Chapter 3 Project Overview

Issued Date: May 2018
Revision #: 0.18.0
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3 PROJECT OVERVIEW

3.1 History

The initial discovery of the Ranger deposits was made in October 1969 by an exploration joint venture between Peko-Wallsend Operations Limited (Peko) and Electrolytic Zinc Company of Australasia Ltd (EZ) through aerial radiometric survey. Further drilling confirmed the feasibility of mining two ore bodies, ‘Ranger 1’ and ‘Ranger 3’ and, in June 1971, Peko and EZ established Ranger Uranium Mines Pty Ltd to manage and develop the deposits.

The grant of a mining lease to allow development of the project was deferred while the new Commonwealth Government, elected in December 1972, defined and implemented a policy of public ownership of certain energy resources, including uranium. To comply with the government's energy resources policy, Peko, EZ and the Australian Atomic Energy Commission (AAEC), as agent for the Government, signed the 'Lodge Agreement' in October 1975. Under this agreement: (i) the AAEC retained ownership of the uranium and financed 72.5 percent of the project; (ii) Peko and EZ were to fund the balance in equal shares; and (iii) the AAEC would sell the uranium for the Commonwealth Government, with Peko and EZ entitled to share in 50 percent of the net sales proceeds.

A new Commonwealth Government announced approval of the project under the repealed Commonwealth Environmental Protection (Impact of Proposal) Act 1974 (EPIP Act) in August 1977, following submission of an Environmental Impact Statement (EIS) and associated supplements under this Act. The Commonwealth Government made the decision to approve the project following the recommendations of the First and Second Reports of the Ranger Uranium Environmental Inquiry, which had been established under the EPIP Act (termed 'the Fox Inquiry') into the potential impacts of uranium mining in the Alligator Rivers Region (Fox et al., 1976, Hart & Jones, 1984a).

At the same time, much of the Alligator Rivers Region was declared a National Park and Aboriginal people were given a major role in park management. The Commonwealth Government introduced laws covering the Alligator Rivers Region (Commonwealth Environment Protection (Alligator Rivers Region) Act 1978) and established several research bodies and committees to overview the environmental regulation of mining in the region. These included the Supervising Scientist and the Environmental Research Institute of the Supervising Scientist (ERISS), the Alligator Rivers Region Advisory Committee (ARRAC) and the Alligator Rivers Region Technical Committee (ARRTC). In 1978, title to the RPA was granted to the Kakadu Aboriginal Land Trust, in accordance with the Commonwealth Aboriginal Land Rights (Northern Territory) Act 1976 (Aboriginal Land Rights Act) and the Commonwealth Government entered an agreement with the Northern Land Council to permit mining to proceed.

1 The functions of these committees and research bodies are described further in Chapter 5.
Construction of the Ranger mine began in January 1979 and the mine came into full production in October 1981. During the early stages of construction, the Commonwealth Government announced its intention to divest its interest in the project. Peko-Wallsend subsequently established a new company, Energy Resources of Australia Ltd (ERA), to purchase the existing partners' interests. Mining of the Ranger 1 orebody (Pit 1) was completed in December 1994 and development of the adjacent Ranger 3 orebody (Pit 3) commenced in 1996.

In 2008, ERA announced a significant mineral exploration target, 'Ranger 3 Deeps', of 15 to 20 million tonnes with a potential for 30,000 to 40,000 tonnes of contained uranium oxide. In 2011, ERA approved the construction of an exploration decline to conduct close spaced underground exploration drilling of Ranger 3 Deeps and works began on constructing the exploration decline in May 2012. On 16 January 2013, ERA submitted a referral and notice of intent under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Northern Territory Environmental Assessment Act, for the Ranger 3 Deeps underground mine (EPBC 2013/6722). An EIS was lodged for the proposed mine in 2014 (ERA 2014b), however in 2015 ERA announced that the Ranger 3 Deeps project would not proceed to final feasibility study due to a depressed uranium market and project economics.

