NT Mining Operations Pty Ltd
Union Reefs Project Area
Union Reefs North Underground Mine
Notice of Intent

Submission Date: 8 April 2019

KL | KIRKLAND LAKE GOLD

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1 PROPOSAL DETAILS

1.1 Key Characteristics

Element	Proposed
General	
Underground Mine Life	2 years with possible extension
Tenure	MLN1109 (area of 3,998ha) Mary River West Station (Pastoral Lease 815)
Site Description	Highly modified brownfields mining area Existing tenement disturbance is 493ha with 354ha rehabilitated
Surface Clearing	1ha in previously disturbed and predominantly regrowth areas
Underground Mine	
Portal Location	Eastern wall of the existing Prospect Pit (1179.5mRL)
Mine Depth	220m below ground surface (980mRL)
Average Daily Surface Truck Movements	12 per day during first 10 months, increasing to 27 per day
Total Material Movement	
Ore Tonnes	276,089
Gold Ounces	39,232
Waste Rock to Surface	104,000m^3 stored within Prospect Pit 20,000m^3 remains insitu as the portal bench 84,000m^3 temporarily stockpiled and progressively returned underground as backfill
Water	
Water Use	47-63 ML/year
Wastewater Generated	78.5 – 473ML, averaging around 276ML/year
Wastewater Discharge	Not required, reuse in the URPA Processing Plant with adequate storage capacity in Crosscourse Pit
Energy	
Explosive and Detonator Storage	40t and 25kg respectively
Electricity Use	9,000,000 – 12,000,000kWh/year
Diesel Consumption	720,000L/year
Annual Greenhouse Gas Emissions	9,639t-$CO_{2\text{-}e}$
Key Environmental Impacts	
Flora and Fauna	*Macroderma gigas* (Ghost Bats) - vulnerable listing in EPBC Act OK and Prospect Adits within the Prospect Pit and high potential for impacts from noise and vibration NTMO plan to temporarily close and restrict Ghost Bat access to these adits during mining EPBC Act referral of proposed action planned

1.2 Proposal Title

The purpose of this Notice of Intent (NOI) is to enable the Northern Territory Environment Protection Authority (NT EPA) to consider the proposed Union Reefs North Underground Mine and make an informed decision on the significance of the potential environmental impacts and risks. This NOI has been prepared by the NT Mining Operations Pty Ltd (NTMO) to outline the nature, scale and scope of the proposed underground mine, the environment in which it is located, and the likely environmental impacts and risks. This NOI also identifies NTMO measures to avoid, mitigate and minimise any potential environmental impacts and risks.

1.3 Contact Details

The project proponent is NTMO, ACN 136 525 990, 100% owned by Kirkland Lake Gold (KLG). KLG is an Australian and Canadian-listed gold mining and exploration company trading on the Australian, New York and the Toronto Stock Exchanges. KLG is a mid-tier gold producer with target production in 2019 of over 920,000 ounces (oz) from mines in Canada and Australia. KLG mineral and exploration titles in the Northern Territory (NT) comprise an area greater than 2,000 square kilometres (km) and are located 150 to 350km from the NT Capital City of Darwin.

Project contact details are as follows:

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1.4 Location

Geographically, the NTMO operations are centred between the communities of Adelaide River to the north and Pine Creek to the south. The Union Reefs Project Area (URPA) is located approximately 20km north-west of the township of Pine Creek and 175km south-east of Darwin (220km by road). The URPA is shown in a regional context in Figure 1.

The URPA is accessed from the Stuart Highway along a restricted 8km mine-access road (Ping Que Road). The URPA tenements and Ping Que Road occupy land on Mary River West Station (Pastoral Lease 815) and are located in a region of historical mining and pastoral land use (cattle grazing). The current URPA site layout and infrastructure are provided in Figure 2.

The URPA consists of 10 Mineral Titles (Figure 3), which are all owned by KLG (noting that Newmarket Gold NT Holdings Pty Ltd is a subsidiary of KLG). NTMO has been appointed as the Nominated Operator of the URPA on behalf of KLG since 2015. This NOI outlines the proposed underground mining activities within Mineral Lease Number 1109 (MLN1109).

The Darwin to Alice Springs / Adelaide Railway easement (operated by Genesee Wyoming Australia (GWA)) passes through the western side of MLN1109 and the 66kV transmission line (No. 219085) runs along the same route. Gas pipeline (No. 203267) also runs through MLN1109 and the Commonwealth holds the lease for the Telstra microwave repeater tower (No. 8105) and associated access track.

