

## MASTER TABLE OF CONTENTS

<b>1</b>	<b>SCOPE AND PURPOSE</b> .....	1-1
1.1	Operator Details .....	1-1
1.2	Title Details .....	1-2
1.3	Location .....	1-3
1.4	Background .....	1-7
1.5	Purpose of this MCP .....	1-7
1.5.1	Implications of Ranger project reforecast process .....	1-8
1.5.2	Ranger Authorisation and <i>Mining Management Act</i> .....	1-9
1.5.3	Section 41 Authority and ERs .....	1-9
1.5.4	Government agreement .....	1-10
1.6	Scope of this MCP .....	1-10
1.7	Review and updates .....	1-11
1.8	Content and structure of this MCP .....	1-14
	REFERENCES .....	1-16
<b>2</b>	<b>PROJECT OVERVIEW</b> .....	2-1
2.1	Overview of completed operations and exploration .....	2-4
2.1.1	Pit 1 (Walem Madjawulu 1) .....	2-7
2.1.2	Pit 3 .....	2-8
2.1.3	Stockpiles .....	2-8
2.1.4	Ranger 3 deeps exploration decline .....	2-9
2.1.5	Processing .....	2-11
2.1.6	Process plant .....	2-11
2.1.7	Tailings and process water storage .....	2-11
2.1.8	Water management .....	2-12
2.1.9	Site water model .....	2-23
	REFERENCES .....	2-25

<b>3</b>	<b>CLOSURE OBLIGATIONS AND COMMITMENTS</b>	3-5
3.1	Legislative framework	3-5
3.1.1	Applicable legislation and agreements	3-5
3.1.2	Commonwealth	3-8
3.1.3	Northern Territory	3-9
3.1.4	Land and tenure	3-9
3.2	Standards, codes of practice and guidelines	3-12
3.2.1	Corporate policies and standards	3-15
3.2.2	Statutory and Non-Statutory Obligations	3-15
3.2.3	Supervising Scientific Branch (SSB) rehabilitation standards	3-16
3.3	Western Australia Mine Closure Plan guidelines	3-17
3.3.1	Other closure and rehabilitation resources	3-17
3.4	Closure permits and approvals	3-18
	REFERENCES	3-20
<b>4</b>	<b>OVERVIEW OF STAKEHOLDER ENGAGEMENT</b>	4-1
4.1	Engagement with Traditional Owners	4-8
4.2	Managing socio-economic impacts	4-8
	REFERENCES	4-10
<b>5</b>	<b>KEY KNOWLEDGE NEEDS</b>	5-11
5.1	Landform theme	5-12
5.1.1	Background of physical environment	5-12
5.1.2	LAN2 Understanding the landscape-scale processes and extreme events affecting landform stability	5-24
5.1.3	LAN3 Predicting erosion of the rehabilitated landform	5-29
5.2	Water and sediment theme	5-85
5.2.1	Aquatic Ecosystems background	5-85
5.2.2	Water pathway risk assessments (release pathways onsite)	5-95
5.2.3	WS1 Characterising contaminant sources on the RPA	5-103
5.2.4	WS2 Predicting transport of contaminants in groundwater	5-114
5.2.5	WS3 Predicting transport of contaminants between groundwater and surface water	5-128

5.2.6	WS5 Determining the impact of contaminated sediments on aquatic biodiversity and ecosystem health .....	5-142
5.2.7	WS6 Determining the impact of nutrients in surface water on biodiversity and ecosystem health .....	5-149
5.3	Radiation theme.....	5-153
5.3.1	Background .....	5-153
5.3.2	RAD1A, RAD2A, RAD6E, RAD7A, RAD7B, RAD8A, RAD9A, RAD9C, RAD9D .....	5-157
5.4	Ecosystem rehabilitation theme.....	5-160
5.4.1	ESR1. Determining the requirements and characteristics of terrestrial vegetation in natural ecosystems adjacent to the minesite, including Kakadu National Park.....	5-160
5.4.2	ESR7 Understanding the effect of waste rock properties on ecosystem establishment and sustainability .....	5-186
5.4.3	ESR3 Understanding how to establish native terrestrial vegetation, including understory species .....	5-209
5.4.4	ESR8 Understanding fire resilience and management in ecosystem restoration .....	5-267
5.4.5	ESR4 Incidence and abundance of introduced species (flora and fauna)...	5-278
5.4.6	ESR2 Determining the requirements and characteristics of a terrestrial faunal community similar to natural ecosystems adjacent to the mine site, including Kakadu National Park.....	5-283
5.4.7	ESR5 Develop a restoration trajectory for Ranger Mine.....	5-296
5.5	Cross theme .....	5-303
5.5.1	CT1 Assessing the cumulative risks of rehabilitation on-site and to the protection of the off-site environment.....	5-303
5.5.2	CT2 Characterising World Heritage values of the Ranger Project Area.....	5-312
5.6	Future climatic conditions and associated risks .....	5-316
5.6.1	Climate in the Northern Territory .....	5-316
5.6.2	Temperature .....	5-317
5.6.3	Predictions.....	5-318
5.6.4	Rainfall and evaporation .....	5-321
5.6.5	Fire weather .....	5-326
5.6.6	Humidity .....	5-329
5.6.7	Sea level rise .....	5-330
5.6.8	Ocean temperature and chemistry .....	5-331
5.6.9	Future work on climate change risk .....	5-333
	REFERENCES.....	5-345

<b>6</b>	<b>BEST PRACTICABLE TECHNOLOGY</b>	6-1
6.1	Introduction	6-1
6.2	ALARA and BPT	6-3
6.3	Ranking and criteria of BPTs	6-4
6.4	Completed BPTs	6-7
6.5	Active BPTs	6-11
6.6	Future BPT assessments	6-15
	REFERENCES	6-16
<b>7</b>	<b>RISK ASSESSMENT AND MANAGEMENT</b>	7-2
7.1	Standards and requirements	7-3
7.2	Previous closure risk assessments	7-4
7.3	ERA closure risk assessment methodology	7-6
7.3.1	Purpose and scope	7-7
7.3.2	Assumptions	7-7
7.3.3	Risk Management Tool	7-7
7.3.4	Risk Identification	7-8
7.3.5	Risk Relationships	7-8
7.3.6	Risk Evaluation	7-8
7.3.7	Communication and Consultation	7-12
7.4	Current risk profile	7-14
7.4.1	Class IV (Critical) risks	7-14
7.4.2	Class III (High) risks	7-16
7.4.3	Class II (Moderate) risks	7-17
7.4.4	Class I (Low) risks	7-17
7.5	Risk management	7-18
	REFERENCES	7-19