3.1.1 Overview of Ranger Mine EIS Assessment and Recommendations

In February 1974, an EIS was submitted for the Ranger uranium mine under the repealed EPIP Act. Supplements 1 and 2 to the EIS were submitted in May 1975. As outlined above, in August 1977 a new Commonwealth Government announced approval of the project, following the assessment of the proposal via the Fox Inquiry. The draft EIS and supplements described all components of the proposed Ranger uranium mine, including but not limited to:

- Geographic location of the proposed Ranger mine, uranium ore deposits and estimated U₃O₈ content.
- Conformance with standard open cut mining practices propose for ore extraction.
- Intended milling and processing method.
- Water treatment and management, including descriptions of, for example, Retention Ponds 1 & 2 and water release strategies during operations.
- The proposed tailings dam construction and operation, including future tailings dam lifts, intended to ensure there was always an adequate height of embankment above the water surface in the dam.
- Management of potential radiation, air and water pollutants.
- Proposed rehabilitation and the continuing protection of the surrounding region.
The proposed Ranger uranium mine, as defined in the draft EIS, was fully assessed as part of the Ranger Uranium Environmental Inquiry, or Fox Inquiry (Fox et al., 1976, 1977). The final recommendations provided by the Fox Inquiry specifically relevant to rehabilitation and closure include:

- All required rehabilitative work and all measures required for the continuing protection of the environment be carried out by the operator at its expense. It was recommended that:
  - The operator and its successors be bound by a legally enforceable obligation to carry out necessary work.
  - All obligations be enforceable by appropriate authorities which have the right and duty to enforce them.
  - Performance of these obligations at all times be fully secured.
  - The security be available freely to the appropriate authorities.
- The best practicable technology (developed anywhere, which can be applied to the uranium industry in Australia) to prevent environmental pollution and degradation be adopted from the outset.
- The Ranger project be permitted to commence only if there is a firm, legally binding undertaking by Ranger to place in one or other of the pits the tailings and any stockpiles of low grade ore remaining after milling ceases.
- A co-ordinating committee be established to review and consider any major changes in Ranger’s operating procedures. The Minesite Technical Committee (MTC) was formed as a result.

The rehabilitation of Ranger is not subject to assessment under the EPBC Act. As outlined in Section 43(a) of the EPBC Act, certain actions that started prior to 16 July 2000 are exempt from the assessment and approval provisions of the Act. Mining at Ranger commenced in 1980; the Ranger Environmental Requirements (ERs) were subsequently revised in 1999 and include rehabilitation requirements which remain applicable. The overall objective for rehabilitation and closure has been based on the rehabilitation goals outlined in the Ranger Authorisation and the ERs.

ERA is now undertaking and pursuing final rehabilitation and closure of the Ranger mine via the existing statutory review and assessment mechanisms.

3.2 Overview of Operations

In accordance with the Guidelines, the purpose of this chapter is to provide background information on the history and status of the project, and the existing mining operations:

- Sections 3.2.1 to 3.2.8 provide an overview of the components of the Ranger mining and processing operations, including the associated key activities and infrastructure; and the Ranger 3 Deeps exploration decline and associated infrastructure.
Section 3.2.9 summarises the site wide water management system.

Section 3.2.10 describes the key activities and infrastructure relevant in the Jabiru East area and Jabiru Airport.

Conventional open cut mining of uranium ore ceased in November 2012. The processing of stockpiled ore continues through Ranger’s processing plant, where uranium is leached from the ore using sulfuric acid. The uranium is then purified, concentrated, precipitated, calcined (dried), placed into drums and exported. Components of the mining and processing operations are shown in Figure 3-1 and include:

- Processing area comprising power station (which also provides power to the town of Jabiru), administration and maintenance facilities.
- A tailings dam (also referred to as the ‘tailings storage facility’ or ‘TSF’).
- Two mined out pits – Pit 1 and Pit 3.
- Ore and waste rock stockpiles.
- A number of water retention ponds, water storage structures and constructed wetland filters.
- Water treatment plants.
- Irrigation areas for the disposal of managed release water.
- An access road and service tracks.
- Ranger 3 Deeps exploration decline (refer Section 3.2.3).
- Jabiru Airport, Jabiru East and associated infrastructure (refer Section 3.2.10).

