Northern Territory Government

DEPARTMENT OF
NATURAL RESOURCES, ENVIRONMENT, THE ARTS AND SPORT

Guidelines for Preparation of an Environmental Impact Statement

RANGER URANIUM MINE -
- HEAP LEACH FACILITY

- Energy Resources of Australia Ltd -

September 2009

TABLE OF CONTENTS

GLOSSARY

As	Arsenic
ANZECC	Australian and New Zealand Environment Conservation Council
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
BoM	Bureau of Meteorology
Bonn Convention	Convention on the Conservation of Migratory Species of Wild Animals, signed in 1979 in Bonn, Germany and entered into force in 1983.
BPT	Best Practicable Technology (see *Appendix A*)
CAMBA	China-Australia Migratory Bird Agreement. Signed Canberra 1986, entered into force in 1988.
Cd	Cadmium
CF_x	Perfluorocarbons

CH_4	Methane
CO_2	Carbon dioxide
CO_2-e	carbon dioxide equivalent
CPRS	Carbon Pollution Reduction Scheme
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australian Government)
Cth	Commonwealth (Australian Government)
DRDPIFR	Northern Territory Department of Regional Development, Primary Industry, Fisheries and Resources
EA Act	Northern Territory *Environmental Assessment Act* (1982).
EHA	Environment, Heritage and the Arts (Division)
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ERA	Energy Resources of Australia Ltd
Facility	The Heap Leach Facility
GWP	Global Warming Potential
Heap Leach Pad	Lined base of the area where the ore (to be leached) will be stacked
Heap Leach Facility	Refers to the sum of Facility components, including the Ore Stack, the (underlying) Heap Leach Pad, Residue Storage Facility, Water Pond, Leachate Pond, Uranium-Enriched Liquor Ponds, any Processing Plant, Roads, Pipelines, Accommodation and/or other Infrastructure dedicated principally to the Heap Leach Facility. Unless specified, such reference does not include the use of Pit #3 as a tailings storage facility (see Section 1-Introduction)
HFCs	Hydrofluorocarbons
IUCN	International Union for Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement. Signed Tokyo 1974, entered into force in 1981.
Kakadu	Kakadu National Park
LLAA	Long Lived Alpha Activity
mSv/yr.	millisieverts (one thousandth of a sievert) per year. Units of radiation dose.
N_2O	Nitrous oxide
NOI	Notice of Intent
Notice of Intent	Initial proposal document submitted for assessment under the *EA Act.*
NRETAS	Department of Natural Resources, Environment the Arts and Sport
NT	Northern Territory
NTL	Northern Territory Library
Pb	Lead
Radon	Radioactive gas produced from uranium decay
Ramsar wetland	Listed Wetland of International Importance, under the Convention on Wetlands (signed in Ramsar, Iran,1971)

ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SF_6	Sulphur hexafluoride
U	Uranium
U_3O_8	Uranium Oxide
UNFCCC	United Nations Framework Convention on Climate Change

1. INTRODUCTION

Energy Resources of Australia Ltd (ERA) proposes to construct and operate a Heap Leach Facility at Ranger Uranium Mine, to recover uranium oxide (U_3O_8) from low grade mineralised material present both in situ and on existing stockpiles. The process uses sulfuric acid dripped onto ~5m high piles, which are built and removed on a regular cycle. The Facility requires construction of a second residue / tailings storage dam to store heap leach residues, store and evaporate process water, and to receive tailings from existing operations. The leach solutions would be treated in a process similar to that used in the existing Ranger processing plant. Annual output of uranium oxide from the Ranger Mine is limited under licence, and is not intended to increase with addition of the proposed Heap Leach Facility. The new Facility would require a workforce increase of ~650 personnel during the construction phase, and ~140 during the operation phase.

The Ranger Project Area and adjacent Jabiluka Mineral Lease are surrounded by the World Heritage and National Heritage listed, Kakadu National Park (Kakadu) and are upstream of the Ramsar listed[1] wetlands of the Magela Creek floodplain. The Ranger Project Area is on Aboriginal land as defined under the *Aboriginal Land Rights (Northern Territory) Act 1976* and forms part of the Kakadu Land Trust granted under this Act. The Mirarr people are the traditional owners and maintain cultural connection with the land.

The Heap Leach Facility with associated residue/tailings storage dam would cover ~170 hectares (1.7 km^2) of the existing Ranger Project Area, which spans 78.6 km^2. Current Ranger Mine operations cover ~23km^2 of the Ranger Project Area. The Ranger mine is ~250km east of Darwin and 11km east of Jabiru, in the Alligator Rivers Region.

The proposal for a Heap Leach Facility was referred to the Australian Government on 16 March 2009 under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). On 15 April 2009 the proposal was determined to be a controlled action, and therefore it requires assessment and approval under the EPBC Act before it can proceed. The controlling provisions for the Facility are: listed threatened species and ecological communities, listed migratory species, World Heritage, National Heritage, Ramsar wetlands, Commonwealth land and nuclear action. The proposal is being assessed under the bilateral agreement by the Northern Territory on behalf of the Commonwealth. Preparation of an Environmental Impact Statement (EIS) under the NT *Environmental Assessment Act (1982)* (EA Act) will satisfy assessment requirements under the EPBC Act .

Identical documentation to the EPBC Act referral was concurrently submitted as a Notice of Intent[2] (NOI) to the Northern Territory (NT) Department of Regional Development, Primary Industry, Fisheries and Resources (DRDPIFR). On 30 March 2009 DRDPIFR referred the proposal to the Department of Natural

[1] Listed Wetland of International Importance, under the Convention on Wetlands (signed in Ramsar, Iran,1971)

[2] Energy Resources of Australia Ltd (2009)

Resources, Environment the Arts and Sport (NRETAS) for assessment under the EA Act.

The NT Minister for Natural Resources, Environment and Heritage determined that the Heap Leach Facility proposal requires formal assessment under the EA Act, at the level of an EIS. Issues of concern contributing to this decision included:

- Uncertainties with regard to containment capacity on the mine of contaminated (process) water during high rainfall events. Construction of the Heap Leach Facility and associated residue/tailings storage dam (~170ha) will approximately double the process water catchment for the site;
- Suitability of the location with respect to the surrounding environment;
- The proposed time line with respect to tailings management;
- Risks to groundwater and surface water resources, from contaminated seepage from the Facility components;
- Radiation risks may have the potential to extend offsite from the mine; and
- Risks to Matters of National Environmental Significance;

A detailed description of the proposed Heap Leach Facility can be found within the Notice of Intent[2] on the NRETAS website at:
http://www.nt.gov.au/nreta/environment/assessment/register/index.html

These Guidelines have been developed to assist ERA in preparing an EIS for the Heap Leach Facility, in accordance with Clause 8 of the NT *Environmental Assessment Administrative Procedures (1984)* of the EA Act.

The scope of the assessment is limited to the proposed Heap Leach Facility and any parts of the environment potentially impacted by the construction, operations, and remediation of the Facility. Reference to the Heap Leach Facility in this document is a reference to the proposed low-grade ore stack and Heap Leach Pad, Residue Storage Facility, Water Pond, Leachate Pond, Uranium-Enriched Liquor Ponds, and any Processing Plant, Roads, Pipelines and/or other Infrastructure dedicated principally to the Heap Leach Facility. The future use of Pit #3 as a tailings storage facility is subject to an existing authorisation, so is not considered in these Guidelines as a component of the Heap Leach Facility, except in terms of changes to proposed management of tailings deposition that may result from the addition of Heap Leach Residues to the tailings.

2. GENERAL ADVICE ON THE EIS

2.1 GENERAL CONTENT

The EIS should be a stand-alone document. It should contain sufficient information to avoid the need to search out previous or supplementary reports and able to be reproduced in part or whole, on request from interested parties.

The EIS should demonstrate that ERA has identified all risks associated with the issues raised, undertaken comprehensive assessment of those risks (including quantification where practicable) and identified effective controls for significant risks. Residual risks should also be identified. All aspects of the risk assessment

should be accompanied by statements about levels of uncertainty. Steps to reduce uncertainty or precautions taken to compensate for uncertainty should also be identified and their effect demonstrated.

The EIS should enable interested members of the public, the NT Minister, and the Federal Minister for the Environment to understand the environmental consequences of the Facility. Information provided in the EIS should be objective, clear and succinct and, where appropriate, be supported by maps, plans, diagrams or other descriptive detail. The body of the EIS is to be written in a clear and concise style that is easily understood by the general reader. Technical jargon should be avoided wherever possible. Cross-referencing should be used to avoid unnecessary duplication of text.

Detailed technical information, studies or investigations necessary to support the main text should be included as appendices to the EIS.

ERA will be expected to demonstrate the implementation of industry Best Practicable Technology[3] in design of the Facility, project planning, environmental risk assessment, and in all future aspects of the life of the Facility.

To reduce potential for negative impacts from a proposal, the environmental assessment process aims to facilitate the defining of:

1. Best Practice or Best Practicable Technology[3], for each of the elements of the proposal;
2. Environmental Values. To identify the values important to stakeholders, preferably at an early stage in the process. Proponents should be seeking this information beginning from early public consultations, and then identify risks to those values;
3. The degree of degradation / loss of those environmental values that would be acceptable to Stakeholders; and
4. Risks from the proposed development to the identified values.

The assessment process aims to provide a mechanism for ERA and the Government to gain a clear understanding of the potential extent of such impacts, and to examine the likely effectiveness of preventative measures proposed. This understanding creates an opportunity to reduce negative impacts by adoption of more effective up-front engineering and/or management mechanisms.

ERA is expected to work with close regard for community expectations and concerns and to respect that the community may perceive the level of risk for this proposal differently to the proponent. In the interest of achieving a balanced risk assessment, it is expected that ERA will place a high priority on communicating with the local and wider community.

2.2 FORMAT AND STYLE

The EIS should comprise three elements, namely:

- The Executive Summary;

[3] Best Practicable Technology is defined in section 12.4 of the *Environmental Requirements of the Commonwealth of Australia for the Operation of Ranger Uranium Mine* attached in Appendix A.

- The main text of the document; and
- Appendices - containing detailed technical information and other information that can be made publicly available.

The structure of these Guidelines may be adopted as the format for the EIS. This format need not be followed if the required information can be presented alternatively for better effect. However, each of the elements in these Guidelines must be addressed to meet the requirements of NT Government regulatory requirements.

The Executive Summary should include a brief outline of the Facility and each chapter of the EIS, allowing the reader to obtain a clear understanding of the proposed Facility, its environmental implications and management objectives. The Executive Summary should be written as a stand alone document, able to be reproduced by interested parties who may not wish to read or purchase the EIS as a whole. The main text of the EIS should include contact details for ERA; a Glossary to define technical terms, acronyms, abbreviations and colloquialisms; and a Reference list.

The appendices should include:

- A copy of these Guidelines;
- A list of persons and agencies consulted during the EIS;
- Names of, and work done by, the persons involved in preparing the EIS; and
- Qualifications and expertise of the people involved in work contributing to the EIS.

The EIS should be written so that any conclusions reached can be independently assessed. To this end, all sources must be appropriately referenced using the Harvard Standard. The reference list should include the address of any Internet "web" pages used as data sources.

The EIS should be produced on A4 size paper capable of being photocopied, with any maps and diagrams on A4 or A3 size and in colour where possible.

ERA should consider the format and style of the document appropriate for publication on the Internet. The capacity of the website to store data and display the material may have some bearing on how the document is constructed.

2.3 ADMINISTRATION

Approximately 20[4] bound copies of the EIS should be lodged with the Minister, care of the Environment, Heritage and the Arts (EHA) Division of NRETAS for distribution to NT Government and Commonwealth advisory bodies.

The EIS should be provided on CD/DVD in ADOBE *.pdf format for placement on the NRETAS internet site (Chapters and Appendices separate. Optimal file size, for example for chapters or images, is *less than* ~1.5Mb, where possible). This should be done at least 4 business days before newspaper publication. Additionally, two Microsoft Word copies should be provided to facilitate production of the Assessment Report and Recommendations.

[4] Exact number will be ascertained prior to printing.

