- Newman — Shire of East Pilbara
- Meekatharra — Shire of Meekatharra
- Mount Magnet — Shire of Mount Magnet
- Leinster — Shire of Leonora
- Leonora — Shire of Leonora
- Menzies — Shire of Menzies
- Parkeston — City of Kalgoorlie-Boulder

The social context of the Project Area and transport route will be considered in more detail in the ERMP. Cameco will commission a social impact assessment to assess the potential risks and impacts associated with the development and operation of the Project.

5.15 Indigenous Heritage

The Kintyre 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. Cameco Australia acknowledges the Martu people as the

Native Title holders of their traditional land in the Pilbara region of Western Australia. The Martu are represented by the Western Desert Land Aboriginal Corporation (WDLAC).

Cameco commenced consultation about the Kintyre Project with the Martu and WDLAC in 2006 and consultation is ongoing. Cameco is a party to the following native title agreements with the Martu and WDLAC:

- Amended Kintyre Land Access and Mineral Exploration Agreement (July 2007).
- Kintyre Purchaser Deed (July 2008).

Cameco is currently negotiating a mining and native title agreement covering the entire project with the Martu people. While it is expected that the agreement details will be confidential, it is anticipated that it will include heritage management provisions relating to the identification and protection of identified heritage areas, future survey processes and consultation processes to be followed if section 18 consent under the *Aboriginal Heritage Act 1972* is sought.

5.15.1 Heritage Surveys

A number of Aboriginal heritage surveys have been undertaken in the Kintyre area including:

- Regional survey by the WA Museum Department of Aboriginal Sites (WA Museum, 1980);
- Archaeological survey undertaken by Professor Peter Veth in 1999 (Veth, 1999);
- Ethnographic survey undertaken by Nicolas Green in November 2006 (Anthropos 2006); and
- Aboriginal Heritage surveys undertaken by Nicolas Green and employees of Anthropos Australia in December 2008 and January 2009 (Anthropos 2008 and 2009) for a S18 application.

The surveys conducted by Veth and Green (2006) were arranged through WDLAC and involved participation by relevant Martu traditional owners. The survey reports have been submitted to the DIA.

Cameco will conduct further archaeological and ethnographic surveys within the project area and associated areas such as the proposed airstrip. The scope and type of these surveys will be determined in consultation with WDLAC and the Martu and in accordance with relevant heritage provisions of the agreements between the parties. These surveys will take into consideration guidance outlined in EPA Guidance Statement No. 41.

5.15.2 Heritage Management within the Project Area

The previous surveys have identified a number of ethnographic and archaeological sites within the Project area. The largest is Site ID 11786 which is recorded on the DIA register as a closed site. This site is known as Yandagudji (also Yandagooge Creek and Yantikurji)

and is described in the most recent Green report (2009) as "recorded by McCaskill *et al* (1980) as a mythological and ritual site of the Nyangamarda people on the Yandeecoodgee Creek. It is understood that the site comprises the catchments, bed and banks of the Yantikurji Creek right through to where it joins Coolbro Creek in the north."

There is another ethnographic site located within the project area (Site ID 27487) and it has been previously agreed with the Martu and WDLAC that this area should be fenced (with Martu monitors present) and avoided.

There are two archaeological sites (Site ID 27483 and 27484) located within the project area. Further details in relation to these sites including their significance and the likelihood of the project impacting on the sites have been addressed in the relevant reports.

Cameco will endeavour to avoid heritage sites where possible and will seek consent under section 18 of the *Aboriginal Heritage Act 1972* if disturbance cannot be avoided.

In addition, Cameco has developed a draft Cultural Heritage Management Plan (CHMP) for the project area and this has been provided to WDLAC for their input. The draft CHMP is based on indigenous involvement in the identification and management of heritage areas within the project area. It provides for Martu monitors to assist in the protection of identified sites and to be present during ground disturbing work within identified sites (in areas where s18 consent has been obtained). In advance of the finalisation of the CHMP Cameco will continue the current practice of inviting Martu members (via WDLAC) to be present during any ground disturbing activity in and around identified heritage areas.

The CHMP will continue to be developed separately from other social impact assessments.

5.15.3 Section 18 Consent

Cameco has sought and obtained consent under section 18 of the *Aboriginal Heritage Act 1972* prior to conducting ground disturbing work within the registered heritage site known as Yandagudgi. These consents relate to two vehicle crossings across the creek and an associated pipeline. Cameco will abide by the conditions of the section 18 consents including having Martu monitors present during ground disturbing activity and providing annual reports on work completed to the Department of Indigenous Affairs (DIA).

Cameco will review the need for, and scope of further section 18 consents within the entire Project area. However, this approach will be subject to consultation with the Martu and the consideration of other factors including commercial considerations. Cameco recognises that further ethnographic and archaeological surveys will be required if any future section 18 consent is sought.

5.16 European Heritage

With the exception of Rudall River National Park (Section 5.13) there are no sites of European heritage significance within or near the Kintyre Project area.

The location of any European heritage sites along the proposed transport route will be investigated as part of the ERMP.

5.17 Traffic

As outlined above, the proposed transport route will pass through the towns of Port Hedland, Newman, Meekatharra, Mount Magnet, Leinster, Leonora and Menzies to Parkeston (Figure 4). Should the Parkeston transport hub not be available by the time transport was to commence, the road transport route to South Australia would follow the proposed route to Kalgoorlie, then proceed through Kalgoorlie via the Goldfields Highway Eastern Bypass, then south via the Goldfields Highway to the Coolgardie-Esperance Highway and on to the Eyre Highway. This route is sealed with exceptions between the Project area, Telfer and Marble Bar. This route is currently used for heavy haulage.

An assessment of the impact of increased traffic along this route as a result of the Project will be addressed in the ERMP. Cameco will undertake a transport risk assessment to assess the potential risks and impacts associated with the transport of raw materials and products.

6 Principles of Environmental Protection

Cameco will address the Principles of Environmental Protection outlined in the *Environmental Protection Act 1986* in the following ways.

Table 10: Principles of Environmental Protection

Principal	Applicability to Project
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of this precautionary principle, decisions should be guided by – (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk – weighted consequences of various options.	The environmental impact assessment for the Kintyre Project is currently underway to gain a better understanding of the potential impacts of the Project. This study will enable Cameco's Project team to design the Project and develop appropriate measures to mitigate and manage these potential impacts. Part of the environmental impact assessment will include a risk analysis to investigate the likelihood and consequence of certain events occurring, and identify high risks areas that may require further mitigation and management. Where there is uncertainty Cameco will use conservative assumptions in assessing the potential impact of the Project and developing suitable management measures.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Cameco will ensure that the development of the Kintyre Project does not affect the ability of future generations to benefit from a healthy, diverse and productive environment. One of the key issues will be the management of radioactive materials during all stages of the Project.
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Cameco will ensure the disturbance of flora and fauna is kept to the minimum required for safe operation of the Project. Cleared areas no longer required, will be rehabilitated with native species throughout the life of the mine, and monitored for a period of time following closure to ensure the establishment of a self-supporting ecosystem. All aspects of the Project from clearing, dewatering, mining, processing and rehabilitation will take into consideration the biological diversity of the Project Area to be developed to ensure the ecological integrity of the broader area is protected.

Table 10: Principles of Environmental Protection

Principal	Applicability to Project
4. Principles relating to improved valuation, pricing and incentive mechanisms (1) Environmental factors should be included in the valuation of assets and services. (2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. (3) The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste. (4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.	Cameco will: (1) consider environmental factors in the valuation of the Project's assets; (2) minimise the risk of pollution and generation of waste and ensure that any pollution that may occur is cleaned up. Cameco will be required to submit bonds to the Government that will be held until such time that agreed closure criteria have been met; (3) consider the full life cycle of materials used and generated by the Project and ensure waste is reused or recycled where practical; (4) pursue environmental goals in a cost effective manner whilst not compromising the environmental outcomes.
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Cameco will implement the waste hierarchy of: • Avoid; • Reduce; • Reuse; • Recycle; • Recover; • Treat; and • Dispose.

7 Potential Impacts and Management

The Kintyre Uranium Project is in the conceptual stage of development, with baseline environmental and social studies recently commenced, or due to be commenced soon. The environmental and social impacts of the Project will therefore require more detailed investigation as part of the ERMP. However, the following sections present an overview of the current understanding of the potential environmental and social impacts of the Kintyre Uranium Project and possible management measures.

Management of the impacts of the Project will be undertaken in accordance with Cameco's commitment to the environment as defined in its Safety Health Environment and Quality (SHEQ) Policy. The main principles of the Policy are:

- keeping safety and health and safety hazards, including radiation exposures, and environmental risks, at levels as low as reasonably achievable;
- preventing pollution;
- complying with and moving beyond legal compliance requirements;
- ensuring quality of processes, products and services, and
- continually improving overall performance.

The potential impacts of the Project are discussed in the following Key Environmental Factors Table.

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
Biophysical					
Flora and Vegetation	Transition zone between the Great Sandy Desert and the Little Sandy Desert in the Eastern Pilbara region of Western Australia.	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	• Clearing of approximately 600 ha of native vegetation. • Potential clearing of significant flora species such as *Comesperma pallidum* (Priority 3). • Introduction or spread of weeds. • Reduced regional representation of significant or restricted vegetation communities. • Possible impact on groundwater dependent ecosystems (GDEs) due to pit dewatering and borefield operation. • Degradation of vegetation from changes to surface water flows, dust deposition, saline overspray during dust suppression,	• Take into account the location of significant or restricted flora and vegetation communities in design of the final Project layout. • Minimise areas of clearing and ground disturbance. • Manage topsoil to ensure its optimal use for rehabilitation. • Undertake progressive rehabilitation of cleared areas. • Implement vehicle hygiene measures to reduce the risk of introduction or spread of weeds. • Develop and implement a Flora and Vegetation	Studies completed: • Comprehensive flora, vegetation and rehabilitation studies including vegetation mapping were undertaken between 1986 and 1992 by Martinick McNulty and Hart Simpson & Associates. • Flora and vegetation survey of drill area by Bennett Environmental Consulting 25 June – 4 July 2007. • Detailed flora and vegetation survey of Kintyre leases 27 April - 4 May 2010 in accordance with EPA Guidance Statement No. 51 and Position

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
			poor erosion control and spills.	Management Plan.	Statements 2 and 3. Proposed investigations: • Defining areas of groundwater-dependent vegetation. • Flora and vegetation survey of Project area and along access road from Telfer to Kintyre following significant rainfall.
Terrestrial Fauna (including SREs)	Transition zone between the Great Sandy Desert and the Little Sandy Desert in the Eastern Pilbara region of Western Australia.	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	• Loss or disturbance of fauna including significant fauna species. • Loss or fragmentation of habitat from vegetation clearing, changes to surface water patterns and abstraction of groundwater within GDEs. • Attraction of fauna to process water ponds, TSF, landfill or accommodation village. • Attraction of feral fauna	• Take into account the location of significant or restricted fauna habitats in design of the final Project layout. • Minimise disturbance to fauna habitat. • Undertake progressive rehabilitation of cleared areas. • Exclude fauna from process and mining areas, TSF, landfill and accommodation village	Studies completed: • Comprehensive fauna surveys were undertaken by Hart Simpson & Associates between April 1986 and November 1988 over a number of seasons and varied conditions. • Review of previous studies and survey by Bamford Consulting Ecologists in October 2007 to search for

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
			which compete with, or prey on native species. • Increased risk of collisions with vehicles. • Dust, noise and vibration impacts. • Light impacts on nocturnal species. • Impacts from hunting due to improved access. • Loss of habitat from frequent and intense fires.	where practical. • Monitor the presence of feral animals and implement controls in consultation with Department of Environment and Conservation (DEC) and Department of Agriculture and Food (DAF) if required. • Monitor the presence of pests and undertake appropriate pest control in accordance with Health (Pesticides) Regulations 1956. • Enforce vehicle speed limits within Project area and along access roads. • Implement dust control measures. • Keep lighting to the minimum required for safe operating, and shielding of lights.	significant fauna including short-range endemic (SRE) species within Project area. Survey was undertaken in accordance with EPA Guidance Statement No. 56 and Position Statement No. 3. • Targeted search for significant vertebrate fauna in and around the Kintyre area in August 2010 by Bamford Consulting Ecologists with the assistance of Martu trackers. • Targeted search for potentially significant SRE invertebrates such as millipedes, land snails and scorpions in August 2010 by Bamford Consulting Ecologists. Survey was undertaken in accordance with EPA Guidance Statement

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
				• Undertake workforce training on wildlife awareness and protection. • Develop and implement a Fauna Management Plan.	No. 20. Proposed investigations: • Fauna survey of Project area and along access road from Telfer to Kintyre following significant rainfall.
Aquatic fauna	Semi-permanent pools upstream of the Project area and in smaller drainage lines in adjoining hills.	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	• As semi-permanent pools occur predominantly upstream of the Project area direct impacts on aquatic fauna is considered unlikely. • Alteration of hydrology of pools from groundwater abstraction if there is a connection with the groundwater	• Determine the conservation significance of aquatic fauna within the vicinity of the Project area.	Studies available: • Davis & Whittle (1988); • Pinder *et al.* (2010) Proposed investigations: • Review the taxonomy of species recorded by Davis & Whittle (1988) and compare with findings of Pinder *et al*. (2010).
Subterranean fauna	Near-surface soils (for troglofauna) and groundwater within the zone of hydrological influence (for	To maintain the abundance, diversity, regional distribution and productivity of subterranean fauna at the species and ecosystem levels	• Loss or disturbance of subterranean fauna including restricted or otherwise significant species. • Loss of habitats through soil	• Determine the conservation significance of subterranean fauna within the Project area. • Should species of conservation significance	Studies completed: • Stygofauna sampling was undertaken in accordance with EPA Guidance Statement No. 54a by Bennelongia

