



Australian Government

Department of the Environment, Water, Heritage and the Arts

Supervising Scientist

# SUPERVISING SCIENTIST



*Annual Report*  
2009-2010



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**Australian Government**

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**Department of Sustainability, Environment, Water, Population and Communities  
Supervising Scientist**

The Hon Tony Burke MP  
Minister for Sustainability, Environment, Water, Population and Communities  
Parliament House  
CANBERRA ACT 2600

18 October 2010

Dear Minister

In accordance with subsection 36(1) of the *Environment Protection (Alligator Rivers Region) Act 1978* (the Act), I submit to you the thirty-second Annual Report of the Supervising Scientist on the operation of the Act during the period of 1 July 2009 to 30 June 2010.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Alan Hughes'.

Alan Hughes  
Supervising Scientist

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Photos (from top left) Measuring stream discharge, sieving soil, field spectral calibration on Jabiluka billabong, testing probes on Ranger trial landform (TL), bushtucker collecting and (inset) green plums, community liaison, ground calibration of satellite image (and below that) soil sampling, spectral sampling on Ranger TL, ARRTC members field trip, biomass survey on Magela floodplain, seminar at SSD, snail aquaculture tanks at Jabiru Field Station, (bottom right) deployment of uranium-spiked sediments.

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# FOREWORD

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Subsection 36(1) of the *Environment Protection (Alligator Rivers Region) Act 1978* requires the Supervising Scientist to provide an Annual Report to Parliament on the operation of the Act and on certain related matters. The Act requires the following information to be reported:

- all directions given to the Supervising Scientist by the Minister who, for this reporting period, was the Minister for Environment Protection, Heritage and the Arts;
- information on the collection and assessment of scientific data relating to the environmental effects of mining in the Alligator Rivers Region;
- standards, practices and procedures in relation to mining operations adopted or changed during the year, and the environmental effects of those changes;
- measures taken to protect the environment, or restore it from the effects of mining in the region;
- requirements under prescribed instruments that were enacted, made, adopted or issued and that relate to mining operations in the Alligator Rivers Region and the environment;
- implementation of the above requirements; and
- a statement of the cost of operations of the Supervising Scientist.

# **SUPERVISING SCIENTIST'S OVERVIEW**

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The Supervising Scientist plays an important role in the protection of the environment of the Alligator Rivers Region of the Northern Territory through the supervision, monitoring and audit of uranium mines in the Region, as well as research into the possible impact of uranium mining on the environment of the Region.

Ranger is currently the only operational uranium mine in the Region, and is owned and operated by Energy Resources of Australia Ltd (ERA). Production commenced at Ranger in August 1981, and current plans will see mining of the Ranger 3 deposit cease in 2012 with milling of stockpiled ore expected to continue through until 2020. Recent proposals by ERA to include a heap leach facility at Ranger have not affected the current mining and milling operations timetable but could potentially increase production over the same period.

As the time of mine closure and rehabilitation draws closer, the work of the Supervising Scientist includes a focus on these themes as well as on current operational issues. Staff have been engaged with stakeholders in discussions and research activities associated with rehabilitation and closure.

Staff of the Division remain active in ongoing supervision, inspection and audit, radiological, biological and chemical monitoring, and research activities in relation to both present and past uranium mining activities in the Region. Significant work has continued in developing improvements to the Supervising Scientist's surface water monitoring program. This program is relevant to both the operational and rehabilitation phases of mining.

At Ranger mine the 2009–10 wet season was around average with rainfall of 1596 mm. During the year there were no reported incidents that resulted in any environmental impact off the immediate minesite. The extensive monitoring and research programs of the Supervising Scientist Division confirm that the environment has remained protected through the period.

Over the past year ERA achieved a small reduction in the process water volumes stored on site by reducing additions to the process water systems through measures including reducing the area of surface runoff catchment reporting to it. However, delays in commissioning of the process water treatment facility and deferred implementation of a proposed enhanced evaporation program mean that the process water inventory at the mine remains a focus.