At a minimum, ERA is to advertise the EIS for review and comment in the *NT News*, *The Australian, The West Arnhem Wire* and on the Kakadu Community Noticeboard: www.kakaducommunity.com.au/.

The EIS should be made available for public review at:

- Northern Territory Library (NTL), Parliament House, Darwin. (contact Diana Richards ph 97364)
- Darwin City Council Library (Casuarina) (casuarinalibrary@darwin.nt.gov.au; Ph: 8930 0200)
- Palmerston City Library, Goyder Square, Palmerston (Contact maeva.fournigault@palmerston.nt.gov.au, Ph 8935 9991)
- Jabiru Public Library (telephone: (08) 8979 9459 Email: library@westarnhem.nt.gov.au)
- Environment, Heritage and Arts Division (Dept. Natural Resources, Environment, the Arts and Sport), 2nd Floor, Darwin Plaza, 41 Smith Street Mall, Darwin.
- Minerals and Energy Information Centre, Dept. Primary Industry, Fisheries and Mines, 3rd Floor, Paspalis Centrepoint, 48 Smith Street Mall, Darwin.
- Department of the Environment, Water, Heritage and the Arts, John Gorton Building, King Edward Terrace, Parkes ACT;
- Supervising Scientist Division, Department of the Environment, Water, Heritage and the Arts, Pederson Road, Darwin Airport, Marrara, Northern Territory.
- Northern Land Council offices in Darwin [45 Mitchell St Darwin] and Jabiru [3 Government Building, Flinders Street, Jabiru NT 0886; Ph: (08) 8979 2410]
- Gagudju Association, Unit 1, 63 Winnellie Rd, Winnellie, NT 0820 Ph: (08) 89792375
- Gundjeihmi Aboriginal Corporation, PO Box 245, Jabiru, NT, Australia, 0886 Ph: (08) 8979 2200
- The Environment Centre, Unit 3, 98 Woods St Darwin.

In recognition of the need for wide ranging consultations with remotely located indigenous people who have traditional responsibilities over the wider Kakadu National Park, and in recognition of the potential of these consultations to be disrupted by other cultural activities, the EIS public exhibition period will span a period of at least 12 weeks.

To ensure optimal opportunity for public and Government scrutiny of the submitted EIS document, EIS exhibition should not occur in late December or January in any year. If EIS public exhibition overlaps any Christmas – January period, additional time will be added to the EIS exhibition period.

The Finalised EIS Guidelines are valid for a period of two years from date of issue to the Proponent.

The Project Officer is Michael Browne from the EHA Division of NRETAS. Contacts are: Ph (08) 8924 4028; Fax (08) 8924 4053; e-mail: michael.browne@nt.gov.au.

2.4 RISK ASSESSMENT

2.4.1 RISK ASSESSMENT APPROACH

This Environmental Impact Assessment should be undertaken with specific emphasis on identification, analysis and treatment of risks through a whole of project risk analysis. Through this process, the Assessment will:

- Acknowledge and discuss the full range of risks presented by proposed actions including those of special concern to the public;
- Quantify (where possible) and rank risks so that the reasons for proposed management responses are clear;
- Acknowledge levels of uncertainty about estimates of risk and the effectiveness of risk controls;
- Extend risk assessment to problems in realising benefits, leading to more realistic claims and community expectations; and
- Explicitly identify those members of the community expected to accept residual risks and their consequences, providing better understanding of equity issues.

Statements about levels of uncertainty should accompany all aspects of the risk assessment, although robust definition of risk levels should be pursued in the design phases. Steps taken to reduce uncertainty or precautions taken to compensate for uncertainty should be identified and their effect(s) demonstrated,

Information provided should permit the reader to understand the likelihood of the risk, its potential severity, and any uncertainty about the effectiveness of controls. If levels of uncertainty do not permit robust quantification of risk, then this should be clearly acknowledged.

Processes for risk management are formalised in Australian Standards. The process for risk assessment; described by Standards Australia / Standards New Zealand (e.g. AS/NZS 4360:2004; HB 436:2004; HB 158:2006) is outlined in the following steps:

1. Establish context

   To define the parameters within which risks must be managed and determine the scope of the risk management process.

2. Identify risk

   To produce a comprehensive list of sources of risks or events that might have an impact on the objectives identified in the context (step 1).

3. Analyse risk

   To develop a deeper understanding of the risk including:

   - Consequences and likelihood, expressed quantitatively or qualitatively;
   - Available methods or tools to control risk; and
   - Examination of uncertainties about risks and the potential influence of uncertainty on decision making.

4. Evaluate risk

To compare the level of risk with criteria established during the description of context and to make decisions about:

- Whether a risk needs treatment;
- Whether an activity should be undertaken at all; and
- Priorities for risk treatment.

5. Treat risk

   To reduce the risks of negative impacts by:

   - Identifying options for mitigating risk;
   - Assessing options in terms of benefit-cost; and
   - Preparing and implementing treatment plans.

6. Monitor and review
7. Communicate and consult

2.4.2 HAZARDS & RISKS TO HUMANS AND FACILITIES

The EIS should include an assessment of the risks to people, the environment and nearby facilities associated with the construction, operation and maintenance of the various components of the Facility, and the storage and transport of materials to and from the Facility. The aim of this assessment is to demonstrate that:

- ERA is fully aware of the risks to human health and safety associated with all aspects of the development;
- The prevention and mitigation of risks to human health and safety are properly addressed in the design specifications for the Facility; and
- The risks can and will be managed effectively during the construction, commissioning, operation, and decommissioning of the development.

Sufficient quantitative analysis should be provided to indicate whether risks are likely to be acceptable compared with similar ventures in Australia and Internationally. Assumptions used in the analyses should be explained. Relevant standards, codes and best practice methodologies that minimise risks should be discussed.

The EIS should draw from the experiences of similar industries nationally and internationally, citing examples where appropriate.

Detailed emergency plans, response procedures and training as they relate to the Heap Leach Facility should be developed as a contingency against the event of a hazardous emergency or accident. Responsibilities and liabilities in such an event should also be described. Appropriate procedures / plans related to the Heap Leach Facility should be presented in an Appendix to the EIS document.

The hazard and risk analysis will identify the critical areas that need to be addressed in management plans, monitoring programs, contingency and emergency plans.

3. DESCRIPTION OF THE FACILITY

The EIS should provide detail of the proposed location (including associated ancillary activity sites) and its surrounding environment to place the Facility in its local and regional context. The infrastructure design and engineering for all phases of construction, operation and management of the Facility should be detailed and relevant plans, photos and maps should be included. This information must also include details on how the works are to be undertaken (including stages of development) and design parameters for those structural aspects of the action that have impact potential.

The following headings should be included in this section:

Facility Objectives and Benefits

The EIS should contain an explanation of the objectives, benefits and justification for the Facility.

Background to the Facility

The EIS should discuss the background to the proposal, covering, as a minimum, the following points:

- History of assessment processes and development of the Ranger Mine site;
- A comprehensive list of relevant Northern Territory and Australian Government legislation, strategies and policies, as well as international and national standards that apply to the Ranger mine and surrounding environment should be considered. Relevant Northern Territory Government environmental, work health and construction legislation and Guidelines, standards and codes should be considered during the design phase of the Facility.
- Existing approvals for Ranger operations relevant to the Heap Leach Facility, including the Environmental Requirements;
- Major outcomes and recommendations of previous assessments and Inquiries into the Ranger Uranium Mine that have relevance to the Heap Leach Facility;
- Outcomes of any relevant additional environmental studies subsequent to previous public assessment processes including scientific studies, surveys and consultations conducted in developing the Heap Leach Facility. Results of these studies should be included as appendix items;
- The roles of the Office of the Supervising Scientist, The Northern Territory Government, and Australian Department of Resources, Energy and Tourism in relation to the monitoring and regulation of the Ranger Uranium Mine;
- An overview of the impacts of the operation of the Ranger Uranium Mine to date upon the surrounding environment, including local communities; and
- Stakeholder consultation with regard to the proposed Heap Leach Facility, to date.

Need for the Facility

- The EIS should provide a comprehensive explanation of the need and justification for the Facility, including:

- The specific objectives the Facility is intended to meet, including market requirements and trends;
- A comparative analysis of expected regional, Territory or national benefits and costs (including those that cannot be adequately described in monetary or physical terms e.g. effects on cultural and aesthetic amenity); and
- A summary of environmental, economic and social arguments to support the Facility.

- Describe why tailings and process water from existing operations need to be sent to the proposed Residue Storage Dam.

Description of the Facility

All components of the Facility (including the ore-stack and Heap Leach Pad, Storage & Residue Dam sites, Processing site, transport corridors, accommodation arrangements, etc) should be described in detail from initial installation to the long term horizon. Alternatives to various components of the Facility should be outlined. Emphasis should be given to those components with the most potential for significant short and long term environmental impacts. Where appropriate, technical information should be supported by maps, figures and diagrams. Detailed technical information should be included in the appendices. Underlying assumptions and forecast reliability should be discussed.

Description of the Facility should include (where relevant):

- Location, site, layout and Facility description including ancillary sites;
- Land Tenure for the sites of the Heap Leach Facility;
- Description of the existing operations at Ranger including;
  - Infrastructure
  - Processes
  - Mining and production rates
- Description of the physical requirements for the Facility including:
  - Hydro-geological setting;
  - Access to existing mine components;
  - Types, total quantities, sources and availability of major construction materials; and
  - Infrastructure requirements.
- Description of the works required, including:
  - Timing and frequency of work program, duration of construction and removal phases including lead times;
  - Extent of earthmoving, vegetation clearance and other site preparatory works including arrangements to minimise unnecessary clearance and disturbance;
  - Construction standards, techniques and site management arrangements, including for onsite storage and handling of construction and process materials (sulfuric acid, uranium-enriched liquor, etc) and rehandling basins;

- Arrangements for disposal of process wastes; and
- Arrangements for erosion control and rehabilitation of construction sites.

- Description of:
  - Procedures/processes/technologies to be utilised, and the major plant components associated with various stages of operations and components of the Heap Leach Facility.
  - Estimated life of:
    - Mining, under current arrangements;
    - The Heap Leach Pad;
    - Residue Storage Dam; and
    - Rehabilitation;
  - Nature, quantities and sources of supply of raw materials for heap leach processing, including feed-stocks and chemical additives;
  - For uranium ore passing through the Heap Leach Facility, detail of the ore life-cycle completed within the Ranger Project Area. Highlight any new infrastructure required for each process stage.
  - Existing and new on-site storage facilities required for raw materials and products (location, capacity and design) required for the Heap Leach Facility;
  - Any new requirements for off-loading facilities, storage depots, or distribution infrastructure for storage and distribution of inputs or outputs from the Heap Leach Facility.
  - The packaging of processed uranium.

- Resultant products and waste including:
  - Detail of environmentally relevant inputs and outputs from the Heap Leach Facility and associated processing circuits, with indications of relevance of each substance to production processes.
  - The nature and quantities of processed mineral generated by the development;
  - Origins, quantities and nature (physical, chemical) of solid wastes produced during various Facility operations and proposals for disposal, including the capacity of proposed disposal sites;
  - Origins, volumes and composition of liquid wastes associated with the Facility. If there is an objective of "no release", explain how this is to be achieved;
  - Origins, quantities and composition of gaseous emissions from Facility operations (include chemical, particulate and radioactive emissions. Provide estimates of both total emissions and ground level concentrations and discuss predicted emission plume formation and dispersal, including from Facility exhausts);
  - Predicted levels of noise (on-site and at site boundaries) generated by individual plant components and the Facility overall;

- Sources, pathways and potential doses of radiation exposure for employees (taking into account epidemiological information on workers in Facilities), members of the public and the surrounding ecosystems, including: radon gas and its decay products, radioactive particles in dust, gamma radiation, including exposure from ore transfer and processing, the reside storage area, and transportation and storage of pregnant liquor from the Facility. Consider all appropriate and feasible radionuclides associated with the Uranium decay chain.
- Sources, pathways and potential doses of chemical constituents that may be released to the environment during processing.