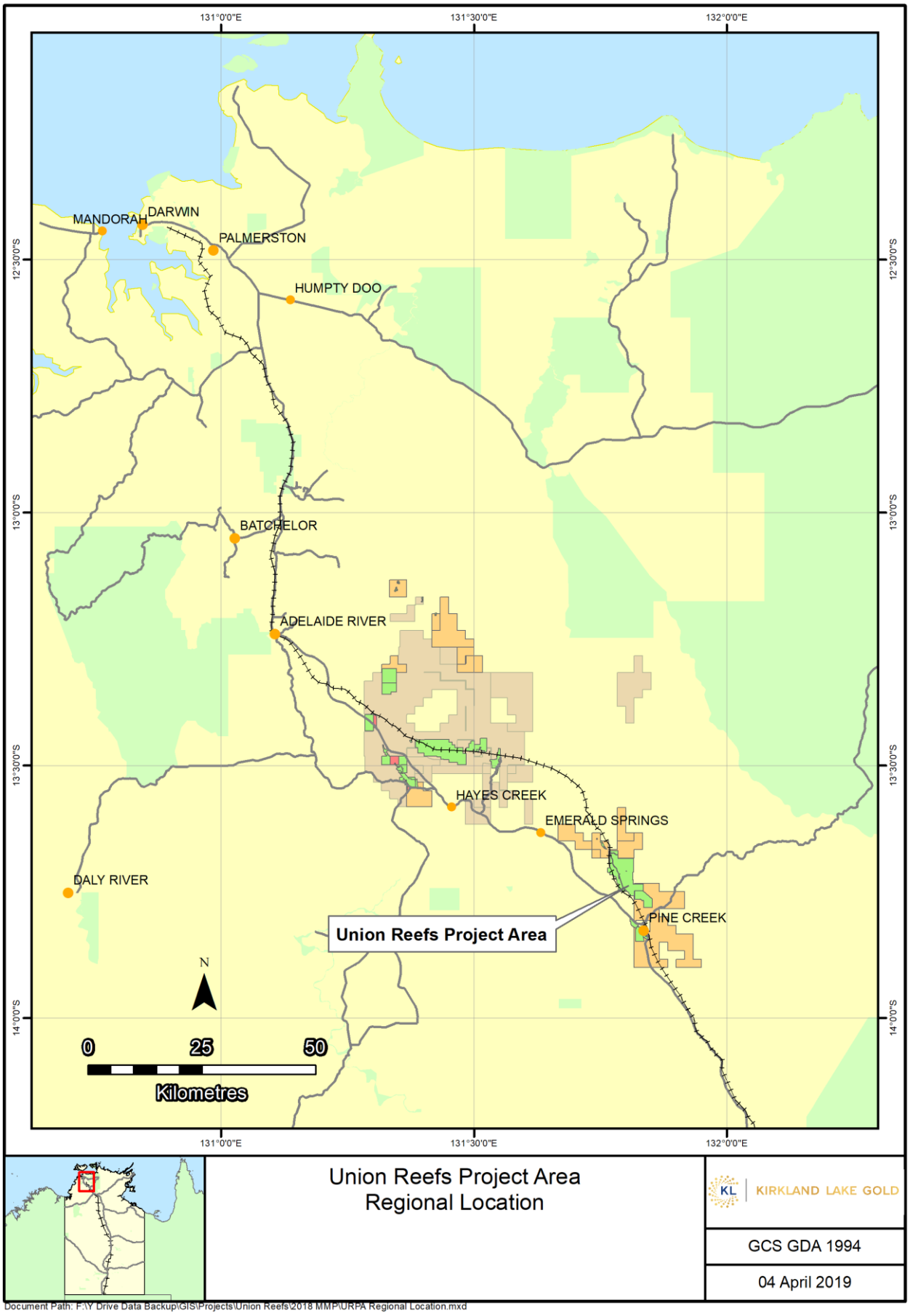

FIGURE 1: REGIONAL LOCATION OF THE URPA

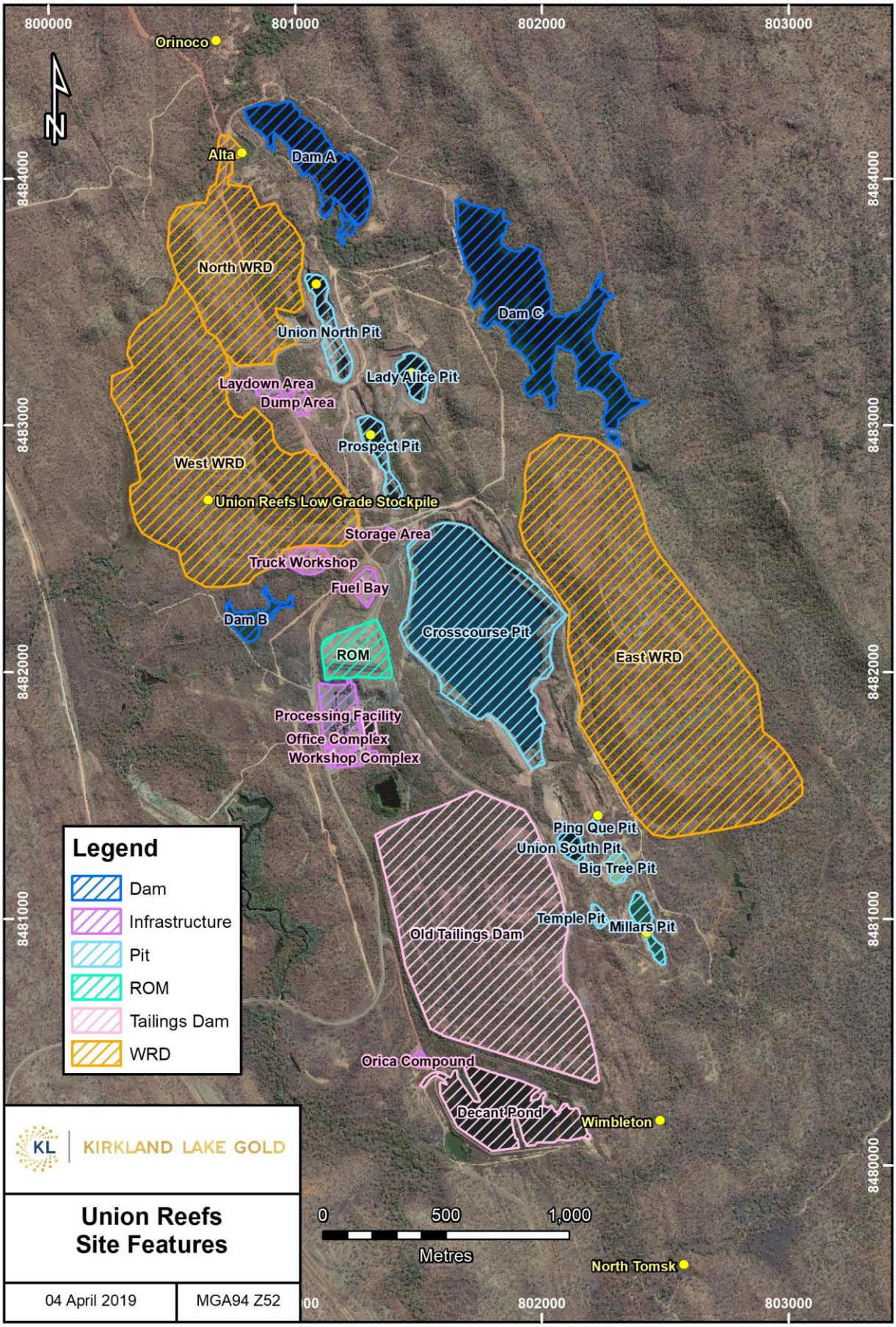

FIGURE 2: URPA CURRENT SITE FEATURES

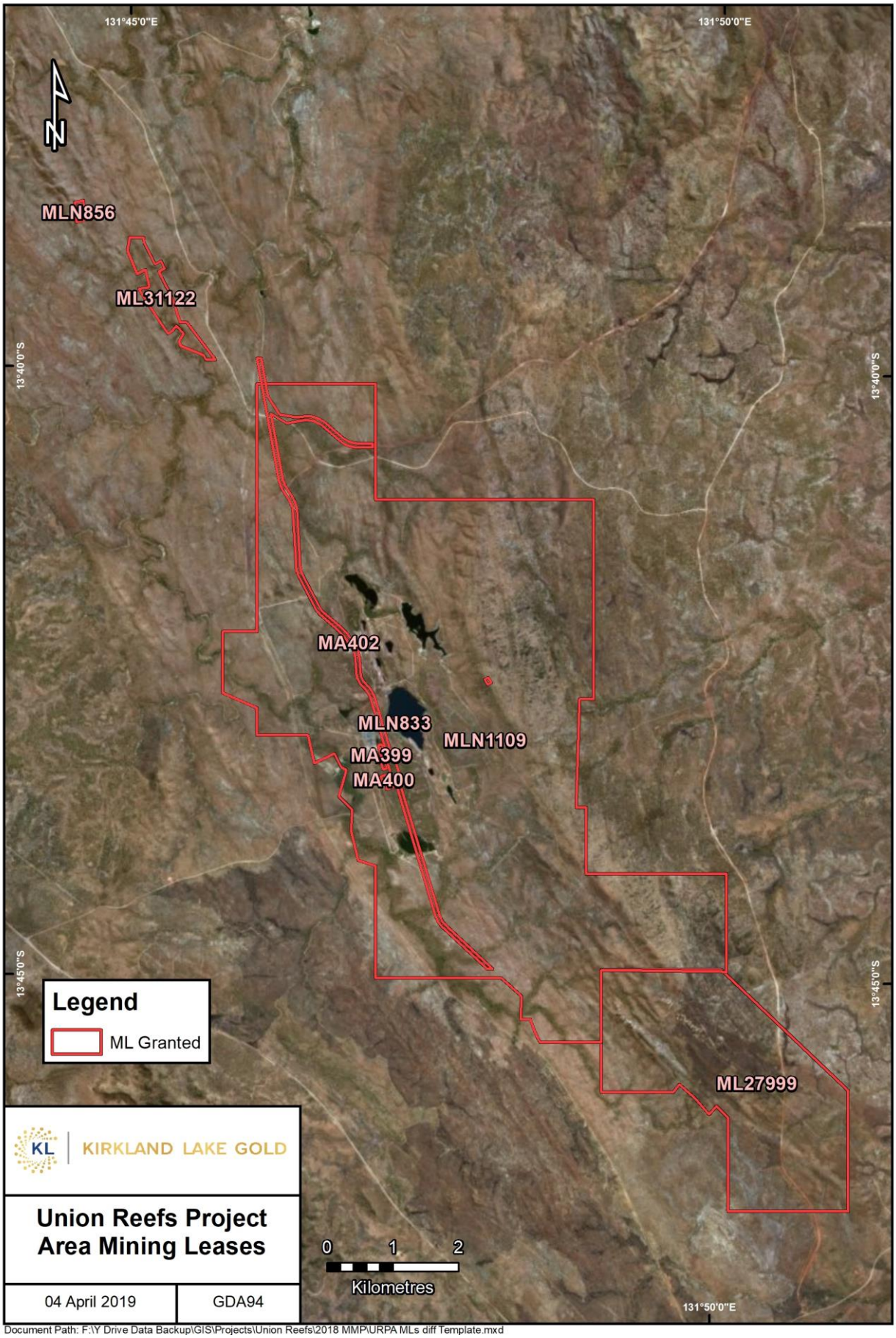

FIGURE 3: URPA MINERAL TITLES

2 STATUTORY REQUIREMENTS AND APPROVALS

KLG is committed to compliance with statutory and other requirements, developing an effective Environment and Social Responsibility Management System (ESRMS), continuous improvement and minimising environmental and social impacts. The KLG Policies outline these commitments and are available on the KLG website http://www.klgold.com/about-us/policies/.

NTMO identifies and tracks statutory and other requirements applicable to its activities and a list of the key legislation is provided in Table 1. The NTMO Management Team are responsible for ensuring that all site Employees and Contractors:

- Comply with all Laws, conditions of any Permits, Licences and Authorisations or any NTMO standards, management plans and procedures applicable to their activities;
- Work safely, protecting people, environment and community;
- Identify any hazards or risks associated with their work and implement appropriate controls; and
- Report and rectify any observed unsafe acts, incidents or hazards.

Specific licensing, approvals or permits required and relevant to this NOI, are outlined in Table 2.

TABLE 1: APPLICABLE LEGISLATION

Northern Territory Legislation	Commonwealth Legislation
Bushfires Management Act *Control of Roads Act* *Dangerous Goods Act* *Electricity Reform Act* *Energy Pipelines Act* *Environmental Assessment Act* *Heritage Act* *Mineral Royalty Act* *Mineral Titles Act* *Mining Management Act* *Northern Territory Aboriginal Sacred Sites Act* *Public and Environmental Health Act* *Soil Conservation and Land Utilisation Act* *Territory Parks and Wildlife Conservation Act* *Traffic Act* *Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act* *Waste Management and Pollution Control Act* *Water Act* *Weed Management Act* *Work Health and Safety (National Uniform Legislation) Act*	*Aboriginal and Torres Strait Islander Heritage Protection Act 1984* *Aboriginal Land Rights (Northern Territory) Act 1976* *Environment Protection and Biodiversity Conservation Act 1999* *National Environment Protection Council Act 1994* *National Greenhouse and Energy Reporting Act 2007* *Native Title Act 1993*

TABLE 2: REQUIRED LICENSING, APPROVALS OR PERMITS

Legislation	Licence, Approval or Permits Required
Environment Protection and Biodiversity Conservation Act 1999	Formal referral and assessment of the project given the proposed impact on *Macroderma gigas* (Ghost Bats) habitat (temporary adit closure) – Listed as vulnerable under the EPBC Act.
Dangerous Goods Act	A Licence to Possess, Store and/or Sell Explosives will be applied for the URPA Explosives Magazine. Individual Shotfirers will be licenced in accordance with the Act.
Environmental Assessment Act	Formal referral and environmental impact assessment of the project (this NOI).
Mineral Titles Act	MLN1109 was granted on 16 December 1993 and expires on 31 December 2034.
Mining Management Act	Authorisation 0539-03 for the URPA operations was issued 8 May 2018. A URPA Mine Management Plan (MMP) Amendment will be submitted to the Department of Primary Industry and Resources (DPIR) to incorporate the Union Reefs North Underground Mine following EPBC and NT EPA assessments.
NT Aboriginal Sacred Sites Act	AAPA Certificate C2009/267 for the URPA was granted on 8 October 2009.
Work Health and Safety (National Uniform Legislation) Act	A URPA Risk Management Plan (RMP) and Certification Letter was submitted to NT WorkSafe on 30 July 2018. An updated Hazardous Chemicals Manifest and Plan will be provided to NT WorkSafe as required.

3 PROPOSAL DESCRIPTION

Gold deposits at the URPA follow the Pine Creek Shear Zone and are located on two smaller sub parallel northwest mineralisation trends (Figure 4). The eastern trend is known as the 'Lady Alice Line' and the western trend is the 'Union Line'. NTMO are proposing to mine (via underground), along the Union Line and extend into the Lady Alice Line. Both of these mineralisation trends have previously been mined via the Union North, Prospect, Lady Alice and Crosscourse Open Pits.

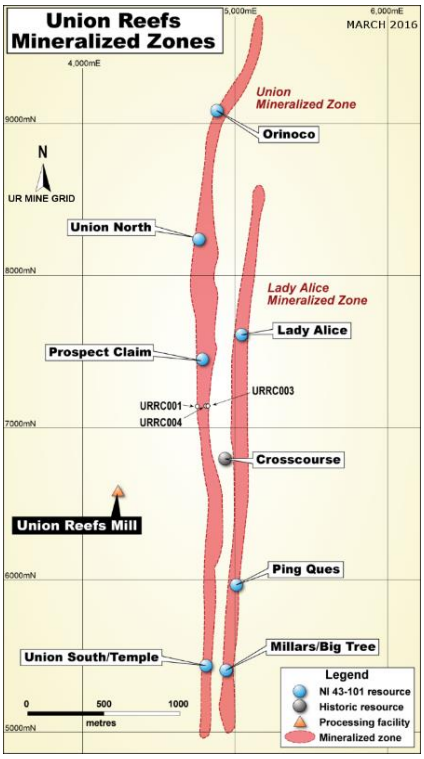

FIGURE 4: URPA MINERALISED ZONES AND GOLD DEPOSITS

NTMO is planning to develop and advance the Union Reefs North Underground Mine to initially target the Prospect Claim Deposit on MLN1109 (Figure 5). The 2017 NTMO NI 43-101 Ore Reserve statement indicates a probable Mineral Reserve of 39,200 ounces of gold from the Prospect Claim Deposit with an estimated Life of Mine (LOM) of around 2 years. Additional drilling from within the underground mine will further define the extent of the mineralisation and aims to convert ore into inventory and grow the reportable Mineral Reserve, to potentially extend the current LOM.

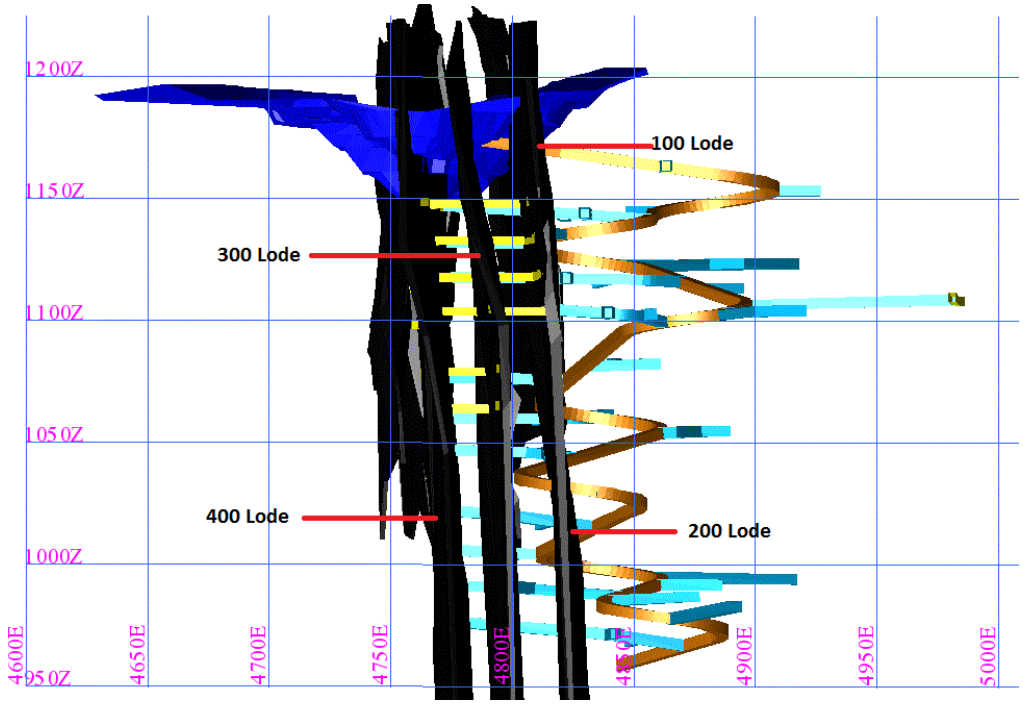

FIGURE 5: PROSPECT CLAIM DEPOSIT UNDERGROUND MINE DESIGN

The Union Reefs North Underground Mine will be accessed via a portal and decline developed from within the existing Prospect Pit. The underground mine plan includes the development of the orebody to around 220m below ground surface (980mRL). This is similar to the depth of the Crosscourse Pit, which was mined to around 240m.

The underground portal is planned to be located at the 1179.5mRL in the eastern wall of the existing Prospect Pit and the existing water level is at 1175mRL. Prior to complete dewatering, NTMO will reduce and maintain the water level in the Prospect Pit (North) below the 1173.5mRL, which is 6m below the portal and incorporates a safety factor for a 1 in 100 year rainfall event during the wet season.

The planned underground mining method is a combination of up-hole benching and Avoca stoping, in a three-lift bottom-up sequence. This method requires the decline to be advanced at least three levels prior to ore production commencing. In summary, the underground mining production cycle includes the following:

- Develop access to the mineralisation;
- Develop the ore (mineralisation) drive to the economic extents;
- Establish a slot rise through to the level above;
- Drill long holes up to within 0.5m of the level above;
- Blast rings;
- Bog ore using conventional and tele-remote techniques until the stope is clean;
- Backfill the stope from level above with waste rock; and
- Continue retreating to the access.

Ore drives will be developed at 3m wide x 5m high to allow for production drills with full electronic boom movement, loaders, installation of ground support and ventilation ducting. The current planned development and production schedules are provided in Table 3 with the underground schematic provided in Figure 6.