Monitoring programs by ERA, the NT Department of Resources and SSD continue to indicate that there is no evidence of seepage from the base of the Ranger tailings storage facility (TSF) impacting on Kakadu National Park. ERA has installed additional monitoring bores around the TSF at the request of stakeholders, including SSD.

The SSD surface water quality monitoring program continues to be improved with refinements to the operation of continuous monitoring of pH, electrical conductivity (EC) and turbidity in Magela and Gulungul Creeks upstream and downstream of Ranger mine. Continuous monitoring results indicate that water quality variations, both natural and mine-related, can occur on a time base measured in hours rather than days. This method of

monitoring has therefore proven to be superior to the statutory weekly grab sampling technique that is currently employed.

The SSD monitoring stations have also been equipped with autosamplers that collect water samples triggered by in-stream events such as increases in EC or turbidity exceeding defined threshold levels. This has enhanced the capability of the monitoring program by allowing collection of samples outside of normal working hours or when conditions in the creeks are unsafe for manual grab sampling.

During April 2010 there were occasions where EC spikes in Magela Creek triggered the SSD autosampler at the downstream monitoring station. Subsequent analysis of the samples confirmed that the cause was elevated levels of magnesium sulfate in the water and that these events did not contain significantly elevated levels of uranium or radium. It was concluded that the anomalous EC readings were mine-related, having resulted from elevated salt levels in Retention Pond 1.

The principal biologically-based toxicity monitoring approach for 2009–10 was in situ monitoring using fresh water snails, with test organisms deployed in containers floating in the creek water. This program was extended from Magela Creek to include Gulungul Creek during the 2009–10 wet season.

Determination of radionuclide levels in mussels from Mudginberri Billabong has been a continuing element of the SSD monitoring program downstream of Ranger. Results for 2009–10 are similar to previous years and it is concluded that the consistently low levels of uranium and radium in mussels collected downstream of Ranger pose no risk to human or ecological health.

Ecotoxicology research programs in progress include determination of responses for a variety of organisms to pulse event durations for a range of magnesium concentrations. Previous work has confirmed a strong correlation between magnesium and EC in Magela Creek. Use of EC as a surrogate for magnesium has the obvious advantage of being suitable for direct measurement rather than relying on sampling and analysis at a remote laboratory.

An eight hectare trial landform was constructed by ERA during late 2008 and early 2009 adjacent to the north-western wall of the tailings storage facility at Ranger mine. SSD is involved in erosion studies on the trial landform to assist in longer term modelling of the performance of ultimate landform created during rehabilitation of the site.

The Jabiluka project remains in long-term care and maintenance, and the next stage of the project is a matter for discussion between ERA and the area's traditional owners.

The Nabarlek mine in western Arnhem Land was decommissioned in 1995 and the rehabilitation of this site remains under ongoing assessment. During the year Uranium Equities Limited undertook exploration and rehabilitation activities at Nabarlek. SSD participated in stakeholder inspections and audits of these activities and there were no significant environmental issues identified.

Detailed research outcomes of the Environmental Research Institute of the Supervising Scientist (*eriss*) are published in journal and conference papers and in the Supervising Scientist and Internal Report series. Highlights of this work are described in this annual report.

In May 2006, the Australian Government announced funding to undertake rehabilitation of former uranium mining sites in the South Alligator River Valley in the southern part of Kakadu National Park. Most of the work associated with this project has now been completed. SSD continues to provide advice and assistance to the Director of National Parks as the rehabilitation works are completed and post works monitoring progresses.

The Alligator Rivers Region Technical Committee (ARRTC) continues to play a vital role in assessing the science used in making judgements about the protection of the environment from the impacts of uranium mining. Dr Gavin Mudd was appointed to ARRTC as a technical member representing environmental non-government organisations. Dr Carl Grant and Professor Peter Johnston resigned as independent members during 2009–10 and replacement members were appointed in early 2010–11. The new members are Professor David Mulligan and Mr Andrew Johnston. Their areas of expertise are in plant ecology and rehabilitation and in radiation protection respectively.