- Water supplies, including:
  - Requirements in terms of quantity and quality for industrial operations, (increased) workforce consumption on site, domestic consumption by Facility workers and their families;
  - Proposals for provision of required supplies including source, new pipelines from existing storage or bore fields; and
  - The proposed infrastructure and methods for exploitation and delivery to Facility sites and arrangements for maintenance of water quality.

- Energy supplies, including:
  - Quantity for the Heap Leach Facility (including liquor processing) and workforce domestic purposes, types of energy which can be utilised, proportions of proposed energy supply mix, and sulphur content in the case of fuel oil; and
  - Proposed sources of energy supplies, increased power generating capacity and transmission nodes (including placement of power lines).

- Transport, including:
  - Transport medium, including loaders, haulage vehicles, transfer equipment; (for raw materials and products both within and beyond Facility sites) existing transport networks to be utilised and proposals for upgraded or additional road links, pipelines, conveyors etc., interim storage sites, transfer and loading of material and decommissioning of transportation and storage sites; and
  - Any transport facilities to be provided by Facility operators linking accommodation site and workplace.

- Required workforce, its establishment and maintenance, including:
  - Numbers in various categories of skilled and unskilled workers required at various stages of Facility development, numbers of part-time, full-time and casual workers and the expected source of labour forces including references to regional availability; workforce establishment and maintenance including predicted increase in total population numbers resulting from direct employment on the Facility;
  - Requirements for accommodation, provision of accommodation by ERA, provision by Territory and local government and private building industry; Describe accommodation arrangements proposed for workers for construction and Operation phases of the Heap Leach Facility.

- Provision of other services and facilities to support the Facility workforce and families (health care, social services, education, recreation, retail outlets etc), the adequacy of provision made by Territory and local authorities and the contribution, if any, of ERA.

- Health and safety, including on-site safety and medical facilities and procedures. Measures to prevent exposure to radiation, diesel fumes and dust both at the sites and during transportation and handling for both employees and nearby communities.
- Community liaison and consultation, including identification of, and ongoing consultation with stakeholder groups, to ensure the full range of community viewpoints are sought. ERA should outline its current and proposed methods for community consultation, including how it will respond to community feedback, questions and concerns.

4. EXISTING ENVIRONMENT

Studies used to describe the existing environment of the Facility area and its surrounds should be of a scope and standard sufficient to serve as a benchmark against which the impacts of the Facility may be assessed, over an extended period. The level of detail should reflect the scale and nature of the likely studies required to clearly define potential for impact from the Facility.

The EIS should include as a minimum:

- Aspects of the physical environment:
  - Hydrology (surface and ground water systems, catchments, flow and discharge rates, water quality);
  - Geochemistry of the ores to be treated through the proposed heap-leaching system;
  - Relevant climate and atmospheric conditions including precipitation and evaporation rates, winds, and temperature, seasonal variability, probability of extreme events, flooding, and cyclonic storms;
  - Existing ambient noise levels in the study area; and
  - Existing air quality in the study area.
- Aspects of the biological environment:
  - Describe the habitats, communities and animal/plant species within them, noting significance of the biological diversity (as per the Convention on Biological Diversity[5]), and current condition;
  - Ecological relationships, including the conservation status of species or associations to be disturbed by the Facility (including species and communities listed under the EPBC Act);

[5] The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. Australia ratified the Convention in June 1993. See links at: http://www.cbd.int/; and http://www.environment.gov.au/biodiversity/publications/cbd/first-national-report.html

- Other sensitive environments or areas of special significance (breeding sites, seasonal habitats, wetlands, etc) in the footprint of the Facility and potentially affected by the Facility (downstream, down-wind, etc);
- Biting insect species present and insect borne diseases of potential health concern;
- Introduced flora and fauna;
- Ecological relationships and interdependencies, including recognised food chains; and radiation dose from existing environment (including current Ranger uranium Facility operations) for both the surrounding ecosystems and the local community;
- Cumulative impacts, where relevant; and
- The extent to which the environment is already affected by existing mining activities.

- Areas of natural and/or cultural environment with identified special values including:
  - Kakadu National Park;
  - Areas listed on the register of the National Estate;
  - Areas listed on the Commonwealth Heritage list;
  - Ramsar wetlands, areas and species important to obligations under the Bonn Convention and other relevant international agreements to which Australia is a party (i.e. CAMBA, JAMBA and ROKAMBA[6]); and
  - Areas of wilderness, wilderness quality, and wild rivers values.

- World Heritage and National Heritage:
  - World Heritage and National Heritage areas, and values (natural and cultural) including a description of the World Heritage property and exclusion zones, a full description of the values for which the property was inscribed on the World Heritage List and National Heritage List, and information on IUCN assessments of the Kakadu World Heritage area.

- Aspects of the socio-economic environment potentially affected by the Heap Leach Facility :
  - Demographic characteristics;
  - Social factors (lifestyle characteristics, existing trends, social problems and underlying reasons) including reference to results and recommendations of relevant studies; employment levels and characteristics;
  - Existing primary, secondary and service industries in the study area together with estimates of the adequacy of existing services and any

[6] The China Australia Migratory Bird Agreement (CAMBA) was signed in Canberra in 1986, and entered into force in 1988. The Japan-Australia Migratory Bird Agreement (JAMBA) was signed in Tokyo in 1974, and entered into force in 1981. The ROKAMBA [Republic of Korea-Australia Migratory Bird Agreement] was signed in Canberra on 6 December 2006, and entered into force on 13 July 2007. The Agreements aim to protect migratory shorebirds and their habitats.

unused capacity to provide for population increases associated with the Facility;

- An overview of the history of land use in the region and proposed site(s);
- Existing and proposed land uses including government land, water resources, power supply, infrastructure corridors, rural, tourism, industrial, residential, commercial, recreational, mining, national parks, Aboriginal land, areas for food gathering and ceremonies, and town planning or zoning considerations; and
- Other physical infrastructure that could be affected by construction or operation of the Facility.

- Aspects of the cultural environment potentially affected by the Facility:
  - Areas listed on the register of the National Estate for Indigenous and historic cultural values;
  - Any other historic cultural values in the footprint of the Facility;
  - Sites of significance to the Aboriginal population and culture;
  - Information on the Kakadu area as a cultural landscape;
  - Sites of archaeological and anthropological significance including a description of their anthropological or cultural significance (including sites within the meaning of the NT Aboriginal Sacred Sites Act 1989);
  - Areas with other special values (landscape/visual environment, commercial/recreational value, fisheries);
  - Places and objects within the meaning of the NT Heritage Conservation Act 1991); and cultural values that are not site specific.

5. KEY RISKS

The Ranger Project Area and adjacent Jabiluka Mineral Lease are surrounded by the World Heritage listed Kakadu National Park (Kakadu) and are upstream of the Ramsar listed wetlands of the Magela Creek floodplain.

The proposal to construct and operate a Heap Leach Facility and associated infrastructure has the potential to pose additional risks to the surrounding environment. Two major watercourses (*Gulungul Creek* and *Magela Creek*) connect the mine site and its catchment, with Kakadu, and the Magela wetlands.

The major risks below have been identified through analysis of the Notice of Intent / EPBC Referral for the Heap Leach Facility at Ranger Uranium Mine. It is possible that further major risks will be identified in the Environmental Impact Assessment process. The major identified risks are associated with:

1. Suitability of the location with respect to the surrounding environment;
2. The lack of detail on alternative locations and timings, and the risk that alternatives may offer improved environmental outcomes;
3. The management of increasing volumes of process water on site during high rainfall events.
4. Risks to groundwater and surface-water;

5. Radiation risks posed by the new process.
6. Use of Hazardous substances in the new process;
7. Risks to Matters of National Environmental Significance.
8. Decommissioning, Removal and Rehabilitation of the Heap Leach Facility, to allow the impacted area to be incorporated into Kakadu National Park.

The key focus of the EIS should be *(1)* to rigorously examine whether heap leaching operations have the potential to or will cause damage to surrounding areas, including Kakadu National Park, and *(2)* that the local disturbance and impacts on the Ranger Project Area due to the Heap Leach Facility will be managed and rehabilitated so the impacted areas can be incorporated into Kakadu National Park.

The Environmental Impact Statement must demonstrate the **Outcomes** defined for each of the Issues / Risks identified below in these Guidelines.

5.1 ALTERNATIVES

Context

The Notice of Intent[2] states:

'Investigations thus far at Ranger have identified a number of possible locations for the facility which will include the ore stack and the associated water, leachate and uranium-enriched liquor ponds.'

General Information Requirements

The EIS should describe any prudent and feasible alternatives to carrying out the proposed activity. These alternatives, including the 'no Heap Leach Facility' option, should be discussed in sufficient detail to make clear the reasons for preferring certain options and rejecting others. The choice of the preferred option(s) should be explained, including a comparison of the adverse and beneficial effects (direct and indirect) used as the basis for selection, and compliance with the principles and objectives of ecologically sustainable development.

Discussion should include:

- Adverse and beneficial effects of alternatives at national, territory, regional and local level;
- Identification of water-resources, habitats, areas and / or stakeholder groups that are adversely or beneficially affected;
- The comparison of short, medium and long term advantages and disadvantages of the options; and
- The criteria and their relative importance in comparing options.

5.1.1 LOCATION OF THE HEAP LEACH FACILITY COMPONENTS

Outcome

ERA is to demonstrate that the selected location of the Heap Leach Pad, Residue Storage Dam, and the associated water, leachate and uranium-enriched liquor

ponds have been optimised to minimise environmental impacts to the maximum practical extent, and represent the best location alternatives.

Information Requirements

- Discuss reasons for and against the proposed locations of the Heap Leach Facility Components, in particular the Heap Leach Pad and Residue Storage Dam, in the Gulungul catchment.
- Compare the proposed sites with alternative locations. Evaluate environmental and cultural risks and considerations alongside mine costs and benefits, and provide a comparative risk analysis of all potential locations.
- A Best Practicable Technology[3](BPT) analysis is to be presented for all alternative locations of Heap Leach Facility components, where alternative locations exist. The analysis is to consider comparative full life-of–mining costs and benefits of each alternative, and include costs of:
  - Rehabilitation trials;
  - Residue / tailings transfer;
  - Infrastructure removal;
  - Groundwater restoration;
  - Site restoration and rehabilitation;
  - Ongoing monitoring;
  - Contingency costs for follow up works;
  - Externalities such as for ecosystem loss / degradation;
    - Loss of individual fauna / flora;
    - Social /cultural costs;
    - Impacts of greenhouse gas emissions;
    - Impacts on Kakadu National Park (including its World and National Heritage list values)
  - Radiation impacts;
  - Biological and/or greenhouse carbon offsets; and
  - Gained or lost opportunities.

Potential Impacts

- Describe the environmental, cultural and flow-on impacts of the final selected locations for the Heap Leach Pad, Residue Storage Dam, and the associated water, leachate and uranium-enriched liquor ponds, in comparison with potential impacts associated with alternative locations.
- Describe the expected impact of the proposed infrastructure on existing monitoring plans / points, statutory and otherwise, on-site.

Protection, Management and Monitoring

- Describe proposed amendments to monitoring plans / points for the Ranger Project Area to be undertaken by ERA, to accommodate the proposed Heap Leach Facility, and maintain monitoring coverage of all risks to water resources.
  - Describe how monitoring plans and points have been determined, with reference each site's hydro-geological features, areas of significant / sensitive habitat and areas of cultural significance.
  - Describe how the proposed protection, management and monitoring will be robust in light of climate change projections e.g. an increase in extreme weather events.

5.1.2 ALTERNATIVE TIMING

Outcome

ERA is to demonstrate that the projected timing of components and phases of the Heap Leach Facility have been optimised to remove/mitigate environmental impacts to the maximum practical extent, and represent the best alternatives for timing of the Facility.

Information Requirements

- Define clearly and discuss ERA's future mining, tailings and water management strategies with respect to optimising the construction and operation of the Heap Leach Facility.
- Describe ERA's planned timing of the operation, any potential future expansion and final removal/rehabilitation of the Heap Leach Facility.