TABLE 3: UNION REEFS NORTH UNDERGROUND DEVELOPMENT AND PRODUCTION SCHEDULE

Development and Production Methods	Meters		
	Year 1	Year 2	Total
Decline (Brown in Figure 6)	909	310	**1,219**
Stockpiles	213	105	**318**
Level Access and Lode Cross Cuts (Blue in Figure 6)	477	155	**632**
Return Air Way (Red in Figure 6)	94	22	**116**
Sumps	36	21	**57**
Ore (Mineralisation) Drives (Yellow in Figure 6)	1,988	869	**2,857**
Total Lateral Development	**3,717**	**1,482**	**5,199**
Return Air Rise and Escape Ways (Red in Figure 6)	273	116	**389**
Total Vertical Development	**273**	**116**	**389**
Development Ore Tonnes	73,292	34,696	**107,988**
Production Ore Tonnes	18,741	149,360	**168,101**
Total Ore Tonnes	**92,033**	**184,056**	**276,089**
Total Gold Ounces			**39,232**

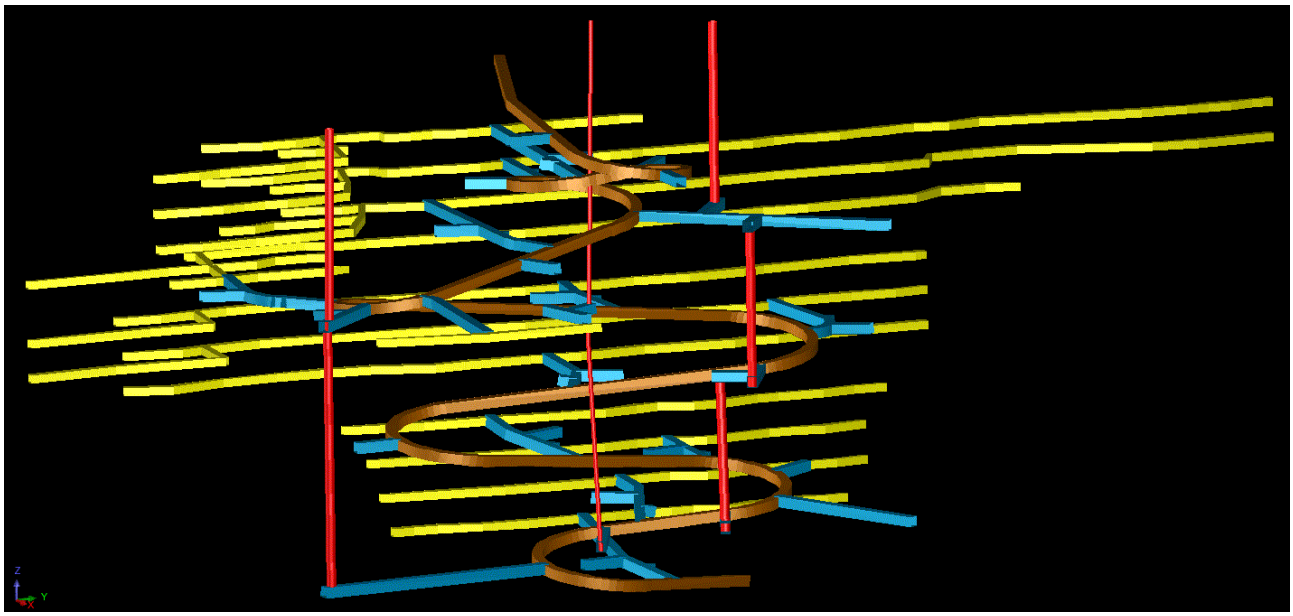

FIGURE 6: UNION REEFS NORTH UNDERGROUND MINE SCHEMATIC

Fresh air will enter the mine via the portal and Fresh Air Rise (FAR) while the return air will be drawn up the Return Air Rise (RAR) system by a fan with a capacity of 150m^3/s. All FAR's and RAR's will be 4m diameter raisebores while the escapeway will be a series of 2m diameter raisebores running from the surface to the lower levels of the mine.

Blasting for development and production will be required for the Union Reefs Underground Mine. Blasting times are limited to shift changes or other times when personnel can be safely removed from the blast area. Underground blasts are smaller than open pit blasts as underground mining requires much smaller volumes of material to be mined. Underground blasting has lower levels of vibration and other potential surface impacts such as dust, airblast and flyrock are essentially eliminated.

Development blasting relates to the excavation of material (generally in waste) required to gain access to the orebody and to provide space for underground infrastructure (i.e. pumps, electrical systems etc.). This includes the development of the portal, decline and drives required for drilling, ore extraction and ventilation requirements. The scheduling and progress of development blasting is critical to mine planning as it provides access to mining production areas. Development blasting will involve approximately one firing every 12 hours with the blast spread over 8 seconds. The maximum charge fired at any point in time will not exceed 35 kilograms (kg) to minimise vibration.

Production blasting is designed to provide optimum fragmentation and minimise dilution of the ore. Production blasting will only be required later in the mine life to extract ore from the stopes. Production blasting will involve one firing every 24 hours with the blast spread over half a second. The maximum charge fired at any point in time will not exceed 40kg to minimise vibration.

The Union Reefs North Underground Mine development will be undertaken using experienced owner operator personnel. The existing URPA fuel farm and workshop will be utilised for refuelling and repairs on mining machinery. On average, there will be 12 trucks per day to the surface during the first 10 months and then 27 trucks per day as ore production increases. It is expected that the required minimum equipment will include:

- 1 x Electric/Hydraulic Two Boom Jumbo;
- 1 x Electric/Hydraulic Production Jumbo;
- 2 x 14 t Loaders;
- 2 x 42 t Diesel Haul Trucks;
- 1 x Agitator Truck (as required);
- 1 x Grader (as required);
- 2 x Integrated Tool Carriers; and
- Other Miscellaneous Equipment (i.e. Light Vehicles, Site Bus).

Some surface infrastructure (around 1 hectare (ha) of clearing in previously disturbed areas) is also required to support the underground mine operations. This includes the surface mine ventilation system (0.013ha), haul road (0.224ha), explosives magazine (0.51ha), and an infrastructure area (0.003ha) (Figure 7). The infrastructure area will include a Substation, Communications Hut and two 30,000 litre (L) water tanks with pumps to supply the underground operations.

3.1 Transport

As the Union Reefs Processing Plant is only 2km from the Union Reefs North Underground Mine, all underground ore will be trucked via the decline and a surface haul road directly to the existing ROM stockpile adjacent to the Plant. A new haul truck route will be established from the portal to the Run of Mine (ROM) Pad; this haul route is approximately 0.64km x 3.5m (0.224ha) and will require minor clearing in previously disturbed mining areas (Figure 7).

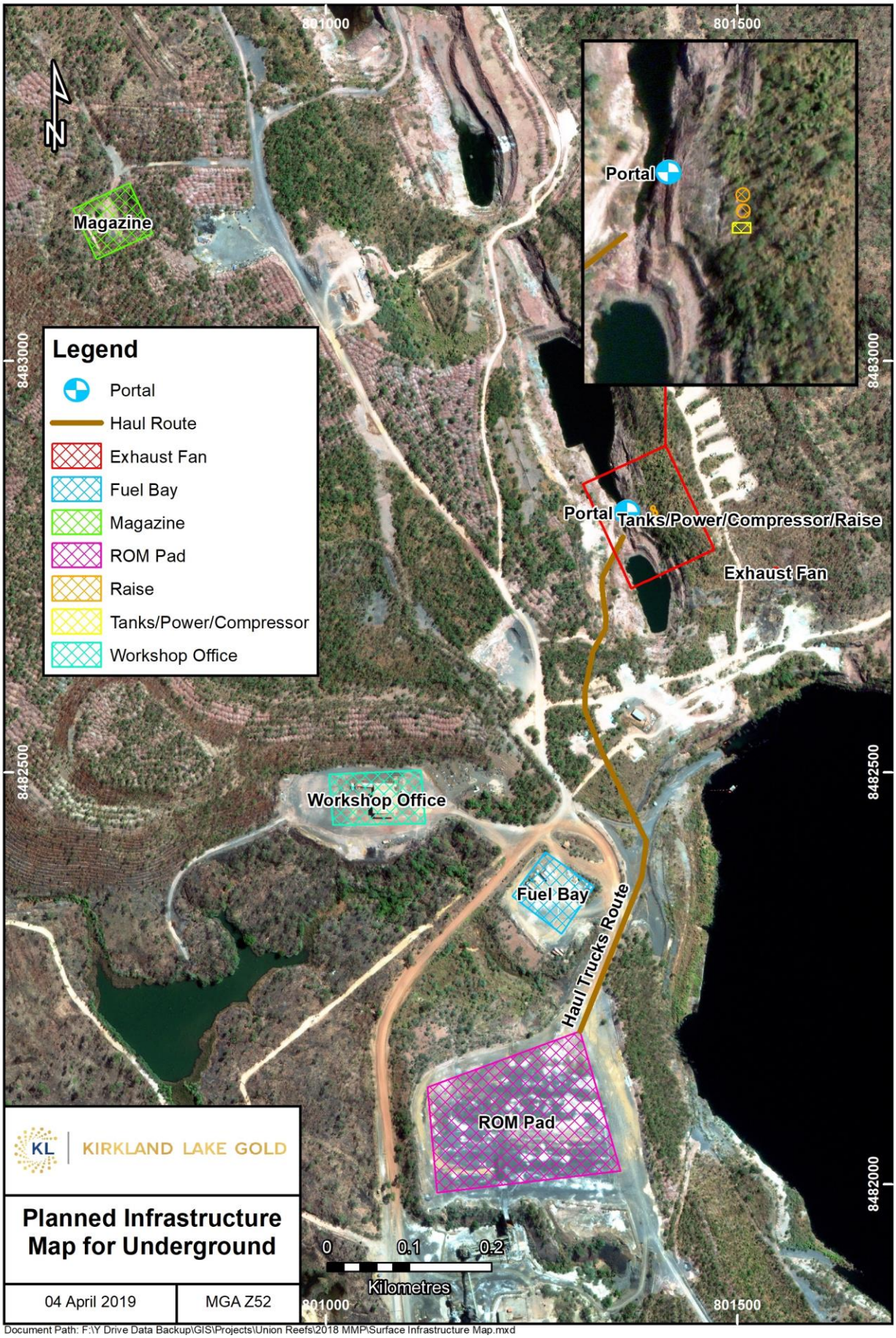

FIGURE 7: UNION REEFS NORTH UNDERGROUND MINE SURFACE INFRASTRUCTURE

3.2 Social and Economic

KLG is committed to focusing on sustainable development and working with employees, their families, and local communities to improve quality of life in a way that is good for both local economic development and shareholders. The planned mining operations at the URPA will provide additional opportunities for NTMO to support local employees, businesses, contractors and community groups.

The NTMO operations have brought increased employment and business to Darwin and surrounding regional towns through a demand for goods and services. Since 2009, NTMO (and the previous CGAO) has spent more than $300 million (M) with NT businesses including more than $30M in the Pine Creek region.

NTMO employs a range of permanent and casual employees, as well as contractors and specialist consultants. The workforce requirements include managers, supervisors, operators, miners, geologists, engineers, surveyors, environmental scientists, safety advisors, maintainers, electricians and various contractors. Most staff are based at the Cosmo Howley Project Area (CHPA) offices and commute to the URPA when required. NTMO also has an office in Darwin for some support services staff (i.e. Finance and Human Resources).

The majority of NTMO Employees and Contractors are accommodated at the Cosmo Village Camp, however some local personnel opt to reside in private residences within the region and commute to site. The Cosmo Village consists of 296 rooms, a pool, gym, recreational areas, wet mess, a fully catered dry mess and barbeque facilities. Personnel such as specialist consultants or contractors may also be accommodated at commercial businesses in Darwin or regional locations.

Employing locally, when the local workforce has the required skills or has the ability to acquire the required skills, is an objective of the NTMO Consultation and Socio-Economic Management Plan. In order to increase local capacity, NTMO have dedicated training personnel to upskill local employees to meet the needs of the operation and have an apprenticeship programme for fitters and boilermakers. NTMO is also working to make available opportunities for indigenous employment and has partnered with two local indigenous employment agencies.

Undergraduate environmental scientists including those from the Charles Darwin University are employed during semester breaks to assist with environmental management programmes over all NTMO project areas. In some cases, undergraduate students have remained employed with NTMO whist completing studies and moved into graduate environmental positions.

NTMO currently has around 130 employees and contractors supporting its operations. It is anticipated that with the recommencement of CHPA mining production and URPA processing and mining operations, there will be more than 300 personnel. Rosters are generally 14 days on / 7 days off and this means that only 70% of personnel are present on site at any one time.

3.3 Water and Energy Sources

The underground mine is expected to use around 1.5 – 2 litres per second (L/s) for underground drilling and dust suppression, equivalent to 47-63 mega litres (ML)/year. Water will be stored in two 30,000L water tanks and will initially be sourced from the Prospect Pit, which currently contains around 85ML (77ML in Prospect North and 8 ML in Prospect South). To effectively manage potential safety risks for the underground mine, the Prospect Pit is required to be completely dewatered within 7 months of commencing the portal and for the duration of the underground mining activities.

Any water from the Prospect Pit not used for underground operations, will be transferred for use in the URPA Processing Plant or used for surface dust suppression depending on water quality, time of year and available capacity. If required, additional make up water for the underground operations will be sourced from Dam C. Dam C is located in the northeast of the URPA and currently contains around 1,200ML. Dam C is also used as a raw water source for office amenities and provides supplementary water for the URPA Processing Plant.

Water quality monitoring is undertaken at the Prospect Pit as outlined in the URPA MMP 2018-19. Water quality results from 2017-18 have been compared to both the Short Term (STV) and Long Term (LTV) Agricultural Irrigation and Stock Watering Guidelines (SWGs) (Table 4). All measured parameters are within the LTV (100-year irrigation period), STV (20 year irrigation period) and SWGs indicating that the water is appropriate quality to be utilised for surface dust suppression or as raw process water.

TABLE 4: PROSPECT NORTH PIT WATER QUALITY VERSES IRRIGATION AND STOCK WATERING GUIDELINES

Parameter		ANZECC Ag Irrigation LTV	ANZECC Ag Irrigation STV	SWGs	Prospect North Pit Water Quality Summary 2017-18			
					Minimum	Maximum	Median	Count
pH		NA	NA	4-9	7.27	8.16	7.73	9
EC	µS/cm	NA	NA	5,970	219	280	255	9
Al	µg/L	5,000	20,000	5,000	10	20	10	9
As	µg/L	100	2,000	500	80	100	85	9
Cd	µg/L	10	50	10	0.1	0.2	0.1	9
Co	µg/L	50	100	1,000	1*	1*	1	9
Cr	µg/L	100	1,000	1,000	1*	1*	1	9
Cu	µg/L	200	5,000	1,000	1*	1*	1	9
Pb	µg/L	2,000	5,000	100	1*	1*	1	9
Ni	µg/L	200	2,000	1,000	1*	1*	1	9
Se	µg/L	20	50	20	1*	1*	1	9
Zn	µg/L	2,000	5,000	20,000	21	53	26	9

* Below Limit of Reporting

Power in the NT is generated and distributed by three government owned corporations including Territory Generation (production), Power and Water Corporation (transmission and distribution) and Jacana Energy (retailer). The Channel Island Power Station is the largest power station in the NT (310 Megawatt (MW)) and the main source of electricity for the Darwin – Katherine Interconnected System. There are three other power stations connected to this system including the Pine Creek Power Station (26.6MW) which is independently owned and operated by Energy Development Limited.