These components are described in the following sections.
Figure 3-1: Ranger mine layout and infrastructure
3.2.1 Mining

Mining at Ranger involved a conventional open cut process, which begins with drilling and blasting. Pit 1 was mined out in 1994 and mining in Pit 3 ceased in November 2012. Prior to the completion of mining in the pits, mined material was categorised by a discriminator, which measured the gamma emissions of each load to calculate uranium grade for either stockpiling or immediate processing according to the grade of the ore (percent uranium oxide) (Table 3-1). Low-grade ore will be returned as backfill to the mined-out pits and covered by un-mineralised rock to create the final landform.

Table 3-1: Indicative ore grades and mineral type

<table>
<thead>
<tr>
<th>Grade</th>
<th>Grade (% U₃O₈)</th>
<th>Material type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;0.02</td>
<td>&lt;0.02</td>
</tr>
<tr>
<td>2</td>
<td>0.02-0.05</td>
<td>0.02-0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.05-0.10</td>
<td>0.08-0.12</td>
</tr>
<tr>
<td>4</td>
<td>0.10-0.20</td>
<td>0.12-0.20</td>
</tr>
<tr>
<td>5</td>
<td>0.20-0.35</td>
<td>0.20-0.35</td>
</tr>
<tr>
<td>6</td>
<td>0.35-0.50</td>
<td>0.35-0.50</td>
</tr>
<tr>
<td>7</td>
<td>&gt;0.50</td>
<td>&gt;0.50</td>
</tr>
</tbody>
</table>

3.2.2 Processing

The major ore processing stages are described below:

- Uranium ore is crushed and ground, then the fine ore is then mixed with water to produce a slurry.
- The ore slurry is pumped to leaching vessels where, over a period of 24 hours, more than 90 percent of the uranium in the ore is dissolved using sulfuric acid and pyrulosite (an oxidant).
- The uranium in solution is then separated from the depleted ore in a seven stage washing circuit.
- After separation, the acidity of the depleted ore (tailings) is partially neutralised with lime before being pumped to the tailings dam, while the leach solution is clarified and filtered.
- The uranium is extracted from the leach solution and concentrated, then pumped to precipitation tanks.
• A bright yellow uranium compound (ammonium diuranate), commonly referred to as ‘yellowcake’ is precipitated using ammonia.

• In the final stage of the process, the yellowcake is heated to 800 Celsius to produce the final product – uranium oxide, which is a dark green powder.

• The product is packed into 200 litre steel drums. These are sealed and transported by road, using an accredited transport company, to a secure holding facility and then exported by ship.

3.2.3 Ranger 3 Deeps Exploration Decline

ERA constructed an exploration decline at Ranger mine from near the south-eastern rim of Pit 3, from early May 2012 to December 2014 (Figure 3-2). This enabled an underground exploration and infill drilling program to increase orebody knowledge, and provide geological, hydrogeological, geotechnical and radiological data.

The decline extends 2,700 metres in length and 450 metres below the ground surface, above and parallel to the target mineralised zone. The decline was intended to provide access to the mineral resource and subsequent underground mine known as 'Ranger 3 Deeps'. The Ranger 3 Deeps exploration decline project has been completed and is currently in care and maintenance.

Infrastructure components of the exploration decline that will require decommissioning include:

• A box-cut and a covered portal.
• The decline (at 1:6 grade).
• A site office, crib room and muster area located near the entry point of the portal.
• An ablution block including showers and waste water system located near the entry point of the portal.
• Roadways.
• Vehicle refuelling bay.
• Water and communication services.
• Warehouse and lay down area for underground consumables.
• Additional storage capacity at the existing surface explosives magazine.
• Remnants of a ventilation shaft.
Figure 3-2: Spatial extent of the Ranger 3 Deeps exploration decline
3.2.4 Tailings Storage

The tailings dam, Pit 1 and Pit 3 have been approved for the storage of tailings and process water in accordance with relevant conditions prescribed in the Ranger Authorisation. Tailings are deposited to achieve the maximum practicable density and both sub-aqueous (below surface) and sub-aerial (in air) deposition methods have been used.