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
	stygofauna).	through the avoidance or management of adverse impacts and improvement in knowledge.	stripping, excavation, pit dewatering and borefield operation. • Reduced humidity in troglofauna habitats from pit dewatering, borefield operations and changes to surface water flows. • Disturbance to subterranean fauna from vibrations from ground disturbance and blasting. • Changes in groundwater quality from contamination of soils, groundwater or surface water.	be present within the Project Area, develop management measures in consultation with DEC and other key stakeholders. This may include avoidance of soil disturbance or minimisation of groundwater abstraction where significant fauna habitats are present. • Minimise ground vibrations where practical. • Ensure hazardous goods are stored and handled in accordance with Australian Standards or other acceptable standards to reduce the risk of spills and groundwater, soil or surface water contamination. • Develop and implement a Subterranean Fauna Management Plan.	Environmental Consultants in April, July, September and November 2010. Identification and analysis of the second round of stygofauna sampling is currently underway. • Troglofauna sampling undertaken by Bennelongia Environmental Consultants in April, July, September and November 2010. Sampling was undertaken in accordance with EPA Guidance Statement No. 54a with the exception that each troglofauna sample consisted of both trapping and scraping. Identification and analysis of the second round of troglofauna sampling is currently

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
					underway
Surface water-quantity	Within the ephemeral Yandagooge Creek catchment area.	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.	• Alteration of the natural water balance and surface water drainage patterns due to diversion of surface water flows around, and collection of surface water within the Project Area. • Alternation of surface water flows which may result in changes to natural erosion and deposition patterns. • Alteration of hydrology of creeks from groundwater abstraction if there is a connection with the groundwater. • Impact on Aboriginal heritage site ID 11786.	• Develop a water balance for the Project. • Design the Project to minimise impacts on natural surface water drainage patterns. • Implement adequate erosion and sedimentation controls. • Manage groundwater abstraction to ensure there is no impact on surface water features. • Consultation with WDLAC/Martu. • Obtain s18 consent prior to any disturbance of the site. • Develop and implement a Surface Water Management Plan.	Studies completed: • Surface water monitoring of stream flows and water quality in Yandagooge Creek was undertaken by Canning Resources from 1988 to 1992. • Rainfall data were collected by Canning Resources for 12 creek flow events over a four-year period from 1988 to 1992. • Cameco commenced a meteorological monitoring programme in 2010 which includes collection of rainfall and evaporation data. Proposed investigations: • A hydrological assessment will be undertaken as part of

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
					the detailed design of the Project to understand potential volumes and direction of surface water flows and flood patterns. • Further surface water monitoring is proposed to measure stream flows and water quality. • Groundwater investigations to determine connectivity between groundwater and surface water features.
Groundwater - quantity	Groundwater within the zone of hydrogeological influence.	To maintain the quantity and quality of groundwater so that existing and potential environmental values, including ecosystem maintenance, are protected.	• Alteration of groundwater flows and volumes, due to abstraction for pit dewatering and water supply borefields. • Possible impact on groundwater dependent ecosystems (GDEs) or surface water features (if there is a connection with the groundwater) due to pit	• Develop a water balance for the Project. • Use pit dewatering as process water where possible. • Re-use and recycle water for mining and processing activities in preference to groundwater abstraction.	Studies completed: • Historic groundwater monitoring of water levels and water quality was undertaken in the1980s and 1990s at approximately 25 sites across the Kintyre leases. Studies underway:

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
			dewatering and borefield operation. • There are no other groundwater users within the targeted groundwater catchment.	• Store industrial waste water in lined evaporation ponds and dispose waste sludge off site. • Manage groundwater abstraction to reduce the risk of impact on GDEs or surface water features. • Consult with relevant stakeholders on groundwater resource use and prior to the closure of the bores to ensure that they are not required for any other purpose. • Develop and implement a Groundwater Management Plan which includes a groundwater monitoring programme and GDE monitoring programme.	• MWH commenced a groundwater exploration and monitoring programme in 2009 using historical and new bores. Data collected will determine dewatering requirements and availability of water for water supply. Data will be used to predict groundwater abstraction rates and volumes, create a groundwater model to predict groundwater drawdown contours and recovery rates of water levels in the different aquifers on cessation of abstraction. Proposed investigations: • Defining areas of groundwater-dependent vegetation.

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
Landform and soils	Arid setting of exposed bedrock, low mesas and ephemeral watercourses	To maintain the integrity, ecological functions and environmental values of the soil and landform.	• Disturbance of approximately 600 ha of land with native vegetation. • Alteration of landforms during mining with final landforms including pit area, waste rock dumps and TSF. • Decreased stability and increased erodibility due to man-made landforms. • Low risk of acid and metalliferous drainage (AMD) from waste rock from the Whale and East Whale deposits. • Potential for contamination of land through inadequate storage and handling of hazardous or radioactive materials.	• Manage topsoil to retain structure and viability for use in rehabilitation. • Undertake progressive rehabilitation throughout the life of mine. • Design the project layout to minimise impacts on natural landforms. • Design final landforms to blend in with the natural landscape as far as practical. • Avoid highly dispersive soils for landform construction and rehabilitation. • Manage potentially acid-forming (PAF) materials (e.g. by encapsulation) to minimise the risk of oxidation and generation of acid and/or metalliferous drainage. • Ensure storage and	Studies completed: • Graeme Campbell & Associates undertook geochemical characterisation of waste rock and soil samples in 1997. The study assessed AMD potential and undertook multi-element composition on a range of waste rock and soils samples. • Dames & Moore undertook a soil survey in 1996 to identify and map soils in the Kintyre area and determine suitability for rehabilitation. Proposed investigations: • Further investigation of geochemical characteristics of tailings waste rock and BOGUM including

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
				handling of hazardous or radioactive materials is in accordance with required standards. • Develop and implement a Mine Closure and Rehabilitation Plan.	potential for kinetic leaching. • Investigation of geo-physical and chemical properties of topsoil, subsoil and waste rock to determine suitability for rehabilitation.
Conservation Areas	Karlamilyi National Park (formerly Rudall River National Park) is located to south of the Project Area. The Project Area is within an area listed on the Register of National Estate.	To ensure that the Project does not adversely impact on the natural and cultural environment, park visitors or management staff of Karlamilyi National Park.	• Potential disturbance of vegetation associated with upgrade of the track through the National Park to provide light vehicle access to the Project from Newman. • Increased risk of fauna colliding with vehicles along the upgraded track through the National Park. • Improved access to National Park may encourage additional visitors and put pressure on natural resources and infrastructure and increase the risk of fires.	• Management measures for the upgrade of track through the National Park to be developed in consultation with indigenous stakeholders and DEC. • Restrict vehicle speed limits along upgraded track. • Weed management in accordance with the Flora and Vegetation Management Plan, including vehicle hygiene measures. • Develop and implement a Fire Prevention and	No specific studies proposed.

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
			• Spread of weeds from the Project area into the National Park. • Low risk of contaminated dust blowing from the mine site into the National Park. • The Project is not expected to be visible from the National Park.	Management Plan. • Manage dust in accordance with the Dust Management Plan and Radiation Management Plan.	
Pollution Management					
Air Quality	Project Area and surrounds located in an arid environment with naturally high dust deposition rates.	To ensure that emissions from the Project do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards	• Distances to nearest settlements (80 km – 113 km) make air quality impacts from the Project area on nearest receptors unlikely. • Generation of dust from site preparation, earthmoving, vehicle movements, unloading trucks and wind erosion of cleared areas, waste dumps and stockpiles. • Generation of dust may	• Use dust suppression measures such as water sprays on cleared areas, roads, stockpiles and rock handling equipment. • Restrict vehicle speed limits within Project area and along access roads. • Develop and implement a Dust Management Plan which includes dust monitoring, during construction and operations.	Studies completed: • Dames & Moore undertook a meteorological and dust monitoring programme June 1996 and November 1997. Studies underway: • ENVIRON commenced baseline meteorological and ambient dust monitoring in 2010 including installing one

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
			create a nuisance and health hazard for the workforce and accommodation village. • Generation of dust may smother vegetation or affect animals within the Project area. • Low risk of dust blowing into the National Park. • Gaseous and particulate emissions from the processing plant and fuel combustion.	• Use of appropriate engineering design on the processing plant and power station to meet ambient air quality standards. • Develop and implement a Fibrous Materials Management Plan for Mineral Processing, Mining and waste rock management.	continuous BAM , a meteorological station, six dust deposition gauges, two Radon Daughter Monitors and two air pumps sampling for total suspended particulates for alpha radiation analysis.
Surface water quality	Within the ephemeral Yandagooge Creek catchment area.	To maintain the quantity and quality of surface water so that existing and potential environmental values, including ecosystem maintenance, are	• Increased sedimentation in runoff from erosion of cleared areas and access roads. • Risk of overtopping TSF or evaporation ponds following extreme rainfall events.	• Diversion of clean surface water flows around active Project Areas. • Maintain separation of 'clean' surface water runoff from 'dirty' (potentially contaminated)	Studies completed: • Surface water monitoring of stream flows and water quality in Yandagooge Creek was undertaken by Canning Resources

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
		protected. To meet the water quality objectives defined in the ANZECC/ARMCANZ water quality guidelines for the defined environmental values.	• Leaks and spills from tailings delivery and process water circuits. • Leaks and spills from chemical and fuel handling and storage areas.	surface water runoff. • Minimise clearing and soil disturbance. • Capture potentially contaminated surface water runoff from mining, stockpile and process areas for use in processing plant, or otherwise retained on site. • Design drainage structures, ponds and TSF for extreme rainfall events to reduce the risk of overtopping. • Chemical and fuel storage will be in accordance with relevant Australian or International standards and in accordance with a Chemical Storage Management Plan. • Install leak detection and spill control measures where appropriate.	from 1988 to 1992. Proposed investigations: • Engineering design of Project components and drainage structures to withstand extreme rainfall events. • Further surface water monitoring is proposed to measure stream flows and water quality.

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
				• Develop and implement a Surface Water Management Plan which includes monitoring surface water quality.	
Groundwater quality	Groundwater within the zone of hydrogeological influence.	To maintain the quantity and quality of groundwater so that existing and potential environmental values, including ecosystem maintenance, are protected. To meet the water quality objectives defined in the ANZECC/ARMCANZ water quality guidelines for the defined environmental values.	Potential contamination of groundwater from leaks, spills and seepage from: • processing areas; • chemical and fuel transfer and storage areas; • TSF and ponds; • landfill areas; and • final pit void.	• Install leak detection and spill control measures where appropriate. • Bund process areas where appropriate. • TSF and process water ponds will be lined to minimise seepage. • Chemical and fuel storage will be in accordance with relevant Australian or International standards and in accordance with a Chemical Storage Management Plan. • Landfill will be constructed in accordance with *Environmental Protection*	Studies completed: • Historic groundwater monitoring of water levels and water quality was undertaken in the1980s and 1990s at approximately 25 sites across the Kintyre leases. Studies underway: • MWH commenced a groundwater monitoring programme in 2009 which included water quality monitoring. Proposed investigations: • Solute fate and transport modelling by

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
				(Rural Landfill) Regulations 2002. • Develop and implement a Groundwater Management Plan which includes a groundwater monitoring programme.	MWH to assess the potential for contaminated seepage from ore treatment and process waste disposal facilities and pit void water following closure.
Noise and vibration	Within and around the Project area. Along the proposed transport route.	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	• The main noise and vibration impacts will be from noise generated as a result of mining activities. • Distances to nearest settlements (80 km – 113 km) make noise and vibration impacts from the Project on these settlements unlikely. • Potential noise and vibration impacts on Accommodation Village creating a nuisance for personnel staying on site. • Potential noise and vibration impacts on sensitive fauna populations.	• Use modern, well-maintained equipment. • Comply with the Environmental Protection (Noise) Regulations 1997. • Develop and implement a Noise Management Plan to monitor noise levels and implement noise reduction measures if required.	Studies underway: • Consultation with communities along the transport route has commenced and will continue throughout the various stages of the Project. Proposed investigations: • Determine sound-power levels for the equipment to be used for the Project. • Model potential noise levels at the project boundary. • Identify if there are any noise-sensitive fauna