The Darwin – Katherine Interconnected System is linked by a 132kV transmission line and a 66kV line connects the URPA to the Pine Creek Township. To supply electricity for its operations, NTMO has established agreements with the Power and Water Corporation and Jacana Energy. Electricity requirements for the underground operations are estimated at between 750,000 – 1,000,000 kilowatt hours (kWh)/month or around 9,000,000 – 12,000,000kWh/year. An additional internal URPA substation and powerline will be required to distribute incoming power to the underground operations.

3.4 Hazardous Substances

The Union Reefs North Underground Mine proposal will require the use and storage of both diesel and explosives at the URPA (Table 5). Diesel requirements for the underground mine will be around 60,000L/month or 720,000L/year. Diesel will be stored at the existing fuel farm, which has a 45,000L tank and deliveries are expected every 3 weeks. This storage facility is included in the URPA Hazardous Substances Manifest and Plan submitted to NT Worksafe in accordance with the *Guide: Manifest Requirements for Hazardous Chemicals*.

TABLE 5: UNION REEFS NORTH UNDERGROUND MINE HAZARDOUS SUBSTANCES LIST

Storage Type	Substance	UN No	Class	Volume
Tank	Diesel	1202	Combustible Liquid 3	45,000L
Magazine	Detonators, Plain	0360	1.1 B	25kg
Magazine	Explosives	Various	1.1 to 1.6	40t

An explosives magazine will be re-established in the historical bunker area (Figure 8) at the URPA. This facility will be managed in accordance with the *Dangerous Goods Act*, which sets out the requirements and allowances for licensing, packaging, storage, transportation and use of explosives.

FIGURE 8: HISTORICAL URPA EXPLOSIVES BUNKER AREA

NTMO has an existing Safety Management System (SMS) which requires the safe storage and management of hazardous substances. Management of hazardous substances will be in accordance with applicable Legislation, Australian Standards and Codes of Practice. The NTMO ESRMS also includes a Hazardous Substances Management Plan, the purpose of this plan is to ensure the safe and responsible use and control of all hazardous materials handled at NTMO sites and to ensure that spills are appropriately managed.

3.5 Wastewater and Waste Rock Streams

Depth to groundwater in and around URPA varies seasonally, occurring at depths ranging from shallow (less than 5m) to deep (more than 60m). Given that the Union Reefs North Underground Mine will extend to a depth of around 220m below ground surface, groundwater will be encountered and mine dewatering will be required. For the underground mine there are also other influences associated with the potential hydraulic connection to the Crosscourse Pit and to a lesser extent other nearby pit lakes (i.e. Union Reefs North and Lady Alice Pits).

To understand the likely groundwater inflows into the proposed underground mine, NTMO engaged AQ2 to undertake an assessment and predictions using an analytical modelling approach based on longer-term calibration data (from historical Crosscourse Pit dewatering). Based on the available data and AQ2 experience with underground mine dewatering assessments, the use of a simple analytical groundwater model was considered to be sufficiently reliable.

In summary, the analytical modelling indicated that the Base Case predictions (best estimate of likely underground mine inflows) dewatering rates increase from around 1 to 2L/s (31.5 – 63ML/year) during initial decline development, up to 8 to 11L/s (252 – 347ML/year) over the remaining 2 year LOM. This case includes active recharge from the Crosscourse Pit and Union North Pit lakes through the shallow aquifer. Inflows could be higher if active recharge from the Crosscourse Pit and Union North Pit lakes also occurs through the deep aquifer, with High Case predictions of around 13L/s (410ML/year). The underground mine design includes a 200m exclusion zone to the Crosscourse Pit which serves to minimise recharge.

Predicted inflows from the Crosscourse Pit lake will also have a significantly different water quality to inflows from the general aquifer and/or other pit lakes, which will largely have low salinity and neutral pH but which could have elevated levels of arsenic. Inflows from the Crosscourse Pit lake (which could be up to 50% of long-term inflows for the Base Case and over 50% for the High Case) will have similar water quality to tailings decant with brackish salinity, slightly alkaline pH and high levels of arsenic.

The likely seepage water quality has been taken into account for the underground water management and occupational health and safety contact protocols. NTMO intends that all recovered underground mine water will be transferred to the Crosscourse Pit for reuse in the URPA Processing Plant. Annual wastewater estimates (including water used for underground drilling and dust suppression) range between 78.5 – 473ML, averaging around 276ML/year.

The Union Reefs North Underground Mine will also include the generation of waste rock, although at a significantly lower volume (strip ratio) than open pit mining. Underground mining operations tend to have lower strip ratios due to increased selectivity and the ability to design the mine to efficiently access ore zones and reduce waste rock material movement. For the Union Reefs North Underground Mine an estimated 104,000m^3 of waste rock will be progressively brought to the surface over a period of 13 months.

Initially, decline waste will be hauled up to the portal and tipped into the centre of the Prospect Pit to extend the portal bench for mine access (Figure 9). The portal bench will require an estimated 20,000m^3 of waste material and will remain for the LOM. The remaining 84,000m^3 of waste rock will be temporarily stockpiled in the southern end of the Prospect Pit until it is progressively returned underground as backfill. The available volume in the southern end of the Prospect Pit is around 110,000m^3 indicating sufficient capacity to contain the temporary surface waste stockpile.

The planned underground mining methods require that all stopes and unsupported open voids are backfilled with waste rock or cemented rock fill (CRF). As the underground mine enters into production, the waste rock generated from lower areas of the mine will be placed directly as backfill (i.e. will not come to surface) and any additional backfill required will be returned underground from the surface stockpiles. During the later stages of development the underground mine will effectively be waste negative (i.e. all waste rock will be contained underground).

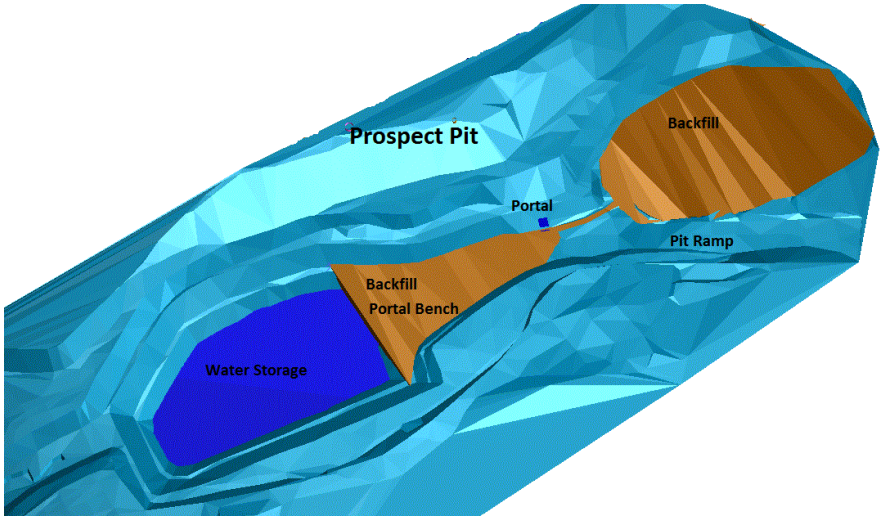

FIGURE 9: CONCEPTUAL PROSPECT PIT WASTE ROCK STORAGE AREAS (PRIOR TO DEWATERING)

3.6 Decommissioning and Rehabilitation

The DPIR released *Draft Guidelines for Mine Closure Plans* in August 2016, however it is understood that these guidelines have not progressed to a final version. NTMO will consult with the DPIR to clarify the appropriate guidelines to use to redevelop the URPA Mine Closure Plan (MCP) 2015 i.e. the DPIR Draft Guidelines or the Western Australian *Guidelines for Preparing Mine Closure Plans*.

The structure and information in the URPA MCP 2015 will need to be reconfigured and reassessed to meet new guideline requirements and the revised URPA MCP is likely to be substantially different to previously submitted versions. NTMO will work with the DPIR to agree on a realistic submission date for the redevelopment of the URPA MCP.

As this NOI is focussed on the recommencement of active mining operations at the URPA, it is considered that the risk of any unplanned closure of operations is low. However, the scenarios under which unplanned closure may occur and the NTMO mitigation measures are outlined in Table 6.

TABLE 6: UNPLANNED CLOSURE SCENARIOS AND MITIGATION MEASURES

Unplanned Closure Scenario	Mitigation Measures
Significant Gold Price Drop Operations suspended and placed into care and maintenance until economic mining and processing could resume.	Development of a robust Business Case. Operational approval by President/CEO and Board. Annual budgets with actual and forecast expenditure. Extensive management and operation expertise.
Major Infrastructure Failure or Incident Operations suspended until the infrastructure failure or incident was addressed and mining and processing could resume.	Routine maintenance and inspections of infrastructure. Risk assessments and management plans. Emergency Response Team and Plans. Established company insurance policies.
Instructed to Close by a Government Agency Operations suspended until any non-conformance with regulatory requirements was addressed and mining and processing could resume.	Approved Mining and Risk Management Plans. Routine reporting of monitoring and performance. Regular consultation to provide updates on activities, clarify expectations and management of risks.
Owner Financial Bankruptcy Operations suspended and placed into care and maintenance until assets sold by administrators.	Strong financial position with quarterly public reporting. NI 43-101 compliant indicated gold resources. Mid-tier gold producer with a solid base of quality assets.

The URPA has identified NI 43-101 compliant indicated gold resources and an established processing plant, which are highly valued assets for mining operations. Based on this and in the event of any unplanned closure, the site would be placed into care and maintenance as there is potential that mining and/or mineral processing operations would resume in the foreseeable future.

The following general site requirements would be completed if the URPA was placed into care and maintenance:

- Notify workers, contractors and the appropriate local and government authorities;
- Assign a person to authorise site access and project management of care and maintenance activities;
- Process any remaining ore on stockpiles;
- Construct fences/barriers as required to restrict access to mining and processing areas;
- Remove all petroleum, chemicals and explosive products, run down stocks or return to suppliers;
- Drain all tanks and pipelines;
- Shutdown mechanical, hydraulic, and electrical systems ensuring they are effectively isolated;
- Remove mobile equipment, and as required salvage and sell machinery/infrastructure;
- Seal, secure and lock buildings or remove/demolish demountable buildings;
- Establish a programme for road maintenance to ensure access is maintained;
- Continue regular inspections;

- Ensure any required water management infrastructure remains operational;
- Establish a schedule and continue required environmental monitoring and management activities;
- Assign an appropriately qualified person to review and report all monitoring data collected; and
- Review and update the URPA MCP.

If no foreseeable plan for future operations is possible, then the URPA MCP would be implemented. This would dramatically increase the cost of re-opening operations in the future, but would reduce the on-going closure liabilities.

The main closure issue specifically associated with the Union Reefs North Underground Mine is public safety. The objectives of closure will be to inhibit public access to underground workings. Public access will be prevented by the construction of an abandonment bund around the Prospect Pit and sealing of the portal and ventilation shafts with concrete slabs. Groundwater will also naturally recharge in the backfilled underground workings. All other surface infrastructure associated with the underground mine will be decommissioned, removed and the areas rehabilitated.

Mine closure planning will also include specific approaches to protect Ghost Bat roosts and maintain habitat stability on advice from Ghost Bat consultant experts. Ghost Bat access to the adits in the Prospect Pit (OK and Prospect Adits) will be restricted during mining but will be re-opened once mining is complete to provide future roosting sites. The Lady Alice adit also has the potential to serve as a backup roost for local Ghost Bats. Its suitability could be enhanced following the completion of mining by opening the entrance with light earthmoving equipment or hand tools to allow access by bats of larger body size.

4 ALTERNATIVES

The Union Reefs North Underground Mine has been designed to target the Prospect Claim Deposit and an alternative portal location has been considered from within the Lady Alice Pit. The Lady Alice Pit portal would be located at the 1158RL, lower in the weathering profile and is potentially more geotechnically stable. However, this could only be confirmed once water is removed from the pit. The lower portal depth also means that there is potentially less decline development required to access the ore.

The existing water level in the Lady Alice Pit is around 1174.6RL and this would need to be reduced and maintained below the 1153RL, which is 5m below the portal and incorporates a safety factor for a 1 in 100 year rainfall event. The Lady Alice Pit currently contains 308ML and an initial water transfer 300ML is required to reduce the water level from 1174.6RL to below the 1153RL. Ongoing water transfer would also be required during the wet season to maintain the pit water level to below the 1153RL, and this is estimated at 86.5ML annually (for average rainfall of 1,380 mm).

It is estimated that the initial transfer of 300ML would take between 1-2 months and, depending on the timing of approvals for the underground operation, is likely to be required prior to the restart of the Processing Plant. The initial water transfer of 300ML would be directly into the Crosscourse Pit (rather than Dams A or C) given the remaining capacity. Lowering the water level in the Lady Alice Pit would be a priority to undertake further technical assessment to confirm the alternative portal location prior to the commencement of development.

While the Lady Alice Pit decline location remains a viable option it is not the preferred location given the larger initial volume of water to be transferred from this pit (300ML compared to 85ML in the Prospect Pit). The timing of this transfer is likely to require that the bulk of this water is directly discharged into the Crosscourse Pit rather than being used in the Processing Plant (and offsetting water inputs from Dam C) or as dust suppression. Until the water is removed the geotechnical condition of the walls cannot be fully assessed to confirm the portal design requirements.

Waste rock would still be temporarily stored in the Prospect Pit for later reuse as underground backfill. There would be a requirement to cut and fill a new access ramp into the Lady Alice Pit for the surface transfer of ore and waste rock. The Prospect Pit (South) is around 500m from the Lady Alice Pit and the alternative portal location would result in an increase in surface vehicle movements for the transfer of waste rock into and later out of the Prospect Pit.