<b>8</b>	<b>POST-MINING LAND USE, CLOSURE OBJECTIVES AND CLOSURE CRITERIA</b> .....	8-1
8.1	Post-mining land use .....	8-1
8.1.1	Future occupancy intentions .....	8-2
8.1.2	Bush food diet .....	8-7
8.1.3	Culturally important flora and fauna .....	8-10
8.2	Closure objectives .....	8-10
8.3	Closure criteria .....	8-13
8.3.1	Landform .....	8-15
8.3.2	Water and sediment .....	8-19
8.3.3	Radiation .....	8-36
8.3.4	Soils .....	8-43
8.3.5	Ecosystem .....	8-45
8.3.6	Cultural .....	8-58
	REFERENCES .....	8-63
<b>9</b>	<b>CLOSURE IMPLEMENTATION</b> .....	9-1
9.1	Introduction .....	9-1
9.2	Closure domains .....	9-1
9.2.1	Pit 1 .....	9-5
9.2.2	Pit 3 .....	9-24
9.2.3	Ranger Water Dam .....	9-64
9.2.4	Land Application Areas .....	9-80
9.2.5	Process plant, water treatment plants and other infrastructure .....	9-85
9.2.6	Stockpiles .....	9-96
9.2.7	Water management areas .....	9-101
9.2.8	Linear infrastructure .....	9-105
9.2.9	R3 Deeps decline .....	9-106
9.2.10	Miscellaneous .....	9-113
9.2.11	Magela Levee .....	9-119
9.2.12	Airport .....	9-128
9.3	Closure activities .....	9-130
9.3.1	Contaminated sites .....	9-130
9.3.2	Waste and hazardous material management .....	9-133
9.3.3	Water treatment .....	9-135

9.3.4	Bulk material movement.....	9-144
9.3.5	Final landform / surface preparation .....	9-149
9.3.6	Revegetation implementation.....	9-163
REFERENCES.....		9-174
<b>10</b>	<b>CLOSURE MONITORING .....</b>	<b>10-1</b>
10.1	Landform theme.....	10-2
10.1.1	Closure research, monitoring, maintenance and adaptive management .....	10-2
10.1.2	Completion criteria monitoring .....	10-9
10.2	Water and Sediment theme .....	10-14
10.2.1	Surface water and sediments - Closure research, monitoring, maintenance and adaptive management.....	10-14
10.2.2	Groundwater – Closure research, monitoring, maintenance and adaptive management .....	10-20
10.2.3	Completion criteria monitoring .....	10-30
10.3	Radiation theme.....	10-34
10.3.1	Closure research, monitoring, maintenance and adaptive management ....	10-34
10.3.2	Completion criteria monitoring .....	10-37
10.4	Ecosystem theme .....	10-40
10.4.1	Closure research, monitoring, maintenance and adaptive management ....	10-40
10.4.2	Completion criteria monitoring .....	10-55
10.5	Cultural theme .....	10-58
10.6	Trigger, action, response plan (TARP).....	10-59
REFERENCES.....		10-64
<b>11</b>	<b>FINANCIAL PROVISION FOR CLOSURE .....</b>	<b>11-1</b>
11.1	Rehabilitation provision.....	11-1
11.1.1	Tailings consolidation .....	11-2
11.1.2	Process water and injection of waste brines .....	11-2
11.1.3	Bulk material movement.....	11-3
11.1.4	Other factors.....	11-3
11.1.5	Cash flow timing .....	11-3
11.2	Closure Feasibility Study Update .....	11-3
11.3	Government Agreement .....	11-4

<b>12</b>	<b>MANAGEMENT OF INFORMATION AND DATA</b> .....	12-1
12.1	Data collection and management .....	12-1
12.2	Data availability and reporting .....	12-2

## FIGURES

Figure 1-1 Regional location of Ranger Project Area .....	1-4
Figure 1-2 Ranger Mine Project Area .....	1-5
Figure 1-3 Proximity of Ranger Mine to natural topographic features .....	1-6
Figure 1-4: Oblique view of Ranger Mine 2019 .....	1-7
Figure 2-1: Ranger Mine site.....	2-5
Figure 2-2: Ranger Mine plant layout.....	2-6
Figure 2-3: Legend to Figures 2-1 and Figure 2-2.....	2-7
Figure 2-4: Spatial extent of the Ranger 3 Deeps exploration decline .....	2-10
Figure 2-5: General arrangement of water class catchments on the RPA (Deacon, 2017) .....	2-15
Figure 2-6: Ranger Mine water circuit.....	2-16
Figure 2-7: Corridor Creek wetland filter view one (CCWLF) .....	2-18
Figure 2-8: Corridor Creek wetland filter view two (CCWLF).....	2-18
Figure 2-9: Land Application Areas.....	2-20
Figure 2-10: Brine Concentrator.....	2-21
Figure 2-11: High Density Sludge plant at Ranger Mine.....	2-22
Figure 2-12: Site water model free process water inventory forecast (August 2022).....	2-24
Figure 3-1: Post-closure tenure and land access .....	3-11
Figure 3-2 Integrated mine closure good practice framework (ICMM 2019) .....	3-14
Figure 4-1 Ranger Mine Stakeholder Matrix .....	4-5
Figure 5-1: Land tenures in the Alligator Rivers Region .....	5-13
Figure 5-2: Jabiru average rainfall and evaporation 1971 to 2020 (Source: CDM Smith, 2021).....	5-14
Figure 5-3: Contour map of the RPA and surrounds .....	5-16
Figure 5-4: Elevation of RPA and the surrounding region .....	5-17
Figure 5-5: Dominant soil types in areas surrounding the Ranger Mine.....	5-19
Figure 5-6: Stratigraphic sequence from regional to mine scale and corresponding geological map of the immediate area of the Ranger Mine orebodies.....	5-23
Figure 5-7: Preliminary slope analysis looking at the steepest slopes in FLV 6.2.....	5-31
Figure 5-8: Catchment areas – Ranger Mine conceptual landform (Lowry & Saynor 2015).....	5-32
Figure 5-9: Surface of Corridor Creek catchment after a simulated period of 10,000 years under (a) dry and (b) wet rainfall scenarios. ....	5-35
Figure 5-10: Predicted distribution of gullies in Djalkmarra catchment after 10,000 years under (a) dry and (b) wet rainfall scenarios. ....	5-35
Figure 5-11: Cross sectional profile of transect A-B across Pit 1 under (a) dry and (b) wet rainfall scenarios. ....	5-36



Figure 5-12: Cross sectional profile of transect A-B across Pit 3 under (a) dry and (b) wet rainfall scenarios .....5-37

Figure 5-13: Drainages in each Final Landform 7 design iteration versions, respectively FLV 7.00 (a), FLV 7.01 (b), FLV 7.02 (c) and FLV 7.03 (d) of Coonjimba working area (southern Coonjimba Catchment)..... 5-40

Figure 5-14: 1000-year average denudation rates of different landform versions in wet-scenario model running ..... 5-41

Figure 5-15: Layout of the erosion plots on the trial landform (Boyden et al., 2016, Saynor et al., 2016) ..... 5-43

Figure 5-16: Runoff through the flume on the trial landform erosion plot 3 during a storm event (Saynor et al., 2014)..... 5-44

Figure 5-17: Relationship between total event rainfall and runoff for erosion plot 1 for 156 runoff events in the 2013–14 wet season (Saynor et al. 2015)..... 5-46

Figure 5-18: Exponential decrease in mean annual bedload yield with time since construction for the four plots on the trial landform. Data represent annual mean and standard error of estimate for all plots (Lowry & Saynor, 2015)..... 5-47