Potential Impacts

- Define, evaluate and discuss the impacts and benefits to ERA, Stakeholders and the environment of alternative timing scenarios for operation of the Heap Leach Facility, with justification of the actual requirement for a temporary Residue Storage Dam.
- A Best Practicable Technology[3] (BPT) analysis is to be presented for all alternatives inclusive of the full life of mining costs and benefits of the Residue Storage Facility. The analysis should include a comparison of waiting for Pit #3 to receive tailings before commencement of the Heap Leach Facility, versus the current proposal requiring a Residue Storage Facility. The Residue Storage Facility option must account for costs, including those of:
  - Rehabilitation trials;
  - Residue / tailings transfer;
  - Residue Storage Dam removal;
  - Groundwater restoration;
  - Site restoration and rehabilitation to similar-to-original state;
  - Ongoing monitoring;
  - Contingency costs for follow up works;

- Externalities such as for ecosystem loss / degradation;
  - Loss of individual fauna / flora;
  - Social /cultural costs;
  - Impacts of greenhouse gas emissions;
  - Impacts on Kakadu National Park (including its World and National Heritage list values)
- Radiation impacts;
- Biological and/or greenhouse carbon offsets; and
- Gained or lost opportunities.

Protection, Management and Monitoring

- Describe ERA's proposed amendments to monitoring plans / points for the Ranger Project Area, to accommodate the proposed timing of the Heap Leach Facility:
  - To maintain monitoring coverage of all risks to water resources; and
  - To obtain appropriate baseline data prior to disturbance by the Facility.
- Describe how negative impacts associated with the proposed timing of the Heap Leach Facility will be managed, and environmental risks avoided or minimised.

5.1.3 FURTHER FACILITY ALTERNATIVES

Outcome

ERA is to demonstrate that the proposed configuration of Facility alternatives (not already discussed in Section 5.1) available for the Heap Leach Facility have been optimised to remove/mitigate environmental impacts to the maximum practical extent.

Information Requirements

Discuss and compare risks and benefits associated with the following alternatives for the Facility:

- Not proceeding with the proposed development;
- Alternative processing arrangements; and
- Other key alternatives to Facility configuration not discussed above.

5.2 PROCESS WATER MANAGEMENT

Outcome

ERA is to demonstrate water management contingencies that are sufficient to fully contain all process water within the Mining Lease in worst-case scenarios.

Information Requirements

- Describe how the Heap Leach Facility will affect the current Water Management Plan for the Ranger Uranium Mine.

- ERA is to provide as background context an abridged draft of its Water Management Plan for the Ranger Uranium Mine, as an Appendix to the EIS, detailing all aspects of direct relevance to the Heap Leach Facility in construction and operational phases. As full context[7], ERA is requested to provide (and host), during the Public Exhibition phase of the EIS, a website reference to its full current Water Management Plan for the Ranger Uranium Mine.

- Present forward sensitivity modeling of the Ranger Water Management Plan for the Heap Leach Facility, particularly in relation to management of the Facility during high rainfall events.
- Define *process water,* and describe its contaminants / water quality and associated risks.
- Describe how the increased catchments from the Heap Leach Facility would affect the process water inventory and operation of existing storage facilities.
- Demonstrate that ERA has the capacity to appropriately manage the additional process water which will be generated by the Heap Leach Facility.

Potential Impacts

- Describe potential environmental impacts from exceeding the process water storage capacity of the Ranger Project Area. Describe in what circumstances this exceedance could occur.

Protection, Management and Monitoring

- Describe proposed Protective Measures, Management and Monitoring that will prevent uncontrolled discharge of process water from the mining lease.
- Demonstrate that process solutions will be retained under the highest probable rainfall scenarios giving consideration to potential increases in climatic variability.

5.3 RISKS TO GROUNDWATER AND SURFACE WATER RESOURCES.

5.3.1 BASELINE DATA

Outcome

ERA will ensure that comprehensive baseline data is gathered of characteristics of hydrological and terrestrial resources prior to disturbance from the Heap Leach Facility. Emphasis is to be placed on resources whose characteristics are likely to be modified by the venture so that data collected on those same resources at a

[7] To allow full public assessment and transparency of effects of the Heap Leach Facility upon the Water Management Plan for the Ranger Uranium Mine, and to place these in proper context with respect to impacts (potential or existing) on the downstream Ramsar wetlands. Given that not all of the (full) Plan will be of direct relevance to the Heap Leach Facility, as well as the size and evolving content of the document, ERA is requested to host its current Water Management Plan on its own website, for the period of Public Exhibition of the EIS for the Heap Leach Facility, and to provide a weblink within the EIS document.

later time can be used to measure change, assess the venture's impacts and inform rehabilitation objectives.

Information Requirements

For the location of (each alternative site of)

- the Heap Leach Pad,
- Residue Storage Dam,
- Leachate Pond; and
- the Uranium-Enriched Liquor Pond,

- Describe its local and underlying geology, and provide depths of underlying geological strata;
  - Establish vertical and horizontal permeability data through the geological strata and any identified anomalies;
  - Quantitatively estimate the capacity of the geology to neutralise any acid and/or metalliferous drainage outputs;
- Provide Information on the following groundwater components:
  - Relevant groundwater resources in any areas likely to be affected by the construction and operation of the Heap Leach Facility;
  - Confining layers and expected hydraulic conductivities and porosities of identified aquifers;
  - Flow domain – including the expected elevation of the water table, lateral and vertical hydraulic gradients, likely flow direction and flow velocities, sources of recharge and possible discharge points and other hydraulic boundaries;
  - Potential receptors including current and realistic future users and groundwater ecosystems; and
  - Identified natural hydro-geochemistry of the groundwater system (heavy metals, toxic metalloids, pH, redox, total dissolved solids, an interpretation of the major anion and cation concentrations, and comparison of these with the natural buffering system);
- Provide a broad description of any waterways or wetland habitats, natural or artificial, ephemeral or permanent, including springs, that may be impacted by the Facility, including impacts to downstream areas. For surface water systems, describe:
  - Catchments;
  - Their significance (Ramsar etc);
  - Current and pre-mining uses;
  - Beneficial uses;
  - Existing surface drainage patterns, flows (including flood contours) and discharge rates;
  - Water quality; and

- Current effects on their water quality from inputs of acid and/or metalliferous drainage, uranium or radium from existing mining activities, and from natural sources;

5.3.2 RISKS ASSOCIATED WITH INFRASTRUCTURE DESIGNS

Outcome

ERA will demonstrate that infrastructure designs, construction practices and operational standards will 'engineer-out', minimise or mitigate all potential environmental impacts from the Heap Leach Facility infrastructure, in keeping with the Best Practicable Technology[3] framework, to be continually optimised over the life of the Facility.

5.3.2.1 Heap Leach Pad design

Information Requirements

- Detail design, construction and management of the Heap Leach Pad.
  - Describe the ore-stack design and 'dynamic' process;
  - Provide detail on the proposed liner, collection and monitoring systems.
  - Describe predicted longevity of the liners; and
  - Provide detail on how animal access to the Facility will be managed.
  - Describe provision for extreme rainfall seasons / events and cyclones;

- For the proposed Heap Leach Pad site and each alternative site:
  - Describe the proposed location and catchment details;
  - Describe geology underlying the sites;
    - Provide depths of underlying geological strata.
    - Detail presence of existing geological faults, drainage lines, paleochannels, aquifers, etc

- ERA's *Notice of Intent* stated that Dynamic Heap Leaching is a "well established technology".
  - Provide details of examples where Dynamic Heap Leaching has been used, particularly with reference to uranium extraction and/or where similar extraction methods are used, and at a scale similar to that proposed by ERA. Provide environmental and institutional/regulatory context of each example.
  - Provide details of climatic regimes and ecological characteristics of areas where dynamic heap leaching has been used.
  - Describe recognised environmental issues encountered/managed by such facilities.
  - Support ERA's proposed design choices with references to studies of facilities that demonstrate integrity of such designs using a Best Practicable Technology[3] framework.

- Clarify which aspects of Heap Leaching technology will be relatively new and used in the proposed process, or is common in other types of heap leaching for other metals.

Potential Impacts

- For the Heap Leach Pad and ore-stack, describe potential for impacts on groundwater, surface-waters and associated ecosystems if leakage / seepage from the pad were to occur;
- Assess the potential for interaction between the pad liners and the ore/leachate mix, in terms of any potential for liner degradation;
- Model potential evaporation and drift of fumes/odour from the irrigation of leachate over the Heap Leach Facility;
- Assess potential impacts on workers, the public and local soils, flora and fauna from fumes/odour from the irrigation of leachate over the ore-stack and Heap Leach Pad.

Protection, Management and Monitoring

For the Heap Leach Pad:

- Provide technical details to demonstrate how the design of the Heap Leach Pad will effectively protect and isolate groundwater aquifers, surface water and soils from leachate (and fit within a Best Practicable Technology[3] framework);
- Describe predicted longevity of the liners, relative to the proposed life of the Heap Leach Pad;
- Describe contingency plans if the liner leaks and what measurement / monitoring parameters are to be used for assessing the integrity of the liners;
- Describe how potential fume drift from the Heap Leach Facility will be monitored and minimised;
- Define sensitive receptors to fume drift from Heap Leach Facility components;
- Provide detail on how animal access to the Facility will be managed; and
- Describe monitoring and contingency measures that will minimise risks from the Heap Leach Pad and ore-stack to groundwater aquifers, surface water, soils flora and fauna.

5.3.2.2 Uranium-Enriched Liquor Pond and Leachate Pond.

Information Requirements

- Characterise the leachate and uranium-enriched liquor, to be stored in the holding ponds.
  - Define expected constituents and concentrations of each, including chemical constituents, radioactive elements, metals and metalloids.
- For the proposed sites of the leachate ponds and uranium-enriched liquor ponds and each alternative site:
  - Describe the proposed location, footprint and catchment details;

- Describe geology underlying the sites;
  - Provide depths of underlying geological strata.
- Detail presence of existing geological faults, drainage lines, paleochannels, aquifers, etc
- Provide detail of the design, construction and management of the ponds associated with the Heap Leach Pad for uranium-enriched liquor, leachate and water.
  - Provide detail on the proposed liners, collection and monitoring systems.
  - Describe provision for extreme rainfall events /seasons, cyclones and wave events;

Potential Impacts

- Describe toxicity levels of the leachate and uranium-enriched liquor and their potential to represent environmental health hazards to humans, flora and fauna.
- For the Uranium-Enriched Liquor Pond and Leachate Pond, describe potential impacts on groundwater, surface-water, soils and associated ecosystems, from leakage / seepage from the ponds and linked pipelines.
- Describe risks to the local airshed and its users from the Uranium-Enriched Liquor Pond and Leachate Pond.
- Detail risks and potential consequences of escape to the environment of any toxic components of the ponds, to the extent predicted by the relevant modelling requested in *Section 5.3.5 - Contaminant Transport Modelling.*

Protection, Management and Monitoring

For the Uranium-Enriched Liquor Pond and Leachate Pond:

- Provide detail and discussion of the design, construction and management of the ponds, to demonstrate how these will effectively protect surface waters, underlying soils and aquifers from contamination.
- Assess the potential for interaction between the liners and storage contents, in terms of any potential for liner degradation;
- Describe predicted longevity of the liners, relative to the proposed life of the dams;
- Describe monitoring plans and parameters to be used for assessing the integrity of the liners;
- Describe monitoring and contingency measures if significant leaks or emissions are detected, that will prevent or reduce risks to sensitive receptors, local soils, water resources and air-quality in the local airshed.
  - Describe how the proposed workforce will have adequate technical capacity to deal with hazardous emergency situations if significant leaks or emissions are detected.