5 Land Use History

The URPA has undergone a lengthy exploration and development history that has spanned over 140 years. This includes historical prospecting and mining and several waves of modern exploration and development in the 1980's and 1990's. Gold was first discovered at Union Reefs in 1873. Some 2300 small pits, shafts, adits and open cuts were developed to exploit the high-grade, lode style mineralisation and were worked by mainly Chinese tributers.

Mining at Union Reefs ceased in 1914, and subsequent attempts to reopen mines in 1922 and 1934 were not successful. Between 1963 and 1988 extensive geological mapping and exploration drilling programmes were undertaken by various organisations across the URPA. Togar Pty Ltd undertook mining and processing alluvial ore at the site from 1987 until 1992.

In 1993, the Shell Company of Australia (SCOA) prepared an Environmental Impact Statement (EIS) to initially mine and process ore from the Crosscourse and Union North Pits. Further mining was proposed as additional resources were identified. The period between 1994 to 2003 represents the most significant mining and processing activities at the URPA which were undertaken by SCOA then Acacia Resources and later AngloGold from 2000-2003.

During the 1994-2003 operational period, 11 open pits were mined and two waste rock dumps (WRDs) constructed. Processing tailings were deposited into the Old Tailings Dam, Union North Pit and Crosscourse Pit (from 2002). Following the cessation of mining in 2003 the site was rehabilitated and the URPA Processing Plant placed into care and maintenance. NTMO understands that these areas were rehabilitated to agreed closure criteria and any security, was released to AngloGold.

GBS Gold Australia Pty Ltd (GBS) officially re-opened the URPA in November 2006, for the processing of site low-grade stockpiles and ore from remote operations. Crocodile Gold International (CGI) commenced remote mining and URPA processing operations via its subsidiary Crocodile Gold Australian Operations (CGAO) in December 2009 following the purchase of the Australian gold mining assets from GBS Administrators.

From 2011, only ore sourced from the Cosmo Underground Mine was processed at the URPA. In early July 2015, CGAO merged with Newmarket Gold Inc. who later merged with KLG in November 2016. All mining activities at the Cosmo Underground Mine were temporarily suspended in June 2017. This halted processing activities and ore haulage to the URPA. The URPA Processing Plant remains in a state of readiness by skeletal staff until the resumption of production which is planned in June 2019.

6 Existing Environment

The Union Reefs North Underground Mine is located within MLN1109 and central to a highly modified brownfields mining area. MLN1109 covers an area of 3,998ha and has a total disturbance footprint of 493ha of which 354ha has been rehabilitated by previous operators (Table 13). The mined Prospect Pit is the key feature associated with the underground mine given that this is the planned location of the underground access portal and the temporary waste rock stockpile. The Prospect Pit was intermittently mined between 1997 to 2003 and is approximately 8ha and up to 60m deep.

6.1 Natural Environment

The URPA lies within the Brocks Creek Ridge land system. This system occurs extensively in the Katherine-Darwin Region, covering about 4,000km². There are five land units covering URPA, described below along with their representative vegetation units (VU):

1. Ridge Crests (3-35%) – skeletal soils/thin stony and poorly developed – VU 1,2;
2. Upper Hill Slopes (10-50%) – uniform textured soils – VU 1,2,3;
3. Mid Slopes (3-35%) – gradational soils – VU 2,3,4;
4. Lower slopes and alluvial flats (1-15%) – duplex soils with yellow and red subsoils – VU 2,3,4,5,6; and
5. Ranging from ridge crests to valley – highly disturbed by past mining activities – little or no vegetation.

The vegetation on MLN1109 site is predominantly regrowth following clearing associated with historical mining activities on the site. The vegetation of the URPA area was studied as part of the 1993 EIS and classified into six broad associations based on landforms within the Burrell Creek Formation:

1. Ridge Crest *Eucalyptus dichromophloia* Low Open Forest;
2. Scree Slope Mixed Low Woodland;
3. Scree Incision Mixed Low Woodland or Low Open Forest;
4. Lowland Mixed Low Open Forest;
5. Riparian Flat Mixed Woodland; and
6. Riparian Channel woodland or Open Forest.

Low Open Forest and Woodland associations are widespread, and their characteristic species are commonly recorded in the Top End. The associations are well represented in the Pine Creek Region in areas with a history of less disturbance than in the URPA.

In the vicinity of the URPA, elevations range from 35 to 50m above mean sea level. Drainage is generally to the north to the Timor Sea via ephemeral creeks, streams and gullied tributaries to Mary and Alligator Rivers, two major rivers running north to the coast. The site topography is dominated by two steep sided north-south orientated ridges, with relief ranging from 240m Above Sea Level (ASL) on the ridges to 160mASL at the McKinlay River.

The URPA is located within the Mary River Catchment and the main drainage sub-catchment system is the McKinlay River, which has its headwaters within the URPA. The McKinlay River flows northwards along the western edge of the URPA lease into the Mary River, which meets the ocean approximately 200 km north of the URPA. The Mary River flows year round but many of its catchment tributaries are ephemeral, flowing only during the wet season.

Groundwater at the URPA is associated with the geology of the Pine Creek Shear Zone an extensive regional geological feature associated with the Pine Creek Geosyncline. The Burrell Creek Formation forms the major aquifer in the URPA, while the Mt Bonnie Formation is intersected in the southern regions of MLN1109.

The fresh bedrock in the URPA has little or no primary permeability. Locally, the permeability is higher with the occurrence of secondary structures. The weathered zone is generally an aquifer, when saturated, particularly in areas of regional cross-cutting structures. As an aquifer, the weathered bedrock will be inhomogeneous and anisotropic, with the largest permeability's being in zones that run parallel to both geological strike, particularly in the presence of secondary structures.

6.2 Significant Sites or Features

There are no National Parks or Reserves in close proximity to the URPA. Aboriginal archaeological sites and artefacts are associated with specific geological features of the region. An AAPA certificate (C2009/267) for the URPA was granted on 8th October 2009 to CGAO (now NTMO). The certificate identified two Restricted Works Areas (RWA) and three Sacred Sites located to the west of MLN1109 (Figure 10). These sites are located more than 1km from the underground mining and surface infrastructure areas.

The McKinlay River is located less that 1km from the URPA and is an important water source for local wildlife, where permanent pools of water and riverine flora serve as refuge habitats through to the end of the dry season. A Beneficial Use Declaration (BUD) to maintain the health of aquatic ecosystems has been set for a section of the McKinlay River that flows to the west of MLN1109 (between lines 8478800 and 8490000). This BUD was gazetted on 11 March 1998 (Gazette G9). Regional hydrology of the McKinlay River sub-catchment and the BUD area are shown in Figure 11.

The main McKinlay River sub-catchments that drain from the URPA include Esmeralda Creek to the south and Wellington Creek to the north. The surface water use changes to livestock drinking water approximately 4km downstream of NTMO surface water monitoring point URSW08, with Pastoral Stations being the main downstream users. All URPA passive discharge points lie within the McKinlay River BUD aquatic ecosystem zone.

The 2015-16 WDL 138-03 Annual Report (prepared by GHD) determined that long-term monitoring results indicate that the water quality within the McKinlay River system is improving with the majority of metal concentrations below the limit of reporting. Water quality at sites downstream of the URPA are similar quality to the upstream site indicating that the passive discharges from the URPA have minimal impact on the McKinlay River downstream water quality.

A BUD for environment, riparian and agriculture has also been set for groundwater within the Mary River catchment and the URPA is located within the upper southwest of this declared area. This BUD was gazetted on 13 February 2002 (Gazette G6) and is shown in Figure 12.

Within the URPA main aquifer system, there are two aquifers, a deep aquifer comprising fresh but fractured and mineralised rock and a shallow aquifer associated with weathered (partially to lightly weathered) basement rock. The main aquifer system is bounded to the east and west by low permeability, weakly fractured, fresh and weathered basement rocks. These would be more appropriately termed aquitards or aquicludes.

Natural groundwater at the URPA typically has a low salinity with Total Dissolved Solids (TDS) less than 200mg/L. However the salinity is higher in previous operational areas (i.e. Tailings Storage Facility (TSF) decant bores) where it is between 800-900mg/L. Groundwater is of a Ca-Mg-Na-HCO_3-SO_4 type that is reflective of the geochemistry of the bedrock and presence of sulphide mineralisation. Historically, the groundwater pH has ranged between 6.6 and 7.9, which is within the normal range for groundwater (6.5 to 8.5).