3.2.5 Tailings Dam

The tailings dam is an above ground facility designed to store neutralised mill tailings and process water (Figure 3-1, 51). The free process water inventory held in the dam is progressively reduced through passive evaporation and water treatment via the brine concentrator. The dam has a dyke (‘turkey nest’) structure with walls constructed using appropriate soil and rock materials. The eastern, southern and western walls of the tailings dam run along ridges approximating catchment divides which separate Coonjimba Creek from adjacent surface water catchments, including Gulungul Creek to the west and the Djalkmarra and Georgetown catchments to the east. The tailings dam embankments have been constructed in seven stages between 1979 and November 2012 to the current clay core elevation of +60.5 metres RL.

Performance of the dam is monitored and inspected annually by independent engineers in accordance with the Ranger Authorisation. It is operated in accordance with the requirements of the Australian National Committee on Large Dams and International Commission of Large Dams guidelines for tailings dam design, construction and operation (Hart & Davies, 1984). These data are reported to the regulators to confirm that the structure continues to perform according to its design and operational criteria. The tailings dam is also operated in accordance with the Rio Tinto Standard D5: Management of Tailings and Water Facilities, which covers all development phases from planning, design through construction, operation, closure and, post-closure where applicable.

Current dredging activities associated with tailings transfer to Pit 3 and estimated volumes are detailed below in Section 3.2.7.

ERA will seek decommissioning of the tailings dam via a standalone application to the MTC, scheduled for submission by 1 December 2019 (refer Chapter 1, Appendix 1.2).
3.2.6 Pit 1

Approximately 18 million tonnes of ore was mined from Pit 1 between May 1980 and December 1994. Once the pit was mined out, tailings deposition into the pit commenced in 1996, to an average height of +12 metres RL\(^2\), until deposition ceased in November 2008.

The proposed method and level of unconsolidated tailings deposition in Pit 1 was described in two Applications to the MTC submitted in 1995 and 2005, respectively (ERA Hart, 1981, 1981). The first Application proposed the deposition of neutralised tailings to 0 metres RL; the second Application proposed tailings deposition to +12 metres RL. Both applications received ministerial approval and were the precursor to the bulk backfill activities currently underway.

Between 1996 and November 2008, ERA deposited approximately 19.9 million cubic metres of tailings into the pit. Pit 1 then functioned as a process water storage facility until 2012. Since then, various works have been undertaken to expedite pit tailings consolidation and facilitate bulk backfilling and landform development. The two latter activities commenced after ERA received Northern Territory and Commonwealth regulatory approval (via the MTC) for a predicted final average tailings consolidation level in the pit of approximately +7 metres RL in March and April 2017, respectively (see Figure 3-1, 46).

For information on Pit 1 tailings consolidation and solute egress modelling, refer Chapter 7, Sections 7.1.2 and 7.7.2, respectively.

3.2.7 Pit 3

Approval to backfill Pit 3 was obtained in June 2007, from the Northern Territory Minister for an Application submitted in November 2006 (Puhalovich et al., 2006). The Application sought approval to backfill Pit 3 "… to an average interim fill level of ~RL -20m during the period from 2009 until 2014 …" Due to a pit expansion in 2007, and later (e.g. Shell 50) further advice to the MTC indicated that the pit tailings would likely be significantly lower.

The 2006 Application was followed up with a "notification" submitted in August 2014, on the "Assessment of Potential Environmental Impacts from an 'Interim' Final Tailings Level of RL-20m in Pit 3" (ERA 2014a). The predicted modelling was based on "… the designated maximum tailings (RL-20 m) and maximum brine (RL-118 m) levels within Pit 3 as a constant level over the full 10,000 year assessment period. In the case of the Pit 3 tailings level this is a very conservative assumption as the expected average tailings level in 2026, after consolidation, is expected to be RL-30.2 m."