Figure 5-19: PSD sampling locations in Pit 1..... 5-48

Figure 5-20: Upper layer with the mass fraction less than 2.36mm..... 5-49

Figure 5-21: Lower layer with the mass fraction less than 2.36mm..... 5-49

Figure 5-22: PSD result average and median for upper and lower layer..... 5-50

Figure 5-23: Upper layer PSD curve and combined PSD curve..... 5-51

Figure 5-24: Particle size distribution from the Ranger trial landform in 2009, 2012,2014 and 2018 (Hancock et al., 2020). ..... 5-51

Figure 5-25: Pit 1 waste rock PSD curve in Phi scale..... 5-53

Figure 5-26: Pit 3 as excavated and as modelled ..... 5-56

Figure 5-27: Pit 3 density profile - end of filling ..... 5-57

Figure 5-28: Predicted final tailings level (m) across Pit 1 ..... 5-59

Figure 5-29: Predicted flow of process water from Pit 1 during consolidation (Fitton 2015, 2017; Figure 5) ..... 5-60

Figure 5-30: Predicted versus measured average tailings settlements in Pit 1 ..... 5-61

Figure 5-31: Cumulative backfill volume compared with the progressive consolidation volume (Fitton 2020) ..... 5-62

Figure 5-32: Settlement data plotted in accordance with the Asaoka method, predicting an ultimate settlement of approximately 4.52m (Fitton 2021a)..... 5-63

Figure 5-33: Calculated tailings surface as of May 2021 (Steven Murphy, personal communication, 1 June 2021) ..... 5-64

Figure 5-34: Typical predicted flow of process water from Pit 3 during consolidation..... 5-68

Figure 5-35: TSF topography (blue: low elevation; green: high elevation) (Fugro 2018) ..... 5-70

Figure 5-36: April 2019 Magnetic Anomaly Map (left frame) comparison with the 2012 Magnetic Anomaly Map (right frame).....5-70

Figure 5-37: Cone penetration locations (Shackleton 2013) .....5-72

Figure 5-38: CPT Locations .....5-73

Figure 5-39: Group 1 SBT profile on the west of the Pit .....5-74

Figure 5-40: Group 1 SBT profile on the west of the Pit .....5-75

Figure 5-41: Typical 2018/2019/2020 cone resistance comparison .....5-75

Figure 5-42: Predicted versus measured fine/coarse tailings interface .....5-76

Figure 5-43: Measured versus predicted excess pore pressure profile .....5-76

Figure 5-44: CPTu probe locations in relation to the Pit 3 tip head and proposed eastern platform .5-77

Figure 5-45: Comparison of corrected cone resistance at location 8 .....5-78

Figure 5-46: Comparison of corrected cone resistance at location 3 .....5-79

Figure 5-47: Comparison of corrected cone resistance at location 5 .....5-79

Figure 5-48: Comparison of excess pore pressures at location 8 .....5-80

Figure 5-49: Comparison of excess pore pressures at location 3 .....5-81

Figure 5-50: Comparison of excess pore pressures at location 5 .....5-81

Figure 5-51: Cross section of tailings and water within the Pit .....5-83

Figure 5-52: Food web for aquatic ecosystems in the Magela Creek catchment (from BMT 2019) .5-94

Figure 5-53: Aquatic source pathway receptor model and risk assessment approach .....5-96

Figure 5-54: Risks by consequence category .....5-100

Figure 5-55: Threat risk by dominant contaminant source. The first four sources (from the right side) are contamination sources predicted by the surface water model (SWM) to enter the surface water after closure. The last three sources are associated with current contaminated soils and sediments. ....5-101

Figure 5-56: Decision framework for determining data sufficiency, ERM (2020c).....5-104

Figure 5-57: Decision framework for extracting and establishing background using weight of evidence, ERM (2020c) .....5-105

Figure 5-58: Framework for developing background for datasets with insufficient data, ERM (2020c) .....5-106

Figure 5-59: Hydrograph showing examples of seasonal groundwater head fluctuations (INTERA 2019a) .....5-115

Figure 5-60: Spatial domain of the hydrogeological Ranger Mine conceptual model relative to the domain of the calibrated groundwater flow model. ....5-117

Figure 5-61: Scatter plot of simulated versus observed groundwater heads for all calibration targets in the entire calibrated model domain for the updated transient model, INTERA (2021b).....5-119

Figure 5-62: Prior Kx probability density function for the shallow weathered Cahill HLU.....5-125

Figure 5-63: Cumulative distribution functions for peak Mg loads from the 983 predictive model runs. ....5-127

Figure 5-64: Updated conceptual model of groundwater surface water interaction .....5-131

Figure 5-65: Similarity between EC increase at end of flow period and creek discharge at GCUS and MCUS for the 2019-2020 flow period.....5-132

Figure 5-66: Regional extent of Magela catchment .....5-134

Figure 5-67: Magela catchment showing government agency gauging stations.....5-136

Figure 5-68: Pre-mining catchments in relation to the Ranger Mine .....5-137

Figure 5-69: Surface water model catchment configuration and site features .....5-139

Figure 5-70: Surface water model sub catchments, billabongs, site features and key reporting nodes.....5-139

Figure 5-71: Sample of simulated model results.....5-141

Figure 5-72: ASS terminologies (Source: ERM 2020a) .....5-148

Figure 5-73: Vegetation of the RPA and surrounding Kakadu NP (Schodde et al. 1987) .....5-164

Figure 5-74: Vegetation types over aerial of the RPA and surrounding Kakadu NP .....5-165

Figure 5-75: Vegetation habitat map (Schodde et al 1987) of the RPA.....5-166

Figure 5-76: Depth of rock over natural soil.....5-170

Figure 5-77: Basins and drainage features of the final landform. ....5-171

Figure 5-78: Variation in the basal area of evergreen trees (•) and deciduous trees (□) in relation to soil depth along downslope catenary sequences at Kapalga in Kakadu National Park (Cook et al 2020). ....5-175

Figure 5-79: Maps of plant analogue sites surveyed by Brennan (2005) (top and bottom) and (Hollingsworth et al. 2003a) (bottom) .....5-177

Figure 5-80: Georgetown Creek Reference Area vegetation type variation across monitoring sites .....5-178

Figure 5-81: Dendrogram illustrating similarity of SSB sites near Ranger (2019/2020 data) and all of Saynor et al. (2009) and Georgetown (Hollingsworth & Meek 2003, Humphry et al (2012) using stems/ha overstorey/midstorey species (Mattiske & Meek 2020).....5-180

Figure 5-82: Dendrogram illustrating similarity of a subset of SSB sites near Ranger (2019/2020 data), Saynor et al. (2009) and Georgetown (Hollingsworth & Meek 2003, Humphry et al (2012) using stems/ha of overstorey/midstorey species (Mattiske & Meek 2020).....5-181

Figure 5-83: Location of conceptual reference ecosystem sites in relation to the Ranger Project Area.....5-183

Figure 5-84: Stem density and species composition of the dominant ten shrub and tree species present in the CRE sites .....5-184

Figure 5-85: Dominant understorey species (> 0.4% average) vegetation cover in the CRE sites.5-185

Figure 5-86: Changes in PSD on TLF from 2009 to 2014 inclusive .....5-189

Figure 5-87: Changes in PSD on TLF1A (including 2018 surface soil samples) at 5 cm depth.....5-190