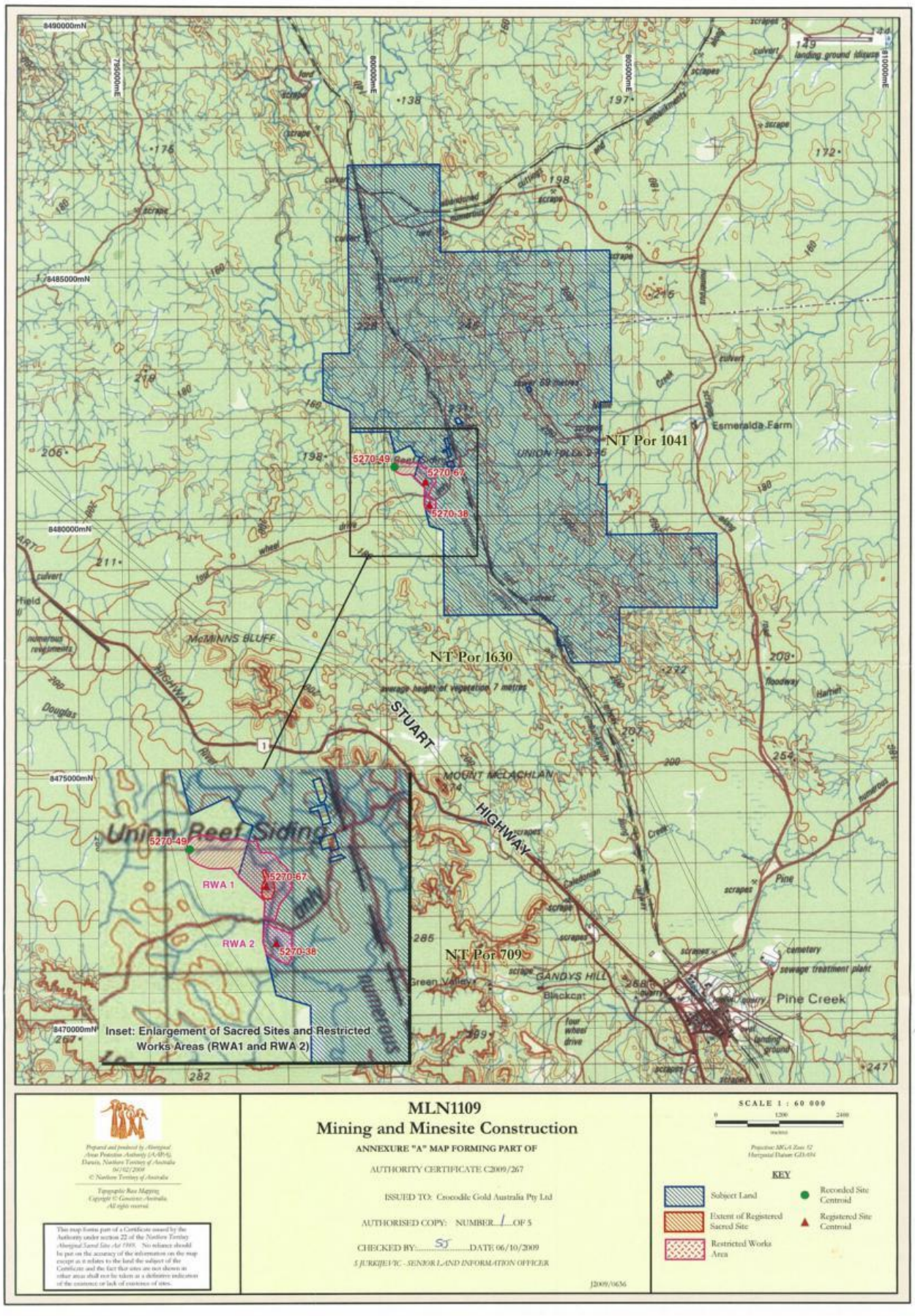

FIGURE 10: URPA AAPA CERTIFICATE – RESTRICTED WORK AREAS AND SACRED SITE LOCATIONS

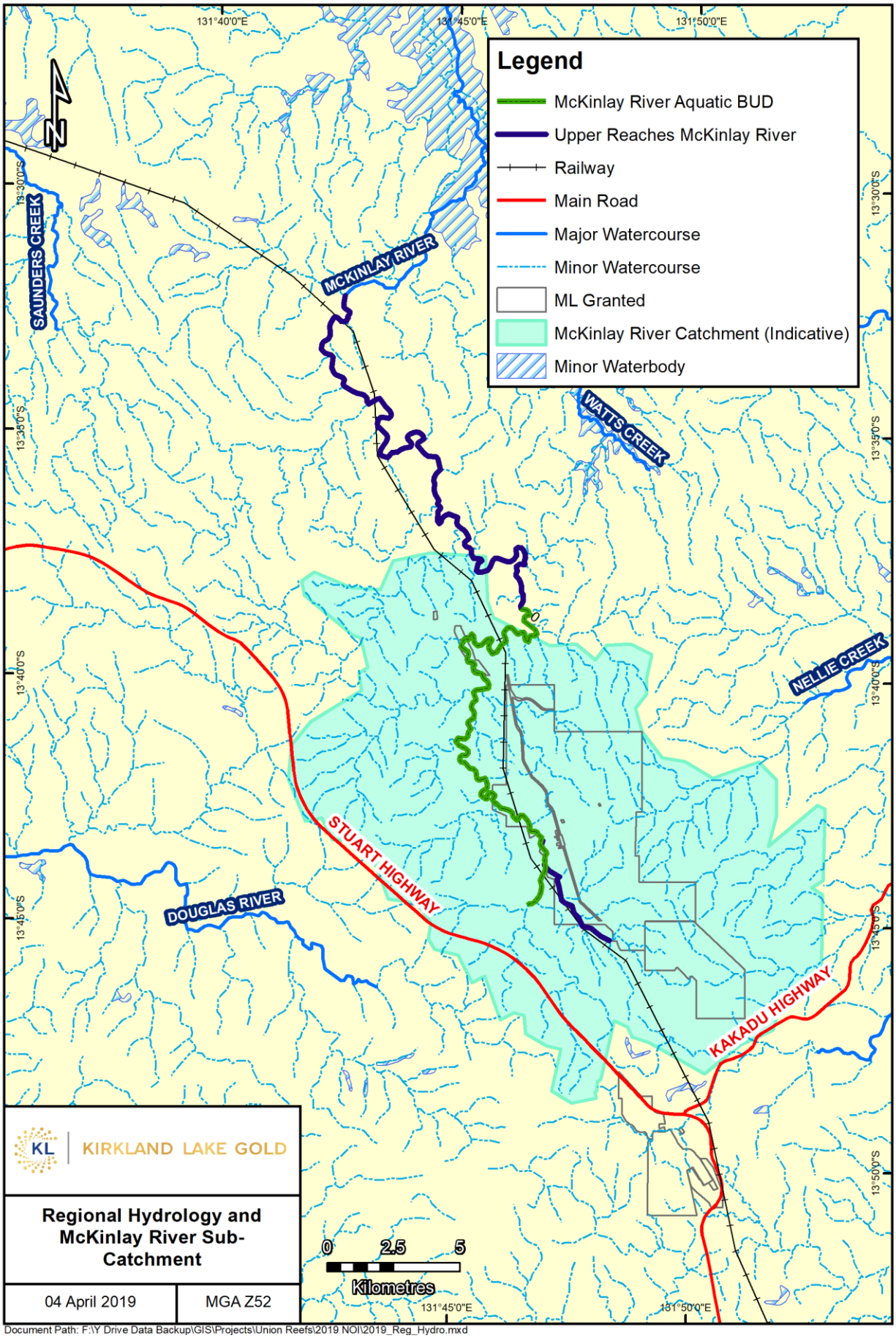

FIGURE 11: MCKINLAY RIVER BENEFICIAL USE DECLARATION AREA AND REGIONAL HYDROLOGY

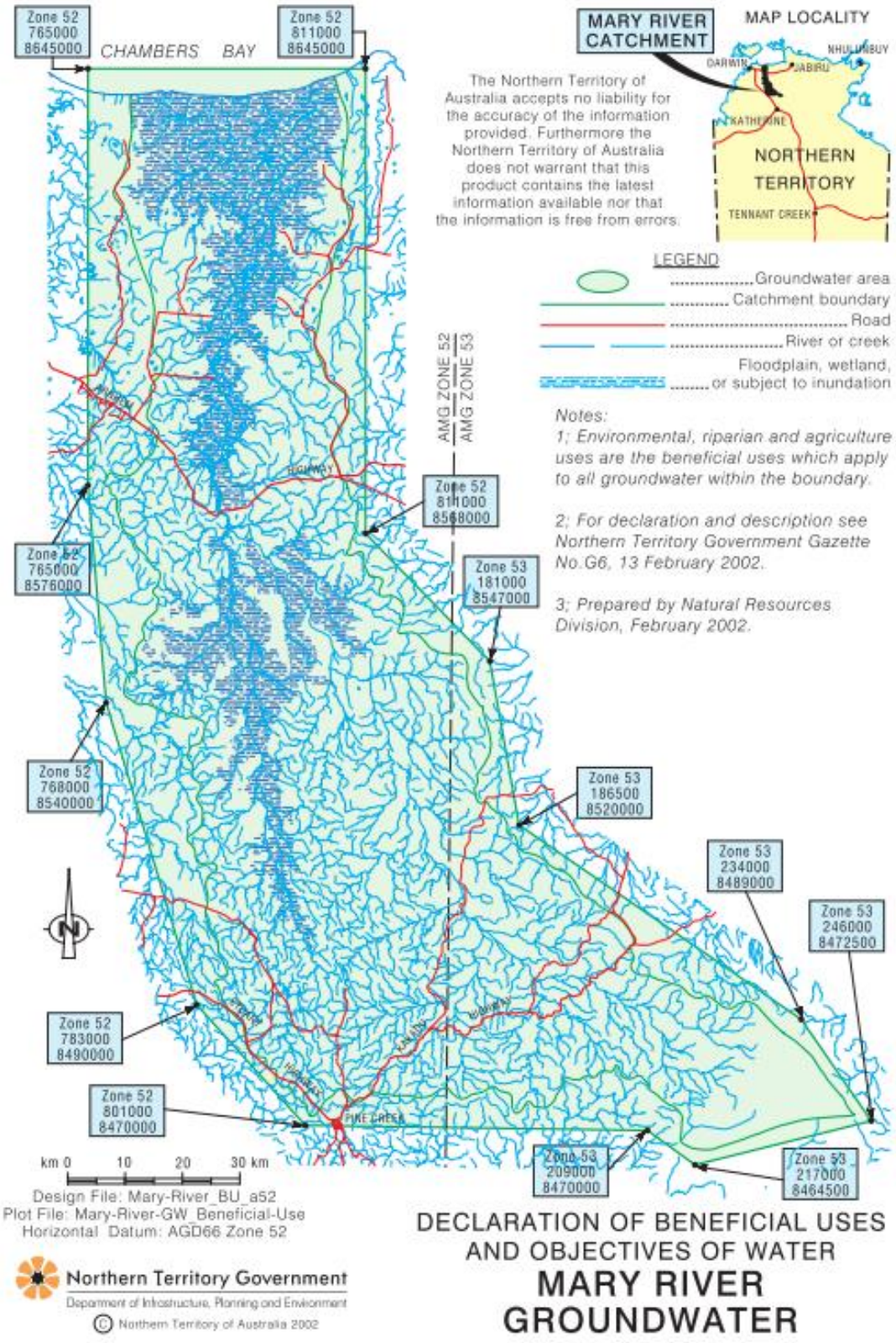

FIGURE 12: MARY RIVER GROUNDWATER BENEFICIAL USE DECLARATION AREA

7 POTENTIAL IMPACTS

7.1 Environmental Factors

NTMO has assessed the activities associated with the Union Reefs North Underground Mine to identify the NT EPA environmental factors potentially impacted by the proposal. A summary of this assessment is provided in Table 7.

TABLE 7: ENVIRONMENTAL FACTORS POTENTIALLY IMPACTED BY THE PROPOSAL

Theme	Factor	Potential Impacts	Risk
Land	Terrestrial Flora and Fauna	Yes	Medium
	Terrestrial Environmental Quality	No	NA
	Landforms	No	NA
Water	Aquatic Ecosystems	No	NA
	Inland Water Environmental Quality	Yes	Low
	Hydrological Processes	Yes	Low
Sea	Marine Flora and Fauna	No	NA
	Benthic Communities and Habitats	No	NA
	Marine Environmental Quality	No	NA
	Coastal Processes	No	NA
Air	Air Quality and Greenhouse Gases	Yes	Low
People and Communities	Social, Economic and Cultural Surroundings	Yes	Low
	Human Health	Yes	Low

For those factors identified as having potential impacts, further details are provided in the following sections regarding the receiving environment, potential impacts and NTMO mitigation measures.

7.2 Land Factors

7.2.1 Terrestrial Flora and Fauna

7.2.1.1 NT EPA Factor Objective

Protect the NT's flora and fauna so that biological diversity and ecological integrity are maintained.

7.2.1.2 Receiving Environment

A search of the following biodiversity databases was undertaken surrounding MLN1109 using a 5 km buffer:

- Australian Government's Protected Matters Search Tool;
- NT Government's Natural Resource (NR) Maps; and
- Natural Resource Management (NRM) Infonet.

7.2.1.2.1 FLORA

NR Maps (2017) lists previous records of 216 native flora species occurring within or 5km from MLN1109. Many of these species are common within the Pine Creek Region. Flora species were also identified during vegetation mapping for the 1993 EIS for the initial large-scale development of the Union Reefs Project on ML1109. The EIS noted that the Low Open Forest and Woodland associations are widespread, and their characteristic species are commonly recorded in the NT Top End. The associations are well represented in the Pine Creek greater region in areas with a history of less disturbance than the URPA (NSR, 1993).

Threatened Species

NR Maps indicates that there is one species of threatened flora recorded within or 5km from MLN1109. *Acacia praetermissa* (wattle, acacia), listed as vulnerable under both the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Territory Parks and Wildlife Conservation Act* (TPWC Act). The recorded location is more than 3 km from the tenement boundary and this species has not been identified on MLN1109.

Weeds

The *Weeds Management Act* identifies those flora species that are listed as declared weeds for the NT. All declared weeds are divided into three classes:

- Class A (must be eradicated);
- Class B (growth and spread to be controlled); and
- Class C (species not to be introduced).

Thirty-two Weeds of National Significance (WoNS) have been agreed by Australian governments based on an assessment process that prioritised these weeds based on their invasiveness, potential for spread and environmental, social and economic impacts. Landowners and land managers at all levels are responsible for managing WoNS.

Weed infestations are widespread and species rich around some disturbed parts of MLN1109. Declared or WoNS weed species identified at URPA from 2013-2018 are provided in Table 8. The size and density of weed patches vary greatly across the site with disturbed areas adjacent to roads or access tracks containing a higher weed abundance.

TABLE 8: URPA IDENTIFIED DECLARED WEEDS AND WONS (2013 - 2018)

Common Name	Scientific Name	WM Act Declaration	WoNS	Notes
Flannel Weed	*Sida cordifolia*	Class B/C	No	-
Gamba Grass	*Andropogon gayanus*	Class B/C	Yes	URPA within the Class B/C Management Zone.
Hyptis	*Hyptis suaveolens*	Class B/C	No	-
Mission Grass	*Cenchrus* sp.	Class B/C	No	Annual (*C. pedicellatus*) and Perennial (*C. polystachios*) only the perennial is a declared weed but both should be controlled.
Mossman River Grass	*Cenchrus echinatus*	Class B/C	No	-
Rubber Bush	*Calotropis procera*	Class B/C	No	-
Sicklepod	*Senna obtusifolia*	Class B/C	No	-
Spinyhead Sida	*Sida acuta*	Class B/C	No	-

7.2.1.2.2 FAUNA

NR Maps (2017) lists previous records of 122 native fauna species within or 5km from MLN1109. Many of these species are common within the Pine Creek Region based on historical studies of terrestrial fauna. A survey of vertebrate fauna, fish and aquatic micro-invertebrate fauna was also carried out as part of the 1993 EIS for URPA. The survey found that no species was limited to MLN1109 and this was expected given that the habitats at the URPA are widespread in the NT Top End (NSR, 1993).

Threatened Species

NR Maps indicates that there are three species of threatened fauna recorded within or 5km from MLN1109. These are:

- *Geophaps smithi smithi* (Partridge Pigeon) – Listed as vulnerable under the EPBC Act and TPWC Act (occurs principally in lowland eucalypt open forests and woodlands, with grassy understoreys);
- *Dasyurus hallucatus* (Northern Quoll) – Listed as endangered under the EPBC Act and critically endangered under the TPWC Act (occurs in a wide range of habitats, but the most suitable habitats appear to be rocky areas. It is also common in many eucalypt open forests); and
- *Macroderma gigas* (Ghost Bats) - Listed as vulnerable under the EPBC Act and near threatened under the TPWC Act (foraging habitat generally consists of tropical savannah woodlands and rainforests. Favoured roosting sites are undisturbed caves or mine adits).

The URPA Fauna Register indicates that the following threatened species have been sighted with no impacts, between 2011- 2018:

- Gouldian Finch (*Erythrura gouldiae*) listed as endangered (EPBC Act) and vulnerable (TPWC Act) – sighted 2011;
- Mertens Water Monitor (*Varanus mertensi*) listed as vulnerable (TPWC Act) – sighted 2012 and 2018; and
- Partridge Pigeon (*Geophaps smithi smithi*) listed as vulnerable (EPBC Act and TPWC Act) – sighted 2017 and 2018.

Ghost Bats require undisturbed caves and mine adits for daytime roosting, which are present at the URPA as a result of historical mining activities. Ghost Bat studies and a research programme at the URPA were undertaken as part of and following the 1993 EIS in conjunction with the then Conservation Commission NT (CCNT - now NT EPA). From 1993-1996, the eight adits identified at the URPA to have a very low level of bat usage were closed off (or mined) in consultation with the CCNT. The purpose was to force the bats to use other roosts distant from the mining area.

Archaeological and heritage surveys in 2011, several remaining adits at the URPA, mainly to the north of the Lady Alice Pit (Figure 13). In order to understand the role of these adits with respect to regional populations, NTMO engaged Ecological Management Services (EMS) and Specialised Zoological (SZ) to conduct a desktop assessment and field survey of Ghost Bats at the URPA. The key findings from this assessment as provided in Armstrong & Barden, 2018 are outlined below.

Field surveys were conducted over a four-day period (20 to 24 August 2018). The surveys included searches for and inspections of historical mining structures to assess their suitability as potential Ghost Bat roosts, detection of Ghost Bats and other bats at potential roost sites using video, static acoustic recording and nocturnal observations (spotlighting and acoustic recordings) of bats at key locations within the URPA.