During the reporting period, SSD provided advice to the Approvals and Wildlife Division of the department on referrals submitted in accordance with the EPBC Act for proposed new and expanding uranium mines, including the following projects:

- Olympic Dam Expansion, SA
- Ranger Mine Heap Leach proposal, NT
- Beverley North Project, SA
- Yeelirrie WA

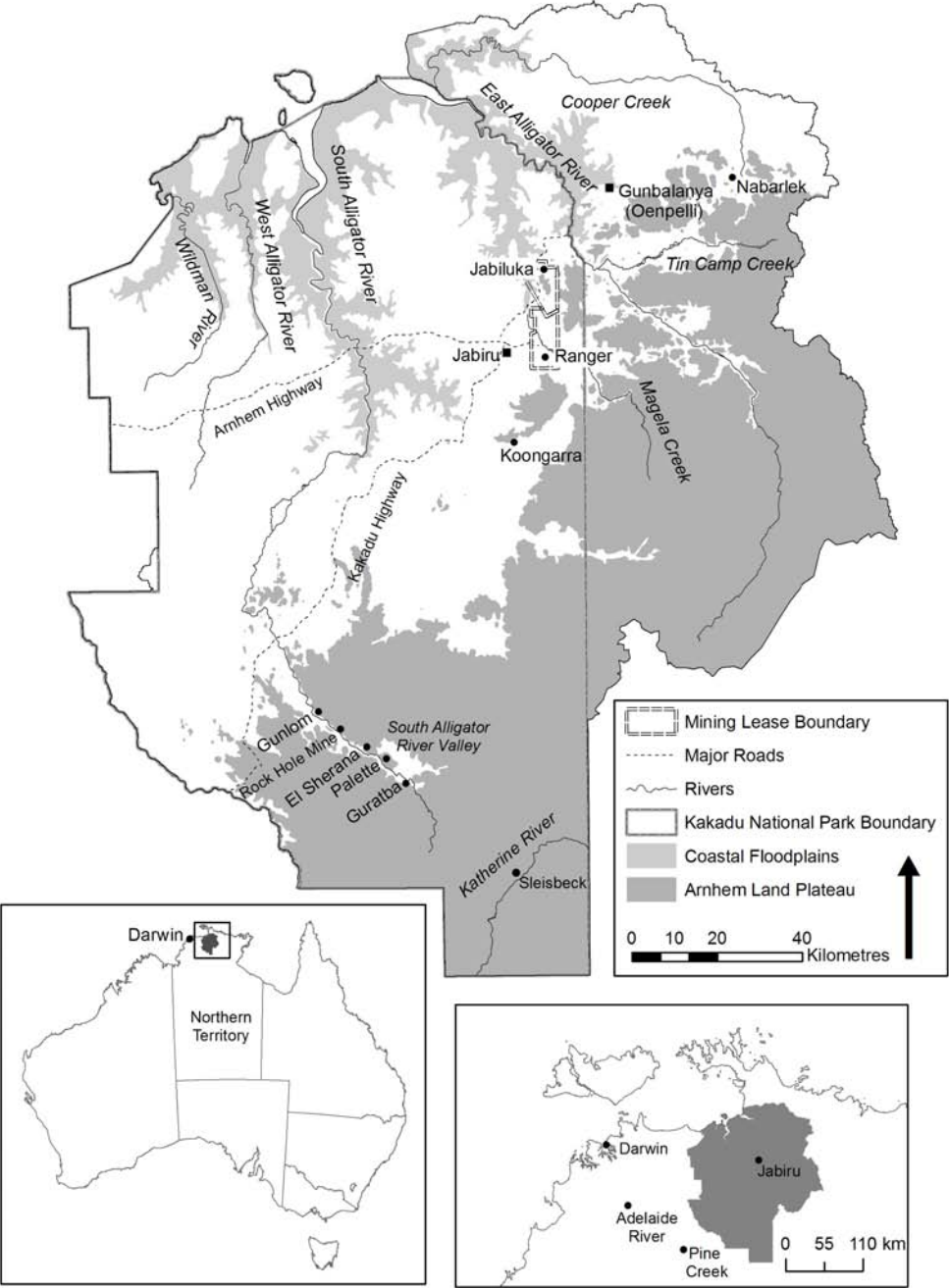
Funds were provided in the 2009–10 Federal Budget for a four-year program to progress and implement environmental maintenance activities, conduct appropriate environmental monitoring programs and develop contemporary site rehabilitation strategies at Rum Jungle under a national partnership agreement between the Northern Territory and the Australian Government. The Rum Jungle Technical Working Group (RJTWG) comprises representatives from the NT Department of Resources, NT Department of Natural Resources, Environment, the Arts and Sport, Australian Government Department of Resources, Energy and Tourism, the Northern Land Council and SSD. SSD has contributed to the work of the RJTWG during the reporting period.