Figure 5-88: PSD result average and median for upper and lower layer.....	5-191
Figure 5-89: Rooting pattern of the savanna woodland trees in the Top-End (Source: Hutley 2008).....	5-195
Figure 5-90: Key features of savanna vegetation water-use and carbon allocation strategies adapted to the Top-End seasonality (Source: Hutley 2008).....	5-195
Figure 5-91: Seasonal change in leaf area index at the Georgetown Creek Reference Area (Source: Lu et al. 2018).....	5-197
Figure 5-92: LAI dynamics at the four ecohydrological study sites (missing data during the wet season due to site inaccessibility).....	5-197
Figure 5-93: Evapotranspiration and its components.....	5-198
Figure 5-94: General view of an instrumented study site.....	5-199
Figure 5-95: Annual dynamics of over storey tree transpiration at Site 21.....	5-199
Figure 5-96: Temporal dynamics of the groundwater depth at Site 21.....	5-200
Figure 5-97: Relative extractable water contents measured at different depths and ground water table depth (GWT, in Red) at Site 21.....	5-201
Figure 5-98: Selected soil chemical properties pH (A), EC (B), and nutrient availability, including total organic carbon (C), total nitrogen (D), Available N in the form of NH <sub>4</sub> <sup>+</sup> -N, NO <sub>2</sub> <sup>-</sup> -N and NO <sub>3</sub> <sup>-</sup> -N (E) and Available P (F) among reference Site 30, TLF-1A and TLF-1B.....	5-208
Figure 5-99: Revegetation conducted on Ranger Mine (1982 – 1998).....	5-213
Figure 5-100: Proposed conservative provenance zone (bordered by the red line) and the GAC approved provenance zone within Kakadu NP (bordered by the blue line).....	5-217
Figure 5-101: Replicate from seed testing germination trials (Heteropogon triticeus).....	5-219
Figure 5-102: Greenhouse tunnel trials at the ERA Nursery.....	5-224
Figure 5-103: Trial Landform layout from northwest to southeast are sections 1A & 1B (waste rock only) and 2 & 3 (waste rock / laterite mix). Includes 15 x 15m permanent monitoring plot locations.....	5-228
Figure 5-104: Daily rainfall for 2009 – 2010. Data up to 17 April 2009 from Jabiru Airport (Bureau of Meteorology): subsequent data from the TLF.....	5-231
Figure 5-105: Tubestock Survival on 1A and 3 after ten years.....	5-233
Figure 5-106: Longitudinal plant density (stems per ha <sup>-1</sup> ) based on the tubestock only (0 -14) and direct seeding only (15 – 29) Permanent Monitoring Plots on the TLF, not including recruits. ....	5-234
Figure 5-107: Longitudinal plant growth (height) based on the tubestock only (0 -14) and direct seeding only (15 – 29) Permanent Monitoring Plots on the TLF, not including recruits.....	5-236
Figure 5-108: Flowering and fruiting on the Trial Landform. Top left to bottom right: Brachychiton megaphyllus, Jacksonia dilatata, Eucalyptus tectifica, Cochlospermum fraseri.....	5-240
Figure 5-109: Directly seeded Galactica tenuiflora in a mixed treatment plot with fallen tree, March 2022.....	5-242
Figure 5-110: Directly seeded Heteropogon triticeus in an ‘organic matter’ plot in February 2021 (left) and March 2022 (right).....	5-243

Figure 5-111: Understorey ‘island’ on section 1A of the TLF.....	5-244
Figure 5-112: Rate of native understorey species naturally colonising the TLF since September 2018.....	5-245
Figure 5-113: Natural colonisation of species, including multiple <i>Brachychiton megaphyllus</i> , <i>Livistona</i> sp., and <i>Tacca leontopetaloides</i> individuals underneath a large tree on Section 1A, February 2021.....	5-246
Figure 5-114: Stage 13.1 revegetation. Research trial area A (0.52 ha) planted in April 2020, research trial area B (1.18 ha) planted in November 2020, and progressive revegetation area C (2.37) planted in August 2021 and infill planted January 2022.....	5-247
Figure 5-115: Dead Eucalyptus in saturated substrate at Stage 13.1A.....	5-248
Figure 5-116 Average species survival on Stage 13.1 Area A after 25 months.....	5-248
Figure 5-117 Species survival on Stage 13.1 Area A after 18 months for the full suite of treatments.....	5-249
Figure 5-118 Species survival on Stage 13.1 Area A after 18 months for the partial suite of treatments.....	5-250
Figure 5-119 Species survival on Stage 13.1 Area A after 18 months with puffball and combination microbe treatments.....	5-250
Figure 5-120: Seedling survival and health at Stage 13.1B at six months after planting when substrate impacts became apparent. Green is an alive seedling, yellow is a stressed seedling, and red is a seedling that appeared dead.....	5-251
Figure 5-121: Overall species survival on Stage 13.1 Area B after 18-months.....	5-252
Figure 5-122: Plant density (stems per ha <sup>-1</sup> ) based on all midstorey and overstorey individuals on Stage 13.1 Area A and B regardless of height, not including recruits.....	5-253
Figure 5-123: Species average height at Stage 13.1 Area A after two years.....	5-254
Figure 5-124: Species average height at Stage 13.1 Area B after 18-months.....	5-255
Figure 5-125: Plant growth at Stage 13.1 Areas A and B over two years.....	5-255
Figure 5-126: Pit 1 research areas: March 2021 ‘Wet season’ planting (6.6 ha), July 2021 ‘Dry season’ planting (3.8 ha) and October 2021 ‘Build-up’ planting (3.1 ha).....	5-257
Figure 5-127: Overall tubestock survival of the research trial areas on Pit 1 and Stage 13.1 within approximately one year of planting.....	5-259
Figure 5-128: Survival maps at 12-months for the Wet season trial (Mar 2022, top), and 6-months for the Dry season trial (Feb 2022, left bottom) and Build-up trial (May 2022, right bottom). Green is an alive seedling and red is a seedling that appeared dead.....	5-260
Figure 5-129: Survival of overstorey and midstorey seedlings with only ‘older’ treatments in Pit 1 Wet season trial 12-month survey.....	5-262
Figure 5-130: Survival of overstorey and midstorey seedlings with all four treatments in Pit 1 Wet season trial 12-month survey.....	5-263
Figure 5-131: Survival of overstorey and midstorey seedlings with multiple treatments in Pit 1 Dry season trial 6-month survey.....	5-263

Figure 5-132: Survival of overstorey and midstorey seedlings with multiple treatments in Pit 1 Build-up trial 6-month survey ..... 5-264

Figure 5-133: Survival of understorey seedlings with multiple treatments in Pit 1 Wet season trial 12-month survey ..... 5-265

Figure 5-134: Survival of understorey seedlings with multiple treatments in Pit 1 Dry season trial 6-month survey ..... 5-265

Figure 5-135: Survival of understorey seedlings with multiple treatments in Pit 1 Build-up trial 6-month survey ..... 5-266

Figure 5-136: *Acacia holosericea* exposed to fire (top) and protected from fire (bottom), four months after 2019 June burn. .... 5-276

