

GLOSSARY

Below are terms used within the Ranger Mine Closure Plan.

Key Term	Definition
As low as reasonably achievable	As low as reasonably achievable, economic and social factors being taken into account.
Becquerels	The Becquerel is the International System of Units derived unit of radioactivity. One Becquerel is defined as the activity of a quantity of radioactive material in which one nucleus decays per second.
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: 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	A generic term for the waste stream from the Brine Concentrator, Brine Squeezer or Water Treatment Plant. 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.
Brine Concentrator	A treatment facility that treats process water by distillation to produce a clean product stream (distillate) and a waste stream (brine).
Brine Concentrator distillate	The product stream produced by Brine Concentrator plant treatment that has very low dissolved solids. Subject to water quality criteria this product may be discharged to the environment.
Brine Squeezer	A treatment facility designed to recover 'clean' water from the reject stream of pond and/or process water treatment through sequential stages of reverse osmosis.
Bulk Material Movement	The movement of stockpiled waste rock for the purposes of backfill of Pit 1 and Pit 3 (not including capping of tailings) and the construction of the final landform.
Capping (initial and secondary)	The placement of waste rock on or within the tailings in Pit 1 and Pit 3. Capping layers provide drainage and act to dissipate the bearing pressure of construction equipment.
Close out	The formal handover of a rehabilitated Ranger Project Area to the Commonwealth following the issue of close-out-certificate(s). Close-out certificates may be obtained for specified areas rather than for the entire Ranger Project Area at a single point in time.
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 (comprised of Collection Basin 1, CB3, CB4, CB5, and CB6) which requires pond water treatment. Note that CB2 collects clean runoff and Water Treatment Plant permeate which passively drains into RP1.

Key Term	Definition
Constituents of potential concern	Chemical elements identified as being of potential concern to the receiving environment.
Contaminated Sites Register	Register of all sites where activities have occurred that have the potential to contaminate land on the Ranger Project Area.
Digital Elevation Model	Digital representation of the land topography.
Discharge	The disposal of release water from a control point into an authorised watercourse location during flow conditions (i.e. MG001), or through a pathway that enables passive transfer to the environment (i.e. RP1 and GC2).
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.
Electrical Conductivity	A measure of how well a material accommodates the transport of electric charge.
Environmental Requirements	The Ranger Environmental Requirements are attached to the Section 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.
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.
Grade 1s	Waste rock material that typically has a grade of less than 0.02% U3O8
Grade 2s	Waste rock (or low grade ore) material that typically has between 0.02% and 0.12% U3O8
Gray	The Gray is an International System of Units derived unit of ionizing radiation dose. One Gray is defined as the adsorption of one joule of radiation energy per kilogram of matter.
Groundwater Conceptualisation	Calibrated numerical groundwater flow model encompassing all hydrogeologic elements governing groundwater flow and transport at the Ranger Project Area 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.
Intermediate Water	Water that is derived from rainfall runoff or groundwater and has not yet been discharged into Pond water storage, or an approved release pathway. Intermediate water can include water that is waiting on water quality analysis before appropriate transfer is made or is in the process of being transferred across site and has not yet reached either pond water storages or release pathways.
Irrigation	In the context of land application areas - A form of disposal which allows release water to be dispersed via a sprinkler system over an approved land application area at an approved rate. In the context of ecosystem establishment – Initial watering of planted tubestock for the first three to six months.
Land Application Area	An area on the Ranger Project Area used for evapotranspiration of both polished and unpolished pond water from the constructed wetlands filters and, more recently, permeate 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 Ranger Project Area that may lead to surface disturbance, for example ground breaking, surface disturbance, clearing etc.