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
			• Low risk of noise impacts on visitors to the National Park resulting in loss of amenity. • Low risk of noise impacts on communities along the proposed transport route due to additional truck movements.		populations within the vicinity of the Project area. • Determine the number of additional truck movements that will be required along the transport route as a result of the Project.
Radiation[4]	Within and around the Project Area. Along the proposed transport route.	To minimise potential human and ecological radiation exposure to as low as reasonably achievable. To limit radiation exposure to members of the public to less than 1mSv per year over and above background.	• Contamination of air, water and soil with radionuclides. • Human and ecological radiation exposure above acceptable limits. • Health and safety impacts to workforce and members of the public from increased gamma, dust and radon exposure.	• Develop and implement a Radiation Management Plan and a plan for the Safe Transport of Radioactive Materials. • Appoint a suitably qualified and experienced Radiation Safety Officer as required by the *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste in Mining and Mineral Processing*.	Studies underway: • Baseline radiation investigations were commenced by Radiation Advice & Solutions Pty Ltd and are being continued by KBR. • KBR will undertake definition and modelling of the radiation exposure pathways; provide exposure estimates of the workforce and an

4 Further detail on potential radiation impacts and further investigations required are presented in Appendix A.

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
				• Manage dust in accordance with the Dust Management Plan. • Capture potentially contaminated surface water runoff from mining, stockpile and process areas for use in processing plant, or otherwise retained on site. • Develop and implement a Mine Closure and Rehabilitation Plan that takes into account long-term management of landforms.	Hypothetical Critical Group and undertake an ERICA (environmental risks from ionising contaminants) investigation on selected reference plants or animals. Proposed investigations: • Transport risk assessment to assess the potential risks and impacts associated with the transport of raw materials and products.
Radioactive Waste Disposal	Project Area	To minimise potential human and ecological radiation exposure to as low as reasonably achievable. To limit radiation exposure to members of the public to less than 1mSv per year	• Contamination of air, water and soil with radionuclides. • Human and ecological radiation exposure above acceptable limits. • Health and safety impacts to workforce and members of the public from increased gamma, dust and radon	• Develop and implement a Radioactive Waste Management Plan. • Develop and implement a BOGUM Management Plan. • BOGUM will be processed (should this become viable), used for	Proposed investigations: • Engineering design of TSF, waste rock dumps and open pit(s) to minimise risk of human and ecological radiation exposure to as low as reasonably achievable. • Development and

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
		over and above background.	exposure.	backfilling the open pit or otherwise encapsulated prior to mine closure. • Ensure handling, storage, transport and disposal of contaminated wastes is in accordance with appropriate standards and guidelines. • Design drainage structures, ponds and TSF to reduce the risk of overtopping and seepage. • Develop and implement a Mine Closure and Rehabilitation Plan that takes into account long-term management of landforms.	implementation of a radiation monitoring programme as part of the Radiation Management Plan.
General Waste Disposal	Project Area including accommodation village.	To ensure that liquid and solid wastes do not affect groundwater or surface water quality, lead to soil contamination or impact fauna	• Inefficient use of resources. • Contamination of soil and water from inappropriate waste disposal or seepage from landfill. • Attraction of fauna to landfill	Develop a Waste Management Plan. Implement the following waste management hierarchy: 1. Avoid;	Studies underway: • Site selection for landfill. • Review of alternative waste treatment options.

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
		populations.	site. • Wind-blown litter.	2. Reduce; 3. Reuse; 4. Recycle; 5. Recover; 6. Treat; and 7. Dispose. • Design temporary waste storage areas with bunding and drainage controls to avoid contamination of soils, surface water and groundwater. • Construct and operate landfill in accordance with *Environmental Protection (Rural Landfill) Regulations* 2002. • Hazardous wastes will be stored separately and will be handled, stored and transported in accordance with relevant Australian Standards or equivalent	

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
				international standards.	
Greenhouse Gases	Project Area and transport routes within a National and Global context.	To minimise 'greenhouse gas' emissions to levels as low as practicable on an on-going basis and consider ways to reduce emissions or apply offsets to further reduce cumulative emissions.	Greenhouse gas emissions as a result of: • power generation for the Project; • fuel usage by vehicles and machinery; • release of stored carbon in soils during clearing; and • decomposition of cleared vegetation.	• Incorporation of energy efficient technologies in Project design. • Annual monitoring and reporting of greenhouse gas emissions. • Regular review of greenhouse gas reduction objectives and targets. • Develop and implement a Greenhouse Gas Management Plan.	Proposed investigations: • Assess project options for their greenhouse gas production. • Calculation of greenhouse gas emissions as a result of the Project.
Social Surroundings					
Indigenous Heritage	Project Area and surrounds	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant	There several sites of indigenous heritage significance that occur within or near the Project Area that could be impacted by Project activities.	• Protection of sites within and near the Project Area will be undertaken in consultation with the Traditional Owners. • Comply with the provisions of the *Aboriginal Heritage Act*	Studies undertaken: A number of Aboriginal heritage surveys have been undertaken including: • Regional survey by the WA Museum Department of

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
		heritage legislation.		*1972*. • Review need for and scope of future s18 consent within entire project area subject to consultation with Martu. • Provide workforce and contractor training on obligations under the *Aboriginal Heritage Act 1972*. • Continue consultation with WDLAC in conjunction with the Martu people. • Use Aboriginal people to monitor all ground disturbance activities. • Develop and implement a Cultural Heritage Management Plan.	Aboriginal Sites 1980; • Archaeological survey undertaken by Professor Peter Veth in 1999; • Ethnographic survey undertaken by Nicolas Green (Anthropos) in November 2006; • Aboriginal Heritage surveys undertaken by Nicolas Green and employees of Anthropos Australia in December 2008 • Further heritage surveys will be undertaken with the scope of these surveys to be determined in consultation with WDLAC and the Martu people • Draft Cultural Heritage Management Plan provided to

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
					WDLAC/Martu for input.
European Heritage	The Project Area and areas along the transport route	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	• The Project Area is located within an area listed on the Register of National Estate. The values for which the area was listed on the Register of National Estate are protected within the Karlamilyi National Park to the south of the Project area. • Sites of European heritage may occur along the transport route.	• Discuss any proposed management measures for protection of European heritage sites along the transport route in consultation with the relevant municipality.	Proposed investigations: • Desktop search of Shire, State and Federal heritage databases along the proposed transport route.
Social	Local and regional communities.	To minimise adverse impacts on, and provide benefits to the local and regional communities.	• Fly in-fly out rosters may mean local and regional communities don't experience economic benefits from the Project. • Interference with local communities' traditional way of life. • Increased pressure on	• Develop and implement a Cultural Heritage Management Plan. • Continue community consultation throughout the life of the Project. • Provide training, education and employment opportunities	Studies underway: • Cameco has commenced a community consultation programme which will continue throughout the life of the Project. Proposed investigations: • Social Impact

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
			transport services (e.g. regional flights to and from site), medical services (e.g. Royal Flying Doctor Service) and other services and infrastructure. • Increased risk of communicable diseases from interaction between the remote communities and the workforce.	for local and regional communities. • Provide drive in-drive out and local air charter support to local and regional-based employees. • Continue consultation with government stakeholders regarding infrastructure and service requirements.	Assessment with the scope to be defined in consultation with relevant stakeholders • Draft Cultural Heritage Management Plan to be provided to WDLAC/Martu for input.

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
Other					
Fire Management	Project Area and surrounds.	To ensure that the risk of fire as a result of the proposal is as low as reasonably achievable. To prepare for and manage wildfires that may occur in the area.	• Increased risk of fires as a result of Project activities (e.g. welding, vehicles). • Increased access to previously remote areas resulting in increased risk of fires (e.g. from vehicles, camp fires, cigarette butts, deliberately lit fires). • Increased risk to life and property as a result of wildfires and man-made fires. • Impacts on ecosystems as a result of more frequent fires.	• Develop and implement a Fire Prevention and Management Plan in consultation with Martu people. • Train the Project Emergency Response Team in fire response.	Proposed investigations: • Undertake a Wildfire Threat Analysis.
Decommissioning and Rehabilitation	Disturbance within the Project Area.	To ensure, as far as practicable, that rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other	Poor rehabilitation could result in: • Unstable post-mining landforms. • Erosion. • Exposure and dispersal of	• Manage topsoil to retain structure and viability during clearing, handling, storage and rehabilitation. • Develop and implement a Mine Closure and Rehabilitation Plan.	The Mine Closure and Rehabilitation Plan will take into account information from the other studies undertaken as part of the ERMP.

Table 11: Key Environmental Factors Table

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Potential Management	Investigations
		environmental values.	mineralised material. • Residual human health risks. • Non-functional or nonexistent ecosystems. • Adverse impacts on soil, surface water and groundwater quality. • Poor visual amenity. • Long-term financial liabilities.	• Throughout construction and operations review and revise the Mine Closure Plan to develop a Final Mine Closure Plan for approval by the regulators.	

8 Scope of Works

8.1 Flora and Vegetation Survey

Comprehensive flora, vegetation and rehabilitation studies were undertaken in the Kintyre area between 1986 and 1992 (Hart, Simpson and Associates, 1994a) including the preparation of a vegetation map (Section 5.7). Bennett Environmental Consulting undertook a survey of the Kintyre proposed drill area, village and associated infrastructure between 25 June and 4 July 2007.

Further study of the whole lease area was proposed by Cameco in 2010 and the scope of work was developed in consultation with DEC. Bennett Environmental Consulting Pty Ltd undertook a survey between 27 April and 4 May 2010 of the Kintyre leases. It was agreed with the DEC that due to the intense survey effort by Hart *et. al.* that permanent quadrats were only required to be established in each of the different vegetation units previously mapped. The survey methods used during the survey met the requirements of the Environmental Protection Authority Guidance No 51 (2004). Dr van Leeuwen, a research officer at the DEC confirmed that 50 m by 50 m quadrats were to be used. A permanent marker peg was left at the northwest corner of each quadrat at the completion of the assessment.

Cameco will undertake further targeted investigations of the Project area following significant rainfall received in the first quarter of 2011, since the 2010 survey was preceded by dry conditions. A flora and vegetation survey will be conducted along the access road which will be upgraded from Telfer to Kintyre. It is anticipated this work will be undertaken in the May 2011.

Cameco will consider the findings of the flora and vegetation surveys in a regional context using relevant regional information (e.g. Burbidge & McKenzie, 1983). The conservation significance of species and ecosystems observed and protected under the following instruments will also be considered:

- Declared Rare Flora (DRF) and Priority Flora (PF) under the Western Australian *Wildlife Conservation Act* 1950;
- DEC's lists of Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs); and
- EPBC Act list of threatened species and ecological communities.

Bennett Environmental Consulting will provide input into the development of a Flora and Vegetation Management Plan in the Environmental Management Programme (EMP) required as part of the ERMP document (Section 8.14).

8.2 Fauna Surveys

Fauna survey work has been restricted to terrestrial fauna (including short range endemic fauna) and subterranean fauna. Cameco will undertake a review of available information on aquatic invertebrate fauna of nearby semi-permanent pools of water and in the Pilbara

region, but is not proposing to undertake a survey of aquatic invertebrate fauna unless the review indicates a high level of endemism of aquatic fauna in the vicinity of the Project area.

Cameco will consider the findings of the fauna surveys in a regional context using relevant regional information (e.g. Burbidge & McKenzie, 1983). The conservation significance of species and ecosystems observed and protected under the following instruments will also be considered:

- Specially protected fauna listed under the Western Australian *Wildlife Conservation Act* 1950;
- DEC's lists of Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs);
- EPBC Act list of threatened species and ecological communities; and
- International Migratory Bird Agreements with Japan (JAMBA) and China (CAMBA) (refer to Table 4).

8.2.1 Terrestrial Fauna

The fauna of the Kintyre Project area and surrounds have been extensively surveyed in the past by Hart Simpson & Associates and Bamford Consulting Ecologists. Terrestrial fauna surveys were undertaken between April 1986 and November 1988 over a number of seasons and varied annual conditions at a total of 39 sites covering all of the habitats present in the Kintyre area. A summary and compilation of the fauna surveys undertaken during these periods was prepared in 1994 (Hart Simpson & Associates, 1994b).

Bamford Consulting Ecologists conducted a review of the existing information on the fauna of the area and updated the species lists presented in the earlier reports in terms of taxonomy and changes in conservation legislation (Bamford Consulting Ecologists, 2007a). As part of this review, an extended site inspection was undertaken in October 2007 with particular emphasis on searching for signs of significant species within the Project Area (Bamford Consulting Ecologists, 2007b). This included an opportunistic search of the Project Area for potentially significant short-range endemic invertebrates such as millipedes, land snails and scorpions.

A further survey was commissioned by Cameco in August 2010. The survey was undertaken by Bamford Consulting Ecologists with the assistance of Martu trackers and the scope of work developed in consultation with the DEC. The DEC acknowledged extensive previous fauna studies undertaken in the area, and therefore suggested that the further survey should focus on: invertebrates of potential conservation significance that would not have been considered in earlier surveys (searching for and hand-collection of scorpions and trapdoor spiders; litter samples), acoustic surveys of bats using technology not available in the 1980s, searching for frogs of the genus *Uperoleia* (not previously recorded but, if present, probably of taxonomic interest), and searching for endangered mammals (e.g. Bilby) with assistance from traditional owners The fauna survey was undertaken in accordance with the requirements of EPA Guidance Statements No. 56 (for terrestrial fauna) and No. 20 (for short-range endemic invertebrate fauna).

Further survey work is proposed in the Project area and along the access road which will be upgraded from Telfer to Kintyre. It is anticipated this work will be undertaken in May 2011 following significant rainfall received in the first quarter of 2011. Bamford Consulting Ecologists will provide input into the development of a Fauna Management Plan in the EMP required as part of the ERMP document (Section 8.14).