Finally, I would like to offer my personal thanks to all the staff of the Supervising Scientist Division for their continued enthusiasm and efforts during the year. The commitment and professionalism of the Division's staff remain vital factors in the Division being able to fulfil its role in environmental protection.

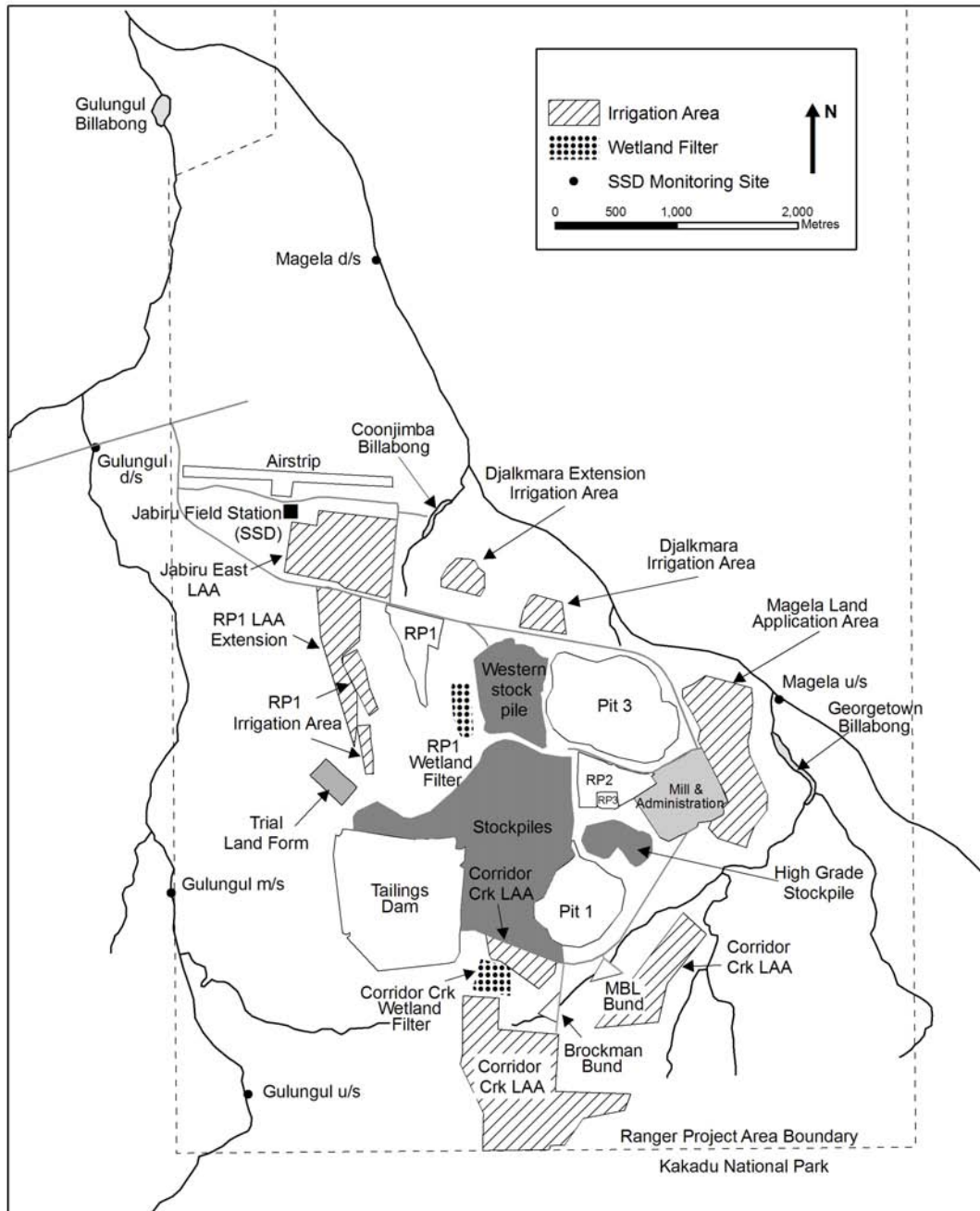
A handwritten signature in black ink, appearing to read 'Alan Hughes', with a stylized flourish at the end.