Figure 5-137: Recovery of the revegetation from a prescribed burn in May 2016. View of the burnt vegetation on the trial landform 12 days post fire (left) and 6 months post fire (right)..... 5-277

Figure 5-138: Height and DBH ranges and associated health classes after the 2016 burn on laterite mix areas of the TLF (Wright 2019a) ..... 5-277

Figure 5-139: Fauna survey site locations across RPA and Kakadu NP (SLR Consulting 2021) ... 5-289

Figure 5-140: Partridge Pigeon on waste rock section of the TLF ..... 5-291

Figure 5-141: Location of the 2018 invertebrate study, with four TLF revegetation sites and seven natural reference sites (Andersen & Oberprieler 2019) ..... 5-292

Figure 5-142: Next box trial site locations (from SLR 2022b) ..... 5-295

Figure 5-143: Flowchart showing relationship between S&T model and TARPs ..... 5-297

Figure 5-144: Wet-dry tropical woodland archetype reference dynamic ecosystem model (diagram from CSIRO 2020)..... 5-298

Figure 5-145: Pictorial summary of an S&T model for Ranger mine rehabilitation (diagram from CSIRO 2020)..... 5-299

Figure 5-146: Diagram summarizing the updated model for Ranger Mine waste rock rehabilitation .... 5-301

Figure 5-147: Ranger Mine Closure Water Quality Framework Project phases ..... 5-306

Figure 5-148: Modified version of the generalised ecological vulnerability assessment framework of De Lange et al. (2010) ..... 5-307

Figure 5-149: Trend in mean temperature, 1910 - 2020 (Source: State of the Environment, 2021) ..... 5-318

Figure 5-150: Change in number of days with the FFDI above the 90th Percentile, 1950-85 to 1985 - 2020 ..... 5-326

Figure 5-151: Sea surface temperature trends in the Australian region (a) 1910-2020; (b) 1980 - 2020 (State of the environment, 2021 source: BOM, using ERSSTv5 dataset). ..... 5-332

Figure 6-1 Framework for the integration of risks from multiple hazards into a holistic ALARA demonstration (source: Bryant et al, 2017) ..... 6-4

Figure 6-2 Illustration of stages 1-3 of Pit 3 capping Option D (Hatch, 2021) ..... 6-13

Figure 6-3 Illustration of stage 4 of Pit 3 capping Option D (Hatch, 2021) ..... 6-14

Figure 6-4 Illustration of stages 4 - 6 of Pit 3 capping Option D (Hatch, 2021) ..... 6-14

Figure 6-5 Illustration of stages 7 - 8 of Pit 3 capping Option D (Hatch, 2021) .....	6-15
Figure 7-1: ISO 31000 Risk Management Process .....	7-3
Figure 7-2: Risk Reporting Structure.....	7-13
Figure 8-1: Estimated location for occupancy post closure .....	8-4
Figure 8-2: Fungi on Trial Landform.....	8-14
Figure 8-3: Typical rocky surface of the Trial Landform (2019) .....	8-16
Figure 8-4: The Water Quality Management Framework (ANZG, 2018) .....	8-20
Figure 8-5: (Top) The main features of the ALARA procedure (Oudiz et al. 1986) and (Bottom) Framework for the integration of risks from multiple hazards into a holistic ALARA demonstration (from Bryant et al. 2017). Aspects related to the surface water risk assessment are circled. ....	8-35
Figure 8-6: Constrained optimisation and regions of effective dose for members of the critical group in the release of sites (IAEA, 2006) .....	8-41
Figure 8-7: Georgetown Creek.....	8-62
Figure 9-1: Ranger Mine closure domains .....	9-4
Figure 9-2: Pit 1 (June 2021) .....	9-5
Figure 9-3: A view of some of the 7,554 vertical wick drains installed in Pit 1 in 2012.....	9-8
Figure 9-4: Pit 1 water balance schematic.....	9-10
Figure 9-5 Scarification as seen on 28 Oct 2020 (top), 6 Jan 2021 (middle), 17 Feb 2021 (bottom).....	9-11
Figure 9-6 Time sequence of one channel forming on Pit 1. (2rog, 2021) .....	9-12
Figure 9-7: View of the perimeter drain along the southeast edge of Pit 1 (January 2021) .....	9-13
Figure 9-8 Completed CRS upgrade works with pumping infrastructure installed (January 2021).....	9-13
Figure 9-9 Pit 1 groundwater monitoring bores (ERA, 2021c).....	9-15
Figure 9-10 Backfilled Pit 1 surface topography, three stations positioned in the northern part of Pit 1 (ERA, 2021c).....	9-17
Figure 9-11 Location of the central pivot tower, including the wheel tracks. Total area of the pivot circle is approximately 29 hectares (ERA, 2021c) .....	9-18
Figure 9-12 Pit 1 Revegetation Areas .....	9-20
Figure 9-13 Preliminary plan for location of rocky outcrop habitat features on the final landform.....	9-22
Figure 9-14 Rocky outcrop habitat feature on installed on Pit 1 .....	9-23
Figure 9-15 Pit 3.....	9-24
Figure 9-16: Pit 3 backfill conceptual design .....	9-26
Figure 9-17: Pit 3 before and after underfill construction .....	9-27
Figure 9-18 Pit 3 underfill during construction in 2014.....	9-27
Figure 9-19 Pit 3 underdrain schematics .....	9-28
Figure 9-20: Flow Diagram of Brine Injection.....	9-29

Figure 9-21 Schematic cross-section of Pit 3 before tailings deposition commenced.....	9-30
Figure 9-22 Southeast wall of Pit 3 - subaerial discharge point for mill tailings (November 2019) ...	9-31
Figure 9-23: Pit 3 showing the original location of mill and dredge tailings deposition points .....	9-31
Figure 9-24: Tailings surface in April 2019 (Source: Fitton, 2019) .....	9-32
Figure 9-25: Subaerial deposition of mill tailings from multiple spigot points .....	9-33
Figure 9-26: Subaqueous deposition of dredge tailings via floating pipelines and diffusers .....	9-34
Figure 9-27: Novel subaqueous diffuser design .....	9-34
Figure 9-28: Pit 3 dredge tailings deposition plan.....	9-35
Figure 9-29 Transfer of tailings works from the Ranger Water Dam to Pit 3 2021 .....	9-36
Figure 9-30 Ranger Water Dam floor.....	9-37
Figure 9-31 View of the Pit 3 wall for proposed tip head (south west view) .....	9-37
Figure 9-32 Construction of Pit 3 tip head .....	9-38
Figure 9-33 Transfer of tailings down tip head in Pit 3.....	9-38
Figure 9-34 Pit 3 bathymetric survey, 10 March 2022 .....	9-40
Figure 9-35 : Concept design for additional injection wells.....	9-42
Figure 9-36: Concept section for additional injection wells.....	9-43
Figure 9-37 Wicking Trial Layout .....	9-44
Figure 9-38 Typical anchor as used in the trial .....	9-45
Figure 9-39 Pit 3 tailings bathymetry (horizon) as at 9 Dec 2021 with North up the page. The red lines show the wicking zones, Zone 1 the inner most to Zone 4 the outer most area. ....	9-46
Figure 9-40 Diagram of wicking barge .....	9-47
Figure 9-41 Shallow water turret suction intake .....	9-47
Figure 9-42 Mud Master at Yarwun Alumina Refinery Red Mud Dam.....	9-48
Figure 9-43 CPTu locations within Pit 3.....	9-50
Figure 9-44 Placing CPTu barge in Pit 3 with CPTu rig mounted.....	9-50
Figure 9-45 Pit 1 Capping construction method showing material 'fingers' pushed across the geotextile.....	9-52
Figure 9-46 Pit 3 capping locations delineating based on expected tailings surface conditions .....	9-52
Figure 9-47 Typical geotextile placement (plan view).....	9-53
Figure 9-48 Typical initial capping layer placement, post geotextile, finger or groyne method, infill (plan view).....	9-54
Figure 9-49 Initial capping placement typical detail – section view .....	9-54
Figure 9-50 Options for initial capping progression .....	9-55
Figure 9-51 Typical perimeter access road – section view.....	9-56
Figure 9-52 Typical geotextile anchor berm detail – section view .....	9-56