Key Term	Definition
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	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	The Ranger downstream statutory or compliance surface water monitoring point (MG009). It is located on the Magela Creek, downstream of Ranger operations.
Magela Creek Upstream	The upstream statutory surface water monitoring point, located on the Ranger Project Area (MCUS).
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 Rehabilitation Requirements. Submitted annually for approval, the plan provides updates of the preceding year.
Minesite Technical Committee	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: • Reviewing proposed and existing approvals and decisions under Northern Territory 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. The Minesite Technical Committee 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 Minesite Technical Committee meetings.
Mirarr	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). The Mirarr are the Traditional Owners of the land encompassing the Ranger Project Area.
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.
Plan of Rehabilitation	High level plan used to determine the securities amount to be held by the Commonwealth Government for Ranger Mine rehabilitation obligations.
Plant Available Water	The amount of water that can be stored in substrate that is accessible for plants, including crops, for growth and development.
Pond water	Water that is derived from rainfall runoff or groundwater and is of a quality that requires treatment before it can be released to the environment. The main storage facilities for pond water include Retention Pond 2, and 6.
Potable water	Water that is used for drinking and ablution purposes, including safety showers, and parts of the plant where high quality water is required, such as within the demineralisation plant. Potable water is sourced from the Brockman Borefield located in the south-east of the Ranger Project Area. 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.

Key Term	Definition
	Grey water (e.g. from showers and toilets) is treated on site and pumped into septic tanks and then to leach drains.
Process water	The most impacted water class on site. Currently present in the Ranger Water Dam and Pit 3. 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.
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	The short-lived radioactive decay products of radon-222. 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 polonium-214 (radium C).
Radon Exhalation	Amount of radon leaving the surface of the landform.
Ranger	Ranger uranium mine
Ranger Project Area	The Ranger Project Area means the land described in Schedule 2 to the <i>Commonwealth Aboriginal Land Rights (Northern Territory) Act 1976</i> .
Reference Level	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 Ranger Water Dam 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. Brine Concentrator brines: Residue water after the distillate has been extracted. Brine Squeezer brines: Residue water that contain the remaining dissolved solids removed from the treatment of pond and/or process water. Typically, discharged to the process water inventory or alternatively to pond water inventory based on operational requirements. High Density Sludge product water: Water arising from the lime treatment process of the High Density Sludge plant to remove most salts present in process water. High Density Sludge 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. High Density Sludge operations ceased in 2022.
Release Water	Water that is derived from rainfall runoff, water treatment or groundwater that is of a quality suitable for disposal to the environment.
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 that 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	The systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analysing, assessing, controlling and monitoring risk.
Risk Register	A register of risk information and controls kept at ERA, categorised into functional areas.

Key Term	Definition
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.
Treated Water	Treated water is water that has passed through one of the three water treatment plants, the Brine Squeezer or through the Brine Concentrator. Treated water is divided into the following categories: - Water treatment plant permeate: water that has been treated to remove a significant amount of its dissolved solids to allow it to be released. - Brine Concentrator distillate: purified water that is produced by the Brine Concentrator. Treated distillate is subject to release criteria. - Brine Squeezer 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. - Brine Squeezer treated permeate: water derived from treatment of process water by the Brine Squeezer. Treated permeate is subject to release criteria.
Treatment Waste	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.
Trigger, Action, Response Plan	Plan of tasks to be undertaken should monitoring detect a change in parameters of a level that requires preventative or remedial action.
U ₃ O ₈	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 U ₃ O ₈ . Uranium is normally sold in this form.
Underfill	Initial fill of waste rock placed in the base of Pit 3.
Vadose Zone	The portion of the sub-surface that lies between ground surface and the water table or saturated zone.
Waste Rock	Mineral waste produced in the mine that is stockpiled due to its low grade of U₃O₈ i.e. material which does not enter the processing plant. 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.
Water Inventory	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.
Water Management System	The infrastructure, operations and procedures required to manage water at Ranger, including capturing, storing, transferring, treating and disposing volumes of water.
Water Treatment Plants	A series of ultrafiltration/reverse osmosis treatment plants that treat pond water to create a clean product stream suitable for disposal (permeate) and a waste stream (brine).
Wetland Filter	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.
Wicks / Prefabricated Vertical Drains	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.