Alan Hughes  
Supervising Scientist

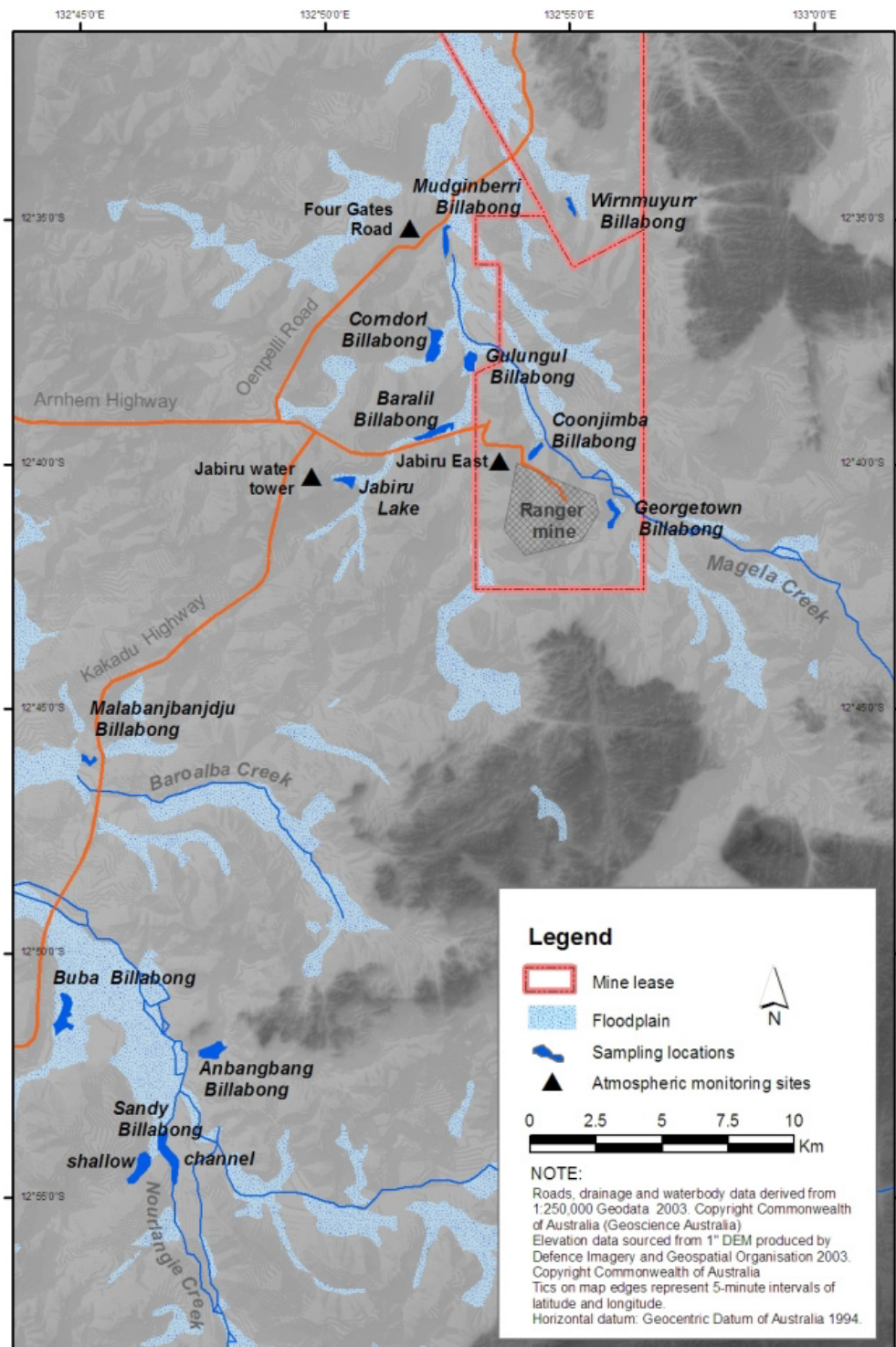




Map 1 Alligator Rivers Region



**Map 2** Ranger minesite



# ABBREVIATIONS

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<b>ARR</b>	Alligator Rivers Region
<b>ARRAC</b>	Alligator Rivers Region Advisory Committee
<b>ARRTC</b>	Alligator Rivers Region Technical Committee
<b>DEWHA</b>	Department of the Environment, Water, Heritage and the Arts
<b>DRET</b>	Department of Resources, Energy and Tourism
<b>DoR</b>	Department of Resources (formerly Department of Regional Development, Primary Industry, Fisheries and Resources)
<b>EMS</b>	Environmental Management System
<b>ERA</b>	Energy Resources of Australia Ltd
<b>ERAES</b>	ERA Environmental Strategy (formerly EWLS)
<b><i>eriss</i></b>	Environmental Research Institute of the Supervising Scientist
<b>ERs</b>	Environmental Requirements
<b>G8210009</b>	Magela Creek d/s (downstream) gauging station
<b>GAC</b>	Gundjehmi Aboriginal Corporation
<b>IAEA</b>	International Atomic Energy Agency