Given the absence of landscape and geological features supporting natural cave systems in the area within and immediately surrounding the URPA, the most likely sites supporting Ghost Bat colonies were considered to be historical mine workings. A total of 82 'underground' workings were documented during the field survey, which included three adits, 21 scrapes and 58 filled or shallow shafts and stopes. The three adits (Union Reefs, OK and Lady Alice Adit – shown in Figure 14) were the most likely features to be used by Ghost Bats for diurnal roosting. The remaining features were too shallow. Two sets of steel culverts under the railway to the west of the project area had prey remains and scats of the Ghost Bat, confirming presence of the species in the general area.

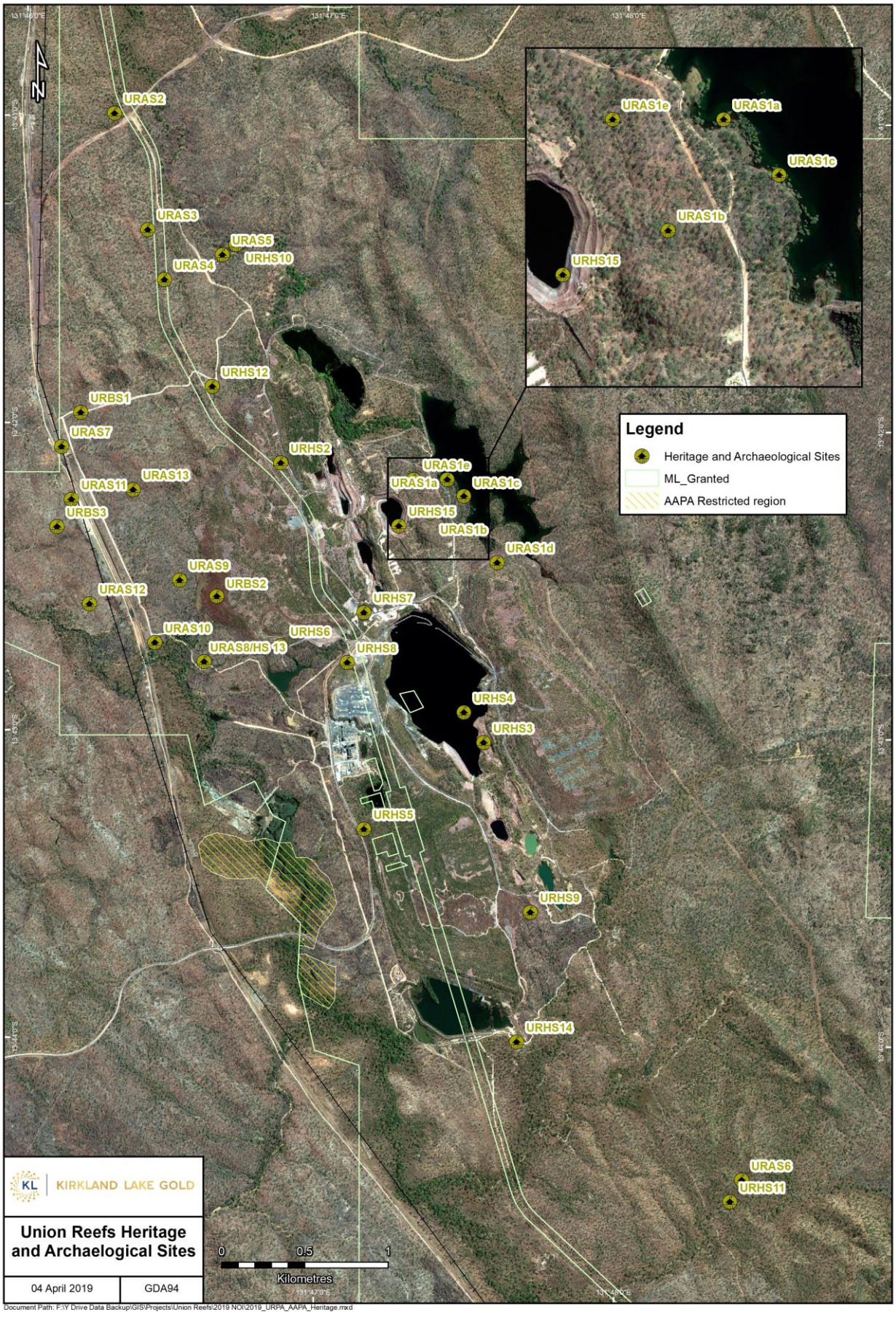

FIGURE 13: URPA HERITAGE AND ARCHAEOLOGICAL SITES

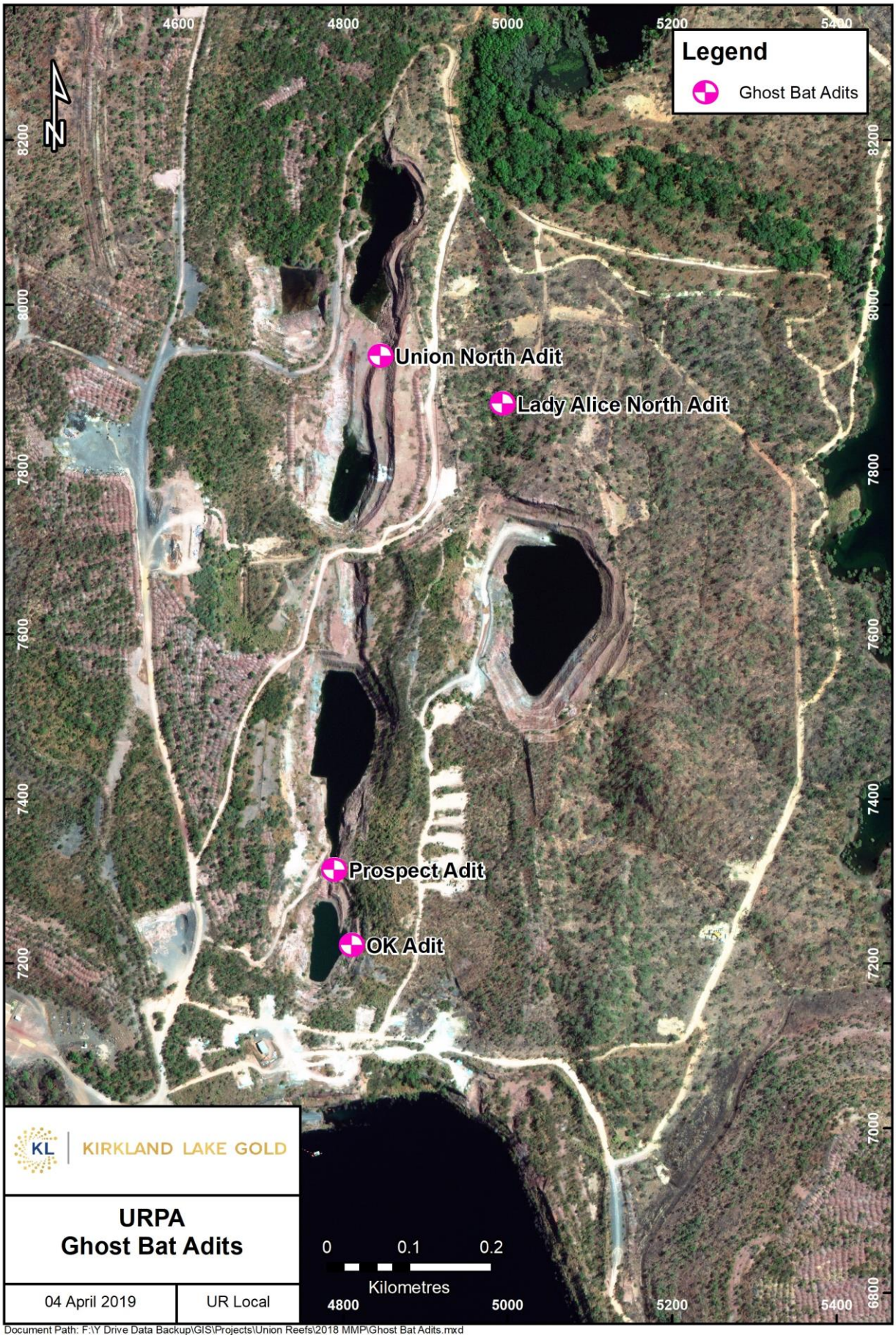

FIGURE 14: URPA GHOST BAT ADIT LOCATIONS

Based on initial acoustic and video recordings in August 2018, it appeared that a diurnal roost was present only at the Union Reefs Adit during the survey. The presence of Ghost Bat scats at the entrance of the OK Adit indicates that it might be used occasionally during the day by fewer individuals, or as a nocturnal refuge. The Lady Alice Adit was visited by one or more Ghost Bats after the end of civil twilight based on echolocation recordings, but it is not known whether they could enter the narrow adit portal.

A shaft close to the Lady Alice Adit (referenced as waypoint 115) is probably not used by Ghost Bats, with echolocation and social calls being recorded from individuals that probably 'perched' in nearby trees. The culverts on the railway line are probably only visited as a nocturnal refuge and feeding site. Since this study, a fourth adit portal near the OK Adit in the Prospect Pit has been discovered (named the Prospect Adit – shown in Figure 14), but the entrance aperture and depth of the structure is probably not sufficient to support regular use by a large colony. Ghost bat scats were observed at the entrance indicating that the Ghost Bats use it as a feeding site.

Of all the identified structures, the Union Reefs and OK Adits have been assessed as being of the greatest importance for Ghost Bats in the URPA, and small colony of approximately 11 individuals was estimated from fly-out counts from the Union Reefs Adit. This colony is present inside the workings during the day. An unknown number of Ghost Bats were roosting within the OK Adit during the day in October 2018, and more recently, thermal video recordings showed the presence of up to 26 Ghost Bats using the OK Adit as a diurnal roost.

Baseline monitoring for Ghost Bat, Diamond-faced Bat (a.k.a. Orange Leaf-nosed Bats, *Rhinonicteris aurantia*) and Northern Leaf-nosed Bat (*Hipposideros stenotis*) activity at the URPA commenced on 22 October 2018 and is continuing. Three sites are being monitored: the Union Reefs Adit (diurnal roost), the OK Adit (occasional diurnal roost/nocturnal refuge) and the Prospect Adit (occasional diurnal roost/nocturnal refuge). Monitoring includes ultrasonic recordings and infrared video (Raspberry Pi infrared cameras were trialled in December 2018 and redeployed in January 2019).

In addition, further examinations will be made of all four adits of relevance to Ghost Bats – the Union Reefs, OK, Lady Alice and Prospect Adits (Figure 14). This will involve a determination of the internal structure and the length of adit tunnels. Some preliminary examinations have already been undertaken with a Rovio pipe inspection robot, but further effort is required to fully characterise the structures.

7.2.1.3 Potential Impacts

7.2.1.3.1 Flora

Some clearing will be required to establish surface infrastructure for the Union Reefs North Underground Mine. The vegetation on MLN1109 is predominantly regrowth following extensive clearing associated with historical mining activities. The planned infrastructure is located in previously disturbed mining areas surrounding existing open pits.

Acacia praetermissa (wattle, acacia) has not previously been identified on MLN1109 and is unlikely to be impacted given the highly disturbed nature of the proposed mining area. Weed infestations occur around some disturbed parts of MLN1109 and there is the potential for further spread of these weed populations.

7.2.1.3.2 Fauna

Ghost Bats are a predatory species that have an obligate requirement for underground roosts in natural caves and old mine adits, partly because of their physiological requirement for warm, humid roost microclimates. Within their roosts, a single individual may be observed, or colonies up to several hundred individuals. Young are born and raised in such colonies. Some caves and mine adits are used by small colonies or individuals for only part of the year. Whilst out foraging at night, they may visit underground structures they do not roost in during the day, for a short rest period, or to consume captured prey. The greatest threats to ghost bats are those that impact the structure of a roost site or disturb individuals when they are within a roost (review in Armstrong & Barden, 2018).

The greatest risks to Ghost Bats from mining activities are those that:

- Compromise the structure of a roost through internal collapses or blockages to the entrance portal;
- Cause bats to relocate to suboptimal roosts elsewhere the following night, thus increasing the likelihood of mortality from being forced to use a less energetically benign roost; and
- Cause bats to exit into daylight after excessive noise or vibration, thus exposing them to predation by raptorial birds and exposure to hot ambient conditions should they not be able to return to a suitable roosting area.

The OK and Prospect Adits within the Prospect Pit are in very close proximity to the proposed Union Reefs Underground Mine activities and there is a high potential for noise and vibration impacts on Ghost Bats using these adits. NTMO plan to temporarily close and restrict Ghost Bat access to the OK and Prospect Adits during mining to force the bats to use other nearby roosts such as the Union Reefs Adit (or Kohinoor Adit at Pine Creek) further from the mining area. SZ consider that the adit closure will not have a significant long-term impact on Ghost Bats, both locally and regionally. This opinion and outcome is based on the further development of appropriate management actions (Armstrong, 2019).

The Union Reefs Adit is less likely to be impacted by activities for the Union Reefs North Underground Mine. This adit is located around 615m from the mine portal and 265m from the most northerly point of underground development (Figure 15). Given the separation distance from the mining activities, noise emissions are not expected to impact on the Ghost Bats at the Union Reefs Adit, however the potential impact of blast induced ground vibration needs to be considered.