Copies of all fauna studies will be provided to the Martu for their comment. Cameco will seek to continue Martu participation in future fauna studies.

8.2.2 Subterranean Fauna

Cameco proposed a Subterranean Fauna assessment including both stygofauna and troglofauna sampling. Bores suitable for sampling stygofauna were drilled in April 2010 and sampling was undertaken by Bennelongia Environmental Consultants in April and September 2010.

Troglofauna sampling was undertaken in February 2010 (with traps retrieved in April) and in July 2010 (with traps retrieved in September). Sampling effort and methods for stygofauna and troglofauna followed those recommended in EPA Guidance Statement 54A, with the exception that each troglofauna sample consisted of both trapping and scraping.

The timing of the initial stygofauna sampling round was not ideal because the bores had not been established for the recommended time and therefore colonisation of the bores by subterranean fauna had only just begun. If the second round of stygofauna sampling yields significantly better than the first, a third round of sampling will be undertaken. Sampling was commenced as soon as the bores were drilled to enable late wet season sampling. Identification and analysis of the second round of stygofauna sampling is currently underway.

Bennelongia Environmental Consultants will provide input into the development of a Subterranean Fauna Management Plan in the EMP required as part of the ERMP document (Section 8.14).

8.3 Surface Water Investigations

The Project Area lies within two tributaries of the Yandagooge Creek. Surface water monitoring was undertaken by Canning Resources from 1988 to 1992 to determine the hydrological characteristics of the creeks in and around the Project Area. The monitoring programme involved the measurement and collection of stream flow, water quality and rainfall data (Section 5.5).

Cameco is proposing to undertake further surface water quality monitoring following rainfall events. This monitoring will include data collection on stream flows and water quality. Parameters measured will include a combination of field readings and laboratory analyses of recovered water samples as follows:

- Field measurements will include pH, conductivity, temperature and total suspended solids (TSS);

- Laboratory analyses will include major ions (such as calcium, magnesium, sodium, potassium, chloride, sulphate, nitrate, alkalinity, total nitrogen and total phosphorus), trace metals (such as arsenic, iron, manganese, copper, zinc, lead, selenium, molybdenum, aluminium, cobalt, chromium and uranium) and radionuclides.

Design of the monitoring programme will be undertaken by MWH Australia with water quality analysis by a NATA certified laboratory. Commencement of this investigation is subject to granting of access to the creeks within and around the Project area, by the local indigenous stakeholders.

As part of the engineering design of the Project, MWH will also calculate flood estimates over a range of Average Recurrence Interval (ARI) events (including Probable Maximum Precipitation) to enable design of appropriate diversion structures and containment facilities to withstand extreme rainfall and runoff conditions. Stream gauging equipment will be installed. Any new data will be used to revise the existing catchment runoff models. Cameco will also ensure that surface water drainage management is considered in the upgrade of the access road from Kintyre to Telfer. MWH will work with Cameco's engineers to develop a site-wide water balance for the Project.

Cameco will take into consideration the potential for mosquito breeding habitats in the design of water holding or diversion structures and will develop appropriate mosquito management measures in consultation with DoH.

MWH will provide input into the development of a Surface Water Management Plan in the EMP required as part of the ERMP document (Section 8.14). This management plan will include information on the proposed surface water monitoring programme for construction and operations.

8.4 Groundwater Investigations

Hydrogeological studies in the Kintyre area were undertaken from 1987 to 1990 by Dames & Moore. A report was prepared in 1993 that consolidated and summarised the groundwater monitoring programme and findings from the 1987 to 1990 studies (Section 5.6). A gap analysis of the available data was undertaken before commencing on further groundwater investigations for the Kintyre Project.

The groundwater investigations were commenced by MWH in 2009 and essentially contain two components:

1. Estimation of mine dewatering volumes, flows and water quality and assessing the potential impacts of drawdown from this abstraction; and
2. Identifying suitable water sources to provide processing and potable water for the Project, and assessing the potential impacts of drawdown from this abstraction.

Results of the groundwater investigations will also be used to determine the extent of (if any) interaction between groundwater and surface water features.

MWH will provide input into the development of a Groundwater Management Plan in the EMP required as part of the ERMP document (Section 8.14). This management plan will include information on the proposed groundwater monitoring programme for construction and operations.

Based on the information provided by the groundwater investigations Cameco will apply the ANZECC/ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality framework to:

- determine appropriate environmental values;
- apply the relevant water quality guidelines;
- define the water quality objectives; and
- develop a monitoring and assessment programme.

8.4.1 Pit Dewatering

Groundwater monitoring of water levels and water quality was undertaken in the 1980s and 1990s at approximately 25 sites across the Kintyre leases, with most sites having a nest of bores drilled to shallow, intermediate and deep levels. These groundwater bore holes were cut and capped, and the area rehabilitated in 2002.

In 2009 Cameco commissioned MWH to undertake further groundwater monitoring. Attempts were made to recover and flush the historical bores to allow groundwater monitoring to continue. Where these were not recoverable replacement bores were drilled. An additional 12 bores were also installed to supplement the old monitoring network. These groundwater monitoring bores were also used in the subterranean fauna sampling programme (Section 5.8.4) where practicable.

The parameters being monitored during the current monitoring programme include:

- Groundwater abstraction rates and volumes as part of pump tests;
- Groundwater levels plus continuous data loggers ;
- Groundwater quality (pH, Conductivity, TDS, Na, K, Ca, Mg, Cl, CO_3, HCO_3 SO_4, NO_3).

This information will be used in the development of a site water balance and design structures to retain excess dewatering (not used in processing), if required. These data will also be used to create a groundwater model to predict groundwater drawdown contours as a result of dewatering, and recovery rates of water levels in the different aquifers on the cessation of dewatering. This information will be used by Cameco's flora and fauna consultants to determine if there are likely to be impacts on groundwater-dependent ecosystems (if any are identified) and subterranean fauna.

8.4.2 Water Supply Borefield

Cameco has commissioned MWH to undertake groundwater exploration to identify and test a water supply source to meet the water requirements of the Project.

The current focus is on the water supply areas that provided water for the previous exploration activities, known as the North Bore and South Bore. Should water supply from these bores be insufficient to meet the Project's process and potable water requirements, then exploration will be undertaken further afield.

Five potential production bore locations to provide process water have been identified for construction and test pumping during the current (2010) drilling programme. These sites have potential to provide significant groundwater from aquifers associated with the basal conglomerate unit of the Permian glacial sediments of the Paterson Formation. In addition to the above sites, two further production bore locations have been identified, targeting potential shear zones within the Coolbro Sandstone unit, adjacent to the planned mining pits. These bores will potentially assist in dewatering the pits in advance of mining.

8.5 Seepage Investigations

Solute fate and transport modelling will be undertaken by MWH to assess the potential for contaminated seepage from ore treatment and process waste disposal facilities and the pit void water following closure. This work will consider the effects of contaminants including heavy metals and radiation that could be present, and the potential impact on the underlying groundwater.

Cameco will address the management of pit voids, including water quality, mobility of uranium and appropriate water quality standards for closure of the pit and long-term management of groundwater movement around the pit void.

8.6 Radiation Assessments

KBR will undertake radiation baseline studies at the site, conduct a radiological assessment of the Project and prepare the Radiation Management Plan and associated management plans. The broad scope for the investigations is as follows:

- Baseline investigations to assess the concentration of radon and radon decay products, long-lived, alpha-emitting radionuclides and surface gamma dose rate.
- Definition and modelling of the radiation exposure pathways from all Project activities for both the workers and public.
- Exposure estimates to estimate exposure of workforce, annual average exposure of individuals in the Hypothetical Critical Group.
- ERICA (environmental risks from ionising contaminants) investigation of potential radiation exposure rate to selected reference animals or plants.
- Input to the Project design team on radiation criteria.
- Preparation of radiation management plans as outlined below.

A Radiation Management Plan will be prepared as part of the ERMP in accordance with regulatory and industry standards and cover all aspects of radiation management

associated with the project including detail of the radiation monitoring programme. It will also include the following associated plans:

- The Radioactive Waste Management Plan will cover the management of radioactive waste such as contaminated personal protective equipment (PPE), ground engaging equipment and any other equipment that cannot reasonably be decontaminated. The plan will describe the key objectives and proposals for radioactive waste management both during mining operation and at closure. The plan will be developed with regard to the ARPANSA Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing.

- The Safe Transport of Radioactive Materials Plan will address the handling and transport of UOC by road from the Kintyre Project and then rail or road to Adelaide or Darwin in accordance with the current international and national codes of practice and State and Federal legislation. It will include emergency response procedures in case of accidents or spills.

- The BOGUM Management Plan will cover the management of below ore-grade uranium material including handling, stockpiling, surface water runoff management and dust management.

Further detail on the scope of the Radiation Assessment is provided in Appendix A.

8.7 Meteorology and Ambient Dust Study

Meteorological monitoring at Kintyre was undertaken between 1987 and 1992, and again between 1996 and 1997 until the Project was placed under care and maintenance (Section 5.2). Ambient dust deposition monitoring was also undertaken from mid-1996 through to the end of 1997 (Section 5.11).

Cameco has commissioned a baseline meteorological and ambient dust monitoring network, which consists of the following:

- A meteorological monitoring station with the capacity to measure:
    - wind speed;
    - wind direction and standard deviation of wind direction;
    - temperature;
    - solar radiation;
    - relative humidity;
    - barometric pressure;
    - rainfall; and
    - evaporation;

- One continuous Beta Attenuation Monitor (BAM) to measure particulate matter with an effective aerodynamic diameter of less than 10 microns (PM_{10});
- Six dust deposition gauges to measure particulate matter deposition rates;
- Two air pumps to sample TSP for airborne alpha radiation monitoring; and
- Two environmental radon daughter monitors.

Locations of the monitoring stations are shown on Figure 5.

The meteorological and PM_{10} data will be downloaded from the monitoring stations on a weekly basis and forwarded to ENVIRON for review (with evaporation measured on a daily basis). ENVIRON will report any observed issues with the data to Cameco as soon as these are identified to minimise any loss of data.

The dust deposition samples will be collected from the deposition gauges on a monthly basis and Cameco will be required to transport these samples to an accredited laboratory for analysis.

The dust deposition samples will be tested for total insoluble solids (those that do not dissolve in water) and total soluble solids (those that do dissolve in water). This information will be used to characterise the existing dust levels in the Kintyre area. The existing dust levels will be compared to the dust levels measured once mining operations begin at Kintyre, in order to monitor the impact of fugitive dust emissions from the uranium mine on the surrounding environment. The dust samples may also be analysed to determine what compounds are contained within the regional dust. It is expected that the results of this analysis will be forwarded to ENVIRON for review and analysis.

ENVIRON will prepare a Dust Management Plan in the EMP required as part of the ERMP document (Section 8.14). This management plan will include information on the proposed dust monitoring programme for construction and operations. The construction phase of the Dust Management Plan will take into consideration EPA Guidance Statement No. 18.

8.8 Noise Assessment

A noise assessment of the Kintyre Project is proposed which will include determining sound-power levels for the equipment to be used for the Project and modelling potential noise levels at the Project boundary.

The results will be used to determine compliance with the noise regulations and if there are likely to be any impacts on any noise-sensitive fauna populations within the vicinity of the Project area, or on personnel staying at the accommodation camp. No other noise-sensitive premises are present within the vicinity of the proposed plant and mine.

Cameco will discuss noise impacts with the local communities. Cameco will also consider if the noise from additional truck movements proposed along the transport route is likely to affect existing populations along the route.

8.9 Greenhouse Gas Assessment

Cameco will undertake an assessment of greenhouse gas emissions over the life of the Project, based on areas proposed for clearing, consumption of diesel for vehicles and consumption of gas and/or diesel for power generation, blasting, and any process related emissions.

This assessment will take into consideration EPA Guidance Statement No. 12 and National Greenhouse and Energy Reporting legislation and guidance. The assessment will include:

- estimation of the total emissions of greenhouse gases from the Project for each year of operation;
- detail of the project lifecycle greenhouse gas emissions and greenhouse gas efficiency of the proposed project (per unit of product) and comparison with other uranium projects using similar processes; and
- proposed best practice greenhouse gas minimisation measures.

ENVIRON will prepare a Greenhouse Gas Management Plan in the EMP required as part of the ERMP document (Section 8.14).

8.10 Geochemical Characterisation

Information on the physical characteristics, geochemistry and mineralogy of the waste rock, ore, BOGUM and tailings is required to determine if there are likely to be any potential environmental issues associated with these materials including elements that may leach from these materials, or fibrous minerals that may present a health risk.

A geochemical characterisation of waste rock and soil samples was undertaken for the Kintyre Project by Graeme Campbell & Associates in 1997 (Section 5.3.1). Test work indicated that the majority of waste rock from the Kintyre Project area is mildly alkaline with a low salt content and classified as non-acid forming (NAF) (Graeme Campbell & Associates, 1997).

Characterisation of the ore is ongoing throughout the current exploration programme. Geochemical and radiological characterisation of tailings will be undertaken once samples become available as part of the engineering studies batch testing. This will be undertaken by consultant analytical laboratories in conjunction with the solute fate and transport model (Section 8.5).