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\(^2\) Reference 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 tailings dam, depth of Pit 3.
The initial backfill of Pit 3 to construct the in-pit drainage and extraction pumping system was successfully completed in August 2014 with 33.7 million tonnes of waste rock placed into the pit (ERA, 1984b) (Figure 3-1, 70). The in-pit drainage and extraction pumping system installed in Pit 3 at the end of 2014 enables the removal of water associated with the tailings slurry mixture and water within the backfilled rock. This water returns to the tailings dam, where it is treated by the brine concentrator.

The transfer of tailings from the mill to Pit 3 began in early 2015 and will cease when processing stops. Dredging and tailings transfer from the tailings dam commenced in December 2015 and is expected to be completed in 2020.

The combined tailings from the mill and tailings dam will fill the Pit 3 void from a starting elevation of approximately -100 metres RL to approximately -20 metres RL by the end of the deposition phase in 2020. Approximately 23 million cubic metres of tailings stored in the tailings dam will be transferred to Pit 3 during 2016 to 2020. The dredge can pump approximately 3.5 megalitres of tailings slurry per hour from the tailings dam to Pit 3. Further information on the dredging program is provided in Chapter 10, Section 10.4.

ERA will seek approval for the whole of Pit 3 closure via a standalone application to the MTC, scheduled for submission by 31 March 2019 (refer Chapter 1, Appendix 1.2).

3.2.8 Stockpiles

A number of stockpiles comprising ore grade material and waste are situated in the vicinity of the Ranger pits and the tailings dam. Approximately 21 million tonnes of ore will be processed from these stockpiles, while about 127 million tonnes of waste exists within the stockpiles, which will be used for backfilling of pits and shaping of the final landform for closure.

Throughout the mine life, Ranger stockpiles have been segregated according to both grade and material type. Three main material types are used: primary, weathered and laterite. Primary material consists of unweathered host rock, which consists mainly of altered quartz-feldspar schists and to a lesser extent, cherts and carbonaceous materials. Weathered material consists of friable rock (usually quartz-feldspar schist) with altered mineral assemblages but generally still low in clay content. Laterite is a near-surface, highly weathered and sometimes reconsolidated material that is generally high in iron and aluminium clays and other gangue minerals that have made it difficult to process conventionally. Early in the mine life, improved processing performance led to the combination of the weathered with the primary material being fed to the processing plant. In more recent years a separate laterite processing circuit was developed that allowed this material to also have uranium recovered.

Figure 3-3 shows the location of stockpiles on the RPA which are segregated and categorised based on the grade of mined material (i.e. percentage of U3O8). As outlined previously, grade determinations are made on a truck-by-truck basis using gamma analysis via a discriminator. Seven grade classes are assigned to mined material, refer Table 3-1. Grade 1 material is considered waste whereas all other grades have, at some time through the mine life, been processed for uranium content. Grade 2 material has been further classified into high 2's and low 2's, the latter being below economic cut-off.
A prefeasibility risk assessment conducted in 2008 identified that there was not a complete understanding of the locations of the various grades of materials in the stockpiles. Consequently an extensive drilling program was undertaken to ascertain the grades and their respective locations. The drilling results enabled the stockpile tonnages and grades to be completely re-evaluated, allowing a block model of the stockpiles to be developed.

A large number of the drill core samples taken in the 2008 program were analysed for elements other than uranium. A substantial number of samples (2,944) were analysed for sulfur; the average and median concentration of these samples was found to be 0.06% and 0.005%, respectively. Of the Grade 1 material that will be used for rehabilitation, the risk of acidic drainage from this material is considered to be very low with the average and median sulfur content being 0.03% and 0.005%, respectively.

Figure 3-3: Ranger stockpile locations

3 Within the stockpiles, it is recognised that some of this sulfur could be in the form of sulfate (either from previous oxidation of sulfides or from the presence of sulfate in dust suppression water).
3.2.9 Water Management

Water management is the most significant environmental and operational aspect of the Ranger mine, and is an integral part of ERA's health, safety and environment management system. It encompasses all aspects of water capture, storage, supply, distribution, use, and disposal. Water is managed according to the Ranger water management plan, which describes the method used to control water on site. The plan, which fulfils the requirements of the Ranger Authorisation and is approved annually by regulators, outlines the approach ERA takes to:

- Protect both the wider environment and Magela Creek from the impacts of mining and processing operations.
- Meet all current statutory requirements.
- Manage water inventories and discharge mechanisms based on water quality according to a whole of mine approach rather than the source of the water.
- Strategically manage process and pond water inventories in accordance with current closure planning and strategies.

