

GLOSSARY

Below are terms used throughout the Ranger Mine Closure Plan.

Key Term	Definition
Annual Plan of Rehabilitation	High level plan used to determine the securities amount to be held by the Commonwealth Government for Ranger Mine rehabilitation obligations.
As low as reasonably achievable	Abbreviated to ALARA. As low as reasonably achievable, economic and social factors being taken into account.
BC distillate	The product stream produced by BC plant treatment that has very low dissolved solids. Subject to water quality criteria this product may be discharged to the environment.
Becquerels	The Becquerel (Bq) is the SI derived unit of radioactivity. One Becquerel is defined as the activity of a quantity of radioactive material in which one nucleus decays per second.
Benchmark dose rate	Also referred to as environmental reference level, a chronic radiation dose rate received by the most highly exposed individuals of non-human biota that would be unlikely to have significant effects on terrestrial or aquatic populations
Best Practicable Technology	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.
Bininj	Bininj means many things depending on context: <ol style="list-style-type: none"> 1. Bininj means 'Aboriginal person' as opposed to a non-Aboriginal person. 2. Bininj means a speaker of Bininj Kunwok languages and a person of local Aboriginal descent (as opposed to say, a Yolngu person from NE Arnhem Land or 'Mungguy' which is the Jawoyn language equivalent). 3. Bininj means a man as opposed to a daluk (a woman). 4. Bininj means a human being as opposed to a non-human animal. In the context of the mine closure Bininj means a speaker of Bininj Kunwok languages and a person of local Aboriginal descent.
Brine Concentrator (BC)	A treatment facility that treats process water by distillation to produce a clean product stream (distillate) and a waste stream (brine).
Brine	A generic term for the waste stream from the BC, BS or WTP. For each plant, the brine stream contains most of the salt removed from the feed stream to the plant in a concentrated liquid form. The handling of a brine stream depends on the characteristics of that stream.
Bulk material movement	The movement of stockpiled waste rock for the purposes of backfill and the construction of the final landform.
Capping (initial and secondary)	The placement of waste rock above the tailings in Pit 1 and Pit 3. Capping layers provide drainage and act to dissipate the bearing pressure of construction equipment.
Closure criteria	Direct, measurable and quantifiable target values or tiered assessment processes, developed to demonstrate achievement of the closure objectives.
Closure domain	Areas with similar features, decommissioning and/or rehabilitation requirements for closure.
Closure phase	Decommissioning, completion of rehabilitation and transition of monitoring requirements.
Collection basin	Smaller constructed storage facility built to capture runoff along the western stockpile (Collection Basin 1, CB3, CB4, CB5, and CB6) which requires pond water treatment. Note that CB2 collects clean runoff and WTP permeate which passively drains into RP1.
Contaminated Sites Register	Register of all sites where activities have occurred that have the potential to contaminate land on the RPA.
Constituents of potential concern	Chemical elements identified as being of potential concern to the receiving environment.