Figure 9-53 Locations of Decant and Settlement towers .....	9-57
Figure 9-54 Decant well (left) and monitoring well (right) .....	9-58
Figure 9-55 Backfill layer construction method. Note thickness, offset and machines are typical and subject to final tailings testing and capping designs .....	9-59
Figure 9-56 Pit 3 access ramps .....	9-60
Figure 9-57: Ranger Water Dam (September 2021).....	9-64
Figure 9-58: The Jabiru dredge.....	9-66
Figure 9-59: The Brolga 1 dredge .....	9-66
Figure 9-60: The Mudskipper .....	9-67
Figure 9-61: Process water return from Pit 3 to the RWD .....	9-68
Figure 9-62: Location of notches within the RWD walls.....	9-69
Figure 9-63 Typical wall cleaning operation above 45 mRL .....	9-70
Figure 9-64 –RWD wall post step 1 & 2, with tailings patches indicated (dark grey/khaki colour) ....	9-71
Figure 9-65 Section of the West wall showing a scraped clean wall section prior to wet season 2020/21. Some fine tailings may potentially sit in between wall armouring .....	9-72
Figure 9-66 Same section of the West wall of Figure 9-6565 showing cleaned surface following rain .	9-73
Figure 9-67: April 2019 Magnetic Anomaly Map (left frame) comparison with the 2012 Magnetic Anomaly Map (right frame).....	9-74
Figure 9-68 RWD wall deconstruction sequence.....	9-79
Figure 9-69 Djalkmarra and Djalkmarra Extension Land Application Areas (May 2019) .....	9-80
Figure 9-70: Infrastructure for removal at Corridor Creek LAA .....	9-81
Figure 9-71: Infrastructure for removal at Corridor Creek LAA .....	9-82
Figure 9-72 Map of Land Application Areas and survey locations within the Ranger Project Area ..	9-84
Figure 9-73 Process plant, mill and water treatment plants (May 2019) .....	9-85
Figure 9-74 Decommissioning stages.....	9-86
Figure 9-75 Plant demolition sequence .....	9-91
Figure 9-76 Areas for disposal of demolition material.....	9-92
Figure 9-77: Stockpile area (May 2019).....	9-96
Figure 9-78: Monitoring of native seedlings planted on Stage 13.....	9-97
Figure 9-79: Planting areas A, B and C of Stage 13.1 .....	9-98
Figure 9-80: Existing pipeline corridors (blue lines) and proposed central services corridor (green line) .....	9-99
Figure 9-81: Retention Pond 1 (RP1) and RP1 Wetland Filter (May 2019).....	9-101
Figure 9-82: R3 Deeps portal and offices .....	9-106
Figure 9-83: Plan view of the decline .....	9-107

Figure 9-84: Oblique view of R3D decline and main closure elements .....	9-108
Figure 9-85: Boxcut and portal, completed in December 2012 .....	9-109
Figure 9-86: Backfilled shaft with waste rock plug (orange), crushed waste rock (purple); cemented rock fill layer (pink) with a crushed rock "cover" for the last 20 m of the weathered zone; and, concrete collar removed.....	9-112
Figure 9-87: Schematic of backfilling detail to below weathered zone .....	9-113
Figure 9-88: Gagudju Yard.....	9-113
Figure 9-89: Range Mine Village.....	9-115
Figure 9-90: Ranger Mine Village area prior to planting (January 2020).....	9-116
Figure 9-91: Rehabilitation site at Ranger Mine Village (June 2020) .....	9-116
Figure 9-92: Nursery and old core yard at Jabiru East (May 2019).....	9-117
Figure 9-93: Magela levee (May 2019) .....	9-119
Figure 9-94: Borrow pit for RWD lift .....	9-120
Figure 9-95: Borrow pit for Magela Creek Levee .....	9-121
Figure 9-96: Temporary waste storage facility on the western edge of Pit 3 (May 2019) .....	9-122
Figure 9-97: Old magazine site (May 2019).....	9-123
Figure 9-98: Trial landform (March 2022) .....	9-124
Figure 9-99: Trial landform – treatment design and associated infrastructure .....	9-125
Figure 9-100: Rock types used to construct the trial landform .....	9-126
Figure 9-101 Profile of the waste rock only section Area 1 of the TLF .....	9-127
Figure 9-102: Final landform footprint around the TLF Green shading shows the area proposed to be backfilled as part of the catchment management trial.....	9-128
Figure 9-103: Jabiru airport (May 2019) .....	9-129
Figure 9-104: Process water flow diagram for the current water model .....	9-137
Figure 9-105: Block flow diagram for the Brine Concentrator following BC3 fan upgrade .....	9-139
Figure 9-106: HDS Plant Block Flow Diagram.....	9-140
Figure 9-107: Material movement excavation areas.....	9-146
Figure 9-108: Material movement placement areas .....	9-147
Figure 9-109: Stockpile material grades variance.....	9-149
Figure 9-110: Final landform boundary .....	9-150
Figure 9-111: Final landform topography contours (FLv 6.2) overlain on the most recent aerial photo.....	9-151
Figure 9-112: Final landform contours .....	9-152
Figure 9-113: Footprint of final landform requiring contour ripping.....	9-156
Figure 9-114 Small scarification trial on Pit 1 (2020) .....	9-157