5.3.2.3 Residue Storage Dam design

Information Requirements

- Describe why tailings and process water from existing operations should be sent to the proposed Residue Storage Dam.
- For the proposed site and each alternative Residue Storage Dam site:
  - Describe the proposed location and catchment details;
  - Describe geology underlying the sites;
    - Provide depths of underlying geological strata.
    - Detail presence of existing geological faults, drainage lines, paleochannels, aquifers, etc potentially affecting containment ability of the dam;
- Provide detailed designs of the Residue Storage Dam. Describe objectives of the design, including:
  - target seepage rates;
  - The design-life of the Residue Storage Dam;
  - Current design capacity (and limits to potential future capacity) in terms of:
    - Volume;
    - Number of Years of Heap Leach and processing plant residue / tailings outputs; and
    - Ranger Water Management Plan requirements.
- Describe design of the Residue Storage Dam, with firm descriptions of:
  - Limits to the life of the Dam under terms of the current Lease arrangements;
  - The proposed groundwater monitoring network, and how this will interact with the existing groundwater monitoring network;
  - The proposed method of transferring Heap Leach Residue from the Heap Leach Pad and its deposition into the Residue Storage Dam and (later into) Pit #3.
  - Residue and tailings disposal and impoundment principles;
  - Surface configurations and measurements;
  - Wall designs and construction, including the maximum possible height of the dam;
  - Provision for extreme rainfall, storm and wave events;
  - Erosion protection;
  - Spillway design and location (if present);
  - Sub-drainage and collection sumps (if present); and

- Design depths and permeability of all dam lining layers[8].

- Investigate the use of an impervious membrane to seal both the walls and floor of the tailings dam.
- Describe the proposed future method of transferring contents of the Residue Storage Dam to Pit#3, once Pit#3 becomes commissioned to receive tailings and Residue.

Potential Impacts

- Detail sensitive receptors, risks and potential consequences of escape to the environment of any contents of the Residue Storage Dam [to the maximum extent predicted by the relevant modelling requested in *Section 5.3.5 - Contaminant Transport Modelling*].
- Detail risks to the environment in the case of Heap Leach Residues or tailings / Residue mixtures escaping from pipelines linked to the Residue Storage Dam.
- Describe potential for interaction between the dam lining system and proposed Residue Storage Dam contents, in terms of any potential for liner degradation. Consider interactions between Heap Leach residue, tailings and any other dam inputs.
- Describe potential impacts on the ability of the Residue Storage Dam to prevent seepage to groundwater from anomalies, faults or high permeability zones in geological strata underlying the dam;
- Describe risks to local waterways, aquatic ecosystems and soils from acidic and/or metalliferous drainage from stormwater runoff through walls of the Residue Storage Dam (consideration is to be included of potential for non-acidic metalliferous drainage).

Protection, Management and Monitoring

For the Residue Storage Dam:

- Describe and discuss how design of the Dam will prevent or minimise seepage, and prevent or minimise risks to the environment from seepage.
- Demonstrate that the most appropriate liner system is being utilised in the Dam design to prevent environmental impacts from dam seepage, and is in keeping with a Best Practicable Technology[3] framework;
- Model and estimate (whole of dam) seepage rates from the dam to underlying aquifers using an appropriate 3-dimensional model. Describe best case, most likely case and worst-case scenarios, including a sensitivity analysis (consider effects of all geological anomalies);
- Describe how dam construction quality control will achieve target permeabilities of Dam liners;

[8] In keeping with recommendation 4 from chapter 7 of the second report of the *Ranger Uranium Environmental Inquiry*: "That the use of an impervious membrane to seal both the walls and floor of the tailings dam should be investigated further" [Fox, R W, et.al (1977)]

- Describe predicted longevity of the dam liner system, relative to the proposed and potential life of the Residue Storage Dam;
- Describe how acid and/or metalliferous drainage from dam contents to underlying aquifers will be prevented / minimised, managed and monitored;
- Describe how risks of acidic and/or metalliferous drainage from dam walls (through stormwater infiltration and runoff) to local streams will be prevented or minimised prior to construction (by characterisation of building materials), by design, and post construction (through monitoring, and contingency management measures).
- Describe how current geotechnical engineering principles/practices and ANCOLD guidelines are being met.
- Describe monitoring and contingency management plans:
  - against occurrence of groundwater contamination from Dam seepage;
  - that will prevent or reduce risks (not discussed above) to nearby sensitive receptors, underlying soils, water resources and air-quality in the local airshed; and
  - supporting maintenance of the Dam objectives;
- Demonstrate that adequate technical capacity will exist within the employed workforce to deal with hazardous emergency situations related to the Residue Storage Dam.

5.3.3 CONTENTS OF THE TAILINGS STORAGE FACILITIES

Outcome

ERA will demonstrate a comprehensive understanding of the characteristics of residue materials generated by the Heap Leach process, as well as the interaction of these residues with future mill tailings. Understanding will be demonstrated of the environmental and human risks associated with the (co-) storage and handling of these materials.

Information Requirements

- Comprehensively characterise the heap leach residue, process tailings and other projected inputs into the Residue Storage Dam.
  - Characterise the residue / tailings mineralogy, heavy / base metal and toxic metalloid content, neutralising capacity, sulfide content, net acid production potential, radioactivity and presence of residual radioactive elements.
  - Characterise potential interactions between co-disposal materials.
  - Describe toxicity levels of the materials for storage and their potential to contaminate air, soil and water resources, and represent environmental hazards to flora/fauna, and humans in current and future generations;
    - Describe for how long and in what scenarios the materials will remain toxic.
    - Describe risks associated with their future exposure, handling, re-handling and storage (in Dam and Pit).

- Predict final tailings seepage quality.
- Compare predicted seepage quality with existing groundwater quality;

Potential Impacts

- For seepage qualities significant to environmental and/or human health, analyse potential of these for environmental and human impacts over time.

Protection, Management and Monitoring

- Detail any proposed method of neutralising:
  - The spent or "barren" liquor that remains after extraction of the uranium-bearing fraction. Detail disposal plans and risks; and
  - The heap leach residue, proposed to initially report to the Residue Storage Dam.

5.3.4 PIT #3 TAILINGS STORAGE FACILITY

Scope of assessment

The future use of Pit #3 as a tailings storage facility is subject to an existing authorisation. As such, the scope of the assessment of Pit#3 is limited to any changes to proposed management of tailings deposition that may result from the addition of Heap Leach Residues to the tailings, and whether these changes will have any adverse impact(s) on the environment or human health.

Information Requirements

- Describe tailings management and final disposal plans that involve disposal or co-disposal of the heap leach residues, to ensure final in-pit disposal will be managed to minimise groundwater movement through the tailings.

Potential Impacts

- Detail how the disposal of heap leach residues may impact on the proposed:
  - Tailings disposal and impoundment principles;
  - Radon containment principles;
  - Lining, containment and/or capping designs and construction, including;
    - Design depths and permeability of all layers, including mill tailings and heap leach residues;
    - The availability of suitable clays or appropriate low permeability material to construct any proposed liner systems;
  - Designs and management of zones where Pit #3 has intersected existing aquifers;
  - Details of the proposed monitoring network;
- Describe any impacts from the Heap Leach Facility on contingency management plans to maintain the design objectives for the Pit #3 Tailings Storage Facility in the short and very long term (10,000 years);

Protection, Management and Monitoring

- Detail how identified potential impacts of co-disposal of Heap leach Residues with mill tailings in Pit#3 will be addressed by ERA.

5.3.5 CONTAMINANT TRANSPORT MODELLING

Outcome

ERA will demonstrate a comprehensive understanding of the likely behaviour and fate of all toxic materials associated with the Heap Leach Facility. Background context of existing mine-related contamination levels of the Ranger Project Area hydrology will be described. Modelling will be peer reviewed to critique the validity of model outputs.

Information Requirements

(Baseline)

- Detail the latest understanding of the extent and flow dynamics of mine-related contamination of water resources in the Ranger Project Area.
    - Model present mine-related contaminant transport patterns over the Ranger Project Area. Quantify contaminant loads, relative to background levels, and to ANZECC guideline levels. Discuss environmental implications of contaminant levels.

(Impact Prediction)

- Provide details of contingency management measures to safeguard downstream water quality in the event of catastrophic failure of elements of Heap Leach Facility infrastructure.
- Model and evaluate predicted changes to surface and near surface groundwater flows and recharge properties in the proposed area of the Heap Leach Facility components. Examine changes to drainage patterns, groundwater levels, springs and stormwater runoff.
- Undertake three dimensional contaminant transport modelling of potential seepage from the Heap Leach Facility components (Heap Leach Pad, Leachate Ponds, Uranium-Enriched Liquor Ponds and Residue Storage Dam). Describe best case, most likely case and worst-case scenarios.
- Compare and discuss current contaminant transport patterns across the Ranger Project Area with those predicted to occur from addition of the Heap Leach Facility.
- Describe likely effects of the proposed Heap Leach infrastructure on the existing groundwater plume from the current tailings dam. Include detail of expected changes to flow rates, flow directions, plume monitoring and seepage signatures.

- Obtain peer review[9] of all Contaminant Transport Modelling presented, to evaluate the validity of model scope, design, inputs and outputs.

5.3.6 SUMMARY OF RISKS TO GROUNDWATER AND SURFACE WATER RESOURCES FROM THE HEAP LEACH FACILITY

Outcome

ERA will demonstrate a comprehensive understanding of potential risks from the Heap Leach Facility on surface and underground water resources, and will demonstrate protection of water resources from contamination by the Heap Leach Facility, in the short and long term.

Information Requirements

- Present a conceptual model of the current hydro-geological regime of the Ranger Project Area, with particular focus on areas affected by Heap Leach Facility components. Consider also findings of studies of sediment (radioisotope ratio) data from the creeks outside of the mine footprint.
    - Identify important data gaps, and outline how ERA intends to address these gaps in order to better understand the potential impact of the operation on water resources.
- Present an exposure assessment, which includes exposure scenarios (to both humans and the environment) to the North, South, West and East of the Facility components; i.e. exposure via all pathways (dermal, ingestion, inhalation, irradiation).

Protection, Management and Monitoring

- Summarise Protective Measures and management strategies used to minimise the impacts of construction and operation of the Heap Leach Facility on surface-water and groundwater resources, particularly water bodies connecting the Ranger Project Area with Kakadu National Park and downstream Ramsar wetlands.

5.4 RADIATION RISKS

Context

As the extraction of uranium by Heap Leach methodology is not a widely developed technology, especially at this scale, unknowns may exist of how radiation risks may differ from the existing well known operations and processing circuits.

Section 3.1.2.6 of the Notice of Intent states that the '*proposed action may incrementally increase worker and public exposure to radiation from increased surface area of low grade ore materials on leach pads*.'

[9] Demonstration is required that the Peer review is being performed by an independent scientist/consultant with appropriate qualifications and experience.

Outcome

ERA will demonstrate that risk management measures are in place to ensure no adverse impacts will occur on the health of employees, the public or connected ecosystems, due to radon release, long lived alpha activity from dust, uranium bearing materials, or radiological aspects of seepage or spills.

Information Requirements

- Baseline studies
    - Establish a baseline monitoring program (as early as possible) of airborne radon and dust (long lived alpha activity) concentrations in the area of the Heap Leach Facility, to determine current baseline levels.
    - Present a baseline Radiation Monitoring Plan to detect impacts from the Heap Leach Facility on water resources (including monitoring of water, sediment and biota for radionuclide activity and concentrations in the Gulungul catchment);
- Systematically describe sources, pathways and potential doses of radiation exposure for employees, members of the public and connected ecosystems from all components of the Heap Leach Facility.
- Describe to what extent uranium, and other elements including thorium, polonium, radium and actinium, will be leached (and persist) at successive stages of the proposed Heap Leaching process and Residue storage.
    - Describe to what extent those radionuclides will be present in the Heap Leach Residue / and final residue / tailings mix.

Potential Impacts

- Systematically identify risks to employees, the public and connected ecosystems from radiation in all its forms, resultant from operation of all stages and components of the Heap Leaching process and Residue storage.
- Define the level of risk and consequences of transport of contaminated dust from the Heap Leach Stack / Pad.
- Provide detailed analysis of inhalation and ingestion doses, assuming that radioactive equilibrium is not valid in both Heap Leach Liquor and Residues.
- Undertake modelling to predict future levels and fate of airborne radon concentrations and long lived alpha activity from dust from the Heap Leach Facility.
- Demonstrate that the predicted incremental increases in radiation doses to members of the public (see *Context* above) from the Heap Leach Facility will not be harmful.

Protection, Management and Monitoring

- Demonstrate that ecosystems connected to the Ranger Project Area shall not suffer any significant deleterious radiological impacts.
    - To assess off-site impacts, the analyte list in the radiation monitoring programme for waters should be extended to include all relative radionuclides of concern, including daughter products.