Key Term	Definition
Digital Elevation Model	Digital representation of the land topography.
Disposal	The final transfer of release water into the environment. Disposal requires compliance with regulatory water quality criteria and must only be transferred from an approved location.
Discharge	The disposal of release water from a control point into an authorised water course location when flowing (i.e. MG001) or enables passive transfer to the environment (i.e. RP1 and GC2).
Electrical conductivity	Abbreviated to EC. Electrical conductivity is a measure of how well a material accommodates the transport of electric charge.
Environmental Requirements	The Ranger Environmental Requirements are attached to the s.41 Authority and set out Primary and Secondary Environmental Objectives, which establish the principles by which the Ranger operation is to be conducted, closed and rehabilitated and the standards that are to be achieved.
ERICA Assessment	Exposure/dose/effect assessment for radiological risk to terrestrial, freshwater and marine biota.
Gamma Radiation	Ionizing electromagnetic radiation emitted by a radionuclide during radioactive decay.
Georgetown Billabong	The statutory surface water monitoring point for Georgetown Billabong, which is located downstream of Corridor Creek and the Corridor Creek wetland filter.
Gray	The Gray (Gy) is a SI derived unit of ionizing radiation dose. One Gray is defined as the adsorption of one joule of radiation energy per kilogram of matter.
Groundwater conceptual model	Calibrated numerical groundwater flow model encompassing all hydrogeologic elements governing groundwater flow and transport at the Ranger Mine to provide the foundation for simulating groundwater flow and transport from all mine sources to potential receptors under post-closure conditions.
Groundwater solute transport modelling	Prediction of the temporal and spatial mobilisation of constituents of potential concern from the Ranger Project Area to the surrounding environment through groundwater using the Groundwater conceptual model.
Hydrolithologic unit	A grouping of soil or rock units or zones based on common hydraulic properties.
Irrigation	A form of disposal which allows release water to be dispersed via a sprinkler system over an approved land application area (LAA) at an approved rate.
Land Application Area	Abbreviated to LAA. An area on the RPA used as an evapotranspiration disposal method polished and unpolished pond water from the constructed wetlands filters and, more recently, permeates from the water treatment plants. However, irrigation of unpolished pond water ceased at the end of 2009.
Land Disturbance Permit	An ERA permit required prior to undertaking any work on the RPA that may lead to surface disturbance, for example ground breaking, surface disturbance, clearing etc.
Landform Evolution Model	Numerical model that simulates the change in landscape over time in response to various parameters.
LiDAR	Remote sensing technique using pulsed laser to measure distances.
Long Lived Alpha Activity	Abbreviated to LLAA. The presence, generally in airborne dust, of any of the alpha emitting radionuclides in uranium ore, except for the short lived alpha emitting radon decay products.
Magela Creek downstream	Abbreviated to MG009. MG009 is Ranger downstream statutory or compliance surface water monitoring point. It is located on the Magela Creek, downstream of Ranger operations.
Magela Creek upstream	Abbreviated to MCUS. MCUS is the upstream statutory surface water monitoring point, location on the RPA.

Key Term	Definition
Mine Closure Plan	A dynamic plan presenting all past, present and future rehabilitation activities of the Ranger Project Area in order to demonstrate that closure activities will achieve the relevant Environmental Requirements. Submitted annually for approval, the plan provides updates of the preceding year.
Minesite Technical Committee	<p>The Minesite Technical Committee, convened in accordance with Attachment A of the Working Arrangements for the Regulation of Uranium Mining in the Northern Territory dated 30 May 2005, is tasked with:</p> <ul style="list-style-type: none"> • Reviewing proposed and existing approvals and decisions under NT legislation. • Reviewing technical information in relation to Ranger Mine, including monitoring data and environmental performance. • Collaboratively developing standards for the protection of the environment. • Developing strategies to address emerging issues. <p>The MTC consists of the representatives of the Department of Industry, Tourism and Trade, the Supervising Scientist, ERA and the Northern Land Council. Representatives of the Commonwealth Department of Industry, Science and Resources may also attend MTC meetings.</p>
Mirarr	<p>Mirarr is a patrilineal descent group. Descent groups are often called 'clans' in English and kunmokurrkurr in Kundjeyhmi language. There are several Mirarr clans with each one distinguished by the language they historically spoke (e.g. Mirarr Kundjeyhmi, Mirarr Urningangk, Mirarr Erre).</p> <p>The Mirarr are the Traditional Owners of the land encompassing the RPA.</p>
Pit 1	The mined out pit of the Ranger #1 orebody. Open cut mining in Pit 1 commenced in May 1980 and ceased in December 1994.
Pit 3	The mined out pit of the Ranger #3 orebody. Open cut mining in Pit 3 commenced in July 1997 and ceased in November 2012.
Pit tailings flux	Process water squeezed from reducing pore spaces during the consolidation of tailings.
Plant Available Water	Abbreviated to PAW. The amount of water that can be stored in a soil and be available for growing crops.
Pond water	<p>Water of a quality that requires active management.</p> <p>Derived from rainfall that falls on the active Minesite catchments.</p> <p>The main storage facilities for pond water include Retention Pond 2 (RP2), RP3 and RP6.</p>
Potable water	<p>Potable water is sourced from the Brockman Borefield located in the south-east of the RPA. A second production borefield (Magela Borefield) was established to the north of Jabiru East, primarily as a source of supply for Jabiru East and the Ranger Mine village.</p> <p>Grey water (e.g. from showers and toilets) is treated on site and pumped into septic tanks and then to leach drains.</p>
Process water	<p>The most impacted water class on site.</p> <p>Currently present in the RWD and Pit 3.</p> <p>The process water inventory is derived predominantly from water that has passed through or encountered the uranium extraction circuit, and rainfall from designated process water catchments.</p>
Processing	Processing is the mining term to describe all phases of the ore treatment from milling through to the final product packaging of uranium oxide.
Radon decay products or radon progeny	<p>The short-lived radioactive decay products of radon-222.</p> <p>This includes the decay chain up to, but not including lead-210, namely polonium-218 (sometimes called radium A), lead-214 (radium B), bismuth-214 (radium C) and dpolonium-214 (radium C).</p>
Radon exhalation	Amount of radon leaving the surface of the landform.