Water at the Ranger mine is categorised into different classes according to its source and composition. Each class of water is managed in a specific way, in accordance with Ranger's water management system (Table 3-2).

Table 3-2: Water classes and their management (Deacon, 2017)

<table>
<thead>
<tr>
<th>Water class</th>
<th>Description and treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process water</td>
<td>The most impacted water class on site. Currently stored in the tailings dam and Pit 3. The process water inventory is derived predominantly from water that has passed through or encountered the uranium extraction circuit, and from rainfall from designated process water catchments.</td>
</tr>
<tr>
<td>Pond water</td>
<td>Water of a quality that requires active management. Derived from rainfall that falls on the active mine site catchments. The main storage facilities for pond water include Retention Pond 2 (RP2), RP3 and RP6.</td>
</tr>
<tr>
<td>Release water</td>
<td>Release water is derived from incident rainfall that falls on catchments within the mine footprint and is of a quality that is able to leave the site as storm water runoff. Specific streams are routed through passive treatment systems or staging points for management and release (Figure 3-4).</td>
</tr>
<tr>
<td>Potable water</td>
<td>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. Grey water (e.g. from showers and toilets) is treated on site and pumped into septic tanks and then to leach drains.</td>
</tr>
</tbody>
</table>
The Ranger mine footprint is divided into catchment areas (Figure 3-5). These areas generate surface run-off and/or seepage as a result of incident rainfall. Each catchment may comprise of several elements such as retention ponds, sumps, collection basins and groundwater interception ponds. The water circuit for Ranger mine, including the five water classes; the different treatments; and water management features are shown in Figure 3-6. A description of the individual water management elements is provided in the following sections.

### 3.2.9.1 Retention Ponds

Four retention ponds are used at Ranger to provide sediment control, and dilution and storage of pond and managed release waters:

- **RP1 (390 mega litres)** comprises an earthen embankment that dams Coonjimba Creek that receives release quality water for discharge into Coonjimba Billabong (both passively and actively) or for active discharge into Magela Creek (see Figure 3-1, 56).
- **RP2 (1,150 mega litres)** comprises an earthen wall impoundment in the former Djalkmarra Creek catchment (now subsumed by Pit 3). RP2 is the primary storage of pond water with distribution networks to the water treatment elements (see Figure 3-1, 42).
- **RP3 (61 mega litres)** is an earthen impoundment within RP2. Water from RP3 is transferred to RP2 via a spillway and pumped for use in the lime mill (see Figure 3-1, 43).
- **RP6 (976 mega litres)** is a turkey-nested, double-lined pond that receives water from RP2 transfers and rainfall (see Figure 3-1, 56).

### 3.2.9.2 Water Treatment Plants

Ranger mine operates three water treatment plants to treat excess pond water to a level suitable for release to the environment (see Figure 3-1, 25 and 36). All water treatment plants are currently configured to treat only pond water to a required standard for release or disposal via land application. The treatment process of pre-filtration followed by reverse osmosis results
in four distinct streams that may be directed to specific destinations: permeate, backwash from pre-filtration, chemical clean water and brine.

3.2.9.3  Wetland Filters

RP1 wetland filter is comprised of a series of earthen embankments forming an impoundment with discrete cells arranged in series. The wetland filter has an ecosystem dominated by water lilies and native reeds (*Eleocharis* sp.). Upon entering the wetland, water flows through each of the cells under gravity over a path length of approximately 1,000 m. The last cell of the wetland filter can be equipped with a pumping station and a controlled overflow channel that spills to RP1.

The primary role of the wetland filter is to attenuate uranium from the flow stream using biogeochemical processes before the water is discharged (passive flow) to RP1, used in Land Application, used in operations for dust suppression or used as construction water.