ABBREVIATIONS & ACRONYMS

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

Abbreviation/ Acronym	Description
3D	three-dimensional
AAPA	Aboriginal Areas Protection Authority
AED	Aquatic Eco-Dynamics
AGPS	Australian Government Publishing Service
ALARA	As low as reasonably achievable
ALARP	As low as reasonably practicable
ANCOLD	Australian National Committee on Large Dams
ANRDR	Australian National Radiation Dose Register
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australian and New Zealand Guidelines
AoPC	Area of Potential Concern
APRA	Aquatic Pathways Risk Assessment
AR	Assessment Report for Climate Change (Intergovernmental Panel on Climate Change)
AR5	Fifth Assessment Report
AR6	Sixth Assessment Report
ARI	Average Recurrence Interval
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ARRAC	Alligator Rivers Region Advisory Committee
ARRTC	Alligator Rivers Region Technical Committee
ASNO	Australian Safeguards and Non-Proliferation Office
ASS	Acid Sulfate Soils
BMM	Bulk Material Movement
BPT	Best Practicable Technology
BTV/s	Background Threshold Value/s
CCD	Counter Current Decantation
CCWLF	Corridor Creek Wetland Filter
CHMA	Cultural Heritage Management Agreement
CoPC	Constituent of Potential Concern
CRE	Conceptual Reference Ecosystem
CRF	Cemented rockfill
CRS	Corridor Road Sump
CRSC	Cultural Reconnection Steering Committee
CSC sump	Central Services Corridor sump
CSIRO	Commonwealth Scientific and Industrial Research Organisation

Abbreviation/ Acronym	Description
CSM	Conceptual Site Model
CSP	Communities and Social Performance
CSR	Contaminated Sites Register
Cth	Commonwealth
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DHLGCD	Department of the Housing Local Government and Community Development
DIPL	Department of Infrastructure, Planning and Logistics
DISR	Commonwealth Department of Industry, Science and Resources
DLPE	Northern Territory Department of Lands, Planning and Environment
DML	Deemed Mining Licence
EC	Electrical Conductivity
ER	Environmental Requirement
ERA	Energy Resources of Australia Ltd
ERISS	Environmental Research Institute of the Supervising Scientist
FLF	Final Landform
FLv6.2	Final Landform Version 6.2
FLv7.0	Final Landform Version 7.0
GAC	Gundjeihmi Aboriginal Corporation
GAC JT	Gundjeihmi Aboriginal Corporation Jabiru Town
GCC	Gulungul Creek Control (upstream)
GCLB	Gulungul Creek Lease Boundary water monitoring site
GCMBL	Georgetown Creek Median Bund Leveline
GIS	Geographic Information System
GLD	Geomorphic Landform Design
GTB	Georgetown Billabong
GV	Guideline Value
HDPE	High Density Polyethylene
HDS	High Density Sludge
HES	High Efficiency Sedimentation
HLU	Hydrolithologic Unit
HSE	Health, Safety and Environment
HV	High voltage
ICRP	International Commission on Radiological Protection
IPCC	Intergovernmental Panel on Climate Change
Jabiru PSG	Future of Jabiru Program Steering Group
JSSC	Jabiru Sports and Social Club

Abbreviation/ Acronym	Description
KKN	Key Knowledge Need
KNPS	Kakadu Native Plant Supplies Pty Ltd
LAA	Land Application Area
LEM	Landform Evolution Model
LiDAR	Light Detection and Ranging
LIMS	Laboratory Information Management System
LLAA	Long Lived Alpha Activity
MB	Mudginberri Billabong
MCP	Mine Closure Plan
MCUS	Magela Creek Upstream (Water Monitoring) Site
MG009	Magela and Gulungul Creeks Monitoring Location MG009
MoU	Memorandum of Understanding
mRL	Metres Reference Level
MSA	Management Services Agreement
MTC	Minesite Technical Committee
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NGO	Non-government Organisation
NHMRC	National Health and Medical Research Council
NLC	Northern Land Council
NRMMC	Natural Resource Management Ministerial Council
NT	Northern Territory
NTASSA	<i>Northern Territory Aboriginal Sacred Sites Act 1989</i>
OPSIM	Operation Simulation Modelling
OSS	Office of the Supervising Scientist
PAH	Polycyclic Aromatic Hydrocarbons
PAW	Plant Available Water
PFAS	Per- and polyfluoroalkyl substances
PSD	Particle Size Distribution
PTF	Pit Tailings Flux
QA/QC	Quality Assurance / Quality Control
R3 Deeps	Ranger 3 Deeps
RASF	Ranger Approvals and Studies Forum
RoM	Run-of-mine
RP1	Retention Pond 1 – also denotes other retention ponds used on site – e.g. RP2, RP3, RP6
RPA	Ranger Project Area