Cameco is proposing further studies on the geochemistry and kinetic leaching potential of waste rock and low grade ore. The findings of these investigations will be considered in the engineering design of the open pit, waste rock placement and dump design, TSF design and mine closure.

Cameco is aware of work being undertaken by the CSIRO on closure strategies for uranium open pits and will consult with them over the proposed baseline geochemical characterisation studies, solute fate and transport modelling (Section 8.5) and closure options to ensure their experience is utilised.

8.11 Ethnographic and Archaeological Studies

A number of ethnographic and archaeological surveys have been undertaken in the Kintyre Area (Section 5.15). The surveys have identified several sites of significance to the Martu people. This includes a closed site and its buffer which covers most of the Kintyre Project Area.

Aboriginal heritage surveys will be required prior to any ground disturbing activities. Further archaeological or ethnographic surveys will be undertaken as part of the ERMP with the scope and type of these surveys to be determined in consultation with WDLAC and the Traditional Owners. These surveys will take into consideration guidance outlined in EPA Guidance Statement No. 41.

The ERMP will include an assessment on the impacts of Aboriginal heritage sites associated with natural water features and groundwater dependent ecosystems that could be affected by groundwater abstraction for mine dewatering and water supply. A visual impact assessment will be undertaken as part of the Culture and Heritage Management Plan to be developed in conjunction with Martu.

8.12 Social Impact Assessment

A Social Impact Assessment (SIA) of the Project will be undertaken as part of the ERMP. Cameco intends to develop the Terms of Reference for the SIA in consultation with the key stakeholders. The SIA will be undertaken by Coakes Consulting and include:

- definition of the scope of the SIA in consultation with relevant stakeholders;
- a profiling phase to understand the context in which the Project is being undertaken;
- identification of issues and impacts and possible strategies for addressing the issues raised, and to inform project design and planning;
- technical assessment of the social impacts;
- development of strategies to enhance social benefits and minimise negative impacts; and
- proposing a social monitoring programme to be implemented during the development, operation and closure of the mine.

8.13 Transport Risk Study

Cameco is proposing to undertake a transport risk assessment as part of the ERMP. The scope of the work will include:

- assessment of potential transport routes and alternatives to identify whether the selected route is socially, environmentally and economically acceptable;
- estimation of the types and numbers of vehicle movements required to transport materials to and from site during construction and also for operations;

- an estimation of the increase in traffic as a result of the Project and an assessment of the associated impact along the proposed transport route ;
- assessment of the potential risks and impacts associated with the transport of raw materials and products; and
- proposed management of Transport Risks including response planning.

It is proposed that this study will be undertaken by Australian Nuclear Science and Technology Organisation (ANSTO).

8.14 Environmental Management Plans

As part of the ERMP, a series of Management Plans within the overarching Environmental Management Programme (EMP) will be developed. The Management Plans will be presented as final plans based on the existing knowledge of the Project, its potential impacts and the significant environmental values to be protected. They will be considered 'live documents' which will be reviewed on a regular basis as the Project develops. Cameco is proposing to develop the following Managements Plans:

- Radiation Management Plan incorporating;
  - Radioactive Waste Management Plan;
  - Safe Transport of Radioactive Materials Plan; and
  - BOGUM Management Plan;
- Flora and Vegetation Management Plan;
- Fauna Management Plan;
- Subterranean Fauna Management Plan;
- Surface Water Management Plan;
- Groundwater Management Plan;
- Chemical and Fuel Storage Management Plan;
- Dust Management Plan;
- Fibrous Materials Management Plan;
- Noise Management Plan;
- Waste Management Plan;
- Greenhouse Gas Management Plan;
- Fire Prevention and Management Plan; and
- Cultural Heritage Management Plan.

8.15 Mine Closure and Rehabilitation Plan

A Mine Closure and Rehabilitation Plan will be required as part of the ERMP. This will be developed using regulatory guidelines including the EPA's Guidance Statement No. 6 for Rehabilitation of Terrestrial Ecosystems and Cameco's corporate standard.

The Plan will be developed in accordance with the DMP and EPA Guidelines for Preparing Mine Closure Plans (DMP and EPA, 2011). This guidance references a number of other national and international references on mine closure including the Australian and New Zealand Minerals and Energy Council (ANZMEC) Strategic Framework for Mine Closure and the International Council on Mining and Metals (ICMM, 2008) Planning for Integrated Mine Closure: Toolkit.

Cameco's Mine Closure and Rehabilitation Plan will describe the key objectives for mine closure, broad land use objectives, identification and management of closure issues, various closure options, completion criteria and proposed closure monitoring and maintenance.

9 Community and Other Stakeholder Consultation Programme

9.1 Overview

Cameco has developed a stakeholder consultation programme including consultation with local indigenous communities, government agencies and key interest groups. Consultation has included communities and municipalities along the transport route.

The methods and materials used during consultation will be tailored to the intended recipient so that communications are culturally appropriate, informative, and promote constructive discussion. It is expected that consultation with the wider community will occur as part of the formal environmental assessment process required under State and Federal legislation.

Consultation with the Martu Aboriginal Community and State Government representatives has already commenced as outlined below.

An intensive program of consultation with local government representatives and other stakeholders along the transport route was undertaken in September 2010. This will be followed by ongoing communication and consultation as required.

9.2 Consultation Programme

Community consultation to date has included:

- Formal meetings with:
    - Kintyre Consultative Committee;
    - Western Desert Lands Aboriginal Corporation;
    - Martu Trust;
    - Martu communities;
    - Australian Uranium Association;
    - Indigenous Engagement Working Group;
    - Department of Resources, Energy and Tourism; and
    - Shires of East Pilbara, Roebourne, Meekatharra, Mount Magnet, Leonora and City of Kalgoorlie-Boulder.
- Informal meetings with:
    - Kanyirninpa Jukurra (KJ) Cultural Communications group;
    - Martu Communities;
    - Martu Engagement and Community Visits;

  - Western Desert Lands Aboriginal Corporation;
  - Shire of East Pilbara;
  - Newcrest Mining;
  - Department of Mines and Petroleum (DMP);
  - Main Roads Department (MRD) Western Australia, Heavy Vehicles Operations Branch
  - Office of the EPA;
  - Department of Resources, Energy and Tourism (DRET); and
  - Department of Sustainability, Environment, Water, Populations and Communities (DSEWPaC).
- Site visits with:
  - Traditional Owners; and
  - Kanyirninpa Jukurra (KJ) Cultural Communications group
- Formal and informal meetings and site visit:
  - Martu Community Visits; and
  - Pundalmurra College.
- Presentations and workshops with:
  - communities in the Pilbara and Kimberleys including Broome, Bidyadanga, Looma, Fitzroy Crossing (Wankatjungka), Port Hedland, Punmu, Kunawarritji (Marble Bar), (Warralong), Newman, Parnpajinya, Jigalong and Cotton Creek.

Consultation with these and other community and government stakeholders will be ongoing throughout the approvals process, project development, construction, operation and closure.

The following consultation is planned to occur during the development of and prior to the submission of the ERMP.

- Martu people (through the Western Desert Lands Aboriginal Corporation)
  - Presentation of a community education package;
  - Consultation over social and health impacts;
  - Consultation over environmental issues in relation to the development of the project and the upgrade to the Telfer to Kintyre Rd; and
  - Consultation over cultural and heritage issues in relation to the development of the project and the upgrade to the Telfer to Kintyre Rd.

- Interested parties along the proposed transport route, including the Shires of East Pilbara, Meekatharra, Cue, Mt Magnet, Sandstone, Leonora and Menzies, the Town of Port Hedland, the City of Kalgoorlie Boulder, the Pilbara and Goldfields-Esperance Regional Development Commissions, local Chambers of Commerce and District Emergency Management Committees and other community representative organisations.
    - Consultation will include the presentation of a transport risk assessment undertaken by Australian Nuclear Science and Technology Organisation (ANSTO) for Cameco;
    - Further consultation regarding the transport proposal;
    - Presentation of a draft Transport Management and Incident Response Plan; and
    - Discussion about Cameco's First Responders program.
- NGO's
    - To date discussion with NGO representatives has been minimal and informal. Meetings are planned with a number of representatives in June 2010 and will continue through the development of the ERMP. An invitation to travel to site will also be extended to these organisations.
- Government Agencies
    - Consultation with range of Government agencies both State and Federal, as listed below, will continue, initially to address the issues raised in submissions to the ESD and then to address other issues as they arise during the preparation of the ERMP. An invitation to a site visit will also be extended to the agencies.
        - MRD;
        - Fire and Emergency Services Authority (FESA);
        - Department of Environment and Conservation (DEC);
        - DMP;
        - Department of Water (DoW);
        - DSEWPaC;
        - DRET;
        - Geosciences Australia;
        - ANSTO; and
        - Australian Safeguards Non-Proliferation Office (ASNO).

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10 Project and Assessment Schedule

Subject to government approvals, Cameco is proposing to start construction of the Project after 2013 and operations after 2015. Based on current mineralisation estimates, the anticipated Project life is nominally 15 years.

The level of assessment for the Project has been set as an ERMP with a 14-week public review period. An indicative project assessment schedule is provided in Table 12.

Table 12: Indicative Environmental Assessment Schedule

Project Stage	Timing
Stakeholder consultation	Commenced 2009 and is ongoing
Baseline studies	October 2009 - July 2011
Submit first draft ERMP for review by the Office of the EPA (OEPA)	January 2012
Submit final draft ERMP for review by OEPA	May 2012
ERMP public review period (14 weeks)	June 2012 – September 2012
Cameco provides draft response to submissions for review by OEPA	November 2012
EPA publishes assessment report	February 2013
Project approval (by Minister)	May 2013

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11 Study Team and Peer Review

Preparation of the ERMP and supporting documentation will be undertaken by ENVIRON Australia Pty Ltd on behalf of Cameco Australia Pty Ltd.

Specialist studies will be undertaken by the following consultants:

- Bennett Environmental Consulting (Flora and Vegetation);
- Bamford Consulting Ecologists (Terrestrial Fauna);
- Bennelongia (Subterranean Fauna);
- MWH (Surface Water and Ground Water Investigations);
- MWH (Seepage Investigations);
- KBR (Radiation Assessments);
- ENVIRON (Meteorology and Ambient Dust Study, Greenhouse Gas Assessment);
- Graeme Campbell & Associates (Geochemical Characterisation);
- Anthropos (Ethnographic and Archaeological Studies);
- Coakes Consulting (Social Impact Assessment); and
- ANSTO (Transport Risk Study).

Collected data, modelling and technical assessments will be reviewed by the technical specialists within the relevant regulator bodies and other organisations during the preparation of the ERMP. In addition the overall ERMP will be peer reviewed prior to release for public review.

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13 Glossary

Abbreviations and Acronyms

Acid and Metalliferous Drainage.....AMD
As Low As Reasonably Achievable.....ALARA
Australian and New Zealand Environment Conservation Council.....ANZECC
Australian and New Zealand Minerals and Energy Council.....ANZMEC
Agriculture and Resource Management Council of Australia and New Zealand.....ARMCANZ
Australian and Torres Strait Islander Commission.....ATSIC
Australian Height Datum.....AHD
Australian Heritage Council Act.....AHC
Australian Nuclear Science and Technology Organisation.....ANSTO
Australian Radiation Protection And Nuclear Safety Agency.....ARPANSA
Australian Safeguards and Non-proliferation Office.....ASNO
Average Recurrence Interval.....ARI
Beta Attenuation Meter.....BAM
Below ground level.....bgl
Below ground surface.....bgs
Below Ore-Grade Uranium Material.....BOGUM
Cameco Australia Pty Ltd..... .....Cameco
China-Australia Migratory Bird Agreement.....CAMBA
Commonwealth Department of Sustainability, Environment, Water, Populations and Communities.....DSEWPC
Convention on Migratory Species.....CMS
Department of Agriculture and Food.....DAF
Department of Environment and Conservation.....DEC
Department of Health.....DoH
Department of Indigenous Affairs.....DIA
Department of Resources, Energy and Tourism.....DRET
Department of Mines and Petroleum.....DMP
Department of Planning and Infrastructure.....DPI
Department of Water.....DoW
Derived Consideration Reference Levels.....DCRL
Environmental Impact Statement.....EIS
Environmental Scoping Document.....ESD
Environmental Management Program.....EMP
Environmental Protection and Biodiversity Conservation (Act).....EPBC Act
Environmental Radon Detection Monitor.....ERDM
Environmental Review and Management Program.....ERMP
Environmental Risks from Ionising Contaminants Assessment.....ERICA