RP1 wetland filter is currently removed from operational use and its operation will be assessed at a future date.

The Corridor Creek wetland filter is the only wetland filter in operation at Ranger (see Figure 3-2, 50). This wetland filter is a combination of natural and constructed wetlands (or cells) with a surface of approximately 17 hectares and a total water volume (at full capacity) of approximately 38 mega litres. Constructed in 2001 and situated at the head of the Corridor Creek Catchment, the Corridor Creek wetland filter was designed primarily to polish ammonia from treated process water permeate and uranium from surface water runoff. The Corridor Creek wetland filter is now used to re-mineralise and remove heat from distillate. The wetland filter continues to polish ammonia from distillate (treated process water).
Figure 3-4: Surface water release points on the RPA (Deacon, 2017)
Figure 3-5: General arrangement of water class catchments on the RPA (Deacon, 2017)
Figure 3-6: Ranger mine water circuit
3.2.9.4 Land Application Areas

The land application areas (LAAs) have been used at Ranger mine since 1985 and have a total area of approximately 350 hectares. ERA defines land application as the process by which water (release water, permeate, wetland polished water) is applied to the LAAs through a network of distribution pipes and sprinkler heads, thereby maximising evapotranspiration loss while minimising surface pooling and seepage, and preventing surface runoff during operations. Table 3-3 provides a generalised description of each operational LAA. Figure 3-7 shows all LAAs on the RPA, noting that Magela LAA (6) was decommissioned in 2007.

Further information on the studies undertaken in the LAAs is provided in Chapter 7, Sections 7.4.2 and 7.7.1.11.

Table 3-3: LAA description of generalised water management

<table>
<thead>
<tr>
<th>Land area application area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corridor Creek Land Application Area (CCLAA)</td>
<td>The CCLAA is comprised of a network of pipes and sprinkler heads located to the south of Pit 1. The area is approximately 135 hectares. This area receives waters from CMBL and GCBR and is operated during daylight hours only (see Figure 3-4). There are no bunding requirements during active operation of CCLAA.</td>
</tr>
<tr>
<td>Djalkmarra Land Application Area (DLAA)</td>
<td>The DLAA is comprised of a network of distribution pipes and sprinkler heads set out across a tract of sparse native woodland north of the Pit 3 access road. The area is approximately 38 hectares. This area receives permeate (via Coonjimba Billabong 2 catchment) only and can be operated 24 hours a day. There are no bunding requirements during active operation of DLAA.</td>
</tr>
<tr>
<td>Jabiru East Land Application Area (JELAA)</td>
<td>The JELAA is comprised of a network of pipes and sprinkler heads that covers an area on the old Jabiru East town site. The area is approximately 52 Ha. This area receives release waters from RP1 and is operated during daylight hours only. While release quality water is used for irrigation on the JELAA there is no requirement for bunding.</td>
</tr>
<tr>
<td>RP1 Land Application Area (RP1LAA)</td>
<td>The RP1LAA is comprised of a network of distribution pipes and sprinkler heads set out across a tract of disturbed sparse woodland to the west of RP1. The area is approximately 43 hectares. This area receives release waters from RP1 and can be operated 24 hours a day and is suitable for flood irrigation. There are no bunding requirements during active operation of RP1LAA.</td>
</tr>
<tr>
<td>RP1 Extension Land Application Area (RP1Ext LAA)</td>
<td>The RP1Ext LAA is comprised of a network of distribution pipes and sprinkler heads set out across a tract of native woodland to the west of RP1. The area is approximately 8 hectares. This area receives release waters from RP1 and is operated during daylight hours only. There are no bunding requirements during active operation of RP1 Ext LAA.</td>
</tr>
</tbody>
</table>
3.2.9.5 Brine Concentrator

The brine concentrator was commissioned in September 2013 to produce 1.83 giga litres per annum of clean distilled water (distillate) by using thermal energy to evaporate water sourced from the process water inventory (see Figure 3-1, 35). Distillate from the brine concentrator is discharged through the Corridor Creek wetland filter prior to release to Magela Creek, with brine currently transferred direct to the tailings dam. In 2015, ERA completed the installation of five injection bores from the surface of Pit 3 to the underfill. The purpose of the injection system is to pump brine from the brine concentrator directly into the underfill layer at the base of the pit for final storage.
3.2.9.6 Site Water Model

Water management and closure planning at Ranger has been supported since 2006 by a dynamic water and solute balance model. The model is implemented using OPSIM, an operational simulation package for the modelling of water resource systems (OPSIM Pty Ltd, 2017).