Key Term	Definition
Ranger Project Area	Abbreviated to RPA. The Ranger Project Area means the land described in Schedule 2 to the <i>Commonwealth Aboriginal Land Rights (Northern Territory) Act 1976</i> .
Relative Level	Relative Level abbreviated to RL. Denotes a specific elevation relative to mean sea level and is regularly used to identify the height or depth of plan or mine infrastructure, e.g. the height of the RWD or depth of Pit 3.
Reject streams	Water treatment plant brines: Water that contains the remaining dissolved solids removed from the pond water. Brines are typically discharged to the process water inventory. However, brines may be discharged to the pond water inventory based on operational requirements. BC brines: Residue water after the distillate has been extracted. BS brines: residue water that contain the remaining dissolved solids removed from the treatment of pond water brines. Typically, discharged to the process water inventory or alternatively to pond water inventory based on operational requirements. High Density Sludge product water: water arising for the lime treatment process of the HDS plant to remove most salts present in process water. HDS product water may be either recycled to the process water inventory, or subject to further approvals, sent directly to the water treatment plants or discharged into the pond water inventory.
Release water	Release water is derived from incident rainfall that falls on catchments within the mine footprint and is of a high enough quality that it is possible to leave on the site as storm water runoff.
Relinquishment	Issue of close-out-certificate(s), relinquishment of RPA. Successive close-out certificates may be obtained for areas rather than for the entire RPA at a single point in time.
Retention Pond	A constructed storage facility that collects runoff and stores pond water for treatment (RP2 and RP6) or release water post-treatment (RP1).
Risk	The chance of something happening that will have an impact on objectives. Note 1: A risk is often specified in terms of an event or circumstance and the consequences that may flow from it. Note 2: Risk is measured in terms of a combination of the consequences of an event and their likelihood. Note 3: Risk can be a threat or an opportunity.
Risk Assessment	The overall process of risk identification, risk analysis and risk evaluation and shall be retained in accordance with procedure.
Risk Evaluation	The process used to determine risk management priorities by comparing the level of risk against predetermined standards, target risk levels or other criteria.
Risk Management Process	The systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analysing, assessing, controlling and monitoring risk.
Risk Priority Class	One of four categories where a hazard can be located on the ERA Ranger Risk Matrix – from Critical to High to Moderate to Low.
Risk Register	A register of risk information and controls kept at ERA, categorised into functional areas.
Sievert	The Sievert is the unit of absorbed radiation dose, taking into account the differing biological effects of different types of radiation.
Subaerial tailings deposition	Deposition of tailings in air, e.g. from spigots or pipes above the surface of the water.
Subaqueous tailings deposition	Deposition of tailings below the surface of the water.
Transfer	The process of physically distributing water across the water management system using pumps, pipes, valves and other supporting infrastructure to meet operational requirements.