Fly In Fly Out.....FIFO
Groundwater Dependent Ecosystem.....GDE
High Density Polyethylene.....HDPE
Highly Enriched Uranium.....HEU
Interim Biogeographical Regionalisation for Australia.....IBRA
International Atomic Energy Agency.....IAEA
International Commission on Radiological Protection.....ICRP
International Labour Organisation.....ILO
Japan-Australia Migratory Bird Agreement.....JAMBA
Kanyirninpa Jukurra.....KJ
Kintyre Advancement Programme.....KAP
Leak Control and Recovery System.....LCRS
Little Sandy Desert (Rudall Region).....LSD1
MWH Global.....MWH
National Directory for Radiation Protection.....NDRP
National Environment Protection Council.....NEPC
National Environmental Protection Measure.....NEPM
National Health and Medical Research Council.....NHMRC
National Occupational Health and Safety Commission.....NHMRC
Naturally-Occurring Radioactive Material.....NORM
New South Wales Department of Environment and Climate Change.....NSW DECC
Non-Acid Forming.....NAF
Non-Proliferation Treaty (Nuclear).....NPT
Office of the Environmental Protection Authority.....OEPA
Organisation for Economic Co-operation and Development.....OECD
Pre-Feasibility Study.....PFS
Potentially Acid Forming.....PAF
Radiation Management Plan.....RMP
Radiation Protection Series.....RPS
Radioactive Waste Management Plan.....RWMP
Regulation for the Safe Transport of Radioactive Material (2005).....TS-R-1
Relative Biological Effectiveness.....RBE
Republic of Korea Migratory Bird Agreement.....ROKAMBA
Run-Of-Mine.....ROM
Safe Transport of Radioactive Materials.....STRM
Safety Health Environment and Quality (Policy).....SHEQ
Short Range Endemic.....SRE
Social Impact Assessment.....SIA
South Australia.....SA
Tailings Storage Facility.....TSF
Thermo-Luminescent Dosimeters.....TLD

United Nations Environment Programme.....UNEP
United States.....US
Uranium Oxide Concentrate.....UOC
Western Australia.....WA
Western Australian Environmental Protection Act.....WA EP Act
Western Australian Environmental Protection Authority.....WA EPA
Western Desert Lands Aboriginal Corporation.....WDLAC
Wildlife Conservation Act.....WCA
World Health Organisation.....WHO

Units of Measurement and Formulae

Annum (year).....a
Becquerel per gram.....Bq/g
Becquerel per filter.....Bq/filter
Bicarbonate.....HCO_3
Calcium.....Ca
Carbon Dioxide.....CO_2
Carbon Trioxide.....CO_3
Chlorine.....Cl
Cubic metres per Tonne.....m^3/t
Degrees Celsius.....°C
Dollar (American) .....US$
Foot.....ft
Gram.....g
Grams per square meter per month.....$g/m^2/month$
Greater than.....>
Hectare (10,000 m^2) .....ha
Hour.....h
Kilo (thousand).....k
Kilogram.....kg
Kilometre.....km
Kilometres per hour.....km/h
Litre.....L
Magnesium.....Mg
Metre.....m
Metres per second.....m/s
Mega Watt.....MW
Mega Litre.....ML
Mega tonnes per annum.....Mt/pa
Metric ton (tonne) .....t

Kilo tonne.....kT
Microns.....µm
Milligrams per Litre.....mg/L
microSieverts per hour.....µSv/hr
MilliGray.....mGy
Millilitre.....mL
Millimetre.....mm
Million/Mega.....M
Million per year.....M/a
Million tonnes.....Mt
Million tonnes per year.....Mt/a
milliSiemen per centimetre.....mS/cm
Millisievert.....mSv
Millisievert per annum.....mSv/a
Minute (time) .....min
Particulate Matter with diameter less than 10 µm.....PM_{10}
Per annum...../a
Per Day.....day
Per Pound.....lb
Per Tonne.....t
Percent.....%
Plus or minus.....+/-
Potential of Hydrogen.....pH
Quality Factor.....Q
Radiation Weighting Factor.....wF
Radon.....Ra
Second (time) .....s
Sodium.....Na
Square kilometre.....km^2
Square metre.....m^2
Sulphate.....SO_4
Thousand tonnes (or kilotonnes).....kt
Thorium.....Th
Tonne (1,000 kg) .....t
Tonnes per cubic metres.....t/m^3
Tonnes per day.....t/d
Tonnes per hour.....t/h
Tonnes per year.....t/a
Total Dissolved Solids.....TDS
Total Suspended Solids.....TSS
Total Suspended Particulate.....TSP

Uranium.....U
Uranium Oxide.....U_3O_8
Uranium Oxides..... UOX
Year (annum) .....a

Definitions

Alpha (α): The ionising radiation resulting from the decay of radioisotopes, where an alpha particle is emitted. For example, when Uranium-238 decays into Thorium-234, an alpha particle is produced in the form of alpha radiation.

Becquerel (Bq): The Becquerel is the International System (SI) derived unit to measure radioactivity. One Becquerel is the activity of a quantity of radioactive material in which one nucleus decays per second.

Benign waste rock: Non-acid producing, non-radioactive rock that must be removed in order to mine an orebody.

Beta Attenuation Meter (BAM): An instrument that measures ambient particulate matter (PM) concentrations on a continuous basis.

Controlled Action: An action that is likely to have a significant impact on a Matter of National Environmental Significance, as determined by the Federal Minister for the Environment under the EPBC Act 1999.

Dosimetry: The determination of the amount of radiation to which an animal or person has been exposed during a given period.

Gamma (γ): Also known as gamma rays (γ), is electromagnetic radiation of high frequency (very short wavelength). These are produced by sub-atomic particle interactions such as electron-positron annihilation, neutral pion decay, or radioactive decay.

Heap Leaching: The separation or dissolving of soluble ore from mined rock by percolating a prepared chemical solution through the mounded (heaped) rock material. The mounded material usually contains low grade mineralised material produced from mining operations.

MilliGray (or mGy): A unit of absorbed radiation equal to 0.001 gray where a gray is the dose of one joule of energy absorbed per kilogram of matter, or 100 rad. Because the gray is a relatively large unit, many radiation measurements are quite often expressed in milligrays.

Pregnant Liquor: Process liquor that contains the dissolved ore.

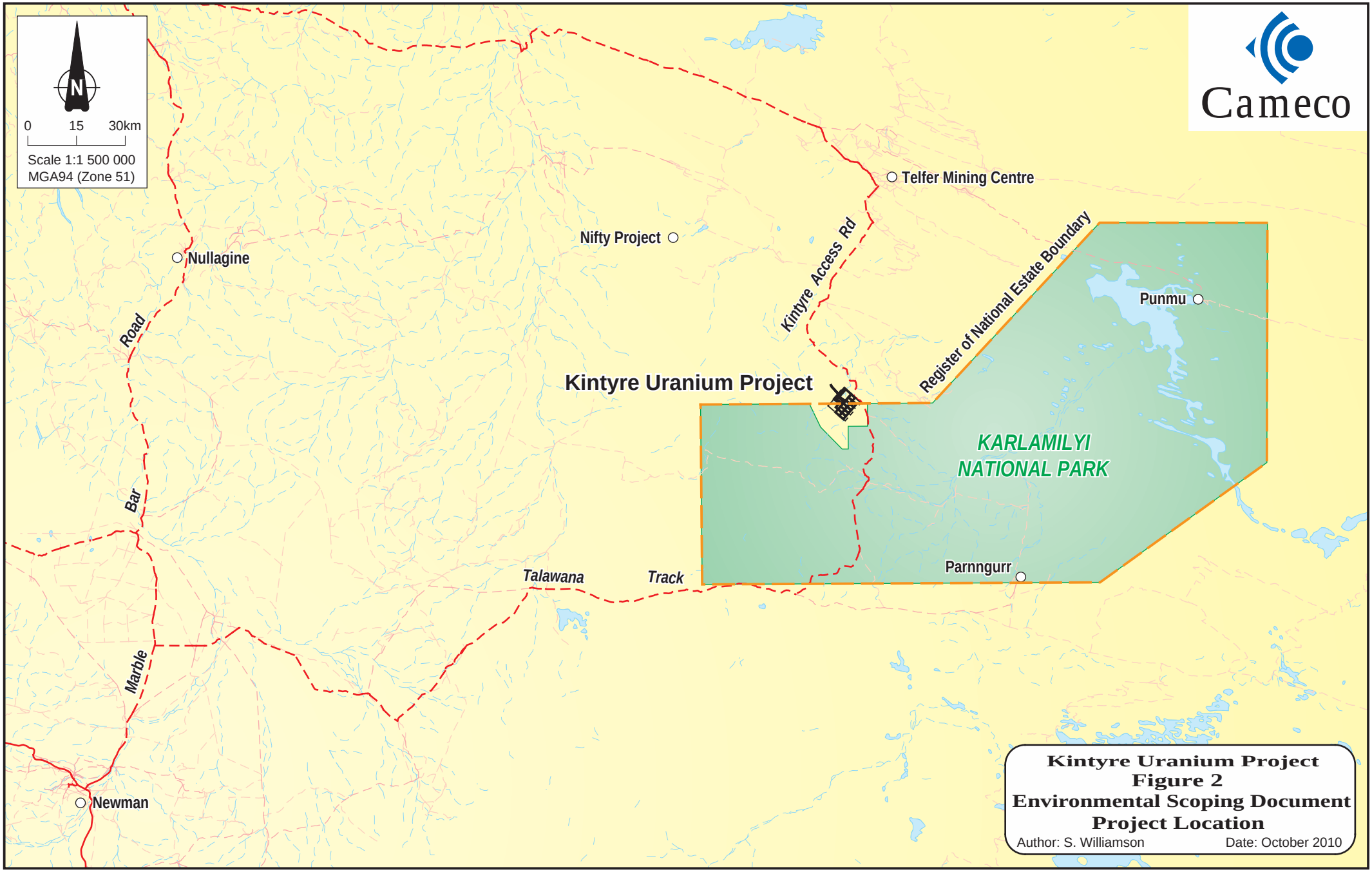
Radiation Weighting Factor (wF): A factor used to correct for differences in the biological damage to tissue caused by chronic exposure to different radiations.

Radionuclide: An atom with an unstable nucleus. This is a nucleus characterised by excess energy which is available to be imparted either to a newly-created radiation particle within the nucleus, or else to an atomic electron. The radionuclide, in this process, undergoes radioactive decay, and emits a gamma ray(s) and/or subatomic particles.

Figures

Author: S. Williamson ~ Drawn: CAD Resources ~ Tel 9246 3242 ~ URL www.cadresources.com.au ~ Date Oct 2010 ~ A4 ~ CAD Ref g1826_Env_ESD_2010_001.dgn

Author: S. Williamson ~ Drawn: CAD Resources ~ Tel 9246 3242 ~ URL www.cadresources.com.au ~ Date July 2010 ~ A4 ~ CAD Ref g1826_Env_ESD_2010_002.dgn



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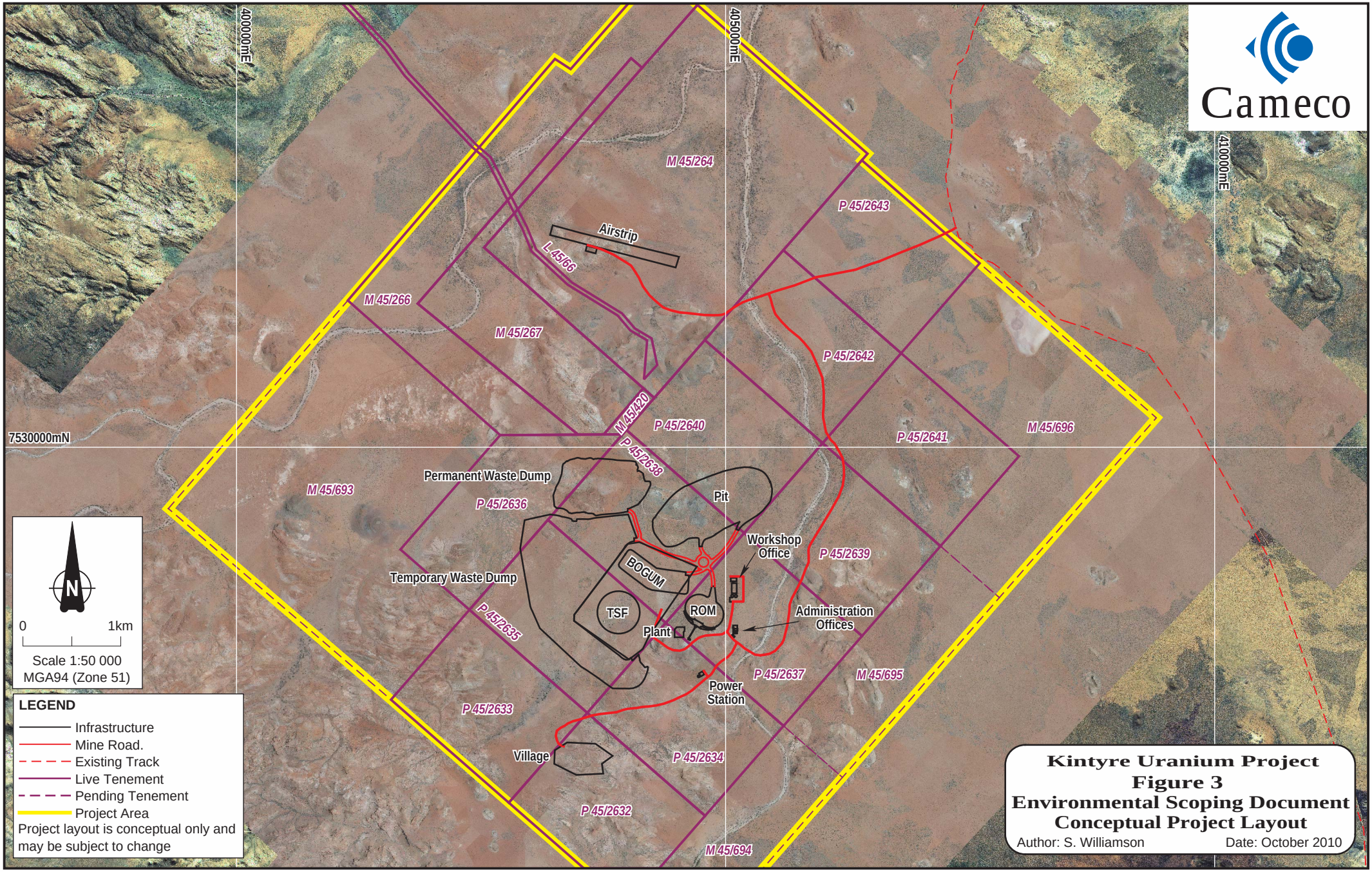