<b>ICRP</b>	International Commission on Radiological Protection
<b>KKN</b>	Key Knowledge Needs
<b>LAA</b>	Land application area
<b>MCUGT</b>	Magela Creek u/s (upstream) site (formerly described as MCUS)
<b>MTC</b>	Minesite Technical Committee
<b>NLC</b>	Northern Land Council
<b>NRETAS</b>	Department of Natural Resources, Environment, the Arts and Sport
<b><i>oss</i></b>	Office of the Supervising Scientist
<b>POSS</b>	Parks Operational Support Section
<b>POT</b>	Parks Operation and Tourism Branch
<b>RJTWG</b>	Rum Jungle Technical Working Group
<b>RL</b>	Reduced Level – the number after RL denotes metres above or below a chosen datum
<b>RMC</b>	Rockhole Mine Creek
<b>RPI</b>	Routine Periodic Inspection
<b>SEWPAC</b>	Department of Sustainability, Environment, Water, Population and Communities
<b>SSAR</b>	Supervising Scientist Annual Report
<b>SSD</b>	Supervising Scientist Division
<b>TRaCK CERF</b>	Tropical Rivers and Coastal Knowledge Commonwealth Environmental Research Facility
<b>TSF</b>	Tailings Storage Facility
<b>UEL</b>	Uranium Equities Limited