Figure 9-115: Contour ripping on trial landform trial of 2m interval (2010) .....	9-158
Figure 9-116: Contour ripping on Stage 13, with 3 m intervals (March 2020) .....	9-158
Figure 9-117: Environmental rock bars – section view .....	9-159
Figure 9-118: Boundary sediment control structure – section view .....	9-160
Figure 9-119: Catchment plan for final landform with sediment basins and environmental rock bars.....	9-161
Figure 9-120: Flow chart of seed collection program.....	9-166
Figure 9-121: Example of a specially modified auger cultivator attached to a small excavator, here seen being trialled in waste rock on the Trial Landform in March 2020.....	9-170
Figure 9-122: A mechanically cultivated planting site.....	9-170
Figure 9-123: Tubestock planting out steps.....	9-172
Figure 10-1: Settlement plates locations (locations indicated by red dots).....	10-4
Figure 10-2: Measured versus predicted tailings settlement .....	10-4
Figure 10-3: Predicted versus measured Pit 3 tailings levels .....	10-5
Figure 10-4: Pit 3 Locations of settlement towers .....	10-6
Figure 10-5: Time sequence of first order drainage channel forming on Pit 1 (2rog, 2022).....	10-8
Figure 10-6: GC2 monitoring station in the dry season .....	10-17
Figure 10-7: GC2 monitoring station in the wet season.....	10-17
Figure 10-8: Statutory and operations surface water monitoring sites at the Ranger Mine.....	10-18
Figure 10-9: Area 8 – Piezometers .....	10-21
Figure 10-10: Pit 1 groundwater monitoring bores.....	10-24
Figure 10-11: Location of Pit 3 monitoring bores .....	10-27
Figure 10-12: Location of R3D closure monitoring bores .....	10-28
Figure 10-13 Systematic random sampling approach (IAEA 2019).....	10-36
Figure 10-14: Areas surveyed by Dendra in May 2022 .....	10-49
Figure 10-15: Weed Management Zones Map .....	10-51
Figure 10-16: Weed loads on the Ranger Project Area 2021 .....	10-52
Figure 10-17: Ranger Fire Management Map.....	10-54

**TABLES**

Table 1-1 Ranger Mine operator details.....	1-2
Table 1-2 Ranger Mine title holder details.....	1-2
Table 1-3 Timelines of the operations and closure phases of the Ranger Mine .....	1-11
Table 1-4 Future Commonwealth applications to be submitted .....	1-13
Table 1-5 Structure and content of this MCP .....	1-14
Table 2-1 Ranger Mine timeline .....	2-1
Table 2-2: Indicative ore grades and mineral type.....	2-4
Table 2-3: Water classes and their management.....	2-13
Table 2-4: LAA description of generalised water management.....	2-19
Table 4-1 Ranger Mine closure stakeholders.....	4-2
Table 4-2 Stakeholder Engagement Forums.....	4-5
Table 5-1: Statistical climate data for Jabiru Airport from June 2021 to June 2022 (BOM, 2022) ....	5-14
Table 5-2: Key to soil characteristics locations around the Ranger Mine shown in Figure 5-5 .....	5-20
Table 5-3: Soil hydraulic conductivity .....	5-21
Table 5-4: Typical erosion susceptibility of soils.....	5-21
Table 5-5: Extreme event likelihood and consequence summary for tailings repositories .....	5-25
Table 5-6: Summary of significant hazards and consequences .....	5-27
Table 5-7: Predicted denudation rates and gully depth for each catchment on FLv6.2. ....	5-34
Table 5-8: Analogue landform terrain properties adopted as FLV 7 design criteria (Hollingsworth, 2010) .....	5-39
Table 5-9: CAESAR-Lisflood simulation results of FLV 7 iterations in Coonjimba catchment compared to FLv6.2 base case .....	5-41
Table 5-10: Statistical values for the observed rainfall events in the four wet seasons (water years) from 2009 to 2013.....	5-45
Table 5-11: Summary of field infiltration parameters for the TLF.....	5-45
Table 5-12: Particle size distribution in percentage for the waste rock dump materials and Koolpinyah surface materials, adapted from Hancock et. al (2020) .....	5-48
Table 5-13: Summary of Consolidation model results .....	5-67
Table 5-14: Details of 2019 CPT.....	5-73
Table 5-15: Summary of Geophysical survey .....	5-84
Table 5-16: Twelve classes of Magela floodplain vegetation (Whiteside and Bartolo,2014).....	5-85
Table 5-17: List of key species indicators of Ramsar and cultural values in relation to the RPA (BMT, 2019) .....	5-88

Table 5-18: Seasonal patterns in aquatic macroinvertebrates in Magela catchment billabongs (BMT 2019 after Marchant 1982) .....	5-90
Table 5-19: Summary of information sources and how used in the risk assessment .....	5-98
Table 5-20: Results of risk assessment .....	5-100
Table 5-21: Ten highest ranked threats identified in the risk assessment .....	5-102
Table 5-22: Calculated BTVs for HLU and Analytes in the Background Evaluation where data sufficiency requirements were met, ERM (2020c) .....	5-108
Table 5-23: Summary of solutes identified as COPCs for the Ranger solute source terms .....	5-111
Table 5-24: Ranger Conceptual Model HLUs, INTERA (2021b).....	5-116
Table 5-25: Calibration statistics for the updated transient groundwater flow model, INTERA (2021b).....	5-120
Table 5-26: Natural catchment runoff water quality relationship parameters.....	5-140
Table 5-27: Flow vs Concentration correlation for TSS .....	5-140
Table 5-28: Regional background values and datasets .....	5-146
Table 5-29: Nutrient limits (concentrations or loads) from Brown et al. (1985).....	5-151
Table 5-30: AALL for nitrate and phosphate compared to loads added to the Magela Creek in rainwater and transported to the flood plain by Magela Creek; load and (error).....	5-152
Table 5-31: Pre-mining radiological baseline determined by the Supervising Scientist (Bollhöfer et al., 2014).....	5-153
Table 5-32: Calculated BTVs for HLU and Analytes in the Background Evaluation where data sufficiency requirements were met, ERM (2020) .....	5-155
Table 5-33: Magela Creek upstream radionuclide concentrations (2010 – 2014 average) .....	5-155
Table 5-34: Radionuclide concentrations in local bush foods .....	5-157
Table 5-35 Exposure estimation methods (JRHC in draft).....	5-159
Table 5-36: Area and proportion of vegetation communities on the RPA and Kakadu NP.....	5-163
Table 5-37: Approximate depth of waste rock over natural soils (based on 2020 BMM plan).....	5-169
Table 5-38: Vegetation survey data collected in the Alligator Rivers Region (adapted from Erskine et al. 2019) .....	5-172
Table 5-39: Rehabilitated waste rock landform properties.....	5-187
Table 5-40: Analogue landscape properties .....	5-187
Table 5-41: Particle size distribution data from TLF 1A section at construction in 2009.....	5-188
Table 5-42: Chemical analysis of waste rock samples taken in January 2010 compared to natural soils (source Gellert 2014) .....	5-203
Table 5-43: key findings of 2018 nutrient cycling study (TLF-1A and Site 21).....	5-206
Table 5-44: Elemental composition in the litter among sites.....	5-207
Table 5-45: Small-scale revegetation trials conducted on the RPA (1982 – 2002).....	5-210