Key Term	Definition
Treated water	<p>Treated water is water that has passed through one of the three water treatment plants, the Brine Squeezer (BS) or through the BC.</p> <p>Treated water is divided into the following categories:</p> <ul style="list-style-type: none"> • Water treatment plant permeate: Water that has been treated to remove a significant amount of its dissolved solids to allow it to be released. • BC distillate: Purified water that is produced by the BC. Treated distillate is subject to release criteria. • Brine Squeezer (BS) permeate: water derived from further reverse osmosis treatment of water treatment plant brines by the Brine Squeezer. Water quality is equivalent to water treatment plant permeate.
Treatment Facility	<p>Infrastructure that has been installed to undertake water treatment to achieve desired water quality outputs that is suitable for disposal. The main treatment facilities on site include: Brine Concentrator (BC), Water Treatment Plants (WTPs), Brine Squeezer (BS) and High Density Sludge (HDS) plant.</p>
Treatment product	<p>Water that has undergone treatment to remove excess solutes and improve water quality. The product stream from primary treatment may be suitable for disposal (i.e. BC distillate, BS permeate and WTP permeate) or may require secondary treatment prior to disposal (i.e. HDS product).</p>
Treatment waste	<p>The waste stream produced by the water treatment facilities which contains a higher concentration of solutes due to removal from the original feed water. This also includes water that is used during backwashing and cleaning processes. Treatment waste must be retained on site and returned to source storage for further processing.</p>
Trigger, Action, Response Plan	<p>Abbreviated to TARP. Plan of tasks to be undertaken should monitoring detect a change in parameters of a level that requires preventative or remedial action.</p>
Underfill	<p>Initial fill of waste rock placed in the base of Pit 3.</p>
U3O8	<p>The most stable form of uranium oxide and the form most commonly found in nature. Uranium oxide concentrate is sometimes loosely referred to as yellowcake. It is khaki in colour and is usually represented by the empirical formula U3O8. Uranium is normally sold in this form.</p>
Vadose zone	<p>The portion of the sub-surface that lies between ground surface and the water table or saturated zone.</p>
Waste rock	<p>The mineral waste produced in the mine but is stockpiled due to its low grade i.e. material which does not enter the processing plant.</p> <p>For example, 1s waste rock is typically material that has a grade of less than 0.02% U3O8; 2s waste rock (or low grade ore) is typically material that has between 0.02% and 0.12% U3O8.</p>
Water inventory	<p>The volume of a water class that exists on site at a single point in time. Inventories are inferred from water level measurements or measured by survey across various storages.</p>
Water Management System	<p>The infrastructure, operations and procedures required to manage water at Ranger which includes capturing, storing, transferring, treating and disposing volumes of water.</p>
Water Treatment Plants (WTPs)	<p>A series of ultrafiltration/reverse osmosis treatment plants that treat pond water to create a clean product stream (permeate) suitable for disposal and a waste stream (brine).</p>
Wetland filter	<p>A constructed biological filter system that is designed for final treatment of release water and is monitored to ensure water quality meets regulatory criteria for disposal.</p>
Wicks / Prefabricated Vertical Drains	<p>Drains inserted vertically into unconsolidated tailings material in Pit 1 and 3. The drains consist of plastic strips wrapped in geofabric with extruded channels that allow water to drain upwards from the tailings as it consolidates.</p>

ABBREVIATIONS & ACRONYMS

Below are abbreviations and acronyms that are used throughout the Mine Closure Plan.

Abbreviation/ Acronym	Description
1s	Waste rock material that typically has a grade of less than 0.02% U ₃ O ₈
2s	Waste rock (or low grade ore) material that typically has between 0.02% and 0.12% U ₃ O ₈
AAPA	Aboriginal Areas Protection Authority
AEP	Annual Exceedance Probability
AHD	Australian height datum
ALARA	As Low As Reasonably Achievable
ANZEEC	Australian and New Zealand Environment and Conservation Council
APR	Annual plan of rehabilitation
AoPC	Area of Potential Concern
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ARRAC	Alligator Rivers Region Advisory Committee
ARRTC	Alligator Rivers Region Technical Committee
ASNO	Australian Safeguards and Non-Proliferation Office
ASS	Acid Sulfate Soils
BC	Brine Concentrator
BMM	Bulk material movement
BOM	Bureau of Meteorology
BPT	Best Practicable Technology
BS	Brine Squeezer
BTV	Background Threshold Value
CCD	Counter Current Decantation
CCWLF	Corridor Creek Wetland Filter
CPT	Cone Penetration Test
CRE	Conceptual Reference Ecosystem
CoPC/CoPCs	Constituent of Potential Concern / Constituents of Potential Concern
CRF	Cemented rock fill
CRS	Corridor Road Sump
CSM	Conceptual Site Model
DEM	Digital Elevation Model
DISR	Commonwealth Department of Industry, Science and Resources
DITT	Northern Territory Department and Industry, Tourism and Trade
EC	Electrical Conductivity
ER	Environmental Requirements

Abbreviation/ Acronym	Description
ERA	Energy Resources of Australia Ltd
ERICA	Environmental Risk from Ionising Contaminants: Assessment and management
ERISS	Environmental Research Institute of the Supervising Scientist
ET	Evapotranspiration
FLF	Final Landform
GAC	Gundjeihmi Aboriginal Corporation
GCLB	Gulungal Creek water monitoring site
GCMBL	Georgetown Creek Median Bund Leveline
GIS	Geographic Information System
GTB	Georgetown Billabong
GV	Guideline Value
HDPE	High Density Polyethylene
HDS	High Density Sludge
HLU	Hydroliithologic Unit
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
KKN	Key Knowledge Needs
KNPS	Kakadu Native Plant Supplies Pty Ltd
LAA	Land Application Area(s)
LEM	Landform Evolution Model
LLAA	Long Lived Alpha Activity
LiDAR	Light Detection and Ranging
MCP	Mine Closure Plan
MCUS	Magela Creek Upstream water monitoring site
MNES	Matters of National Environmental Significance
MoU	Memorandum of Understanding
mRL	Metres Relative Level
MTC	Minesite Technical Committee
NGO	Non-government Organisations
NLC	Northern Land Council
NP	National Park
NT	Northern Territory
NTP	Northern Territory Portion
OPSIM	Operation Simulation Modelling
OSS	Office of the Supervising Scientist
PAEC	Potential Alpha Energy Concentration