- As a minimum, justification is to be provided for exclusion of any radionuclides present and an interpretation provided as to how they will assist / not assist in the assessment of off-site migration.

- For process or treated water on-site, assess levels of all relative radionuclides of concern including daughter products (rather than assuming equilibrium) on-site at various stages in the process, before and after the heap leach starts, to assess its implications on radionuclide activities in the processing circuit, and to be able to give a quick dose estimate should ingestion of process water occur.
- Describe radiation management and monitoring plans to prevent health risks to employees, the public and connected ecosystems, associated with Heap Leach Facility components and other mine-site infrastructure impacted by this Facility. Define how monitoring outcomes will be reported.

5.5 WASTE AND HAZARDOUS SUBSTANCES

5.5.1 HAZARDOUS INPUTS AND OUTPUTS TO THE PROCESSING OF LOW-GRADE ORE

Outcome

ERA will demonstrate that all environmentally relevant emissions (not identified elsewhere in this document) resulting from the full Heap Leach process will be identified, and controlled in accordance with principles of Best Practicable Technology[3] to prevent or minimise risks to sensitive receptors.

Information Requirements

- Provide details of environmentally relevant inputs and outputs from the Heap Leach Facility with indications of relevance of each substance to the processing of the ore.
- Define any new or increased requirements due to the Heap Leach Facility for the Ranger Mine to import sulphuric acid, kerosine, fuels, ammonia, pyrolusite, lime, or any other hazardous substances.
    - Define transport and handling methods for the above, and their significance relative to existing transport and handling operations for the Ranger Mine.
- Define any new or increased requirements due to the Heap Leach Facility for the Ranger Mine to export hazardous substances.
    - Define transport and handling methods for the above, and their significance relative to existing transport and handling operations for the Ranger Mine.

Potential Impacts

- Outline for each substance (identified in the previous dot-point) associated risks to the environment and personnel, and proposed risk management of each. Include (where appropriate to processing of heap leach pregnant liquor)

description of: ‘kerosine’, fuels, sulfuric acid, ammonia, pyrolusite, lime, and classified grades of ore[10].

- Provide detailed description and sources of all emissions from the Heap Leach Facility; and from the Processing Circuit [11].
  - Describe and evaluate risks from Processing Circuit emissions to workers, the public, neighbouring vegetation and wildlife.
- Identify any new or additional risks to the environment, road users or the public associated with transport, loading and distribution of hazardous substances required for the Heap Leach Facility.

Protection, Management and Monitoring

- Describe management, monitoring and contingency plans to address potential risks identified in the previous dot points.
- Describe monitoring and contingency plans for spills, accidental release and pollution from:
  - waste and hazardous substances;
  - unplanned tailings, sulfuric acid, uranium-enriched liquor or other storage discharge;
- Describe management, monitoring and contingency plans to address any identified new risks to the Ranger Mine associated with transport, loading and distribution of hazardous substances required for the Heap Leach Facility.

5.5.2 BUSH TUCKER

Context

Billabongs and waterways in the Gulungul catchment are frequented by Indigenous and non Indigenous groups, who use the area for recreational and cultural activities.

Information Requirements

- Describe potential for trophic transfer of contaminants to/from bush tucker species and other relevant species involving handling or consumption, in areas potentially affected by the Heap Leach Facility.

Potential Impacts

- Describe the potential Indigenous health impacts related to traditional hunting and collection of Bush Tucker and other relevant species involving handling or consumption, from the potential contamination of food chains resulting from the Facility.

[10] include consideration of constituent heavy metals, toxic metalloids and all radionuclides associated with the U-decay chain.

[11] to the extent that the emissions in question, or the changes to levels of emissions are due to the interaction with the Heap Leach Facility.

Protection, Management and Monitoring

- Describe proposed impact management of any identified potential for Indigenous health impacts related to traditional hunting and collection of Bush Tucker and other relevant species involving handling or consumption, from the potential contamination of food chains resulting from the Facility.

5.6 RISKS TO MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Context

The Ranger Project Area and adjacent Jabiluka Mineral Lease are surrounded by the World Heritage and National Heritage listed Kakadu National Park and are upstream of the Ramsar listed Magela Wetlands and floodplains, containing internationally valued habitats and species. Two major watercourses (*Gulungul Creek* and *Magela Creek*) run from the mine site's catchment areas through Kakadu to the Magela wetlands.

The Ranger Heap Leach Facility was determined under the Australian *Environment Protection and Biodiversity Conservation Act 1999* to be a *Controlled Action*. The controlling provisions are:

- World Heritage properties (section 12 & 15A)
- National Heritage places (section 15B & 15C)
- Wetlands of International importance (section 16 & 17B)
- Listed threatened species and communities (sections 18 and 18A);
- Listed migratory species (sections 20 and 20A);
- Nuclear Actions (section 21 & 22A)
- Commonwealth land (section 26 & 27A).

Outcome

ERA is to identify and discuss all potential impacts on the controlling provisions and demonstrate that impacts have been minimised through a hierarchy of avoidance, mitigation and offsetting.

Information Requirements

- Provide detailed maps depicting spatial proximity of the Ranger Project Area and the Heap Leach Facility components to:
  - Sites and regions of ecological and/or cultural sensitivity or significance;
  - Ramsar wetlands;
  - Sites and regions embodying National Heritage values; or
  - Sites and regions embodying World Heritage Property and National Heritage Place values in Kakadu National Park.
- Indicate the location and significance of existing statutory environmental monitoring points.

- The potential impacts and protection, management and monitoring measure for each controlling provision should be discussed under a separate heading with reference to other sections of the EIS if relevant.

Potential Impacts

- The EIS must include a description of all the potential relevant impacts of the action on the ecology, hydrology and geomorphology of the Facility area as it relates to the controlling provisions, for all stages of the Facility:
  - A detailed assessment of the nature and extent of the likely short-term and long-term relevant impacts;
  - A statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible;
  - Analysis of the significance of the relevant impacts; and
  - Any technical data and other information used or needed to make a detailed assessment of the relevant impacts.
- Discussion of impacts on Ramsar wetlands should consider the potential risks to the ecological character[12] of the site/s with reference to the *Ramsar Information Sheet for Kakadu National Park (Stage II)*.
- Discussion of impacts to Kakadu National Park should refer to potential impacts on the World and National Heritage list values.

Protection, Management and Monitoring

The EIS must provide information on mitigation measures, for each controlling provision. Specific and detailed measures must be provided and substantiated, based on best available practices and must include the following elements.

- A consolidated list of mitigation measures proposed to be undertaken to prevent, minimise or compensate for the relevant impacts of the action, including:
  - A description of proposed safeguards and mitigation measures to deal with relevant impacts of the action including mitigation measures proposed to be taken by State governments, local governments or the proponent;
  - Assessment of the expected or predicted effectiveness of the mitigation measures;
  - Any statutory or policy basis for the mitigation measures; and
  - The cost of the mitigation measures.

5.7 FLORA AND FAUNA

Outcome

[12] Ecological Character is defined in the Ramsar Convention as "the combination of the ecosystem components, processes, and benefits and services that characterise the wetland at a given point in time"

ERA will ensure that no net adverse impacts occur on abundance, health or diversity of native fauna or flora of conservation significance, in areas affected by the Heap Leach Facility.

Information Requirements

- Present details and findings of flora and fauna surveys of the area of impact of the Heap Leach Facility, including all alternative sites.
- Discuss flora and fauna species or habitats of conservation significance present and potentially present on the area of impact of the Heap Leach Facility of all (alternative) sites for the Facility, with particular focus on species listed under the EPBC Act and/or the *Territory Parks and Wildlife Conservation Act (NT)*. Species of conservation significance potentially present on the area of impact of all (alternative) sites for the Heap Leach Facility should:
  - be subject to targeted surveys at optimum times of year to best define their likely presence / absence,
  - be discussed with respect to their presence/absence, abundance, condition (health) and regional occurrence; and
  - be discussed with respect to their vulnerability to likely impacts from the Facility.
- Discuss objectives and details of fire management regimes employed by ERA on the general area and operations of the Heap Leach Facility. Discuss with respect to observed (monitored) and expected impacts on biological diversity, flora/fauna community structures, and greenhouse gas emissions.

Potential Impacts

- Describe potential impacts on native flora and fauna from the construction and operation of the Heap Leach Facility. Consider in detail the impacts on ecosystems and individual species from aspects of the Facility including clearing of habitat, radiation, fumes, contamination of water resources and food chains, entrapment, road injuries, etc..
- Predict potential impacts on fauna due to exposure to Heap Leach Pregnant Liquor, Leachate, Residue and Process Water.
- Using the cumulative impacts to date from the Ranger Uranium Mine for comparison, describe any additional impacts upon ecological communities likely to occur from the Facility.
- Identify risks and describe proposed management of these risks to the health of wildlife from Heap Leach infrastructure, in particular, risks associated with the:
  - Uranium-Enriched Liquor Pond;
  - Leachate Pond;
  - The Heap Leach Stack and Pad; and
  - The Residue Storage Dam;

Protection, Management and Monitoring

- For the potential impacts identified above, consider in detail which risks could be effectively 'engineered out' and avoided, minimised, mitigated or offset. Describe, discuss and justify ERA's proposed level of risk avoidance of impacts on native flora and fauna.
- Describe the extent and method by which ERA proposes to offset impacts on biodiversity resulting from construction and operation of the Heap Leach Facility.

5.7.1 WEEDS AND FERAL ANIMALS

Outcome

ERA will avoid or minimise risks to the areas associated with the proposed Heap Leach Facility of introduction of new weeds, plant pathogens or pests (including feral animals); of infestation with weeds or feral animals;, or increase in abundance of existing weed species or pest species in operational and linked areas. Requirements of the *NT Weed Management Act 2001* will be fulfilled.

Information Requirements

- Describe the current status of the areas proposed for the Heap Leach Facility, in terms of the presence of feral animals and weeds.

Potential Impacts

- Describe aspects of the Heap Leach Facility construction and Operation which have potential to facilitate the spread of existing or introduced weed species, or to increase numbers of introduced feral species (on- and off-site).

Protection, Management and Monitoring

- Detail how ERA proposes to monitor and manage feral animals around the area of the Heap Leach Facility.
- Detail how ERA proposes to monitor and manage weeds around the area of the Heap Leach Facility, and associated roads and waterways. Outline methods proposed to prevent the movement of weeds within, around and off the site.

5.7.2 LAND CLEARING

Context

The cleared footprint of the Heap Leach Facility is proposed to total ~170 Ha.

Outcome

Land clearing for the Facility will be minimised and flow-on impacts to flora and fauna from the finally proposed land clearing will be avoided or minimised to the greatest extent possible. ERA will demonstrate how greenhouse gas emissions due to land clearing will be minimised.

Information Requirements

- Define the area of land clearing required for the main Heap Leach Facility components, and the area of total clearing required for the total footprint of the Facility.
- Define the areal extent of each vegetation community, and habitat type to be cleared.
- Describe for each category the extent to which the area is undisturbed, disturbed, heavily disturbed, cleared, and/or regrowth.

Potential Impacts

- Describe how the clearing of native vegetation will impact on native fauna, especially rare or endangered species or significant habitats.
    - Describe all vegetation communities to be cleared of native vegetation;
    - Describe drainage lines, watercourses, wetlands, and sensitive or significant vegetation communities occurring within 200m of the proposed development area.
- Describe the potential greenhouse gas emissions likely to result form clearing of the proposed areas of vegetation.

Protection, Management and Monitoring

- Describe clearing plans and proposed measures that align ERA's proposed clearing of native vegetation with principles defined in the *NT Land Clearing Guidelines*[13].
- If any vegetation clearance is to occur of wetlands or significant vegetation types, describe how impacts to these areas and surrounding areas will be reduced.
- Describe to what extant and how ERA proposes to minimise and offset the carbon footprint of its land-clearing for the Heap Leach Facility.

5.8 DECOMMISSIONING, REMOVAL AND REHABILITATION OF THE HEAP LEACH FACILITY

Outcome

That the Heap Leach Facility and associated infrastructure can be rehabilitated to a standard which would allow incorporation of the impacted areas into Kakadu National Park as required by the Ranger Mine Environmental Requirements.