Table 5-46: Stage 13.1A propagation treatments and rationale	5-226
Table 5-47: TLF Permanent Monitoring Plot details.....	5-227
Table 5-48: Vegetation establishment activities conducted on the Ranger Mine TLF, 2009 – 2020, not including routine weed management .....	5-229
Table 5-49: Approximate total overstorey and midstorey stems on the TLF in 2019, including recruits. ....	5-235
Table 5-50: Flowering, fruiting and self-recruitment of tree, shrub and palm species present on the TLF .....	5-238
Table 5-51: Total overstorey and midstorey stems on Stage 13.1, excluding recruits.....	5-253
Table 5-52: Overstorey/midstorey (OS) and understorey (US) species investigated in the Pit 1 research trials.....	5-257
Table 5-53: Published fire frequencies for the region surrounding Ranger Mine (from Cook 2021)	5-268
Table 5-54: Fire resilience mechanisms in natural ecosystems and 25 year old developing revegetation (Cook 2021).....	5-270
Table 5-55: Actively Managed Weeds in the surrounding RPA .....	5-280
Table 5-56: Feral fauna species known to occur in Kakadu NP and the RPA .....	5-280
Table 5-57: Conservation listed species known to occur on the RPA (adapted from Firth 2012)....	5-284
Table 5-58: Frugivorous and nectivorous bird species that may occur within the rehabilitated Ranger Mine site .....	5-286
Table 5-59: Summary of surveys used for SLR Consulting 2021 analysis .....	5-289
Table 5-60: Nest box design and rationale .....	5-293
Table 6-1: Explanation of relevant matters to be included in BPT assessment .....	6-2
Table 6-2 Summary of completed BPTs .....	6-8
Table 6-3 Summary of Pit 3 Capping Best Practicable Technology .....	6-11
Table 6-4 BPT Assessment Results: .....	6-12
Table 7-1: Risk Class Determination.....	7-8
Table 7-2: Risk management response .....	7-9
Table 7-3: Likelihood qualitative criteria .....	7-9
Table 7-4: Consequence qualitative criteria.....	7-10
Table 7-5: Control and Overall Control Effectiveness .....	7-12
Table 8-1: Estimates of occupancy periods at various locations on the rehabilitated RPA .....	8-3
Table 8-2: Estimate of annual intake of bushfood of local Aboriginal people in northern Kakadu .....	8-9
Table 8-3: Closure objectives.....	8-11
Table 8-4: Final Closure criteria – Landform.....	8-17
Table 8-5: Agreed guideline values for each management goal. The most stringent for each indicator (underlined and italicised) is the draft water/sediment quality objective proposed as closure criteria	8-23

Table 8-6: Draft water and sediment quality objectives under review .....	8-25
Table 8-7: Closure criteria – radiation .....	8-38
Table 8-8: Closure criteria – soils .....	8-44
Table 8-9: Closure criteria – Ecosystems .....	8-46
Table 8-11: Closure criteria – cultural .....	8-59
Table 8-12: Suggested indicators of cultural health of rehabilitated site (Garde, 2015) .....	8-60
Table 8-13: Example of scalar measurement tool for cultural criteria monitoring .....	8-61
Table 9-1: Land disturbance by domains .....	9-1
Table 9-2: Area of progressive revegetation at RPA.....	9-2
Table 9-3 Completed Pit 1 rehabilitation .....	9-5
Table 9-4: Type of waste rock used in rehabilitation .....	9-9
Table 9-5 Summary of Groundwater monitoring plan (ERA, 2021c).....	9-16
Table 9-6 Summary of revegetation trials (ERA, 2021c).....	9-19
Table 9-7: Completed Pit 3 rehabilitation .....	9-25
Table 9-8 Pit 3 tailings quantities .....	9-39
Table 9-9 Current wicking plan per zone .....	9-46
Table 9-10 Pit 3 Water management during capping works .....	9-48
Table 9-11 Pit 3 Backfill Geotechnical Design Criteria.....	9-60
Table 9-12 Bulk Material Movement to Pit 3 .....	9-61
Table 9-13 Waste materials for management and/or disposal at closure .....	9-62
Table 9-14: Completed RWD rehabilitation.....	9-65
Table 9-15: RWD deconstruction material quantities.....	9-77
Table 9-16: Area of the LAAs.....	9-81
Table 9-17 Land application areas surveyed within the Ranger Project Area .....	9-83
Table 9-18: Demolition phases .....	9-93
Table 9-19: Phase 1 demolition areas .....	9-94
Table 9-20: Phase 2 demolition areas .....	9-95
Table 9-21: Geological conditions, decline reinforcement methodology.....	9-108
Table 9-22: Waste materials for management and/or disposal at closure .....	9-133
Table 9-23: Bulk material movements.....	9-148
Table 9-24: Environmental rock bar design features .....	9-159
Table 9-25: Sediment control structure design features .....	9-160
Table 9-26: Information available for the major physical and/or chemical substrate constraints for ecosystem establishment.....	9-165

Table 9-27 Seeding specifications for nursery tubestock.....	9-168
Table 10.1: Landform monitoring for ‘closure’ phase .....	10-10
Table 10.2: Landform monitoring for ‘monitoring and maintenance’ phase .....	10-13
Table 10.3: Parameters and locations for post-closure surface water monitoring to assess compliance with closure criteria .....	10-19
Table 10.4: Groundwater monitoring bores for Pit 1 closure.....	10-23
Table 10.5: Historic trigger values for Pit 1 tailings deposition.....	10-24
Table 10.6: Parameters for groundwater monitoring bores for Pit 3 closure.....	10-25
Table 10.7: Groundwater monitoring for Ranger 3 Deeps .....	10-28
Table 10.8: Groundwater monitoring for the Ranger Water Dam .....	10-29
Table 10.9: General background groundwater chemistry on the RPA.....	10-30
Table 10.10 Groundwater closure and post closure monitoring.....	10-32
Table 10.11: Radiation closure and post-closure monitoring .....	10-38
Table 10.12: Summary of TLF monitoring programs .....	10-42
Table 10.13: Summary of Pit 1 substrate and weather monitoring programs .....	10-44
Table 10.14: Summary of Pit 1 revegetation monitoring program.....	10-45
Table 10.15: Maintenance work that may be required for revegetation during the closure and/or post-closure phases .....	10-48
Table 10.16: Suggested indicators of cultural health of rehabilitated site (Garde, 2015).....	10-58
Table 10.17: An example of a bilingual, scalar cultural index score for cultural criteria monitoring .	10-59
Table 10.18: Trigger, action, response plan.....	10-60
Table 12-1: Data collection types relevant to closure .....	12-3



## **APPENDICES**

Appendix 1-1 Ranger 2022 Mine Closure Plan stakeholder feedback form

Appendix 2-1 Water Management Terminology

Appendix 3-1 Overview of primary legislation, agreements and authorisations

Appendix 3-2 Closure Legal Obligations Register

Appendix 4-1 Ranger Mine Closure Stakeholder Consultation Register

Appendix 5-1 Key Knowledge Needs

Appendix 5-2 Consolidation Model A

Appendix 5-3 Consolidation Model B

Appendix 5-4 Ranger Revegetation Strategy (Reddell & Meek 2004

Appendix 5-5 SERP species ERA are potentially considering for revegetation

Appendix 5-6 Fauna Species List (SLR 2021)

Appendix 6-1 Completed Best Practicable Technology Assessments

Appendix 6-2 BPT Assessment Matrices for Pit 3 Capping

Appendix 6-3 ALARA

Appendix 7-1 Ranger Closure Risk Assessment

Appendix 9-1 Final landform drawings

Appendix 9-2 Hazardous material and contamination control plan

Appendix 10-1 Pit 1 Progressive Rehabilitation Monitoring Framework