Abbreviation/ Acronym	Description
PAW	Plant Available Water
PDF	Probability Distribution Function
PSD	Particle Size Distribution
PTF	Pit Tailing Flux
PVD	Prefabricated Vertical Drains
Q1	Quarter 1, as in first quarter of the calendar year. Also Q2, Q3 and Q4.
R3D	Ranger 3 Deeps
RCCF	Ranger Closure Consultative Forum
RCM	Ranger Conceptual Model
RO	Reverse osmosis
ROM	Run-of-mine
RP1	Retention Pond 1 – also denotes other retention ponds used on site – e.g. RP2, RP3, RP6
RP1WLF	Retention Pond 1 Wetland Filter
RPA	Ranger Project Area
RSWM	Ranger Surface Water Model
SI	International System of Units
SSB	Supervising Scientist Branch (now OSS)
SX	Solvent Extraction
TAN	Total Ammoniacal Nitrogen
TARP	Trigger, Action, Response Plan
TDS	Total Dissolved Solids
TLF	Trial Landform
TO	Traditional Owner
TPH	Total Petroleum Hydrocarbon
TSF	Tailings Storage Facility
TSS	Total Suspended Solids
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
VAF	Vulnerability Assessment Framework
WLF	Wetland Filter
WoNS	Weeds of National Significance
WQMF	Water Quality Management Framework
W/SQO	Water or Sediment Quality Objectives
WTP	Water Treatment Plant

CHEMICAL SYMBOLS AND FORMULAE

Symbols/ formulae	Description
Al	Aluminium
Ba	Barium
Ca	Calcium
Cd	Cadmium
Cl	Chloride
Cr	Chromium
Cu	Copper
Fe	Iron
HCO ₃	Bicarbonate
K	Potassium
Mg	Magnesium
Mn	Manganese
Na	Sodium
NH ₃ -N	Ammoniacal nitrogen
Ni	Nickle
NO ₂	Nitrogen dioxide
NO ₃	Nitrate ion
NO ₃ -N	Nitrate-N
NO _x	Total mono-nitrogen oxides (NO and NO ₂)
OH	Hydroxide
P	Phosphorus
Pb	Lead
²¹⁰ Po	Polonium
PO ₄ -P	Phosphate
²²⁶ Ra / Ra-226	Radium
Si	Silicon
SiO ₂	Silica
SO ₄ ²⁻	Sulfate
TAN	Total ammonia nitrogen
Total-N	Total nitrogen
Total-P	Total phosphorus
U, ²³⁸ U	Uranium
U ³ O ⁸	Uranium oxide
V	Vanadium
Zn	Zinc

SYMBOLS / UNITS OF MEASUREMENTS

Unit of Measure	Description
%	Percentage
µg	Micrograms
Bq	Becquerel(s)
Bq kg ⁻¹	Becquerel per kilogram
Bq m ⁻² s ⁻¹	Becquerel per square metre per second
cm	Centimetre
GL	Gigalitre
ha	Hectare
kg	Kilogram
KL	Kilolitre
km	Kilometre
km/h	Kilometres per hour
km ²	Square kilometres
kt	1,000 metric tonnes
L	Litre
m	Metre
m ²	Square metre
m ³	Cubic metre
m ³ s ⁻¹ ; m ³ /s	Cubic metre per second
mBq	Millibecquerel
mg	Milligram
ML	Megalitre
mm	Millimetre
Mm ³	Million cubic metres
MPa	Megapascal
mRL	Metres relative level
mSv	Milli-sievert
Mt	Metric tonne
t/m ³	Tonne / cubic metre
µm	Micrometre
µS/cm	Micro Siemens per centimetre
µSv/y	Microsieverts per year
wt. %	Weight %
Yr	Year

CONTRIBUTORS

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