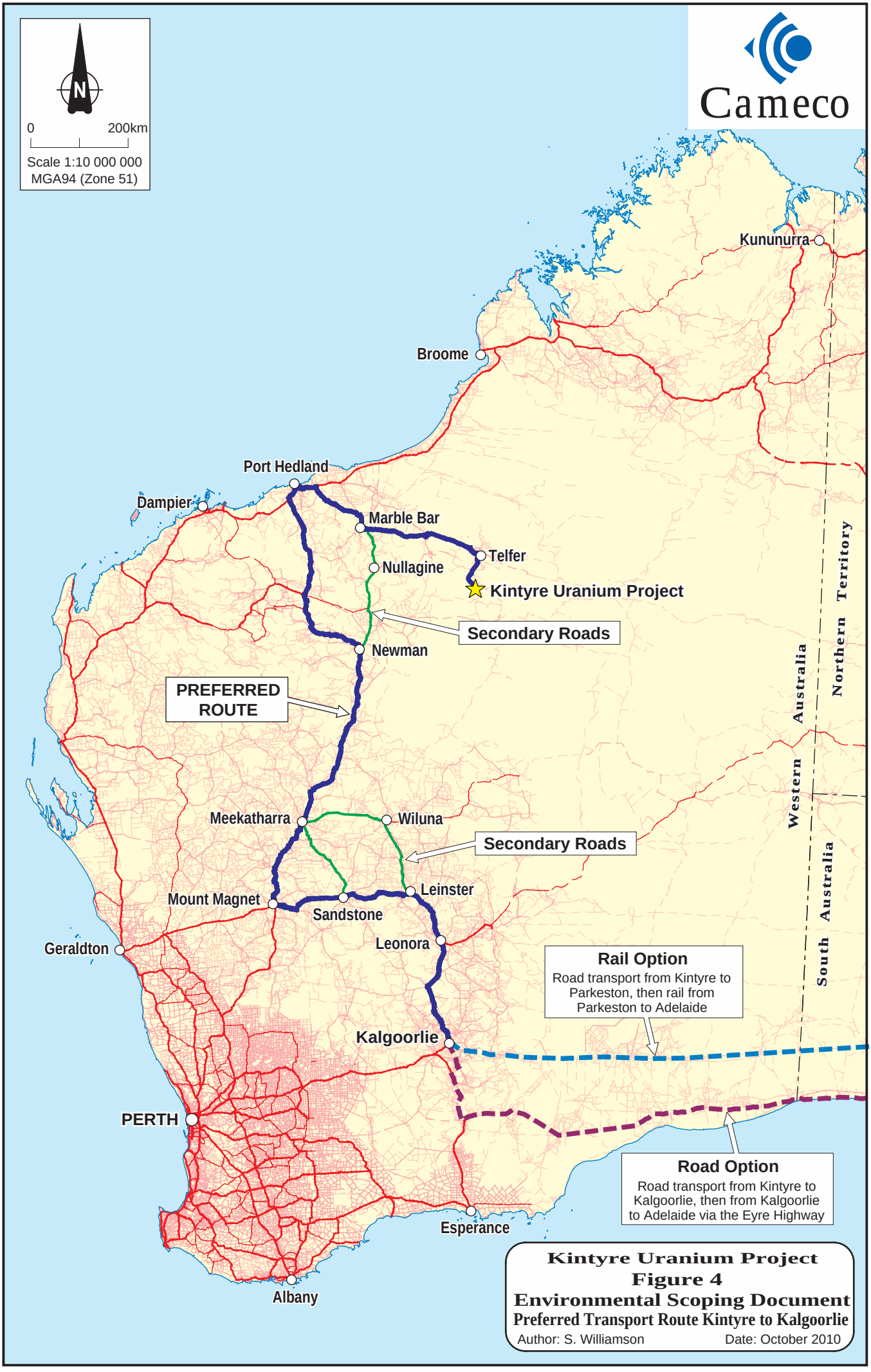

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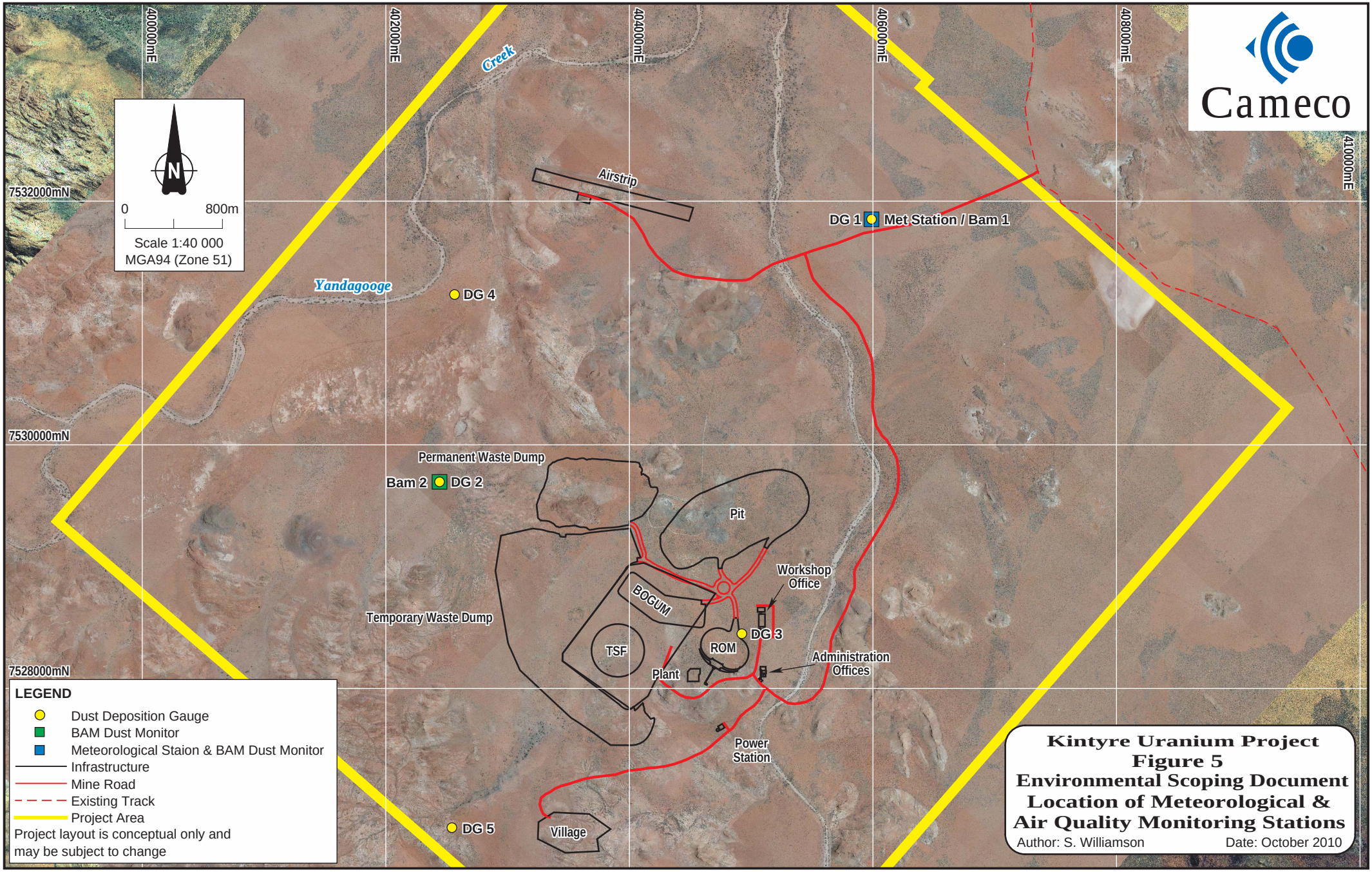

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Kintyre Uranium Project
Figure 5
Environmental Scoping Document
Location of Meteorological & Air Quality Monitoring Stations

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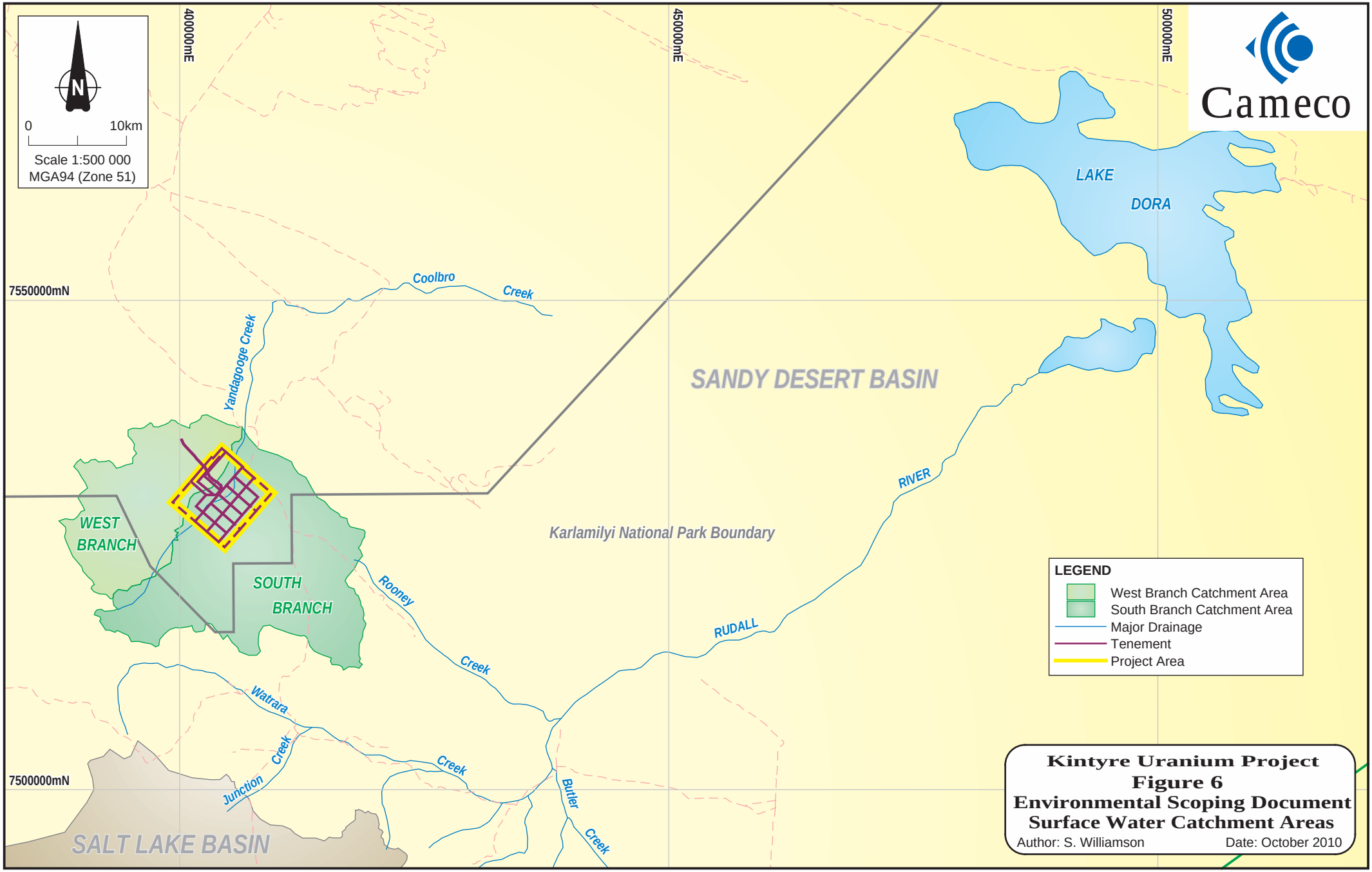