Information Requirements

- Define decommissioning, removal and rehabilitation objectives and goals for the Residue Storage Dam in the short and long term, and for the remainder of the Heap Leach Facility in the long term.
- Identify values for the Heap Leach Facility component sites, and objectives with regard to those values in the decommissioning, removal and rehabilitation of the component sites;

[13] NRETAS (2006)

- Discuss integration of the rehabilitation objectives and program with Heap Leach Facility objectives, designs and operation plans;
- Discuss expected levels and extent of site contamination on final removal of Heap Leach Infrastructure. Define expected site contaminants.
- Identify and discuss any constraints against achieving full restoration of the Heap Leach Site in keeping with the features of the original landscape, vegetation communities and faunal community structure.
    - Identify and discuss successes and problems encountered with rehabilitation (including trials) to date at Ranger Mine, as they relate to techniques to be used for the Dam, and Facility.
- Describe proposed rehabilitation techniques and management of sites after final removal of Heap Leach Infrastructure.
- Provide details of the design of rehabilitated landforms, including:
    - The rehabilitation techniques to be used and the final topographic and drainage morphology;
    - Flora species appropriate for use in rehabilitation, including the collection and selection strategy for native flora species;
    - Rehabilitation methodology, to include:
        - Proposed staging / timing
        - Soil profile reconstruction
        - The proposed revegetation program, with selection and collection of local native species e.g. native grasses and other vegetation
        - Runoff and erosion control measures
        - Water supply
        - Protection from fauna, including cattle and feral animals
        - Weed control
        - Fire management
        - Contingency management against rehabilitation failure

Potential Impacts

- Discuss the impacts of the time lag between clearing and re-establishment of vegetation;
- Provide a detailed description and analysis of risks for the following:
    - Final post-rehabilitation topographic and drainage morphology;
    - Maintenance of water quality; and
    - Post closure local / offsite / downstream impacts from site contamination after final removal of Heap Leach Infrastructure, from radiation, heavy metals and/or toxic metalloids.
- Discuss the potential impacts on decommissioning, removal, rehabilitation and revegetation activities from extreme weather events and climate change.

Protection, Management and Monitoring

- Discuss proposed rehabilitation techniques and management with regard to potential for ongoing post-closure radiation risks from Heap Leach infrastructure sites.
  - Discuss to what extent radiation risks at sites contaminated by Heap Leach operations are likely to be able to be mitigated by rehabilitation techniques;
  - Describe any post-rehabilitation constraints expected to be placed on future uses of the sites due to radiation hazards, once the sites are incorporated back into Kakadu National Park.
- With regard to potential for on/off-site contamination, and ongoing acidic and/or metalliferous drainage after final removal of Heap Leach Infrastructure, and post closure, discuss ERA's proposed:
  - prediction;
  - monitoring;
  - avoidance, minimisation and mitigation strategies; and
  - contingency management, if found to occur.
- Discuss decommissioning, removal and rehabilitation of the Heap Leach Infrastructure sites, in terms of:
  - Runoff and erosion control measures of rehabilitated areas to ensure runoff discharge does not erode or add to downstream siltation;
  - Erosion and sediment control procedures.
  - Amendments to Process-Water Management, water needs, water monitoring, and discharge requirements with successive decommissioning of Facility components.
- Discuss monitoring of vegetation establishment and stabilisation to achieve rehabilitation objectives;
  - Determine whether seed bank in topsoil will be adequate and will remain viable for rehabilitation purposes;
  - Conduct plant revegetation trials on stripped topsoil to determine whether existing local indigenous vegetation is adequate for rehabilitation purposes;
  - Detail any native local provenance seed collection program and local species that may require a research component to optimise recruitment success.
  - Determine whether soil replacement methods for rehabilitation purposes are sufficient to maintain vegetation;
  - Proposed environmental indicators to measure progress in achieving the completion criteria (or process to develop these);
  - Proposed quantitative completion criteria or the process of developing these criteria;
- Describe how achievement of closure criteria will be demonstrated.
- Describe proposed methods for rehabilitating disturbed areas no longer required for mining operations, including revegetation strategies, surface stabilities and monitoring programs.

- Describe any proposed Strategies for the involvement of stakeholders, in determining the rehabilitation goals and objectives;
- Define criteria for success of the decommissioning, removal and rehabilitation, particularly of the Residue Storage Dam.
- Describe and discuss methods proposed for the remediation of any contaminated groundwater that may exist following the removal of the Residue Storage Dam, and again later for the Heap Leach Facility, and how this relates to proposed methods of groundwater remediation of the current Tailings Storage Facility. Summarise the findings of relevant studies to date.
- Describe the proposed final use for the rehabilitated area, taking into account the social, cultural, environmental and economic regime of the region.
- Describe proposed long term monitoring and management of surface and sub surface drainage and subsidence

5.9 SOCIO-ECONOMIC IMPACTS

5.9.1 SOCIAL IMPACT ASSESSMENT

Outcome

A Social Impact Assessment will identify potential social risks resulting from the Facility and develop appropriate mitigation strategies. The design and focus of the Assessment will reflect social and community risks specific to this Facility.

Information Requirements

Describe and discuss the following, including indication of their significance:

- Baseline aspects of the socio-economic environment potentially affected by the Facility, construction, operation and closure/rehabilitation of the Heap Leach Facility, including:
  - Demographic characteristics;
  - Social factors (lifestyle characteristics, existing trends, social problems and underlying reasons) including reference to results and recommendations of relevant studies;
  - Employment levels and characteristics; and
  - Cultural-spiritual environment and values;
- Community liaison and consultation including identification of, and ongoing consultation and negotiations with, all relevant stakeholders, ensuring the full range of community viewpoints are sought.

(Economic aspects)

- Estimate the quantity and value of production/exports as it relates to the Heap Leach Facility, including expected reduction in revenue should the proposal not proceed;
- Estimate the value of expenditure during the construction phase;

- Estimate the value of annual expenditure on regional goods and services as it relates to the Heap Leach Facility;
- Describe potential opportunities related to the Heap Leach Facility for the development of new skills and facilities that may be of benefit to the local community, past the lifetime of the mine;
- Describe relevant opportunities the Heap Leach proposal provides for ERA to contribute to Indigenous economic development and wider regional development in the surrounding region; and
- Describe how potential local and regional business and employment opportunities related to the Heap Leach Facility will be identified and involved.

Potential Impacts

- Define risk of the Heap Leach Facility or associated workforce impacting on identified social issues in the region of the Ranger Project Area.
- Define benefits of the Heap Leach Facility or associated workforce in the region of the Ranger Project Area.
- Describe and discuss risks and benefits posed by the Heap Leach Facility or associated workforce upon:
    - The Cultural-Spiritual environment;
    - Cultural-spiritual values, including connection to country;
    - Demographic characteristics of the area;
    - Social factors (lifestyle characteristics, existing trends, social problems), employment levels); and
    - Sites of archaeological and/or cultural heritage or anthropological significance (as listed above).

Protection, Management and Monitoring

- Define how ERA proposes to manage any identified social, cultural or spiritual risks from the Heap Leach Facility or associated workforce, in the region of the Ranger Project Area.
    - Demonstrate that appropriate management can and will occur.
- Define how ERA proposes to address any identified potential socio-economic impacts associated with the Heap Leach Facility.
- Describe means in relation to the Heap Leach Facility, by which ERA proposes or commits to contribute to:
    - Development of new skills and facilities of benefit to the local community, past the lifetime of the mine;
    - Indigenous economic development and wider regional development in the surrounding region; and
    - Identification and involvement of potential local and regional business and employment opportunities.

5.9.2 TRADITIONAL ESTATE

Context

The Ranger Project Area is on Aboriginal land as defined under the *Aboriginal Land Rights (Northern Territory) Act 1976* and forms part of the Kakadu Land Trust granted under this Act. The Mirarr people are the traditional owners and maintain cultural connection with the land.

Several catchments drain the Ranger Project Area into Magela Creek, which passes through the downstream Aboriginal community of Madjinbardi.

Outcome

- ERA will ensure that the Heap Leach Facility will not have a net negative social, economic or cultural impact for Traditional Owners of the Ranger Project Area, or for other affected socio-economic groups.
- ERA will ensure that no disturbance will occur to Aboriginal artefacts or sites of significance unless prior approval under the relevant legislation and from relevant groups is obtained.
- ERA will ensure Indigenous heritage surveys and heritage impact mitigation and management arrangements will be developed and implemented in collaboration with the local Aboriginal community and/or appropriate representative body, in accordance with the best practice approach outlined in *Ask First: A guide to respecting Indigenous heritage places and values*[14].

Information Requirements

- Describe existing points of ongoing community discussion, and benefit arrangements that ERA has with Traditional Owner groups that are likely to have continued or increased relevance with construction and operation of the Heap Leach Facility.

Describe and discuss the following, including indication of their significance:

- Sites of archaeological heritage, cultural heritage or anthropological significance potentially affected by the impact footprint of the Facility:
  - Sites of Aboriginal or European archaeological significance;
  - Aboriginal art sites;
  - Registered sacred sites with reference to Aboriginal Areas Protection Authority certification;
  - Unregistered sacred sites, with approval of the Gundjeihmi Aboriginal Corporation; and
  - Registered Heritage Sites listed under International Conventions, National or Territory Legislation.

Potential Impacts

Describe any potential for the Heap Leach Facility to impact upon:

- Amenity and traditional practices of Aboriginal communities living in and around Jabiru and downstream locations;
- Aboriginal values or culture in the region;

[14] Australian Heritage Commission (2002)

- Traditional owners' projected use of the land after the proposed Facility has been completed; and
- Aboriginal sites of scientific, mythological and/or cultural significance.

- Describe and discuss risks posed by the Heap Leach Facility or associated workforce upon:
    - Sites of archaeological and/or cultural heritage or anthropological significance (as listed above).

Protection, Management and Monitoring

- Describe how risks identified above will be avoided, minimised, or offset.
- Describe how ERA proposes to utilise the development of a Heap Leach Facility as a means of increasing social and / or economic benefits to Traditional Owner groups of the area.
- Define how ERA proposes to avoid, minimise or mitigate potential risks to sites of identified archaeological and/or cultural heritage or anthropological significance.

5.9.3 WORKFORCE

Information Requirements

- Define the expected source of labour forces. Include references to regional availability; workforce establishment and maintenance including predicted increase in total population numbers resulting from direct employment on the Facility.

Potential Impacts

- Describe socio-economic issues anticipated with providing workers accommodation, and expected social impacts associated with (and caused by) an expanded workforce.
- Describe environmental impacts anticipated with provision of new infrastructure to accommodate workers for the Heap Leach Facility.

Protection, Management and Monitoring

- Describe and discuss how ERA proposes to manage and monitor any identified potential socio-economic impacts and/or benefits associated with the workforce for the Heap Leach Facility.
- Discuss and justify why any increase in accommodation on the ERA lease could be considered acceptable in health terms.
- Describe proposed management to avoid or minimise environmental risks associated with provision of new infrastructure to accommodate workers for the Heap Leach Facility.

6. OTHER RISKS

6.1 SOILS AND SEDIMENTS

Potential Impacts

- Identify and evaluate potential environmental risks to soils and sediments from:
    - Construction works associated with the development of the Heap Leach Facility site, and with Operation of the Facility: and
    - Contamination with heavy metals (e.g. Cd and Pb), toxic metalloids (e.g. As), and radionuclides associated with the U-decay chain.

Protection, Management and Monitoring

- Describe management, monitoring and contingency plans to address:
    - Erosion and sediment control such that it can form the basis for an *Erosion and Sediment Control Plan* identifying risks during construction, operation and extreme rainfall events; and
    - Contamination of soils and sediments with heavy metals, toxic metalloids and/or radionuclides associated with the U-decay chain.

6.2 GREENHOUSE GAS EMISSIONS

- Define projected increases in the level of greenhouse gas emissions as a result of the Heap Leach Facility, and compare this estimate with that from current operations.
    - Consider greenhouse gas release from the processing of uranium enriched liquor, heap leach dissolution and residue storage; and
    - Calculate projected greenhouse gas emissions as a result of land clearing for, and construction of the Facility.