The model considers the characteristics, connectivity and operational rules associated with the material elements of the process and pond water circuits at Ranger, and the planned changes in the nature of those elements through to 2026, as described in Chapter 10. Elements included are the process and pond water catchments and storages, the water treatment plants, the mill, the brine concentrator, and planned additional water treatment facilities. The model also contains approximations for the release water catchments and storages, and the facilities and rules for managed release to the environment.

The understanding of the site’s water systems, as captured in the model, is routinely tested by an annual validation and calibration process that has been conducted since the model was first introduced. This validation and calibration process takes advantage of the extensive array of water related measurements at Ranger to reconcile model predictions against actual observations, and provides updates the model to address any identified variations.

The forecasting approach used applies multiple sequential periods of historical daily rainfall data to the model, using the multiple periods of historical rainfall as an estimate of the possible variation in future rainfall. Model results are collected for each period simulated and statistically analysed to provide confidence traces for each variable of interest.

The historical rainfall data for the forecast has been sourced from a point interrogation (“data drill”) at a geographic point corresponding to Jabiru Airport, of a climate database prepared by the Science Delivery Division of the Queensland Government Department of Science, Information, Technology and Innovation (Jeffrey et al., 2001). The current rainfall data set in use commences on 1 January 1889 and runs through to 30 June 2016.

Typically median forecasts are used for planning over closure timeframes, with higher confidence forecasts (generally corresponding to higher rainfall) used for contingency and capacity planning.

The model’s median forecast for the inventory of process water in the tailings dam and Pit 3 over time, is presented in Figure 3-8. Forecast process water inventory reaches zero ahead of the planned decommissioning of the last process water storage facility, the tailings dam, in 2025.
Revisions are made to the water model in response to updated quarterly measurements of site process water inventory, changes in closure plan tactics and recommendations arising from an annual model validation and calibration process. Revisions to the model will continue as further detail around closure activities is developed during the closure feasibility study, and beyond.

3.2.10 Jabiru Airport

Jabiru Airport is located within the RPA and caters for light aircraft such as those providing tourist flights, medical services and fly in/fly out services from Darwin. It is a particularly important asset for the town, given its community service and tourism roles. However, no decision has yet been reached as to its long-term future. In this context and compliant with the current agreement, the facilities at Jabiru East (airport and support buildings not occupied by the Supervising Scientist Branch) are included for removal within the decommissioning plan. Future plans for the Jabiru Airport, other than removal, will require land tenure issues to be resolved.
Infrastructure located within the Jabiru East area is shown in Figure 3-9. Generally, the Jabiru East area consists of:

- Jabiru Airport runway and airport infrastructure (1).
- ERISS buildings (shown for context but excluded from this plan), including nursery warehouses (2).
- Water storage tanks (3).
- Ranger exploration infrastructure including sample preparation and core store (4).

Demolition will need to include provision for the removal of asbestos within the airport tourist centre identified during asbestos audits undertaken in February 2003 by Environmental Health Services and updated in late 2016. The removal of asbestos containing material from identified locations on the RPA will be undertaken by a suitably licensed asbestos-removal contractor in accordance with the Work Health and Safety Regulations (NT).

As outlined previously in Chapter 1, the Commonwealth Government is responsible for the removal and remediation of the Jabiru field station (ERISS buildings) occupied by the Supervising Scientist Branch.
Figure 3-9: Jabiru airport and infrastructure located within the Jabiru East area

1. Airstrip and infrastructure
2. ERISS buildings, including plant nursery
3. Water storage tanks (x2)
4. Exploration infrastructure, including core storage
3.3 References