Abbreviation/ Acronym	Description
RPI	Routine Periodical Inspections
RR	Rehabilitation Requirements
RRP	Ranger Rehabilitation Project
RSWM	Ranger Surface Water Model
RWD	Ranger Water Dam
RWMP	Ranger Water Management Plan
SERP	Species Establishment Research Program
SVOC	Semi-volatile Organic Compounds
SWSTM	Surface Water Solute Transport Model
SX	Solvent Extraction
TARP	Trigger, Action, Response Plan
TDS	Total Dissolved Solids
TLF	Trial Landform
TRH	Total Recoverable Hydrocarbons
TSS	Total Suspended Solids
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
VAF	Vulnerability Assessment Framework
VOC	Volatile Organic Compounds
VWP	Vibrating Wire Piezometer
W/SQO	Water or Sediment Quality Objectives
WESCP	Water, Erosion and Sediment Control Plan
WoNS	Weeds of National Significance
WQMF	Water Quality Management Framework
WSIS	Western Stockpile Interception System
WTP1	Water Treatment Plant 1
WTP2	Water Treatment Plant 2
WTP3	Water Treatment Plant 3

CHEMICAL SYMBOLS AND FORMULAE

Symbols/ formulae	Description
²¹⁰ Po	Polonium
²²⁶ Ra / Ra-226	Radium
Al	Aluminium
As	Arsenic
B	Boron
Ca	Calcium
Cd	Cadmium
Cl	Chloride
CO ₃	Carbonate
Cr	Chromium
Cu	Copper
Fe	Iron
H ₂ S	Hydrogen sulphide
HCO ₃	Bicarbonate
K	Potassium
Mg	Magnesium
mSv/y	Millisievert per year
Mn	Manganese
Na	Sodium
NH ₃ -N	Ammoniacal nitrogen
Ni	Nickel
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
PO ₄ -P	Phosphate
Po210	Polonium 210
Ra226	Radium 226
Se	Selenium
Si	Silicon
SiO ₂	Silica
SO ₄	Sulfate
TAN	Total ammonia nitrogen

Symbols/ formulae	Description
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
%	Per cent
°C	Degrees Celsius
µg	Micrograms
µm	Micrometre
µS/cm	Micro Siemens per centimetre
µSv/y	Microsieverts per year
ARI	Average Recurrence Interval
Bq	Becquerel(s)
Bq kg ⁻¹	Becquerel per kilogram
Bq m ⁻² s ⁻¹	Becquerel per square metre per second
CDD	Consecutive dry days
cm	Centimetre
EC	Electrical conductivity
GL	Gigalitre
Gy	Gray
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 m ³	Million cubic metres
m ²	Square metre

Unit of Measure	Description
m ³	Cubic metre
m ³ s ⁻¹ ; m ³ /s	Cubic metre per second
mBq	Millibecquerel
mg	Milligram
ML	Megalitre
mm	Millimetre
MPa	Megapascal
mRL	Metres reference level
mSv	Millisievert
Mt	Million tonnes
NTU	Nephelometric Turbidity Unit
R10 mm	annual count of days when precipitation ≥10 mm (days)
Rx1day	annual maximum value of daily precipitation (mm) (intensity)
t	Tonnes
t/m ³	Tonne / cubic metre
tasmax	Daily maximum near-surface air temperature
tasmin	Daily minimum near-surface air temperature
TNn	annual minimum value of tasmin (°C) intensity
TXx	annual maximum value of tasmax (°C) intensity
WSDI	Warm spell duration index: annual count of days with at least six consecutive days when tasmax >90th percentile
wt. %	Weight %
Yr	Year

CONTRIBUTORS

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