# GLOSSARY

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1s – 7s	When referring to ore and stockpiles indicates the amount of extractable uranium in the ore (grade). At Ranger, 1s indicates the lowest grade (waste) and 7s indicates the highest grade ore.
airborne gamma survey	Aerial measurements of the terrestrial gamma radiation using a large volume sodium iodide (NaI) detector on board an aircraft.
alpha radiation ( $\alpha$ )	A positively charged helium ( $\text{He}^{2+}$ ) nucleus (two protons + two neutrons) that is spontaneously emitted by an energetically unstable heavy atomic nucleus (such as $^{226}\text{Ra}$ or $^{238}\text{U}$ ).
application	A document stating how the mining operator proposes to change the conditions set out in the mining Authorisation. These changes need to be approved by all MTC stakeholders.
authorisation	For mining activities authorisation is required under the Northern Territory <i>Mining Management Act</i> (MMA) for activities that will result in substantial disturbance of the ground. It details the authorised operations of a mine, based on the submitted mining management plan and any other conditions that the Northern Territory Minister considers appropriate.
becquerel (Bq)	SI unit for the activity of a radioactive substance in decays per second [ $\text{s}^{-1}$ ].
beta radiation ( $\beta$ )	A high energy electron or positron emitted when an unstable atomic nucleus (such as $^{90}\text{Sr}$ or $^{40}\text{K}$ ) loses its excess energy.
bioaccumulation	Occurs when the rate of uptake by biota of a chemical substance, such as metals, radionuclides or pesticides is greater than the rate of loss. These substances may be taken up directly, or indirectly, through consumption of food containing the chemicals.
bioavailable	The proportion of the total present (in water, sediment, soil or food) of metals and radionuclides, that can be taken up by biota (see also bioaccumulation).
biodiversity (biological diversity)	The variety of life forms, including plants, animals and micro-organisms, the genes they contain and the ecosystems and ecological processes of which they are a part.
biological assessment	Use and measurement of the biota to monitor and assess the ecological health of an ecosystem.
biological community	An assemblage of organisms characterised by a distinctive combination of species occupying a common environment and interacting with one another.
bund	Embankment or wall designed to retain contents (usually liquids) in the event of leakage or spillage from a storage facility.
concentration factor	The metal or radionuclide activity concentration measured in biota divided by the respective concentration measured in the underlying soil (for terrestrial biota) or water (for aquatic biota).
damp-proof course	A waterproof barrier comprising bitumen and aluminium.
direct seeding	Vegetation is established by broadcasting seed across the area to be revegetated.
dissolved organic carbon	Natural organic material from plants and animals that has broken down and is able to pass through a very fine (0.45 micrometre) filter.

dose coefficient	The committed tissue equivalent dose or committed effective dose Sievert [Sv] per unit intake Becquerel [Bq] of a radionuclide. See definition of Sievert and Becquerel.
dose constraint	The International Commission on Radiation Protection (ICRP) defines dose constraint as ' <i>a prospective restriction on anticipated dose, primarily intended to be used to discard undesirable options in an optimization calculation</i> ' for assessing site remediation options.
early detection	Measurable early warning biological, physical or chemical response in relation to a particular stress, prior to significant adverse affects occurring on the system of interest.
flume	A channel control structure with known cross-sectional area used to measure flow rate of runoff water.
fulvic acid	A component of dissolved organic carbon that is especially reactive and forms strong complexes with metals. Fulvic acids account for a large part of the dissolved organic matter in natural water.
gamma radiation ( $\gamma$ )	High energy electromagnetic radiation emitted by excited nuclei (for example after an alpha or beta decay) in their transition to lower-lying nuclear levels.
grab sampling	Collection of a discrete water sample for chemical analysis
Gray (Gy)	Name for absorbed dose 1 Gray = 1 Joule·kg <sup>-1</sup> . The absorbed dose gives a measure for the energy imparted by ionising radiation to the mass of the matter contained in a given volume element.
half-life	Time required to reduce by one-half the concentration (or activity in the case of a radionuclide) of a material in a medium (eg soil or water) or organism (eg fish tissue) by transport, degradation or transformation.
Hydstra	Hydrology data management software package.
IC50	The concentration of a compound that causes a 50% inhibition in a particular response (eg growth, reproduction) of an organism relative to that of a control organism (ie an organism not exposed to the compound).
ionising radiation	Sub-atomic particles ( $\alpha$ , $\beta$ ) or electromagnetic ( $\gamma$ , x-rays) radiation that have enough energy to knock out an electron from the electron shell of molecules or atoms, thereby ionising them.
land application	A method for management of excess accumulated water by spray irrigation. The method depends on the evaporation from spray droplets, and from vegetation and ground surfaces once its reaches them.
laterite	In the Ranger mine context, laterite is a local term used to describe well weathered rock and soil profile material that consists primarily of a mixture of sand and silt/clay size particles. It may or may not exhibit characteristics of a fully-developed laterite profile.
LC50	The concentration of a compound that causes the death of 50% of a group of organisms relative to that of a control group of organisms (ie a group of organisms not exposed to the compound).
MOL	Maximum Operating Level. The maximum level at which a liquid containing impoundment can be operated.
MCUGT	Current acronym for the upstream station u/s (formerly described as MCUS).
ore	A type of rock that bears minerals, or metal, which can be extracted.