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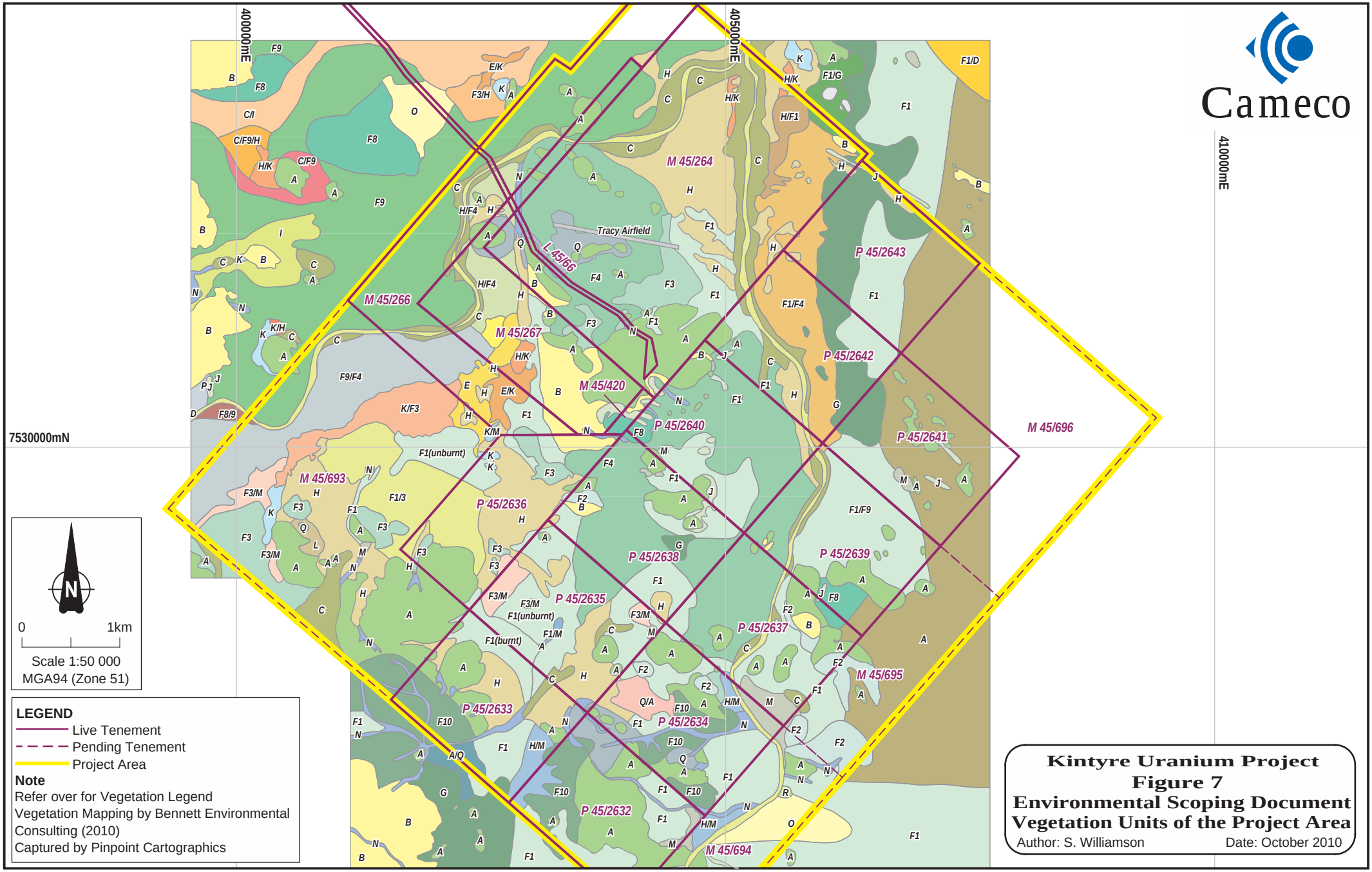

Cameco

VEG TYPE	DESCRIPTION 1	DESCRIPTION 2
C	Woodlands	Woodland of *Eucalyptus centralis*
D	Woodlands	Woodland of *Eucalyptus obtusa* 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	Cassias 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

Vegetation Mapping by Bennett Environmental Consulting (2010)
Vegetation Mapping Captured by Pinpoint Cartographics

Kintyre Uranium Project
Figure 7
Environmental Scoping Document
Legend
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Appendix A

Radiation Assessment Scope

Domain	Area of influence	Objectives	Potential impact	Investigations required	Management initiatives
Pre-operational phase, including resource evaluation					
Air quality	Project area	Establish baseline concentration of radon		At least one year of track-etch measurements.	
		Establish baseline concentration of radon decay products		Continuous radon decay monitors up-wind and down-wind	
		Establish baseline concentration of long-lived, alpha-emitting radionuclides		Medium-volume air samplers and alpha counting	
Water quality	Surface waters in local creeks	Establish baseline concentration of radionuclides		Opportunistic sampling of creeks if they flow Alpha/beta screening Selected radionuclides if indicated by screening	
	Groundwater	Establish baseline concentration of radionuclides		Groundwater sampling of wells Alpha/beta screening Selected radionuclides if indicated by screening	
Soils	Project area	Establish baseline concentration of radionuclides		Collect soils samples up to 40 cm deep at locations in different soil types Analyse samples for selected radionuclides	
Radon emanation	Project area	Establish radon emanation rates for natural surfaces		Radon emanometer studies on representative substrates	

Domain	Area of influence	Objectives	Potential impact	Investigations required	Management initiatives
Gamma	Project area	Establish baseline surface gamma dose rate		Place TLDs at selected locations to provide long-term average surface gamma dose rate	
	Project and surrounding areas	Establish baseline surface gamma dose rate		Calibrate aerial radiometric survey and convert to surface gamma dose rate Plot aerial radiometric survey in units of dose rate	
Biota	Project area	Establish ecological relationships		Flora/fauna surveys Estimate potential source terms Pathway analysis (including atmospheric dispersion) Selection of suitable reference animals and plants ERICA investigation of potential radiation exposure rate to selected reference animals or plants	
Evaluation workforce	Drilling and core areas	Estimate exposures	Radiation exposure of persons directly involved with resource evaluation	Suitable monitoring programme for gamma, radon decay products and long-lived alpha-emitting radionuclides in dust	Provide suitable monitoring and measurement equipment Provide suitably qualified and experienced radiation safety staff Provide suitable radiation induction and training Assess radiation exposures and document in a report

Domain	Area of influence	Objectives	Potential impact	Investigations required	Management initiatives
Operational workforce	Project	Estimate potential exposure of workforce during operations		Calculate potential exposures to gamma radiation and inhalation or ingestion of radionuclides arising from working at Kintyre	
Hypothetical Critical Group	Hypothetical Critical Group location	Estimate annual average exposure of individuals in the Hypothetical Critical Group		Estimate potential source terms Pathway analysis (including atmospheric dispersion) Selection of suitable reference characteristics (lifestyle) of members of the Hypothetical Critical Group Estimate potential annual exposures	
During Design and Operations Phases					
Workforce	Mine, processing plant and waste management areas	To minimise all exposures in accordance with the ALARA principle through design	Design of plant, mining method and equipment and waste management facilities	Radionuclide balance in feed, process and waste streams Examination of engineering alternatives and their differential ability to reduce exposure	Undertake radionuclide balance when process is chosen and materials become available Conduct design workshops to integrate radiation risk into alternatives considered

Domain	Area of influence	Objectives	Potential impact	Investigations required	Management initiatives
		To keep all annual doses to less than the relevant limit through design	Excess risk of cancer. Breach of statutory obligations	Exposure model of mine, process areas and waste management areas to determine likely exposure rates	Document potential exposures and annual doses. Incorporate results into induction and training materials Place physical barriers around areas of high potential exposure rate and allocate workers to either a Supervisory or Controlled status
		Eliminate causes of accidents and incidents through design	Exposure to excess radiation	Risk study to identify processes or actions likely to lead to excess exposure	Conduct risk workshop to identify weaknesses in design or operating practices Re-engineer or modify procedures to reduce accident frequency and/or consequences
		Estimate annual radiation doses	Monitoring and laboratory equipment and methods	Appropriate monitoring programmes and record-keeping systems	Select and purchase appropriate monitoring and laboratory equipment
		Record annual dose assessments	Record management system		Design a record and document management system
People in the immediate vicinity	Within 10 km of perimeter of mine/processing area	To minimise potential exposures to members of the public and non-human species through design	Design of emission control systems and waste containments	Pathway analysis and estimation of exposures to Hypothetical Critical Group	Conduct a design workshop to identify potential emission sources and processes Re-engineer emission control systems if Hypothetical Critical Group annual dose exceeds 0.2 mSv.

Domain	Area of influence	Objectives	Potential impact	Investigations required	Management initiatives
Non-human species in the immediate vicinity	Within 10 km perimeter of the mine/processing area	To minimise emissions to the environment through design	Design of emission control systems and waste containments	Ecological survey to inform selection of appropriate reference animals or plants Use ERICA model to determine potential exposure of non-human species	Write standard operating procedures to ensure emission control systems are maintained and are effective
Surface waters	Local creek systems	To prevent radionuclides from mining, processing and waste management activities reaching surface water courses through design	Pollution of surface waters	Surface hydrology and hydraulics. Terrain model. Long-term rainfall records Construct hydrology/hydraulic model. Determine appropriate ARI Use model in design of diversion and containment structures	Design appropriate monitoring and reporting protocols
Groundwaters	Aquifers potentially affected by mining, processing and waste containments	To limit the contamination of beneficial-use groundwaters with radionuclides through design	Reduced water quality	Groundwater and aquifer flow model Design and construction of appropriate seepage retardants	Design appropriate monitoring and reporting protocols
Tailings storage facility	Immediate vicinity of tailings storage facility	Limit fugitive dust and radon from surface	Increased airborne radionuclide concentrations	Tailings deposition method and TSF design Water balance	Develop standard operating procedures to control dust and radon emanation
Waste rock	Immediate vicinity of waste rock piles	Limit fugitive dust from surface	Increased airborne radionuclide concentrations	Rock deposition method Source estimation of fugitive dust	Investigate progressive rehabilitation Dust control and monitoring
BOGUM	Immediate vicinity of BOGUM stockpile	Limit fugitive dust from surface	Increased airborne radionuclide concentrations	BOGUM deposition method Source estimation of fugitive dust	Dust control and monitoring

Domain	Area of influence	Objectives	Potential impact	Investigations required	Management initiatives
Plant and equipment	Static and mobile plant used in mine, processing and waste management areas	Prevent contaminated plant and equipment leaving site	Spread of radioactive material off-site	Surface contamination levels of equipment leaving site	Establish a clearance protocol and clearance certificates Maintain records of plant and equipment
Product transport	Transport corridor(s)	Prevent uranium product spilling from shipping containers	Increased exposure to members of the public and clean-up crews	Traffic analysis along transport corridors Suitability of roads and any transfer locations along transport corridor(s)	Use only licensed logistics companies Establish communications with trucks and/or rail operators Develop response protocols Train clean-up crews Establish working relationships with emergency services Maintain engagement with communities along transport corridors
Equipment producing ionising radiation	Laboratory XRF/XRD Thickness/density gauges	Prevent accidental exposure	Increased exposure to operators of equipment and maintenance personnel	Manufacturer's manuals	Establish operating and maintenance protocols Train operators and maintenance personnel Maintain appropriate licences and registrations Establish periodic inspection regime
Samples sent off site	Samples sent to external laboratories for testing	Prevent loss of sample materials	Spread of contaminated materials off-site	Procurement policies and protocols with registered laboratories	Establish chain-of-custody record-keeping system Return all used samples to site and dispose of appropriately

Domain	Area of influence	Objectives	Potential impact	Investigations required	Management initiatives
Planning for closure phase					
Tailings storage facility	Immediate vicinity of tailings storage facility	Limit radon emanation through design	Increase in atmospheric concentration of radon decay products	Radon emanation rate from tailings surface Cover design Availability of suitable cover materials ALARA investigation to inform optimum cover design	Early consideration of closure options to ensure options are not closed off Management plan for care and maintenance or sudden closure scenarios Periodic re-assessment of rehabilitation options Periodic recalculation of closure costs
		Limit infiltration of water into tailings storage facility through design	Hydraulic head driving seepage	Cover design Availability of suitable cover materials ALARA investigation to inform optimum cover design Seepage retardant options (preparation of base of tailings storage facility prior to use)	Early consideration of closure options to ensure options are not closed off Periodic re-assessment of rehabilitation options Periodic recalculation of closure costs
		Long-term stability of tailings storage facility through design	Erosion of protective cover	Tailings deposition method options Design of above-ground tailings storage facility	Early consideration of closure options to ensure options are not closed off Periodic re-assessment of rehabilitation options Periodic recalculation of closure costs
Waste rock	Immediate vicinity of waste rock piles	Limit erosion through design	Increase in atmospheric concentration of radionuclides	Waste rock classification	Encapsulate waste rock with higher radionuclide concentration with rock having lower radionuclide concentration

Domain	Area of influence	Objectives	Potential impact	Investigations required	Management initiatives
	Surface of waste rock piles	Limit emanation of radon	Increase in atmospheric radon concentration	Radon emanation rate from waste rock surfaces	Early consideration of the need or otherwise to cover waste rock with material of low radium content
Plant site	Plant and process ponds	Return areas to baseline surface gamma dose-rate	Increased annual gamma exposure rate	Establish baseline surface gamma exposure rate	Survey cleaned up areas for surface gamma exposure rate Remove and bury materials contributing to excess surface gamma dose rate
Plant and equipment	Mobile and static plant and equipment used in process areas	Prevent contaminated plant or equipment leaving site	Spread of contamination off site	Surface contamination of plant or equipment leaving site	De-contaminate any salvageable plant and equipment prior to clearance Bury any plant and equipment that is not salvageable if acceptable under other closure or environmental considerations