Further detailed information requirements on this topic are defined in *Appendix B - Greenhouse Gas Emissions and Climate Change*.

6.3 MOSQUITO BREEDING

Outcome

Management should conform to applicable sections of the Northern Territory Department of Health and Families Guideline: *Guidelines for Preventing Mosquito Breeding Sites Associated with Mining Sites*

Potential Impacts

- Identify risks associated with mosquitoes and biting insects to workers and the public associated with the Heap Leach Facility.

Protection, Management and Monitoring

- Describe measures proposed to prevent mosquito breeding and reduce risks of biting insects to workers and the public, associated with the Heap Leach Facility.

REFERENCES

Australian Heritage Commission (2002) Ask First: A guide to respecting Indigenous heritage places and values, Australian Heritage Commission 2002. Indigenous Heritage Section of the Australian Heritage Commission. Canberra. National Library of Australia ISBN 0 642 54842 0. Available online at: *http://www.environment.gov.au/heritage/ahc/publications/commission/books/ask-first.html*

Energy Resources of Australia Ltd (2009) Notice of Intent 13/03/2009. *Heap Leach Facility For Energy Resources Of Australia Ltd's Ranger Uranium Mine.* Version: *090312_2-2177 Ranger Heap Leach Referral_Final (NRETAS NOI Guidelines).Doc*
identical content to the EPBC referral # 2009/4794, available online at: http://www.environment.gov.au/cgi-bin/epbc/epbc_ap.pl?name=current_referral_detail&proposal_id=4794.
Version: 090312_2-2177 Ranger heap leach referral_final.doc

The Notice of Intent can be viewed on the NRETAS website at: http://www.nt.gov.au/nreta/environment/assessment/register/index.html

Fox, R W, Kelleher, G .G. & Kerr, C B (1977) Ranger Uranium Environmental Inquiry – Second Report.(Australian Government Publishing Service, Canberra, 1977) [NRETA Library 622.349 RAN]

NRETAS (2006) *Land Clearing Guidelines 2006 Updated Version*. Technical Report No. 27/2002. Land Clearing Guidelines. First published 2002. Updated 2006. Department of Natural Resources, Environment and the Arts. Natural Resource Management Division. ISBN: 0 7245 4880 7. Also available at: *http://nt.gov.au/nreta/natres/natveg/guidelines/pdf/Land_Clearing_Guidelines_2006.pdf*

Ramsar Information Sheet for Kakadu National Park (Stage II). Available at: http://www.environment.gov.au/cgi-bin/wetlands/report.pl?smode=RAMSAR&ramsar_refcodelist=30
and
http://media.bmt.org/bmt_media/bmt_services/49/30-RIS_KakaduNationalParkStage2.pdf

APPENDIX A -
(SECTION 12.4 OF) ENVIRONMENTAL REQUIREMENTS OF THE COMMONWEALTH OF AUSTRALIA FOR THE OPERATION OF RANGER URANIUM MINE

Section 2.4 defines **Best Practicable Technology (BPT)** as:

That technology from time to time relevant to the Ranger Project which produces the maximum environmental benefit that can be reasonably achieved having regard to all relevant matters including:

(a) the environmental standards achieved by uranium operations elsewhere in the world with respect to

(i) level of effluent control achieved; and

(ii) the extent to which environmental degradation is prevented;

(b) the level of environmental protection to be achieved by the application or adoption of the technology and the resources required to apply or adopt the technology so as to achieve the maximum environmental benefit from the available resources;

(c) evidence of detriment, or lack of detriment, to the environment;

(d) the physical location of the Ranger Project;

(e) the age of equipment and facilities in use on the Ranger Project and their relative effectiveness in reducing environmental pollution and degradation; and

(f) social factors including the views of the regional community and possible adverse effects of introducing alternative technology.

Also: from *Fox et. al*. (1977), p.14:

*The term **"best practicable technology'** does not refer to a level of pollution control technology representing the economic optimum between the cost of investment in equipment and the cost of environmental damage. The way in which cumulative and insidious environmental effects tend to be produced by successive minor increases in pollution makes it doubtful that such an economic optimum could be determined before major pollution actually occurred.….we mean the best technology developed anywhere which can be applied to the uranium industry in Australia.*

APPENDIX B -
GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE

NT ENVIRONMENTAL IMPACT ASSESSMENT GUIDE:

GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE[15]

PURPOSE

The Northern Territory Government's objective for managing greenhouse gas emissions from new and expanding operations is to minimise emissions to a level that is as low as practicable. This will help fulfil the objective of minimising greenhouse gas emissions from the NT into the future.

The Northern Territory Government's objective for considering future climate change in the assessment process is to ensure projects and developments are planned taking climate change science and projections into account, to minimise future environmental, social and economic costs and take advantage of any opportunities.

This Guide aims to assist proponents in providing the information needed by the Department of Natural Resources, Environment, the Arts and Sport (NRETAS) to assess the impact of greenhouse gas emissions from proposed projects and assess other potential impacts from proposed projects under projected future climatic conditions under the Northern Territory *Environmental Assessment Act (1982)*.

GUIDANCE

Emissions estimates

Note that the Australian Government is establishing a national greenhouse gas emissions trading system (the proposed Carbon Pollution Reduction Scheme – CPRS), which may have implications for some proponents. More information on the CPRS available at http://www.climatechange.gov.au/emissionstrading/index.html

Proponents should detail the following in their environmental impact assessment documentation:

[15] Last updated 2 July 2009.

1. An estimate of the greenhouse gas emissions for the construction and operation phases:

(a) in absolute and carbon dioxide equivalent figures (refer to the Glossary in this Guide) for each year of the Facility;
(b) identified on a gas by gas basis; and
(c) by source (including on site and upstream sources such as emissions arising from land clearing and the production and supply of energy to the site).

Emissions estimates are to be calculated using the methodology developed and periodically updated by the National Greenhouse Gas Inventory Committee or another national or internationally agreed methodology. See http://www.climatechange.gov.au/workbook/index.html for access to the National Greenhouse Accounts Factors which may assist.

For emissions from clearing of vegetation, emissions estimates are to be calculated using the National Carbon Accounting System, or another nationally recognised methodology. For more information see http://www.climatechange.gov.au/ncas/index.html

2. Details of the Facility lifecycle greenhouse gas emissions and the greenhouse gas efficiency of the proposed Facility (per unit and/or other agreed performance indicators).

Lifecycle emissions and greenhouse gas efficiency should be compared with similar technologies producing similar products.

To provide an understanding of the broader impact of the Facility, proponents are encouraged to place the estimated greenhouse gas emissions from the Facility into a national and global context. Information on Australia's national emissions profile can be obtained from the Department of Climate Change at http://www.climatechange.gov.au/inventory/2005/index.html. International emissions can be seen at the United Nations Framework Convention on Climate Change (UNFCCC) website at http://unfccc.int/ghg_emissions_data/items/3800.php

Measures to minimise greenhouse gas emissions

Proponents must demonstrate consideration of a wide range of options and indicate the intended measures and efficient technologies to be adopted to minimise total greenhouse gas emissions from the proposed Facility, including:

(a) identifying energy conservation measures, opportunities for improving energy efficiency and ways to reduce fugitive emissions where applicable;

(b) indicating where potential savings in greenhouse gas emissions can be made through the use of renewable energy sources, taking into account fossil fuels used for supplementary power generation; and

(c) whilst recognising the likely commencement of an emissions trading scheme, their commitment to offsetting greenhouse gas emissions.

The design measures to maximise efficiency and minimise emissions should represent best practice at the time of seeking Facility approval.

Offsets

Emission offsets include activities that remove carbon from the atmosphere or reduce the greenhouse gas intensity (output per unit product) from current or future activities. No Australian standards for offsets currently exist, although the Australian Government is developing a National Carbon Offset Standard (see: http://www.climatechange.gov.au/carbonoffsetting/ncos/ncos.html).

Measures that offset emissions within the NT are strongly encouraged, and NRETAS staff can discuss possible options with proponents. Proposed emissions offsets projects should include an estimate of greenhouse gas emissions savings that will be achieved through implementation.

Emissions monitoring and reporting

Consistent with the principles of continuous improvement, a program is to be outlined in the proponent's Environmental Management Plan which includes ongoing monitoring, investigation, review and reporting of greenhouse gas emissions and abatement measures.

The Australian Government is developing a nationally consistent framework for greenhouse and energy reporting by industry. Projects with significant emissions may be required to report their emissions under the *National Greenhouse and Energy Reporting Act 2007*. Data reported through the system will underpin the proposed CPRS. For more information see http://www.climatechange.gov.au/reporting/index.html

Impacts of climate change

Climate change is projected to result in changes to sea level, land and sea temperatures, cyclone intensity, frequency of fire, weather, and frequency of extreme weather events including storms, drought and flood.

Proponents should discuss how projected climate change has been taken into account in planning the Facility, and how climate change is expected to affect the Facility over its stated lifetime. Proponents should discuss how climate change-related risks (for example, risk of failure of Facility infrastructure during potential extreme weather events) will be managed.

Potential impacts of climate change on the surrounding environment including water, land, biodiversity and ecosystems, coastal zones, and the social environment should also be taken into account in Facility planning.

In assessing climate change risk, proponents should be guided by recent projections published by organisations such as the CSIRO, the Bureau of Meteorology (BoM), and the Intergovernmental Panel on Climate Change. For the latest CSIRO and BoM projections for Australia, see: http://www.climatechangeinaustralia.gov.au

GLOSSARY OF GREENHOUSE TERMS

Abatement: Limiting, abating, avoiding or sequestering greenhouse gas emissions through source reduction, fuel displacement or switching, carbon stabilising techniques or sink enhancement.

Absolute emissions: Refers to the total emissions of greenhouse gases expressed in terms of the actual mass of each individual gas emitted over a specified time period.

Best Practice: A best practice is a process, technique, or use of technology, equipment or resource that has a proven record of success in minimising energy use and greenhouse gas emissions. A commitment to use best practice is a commitment to use all available knowledge and technology to ensure that greenhouse gas emissions are minimised.

Carbon Dioxide Equivalent: A unit of greenhouse gas emissions calculated by multiplying the actual mass of emissions by the appropriate Global Warming Potential. This enables emissions of different gases to be added together and compared with carbon dioxide (see Table 1 below).

Greenhouse Gases: Table 1 lists the greenhouse gases proponents are required to report on.

Global Warming Potential (GWP): The warming potential of a gas, compared to that for carbon dioxide. GWPs are revised from time to time as knowledge increases about the influences of different gases and processes on climate change. Refer Table 1.

Facility Lifecycle Greenhouse Gas Emissions: Those greenhouse gas emissions measured cumulatively over a defined period. Typically this period is from the point of extraction of the raw materials to either the beginning of the consumer phase of a product or the final disposal or recycling stage of a product, depending on its nature. Proponents should justify their choice of the defined period.

National Greenhouse Gas Inventory Committee: A committee comprising representatives of the Commonwealth, State and Territory Governments that oversees the development of greenhouse gas inventory methods and compilation of inventories for Australia.

Sequestration: Removal of greenhouse gases from the atmosphere by vegetation or technological measures. Sequestration is not yet precisely defined for the purposes of recognised trading or offset schemes. Accordingly, NRETAS will take a common sense approach on a case by case basis in the interim. To assist proponents, NRETAS regards sequestration as a process that results in the isolation of carbon dioxide from the atmosphere for a period which is significant in terms of influencing the global warming effect.

Source: Any process or activity that releases a greenhouse gas into the atmosphere.

Table 1: Greenhouse gases and respective Global Warming Potential (GWP) factors

Greenhouse Gas	Global Warming Potential
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
Perfluorocarbons (CF_x)	6,500 – 9,200
Hydrofluorocarbons (HFCs)	140 - 11,700
Sulphur hexafluoride (SF_6)	23,900

Greenhouse gas emissions expressed in carbon dioxide equivalent (CO_2-e) are calculated by multiplying the actual mass of emissions for each greenhouse gas by its respective GWP factor. GWP factors listed are those published by the International Panel on Climate Change in its 4th Assessment Report, 2007, see http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_Ch02.pdf