permeate	The higher purity stream produced by passage of water through a reverse osmosis (RO) treatment process.
polished	Water that has been passed through a wetland filter.
pond water	Water derived from seepage and surface water runoff from mineralised rock stockpiles as well as runoff from the processing areas that are not part of the process water circuit.
potable water	Water suitable for human consumption.
process water	Water that has passed through the uranium extraction circuit, and all water that has come into contact with the circuit. It has a relatively high dissolved salt load constituting the most impacted water class on site.
radiologically anomalous area	Area that displays significantly above background levels of radioactivity.
radionuclide	An atom with an unstable nucleus that loses its excess energy via radioactive decay. There are natural and artificial radionuclides. Natural radionuclides are those in the uranium ( $^{238}\text{U}$ ), actinium ( $^{235}\text{U}$ ) and thorium ( $^{232}\text{Th}$ ) decay series for example, which are characteristic of the naturally occurring radioactive material in uranium orebodies.
radium	A radioactive chemical element that is found in trace amounts in uranium ores.
radon	Colourless, odourless, tasteless, naturally-occurring radioactive noble gas formed from the decay of radium.
Sievert (Sv)	Name for equivalent dose and effective dose 1 Sievert = 1 Joule·kg <sup>-1</sup> . In contrast to the Gray, the Sievert takes into account both the type of radiation and the radiological sensitivities of the organs irradiated, by introducing dimensionless radiation and tissue weighting factors, respectively.
sonde	A water quality instrument that is immersed in water for measuring (typically) electrical conductivity, pH, turbidity and dissolved oxygen.
speciation (of an element)	The forms in which an element exists within a particular sample or matrix.
stable lead isotopes	Lead has four stable isotopes, three of which, $^{206}\text{Pb}$ , $^{207}\text{Pb}$ and $^{208}\text{Pb}$ , are end members of the natural uranium, actinium and thorium decay series, respectively. $^{204}\text{Pb}$ is primordial only.
tailings	A slurry of ground rock and process effluents left over once the target product, in this case uranium, has been extracted from mineralised ore.
thoriferous	Containing thorium.
toxicity monitoring	The means by which the toxicity of a chemical or other test material is determined in the field over time. The monitoring comprises field toxicity tests which are used to measure the degree of response produced by exposure to a specific level of stimulus (or concentration of chemical).
tube stock	Seeds are germinated in a plant nursery and the young seedlings are then planted out.
uraniferous	Containing uranium.
uranium oxide	An oxide of uranium which occurs naturally or is produced by a uranium extraction process. This is the product from the Ranger mine.
water treatment plant (WTP)	The process system that removes undesirable chemicals, materials, and biological contaminants from water thereby decreasing its ability to harm the environment.