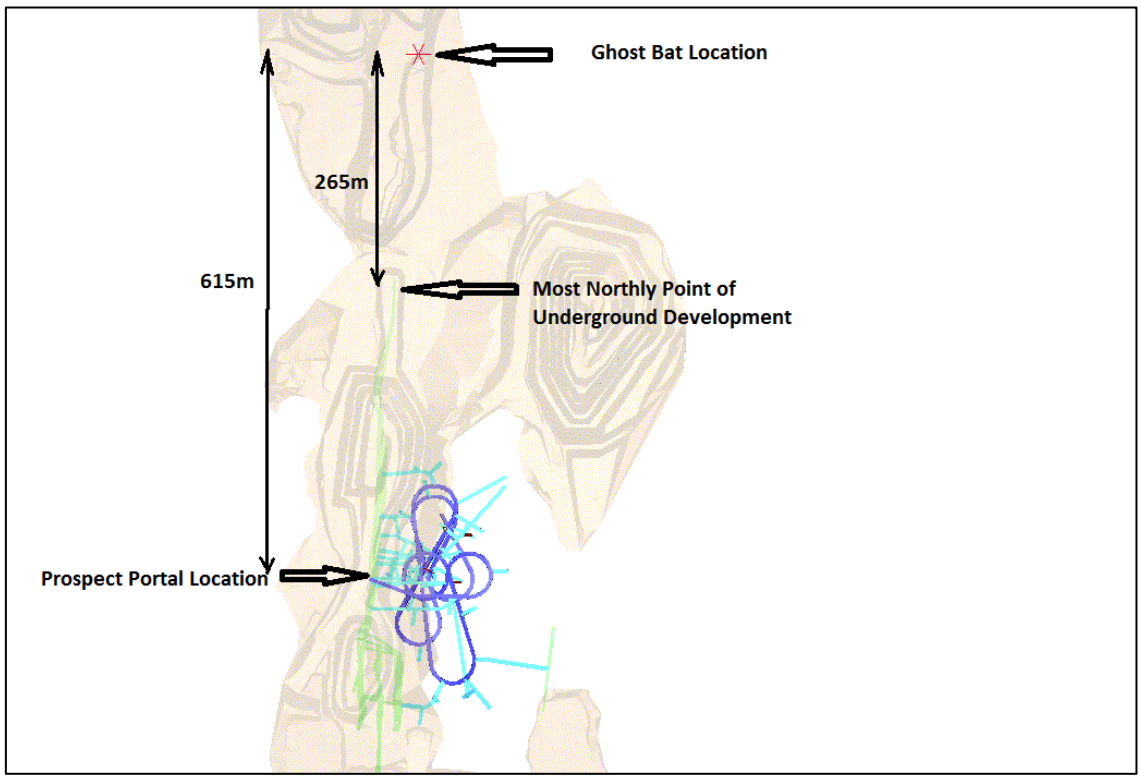

FIGURE 15: UNION REEFS NORTH UNDERGROUND MINE PROXIMITY TO UNION REEFS GHOST BAT ADIT

Many site based factors including rock type, structure, topography, explosive type, blast design and geometry determine the ground vibration level that will be transmitted to a particular location remote from the blast location. In general terms, ground vibration increases with increased charge mass and reduces with distance. The relationships between charge mass, distance and ground vibration can be determined using a predictive formula. Australian Standard AS2187.2 (2006) Appendix J provides the following equation to estimate ground vibration in the absence of any site data:

$$V = K_g (R / Q^{½})^{-B}$$

Where:

V = ground vibration as vector peak particle velocity (ppv) in millimetres per second (mm/s)
R = distance between charge and point of measurement, in meters
Q = maximum instantaneous charge (effective charge mass per delay), in kilograms
K_g, B = constants related to site and rock properties for estimation purposes

Australian Standard AS2187.2 notes that **K_g** = 1140 and **B** = -1.6 can be used to provide an estimate of the mean (50% probability) of ground vibration levels in average free face field conditions. Experience of blast consultants at other projects where the **K_g** and **B** factors were similar to the 1140 and 1.6 (respectively) indicate that by using a **K_g** = 1800 increases the ground vibration estimate to 90% probability.

NTMO have used the Australian Standard equation to calculate the expected order of magnitude of vibration from the blasts in closest proximity to the Union Reefs North Adit. Ground vibration radiates outwards from the blast site and gradually reduces in magnitude, in the same manner as ripples behave when a stone is thrown into a pool of water. This means that the blasts in closest proximity to the receiver will have the highest vibration levels so indicate the 'worst case' conditions.

NTMO blast designs to minimise vibration include for development blasting a maximum charge of 35kg and for production blasting a maximum charge of 40kg. By using the Australian Standard equation and the distance of 265m blasting is expected to generate a vibration of around 2.6 - 2.9mm/s ppv (50% confidence) and 4.1 - 4.6mm/s ppv (90% confidence) at the Union Reefs North Adit.

The predicted vibration levels are below the Australian Standard AS2187.2 ground vibration human comfort limits for sensitive sites (i.e. houses, theatres, schools etc.) for operations lasting longer than 12 months. These vibration limits are less than 5mm/s ppv for 95% of blasts per year and a maximum of 10mm/s ppv.

7.2.1.4 Mitigation

7.2.1.4.1 Flora and Fauna

The NTMO ESRMS includes a Flora and Fauna Management Plan, the purpose of this plan is to ensure that appropriate controls are developed and implemented to effectively protect flora and fauna at NTMO sites. Through implementation of this plan, NTMO aims to meet the following objectives:

- Gather information on the flora and fauna that inhabit NTMO project areas;
- Manage disturbance to flora and fauna;
- Minimise adverse impacts on flora and fauna; and
- Promote awareness of the protection of flora and fauna.

The following flora and fauna mitigation and management measures will be implemented as applicable:

- Implement the NTMO Ground Disturbance SOP, which includes threatened flora and fauna checks, prior to undertaking any ground disturbance activities and issue of a NTMO Clearing/Ground Disturbance Permit;
- Minimise areas of disturbance and vegetation clearing. Staged clearing of vegetation as required to minimise areas of bare ground, particularly on any steep slopes. Avoid land clearing where possible during the Wet Season (Dec-May). Revegetate disturbed areas as soon as possible after disturbance;
- Weed control to be implemented as detailed in the Weed Management Plan;
- Driving speed restrictions are in place and off-road driving is restricted or prohibited to avoid accidental disturbance to flora and fauna;
- Appropriate approvals will be obtained prior to the disturbance of any protected flora and fauna site as a result of NTMO operations;

- Ensure the induction includes a flora and fauna awareness module;
- Fauna sightings to be recorded in the fauna register to assess presence of threatened fauna and assessment of mitigation and management measure effectiveness;
- Disturbance to historical shafts and adits will be minimised and avoided where possible to maintain and provide potential roosts for bats;
- Identify key flora species and collect seeds (where possible and appropriate) for revegetation programmes;
- Assess water quality in the pit voids and mine water dam for suitability for fauna during operations and after mine closure. Fence off or bund access points to water bodies to minimise stock and native mammal access if unsuitable;
- Early Dry Season 'patchy' mosaic approach to controlled burns to leave patches of habitat;
- Limit artificial light to areas where it is essential and turn off lights when not required;
- Manage general site wastes to prevent/reduce interaction with fauna and introduction of vermin;
- A suitable qualified member of the Emergency Response Team (ERT) or Environment Department is to respond to injured animal reports. An injured animal will likely be highly stressed from shock, they may inadvertently cause harm to people attempting a rescue, therefore it is important for responders to consider personal protection;
- Determine the risk of dust emissions and potential impacts on threatened flora and implement mitigation and management measures if required; and
- Determine the risk of noise and vibration emissions and potential impacts on threatened fauna and implement mitigation and management measures if required.

The NTMO ESRMS also includes a Weeds and Pests Management Plan, the purpose of this plan is to limit and reduce the spread of weed and pest populations; to minimise adverse impacts to native flora and fauna; and to manage weed growth to reduce the risk of wildfires. Through implementation of this plan, NTMO aims to meet the following objectives:

- Monitor the occurrence of weed species;
- Prevent the accidental introduction of weeds;
- Implement effective weed management control methods; and
- Effective management of pest species populations.

The following weeds and pests mitigation and management measures will be implemented as applicable:

- Monitor and map sites with declared weeds and weeds of concern;
- Liaison with Key Stakeholders regarding weed or pest control;
- Weed controls implemented according to site-specific Weed Control Action Plans;
- All vehicles and mobile machinery restricted to designated access tracks;
- Mobile equipment entering site will be inspected to ensure it is clean of high-risk indicators such as caked dirt and residual vegetative materials;
- Plant and/or equipment and vehicles are to be washed prior to vacating areas known to contain Weeds of National Significance (WONS) or Class A, B or C weeds;
- Imported fill to be certified weed-free prior to being utilised on site;
- Implement the NTMO Ground Disturbance SOP, which includes a weeds check, prior to undertaking any ground disturbance activities and issue of a NTMO Clearing/Ground Disturbance Permit;
- Weeds are removed as required prior to vegetation clearing so that vegetative material would be clean and able to be mulched and reused directly on site;

- Vegetation and soil stockpiled from clearing activities will be monitored and chemical control undertaken should weeds be identified; and
- Employees and Contractors are educated in weed and pest management during inductions.

7.2.1.4.2 Ghost Bats

Specific management actions will be further informed by the Ghost Bat monitoring currently being undertaken. Current proposed Ghost Bat management and mitigation measures for the project include:

- Temporarily close and restrict Ghost Bat access to the OK and Prospect Adits during mining on advice from EMS and SZ biologists. Access to the portals would be blocked at night when all bat species have left to forage, and other sites within the project area managed and enhanced to ensure that all locally occurring species of obligate cave-dwelling bat species have more than one option for diurnal roosting;
- Minimise ground vibration by limiting blast charge weights to 35kg for development blasting and 40kg for production blasting;
- Prohibit access and entry to the Union Reefs Adit by people and maintain a minimum buffer of 130m from any mining activities;
- Continue baseline Ghost Bat monitoring on advice from EMS and SZ biologists to better understand the levels of Ghost Bat activity within the identified roosts. Ultrasonic recordings commenced in October 2018 and infrared video monitoring commenced in January 2019;
- Undertake long-term Ghost Bat monitoring (i.e. a minimum of one-week period in every month). Continuation of monitoring will provide seasonal information on roost usage and allow a better understanding of the relative importance of sites, both within the URPA, and relative to structures further afield. This information will be used in an adaptive management response to avoiding impacts to Ghost Bats and other obligate cave-dwelling bat species; and
- Develop an effective management and monitoring strategy that considers Ghost Bats and their movements between several underground mines in the region.

7.2.1.5 Assumptions

The key assumption made for this proposal is the NT EPA and Australian Government Minister for the Environment approval of the proposed action to temporarily close and restrict Ghost Bat access to the OK and Prospect Adits during mining activities. Access to these adits is planned to be re-opened once mining is complete to provide future roosting sites.

7.2.1.6 Relevant Policy and Guidance

Guidelines applicable to the Flora and Fauna Management Plan include:

- *DENR Advisory Note: Native Vegetation Buffers and Corridors* – Buffers and corridors support natural processes that occur in a healthy environment, including the movement of species.
- *Australian Government Department of Environment: Matters of National Environmental Significance – Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* – Provides assistance to any person who proposes to take an action to decide whether or not they should submit a referral for a decision on whether assessment and approval is required under the EPBC Act.

Guidelines applicable to the Weeds and Pests Management Plan include:

- *DENR Northern Territory Weed Management Handbook* - Provides information on strategic and planned approaches to weed management, including integrated weed control methods.
- *DENR Weed Data Collection Field Guide* - Provides step-by-step instructions on how to collect weed data in the field and then process it for use in weed management.

7.2.1.7 Potential Cumulative Impacts

No potential cumulative impacts have been identified.

NTMO are working with EMS and SZ biologists to develop a strategy for Ghost Bats that considers the wider context, and the importance of gene flow and the connectedness of colonies in the wider region. This includes the CHPA and Pine Creek Project Area (PCPA), which are likely to be linked through to the URPA. It is important to recognise that colonies of Ghost Bats do not exist in isolation, and that movement occurs between them. Careful consideration of effective management options for the Kohinoor Adit colony at the PCPA is warranted, especially given that it is potentially the largest Ghost Bat colony in Australia, but remains unprotected from a wide range of threats.

7.3 Water Factors

7.3.1 Inland Water Environmental Quality

7.3.1.1 NT EPA Factor Objective

Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are protected.

7.3.1.2 Receiving Environment

As outlined in the URPA MMP, NTMO has existing surface and groundwater quality monitoring programmes (Figure 16) to confirm the effectiveness of site water management and mitigation strategies. Effective and targeted monitoring programmes will ensure that an appropriate and timely response can address any issues at an early stage. The monitoring programmes are tied to the operation's ESRMS to ensure that there are appropriate action and reporting protocols.

The URPA water quality guideline values (GVs) have been developed based on the ANZECC Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC 2000) and sampling results from McKinlay River upstream reference site URSW09. The URPA GVs are used as an early warning mechanism to provide insight into potential adverse water quality changes, and are not intended to be used to assess compliance. The GVs are used to trigger on-site surface water management actions if water quality sampling indicates on-going values outside of the GVs and/or the long-term site data range.

NTMO has adopted the 95% ecosystem protection GVs for environmental protection at the edge of the McKinlay River mixing zone at the downstream monitoring point URSW08; with the exception of aluminium and zinc, which have the 80% species protection level due to the area mineralisation and naturally occurring elevated levels. Site Specific GVs (SSGVs) have also been applied based on the calculated 80th percentile of the upstream data from URSW09 in accordance with ANZECC 2000. Livestock drinking water guidelines (SWGs) are also considered where applicable.

While ANZECC 2000 states that the GVs "are not meant to be applied directly to recycled water quality, contaminant levels in discharges from industry, mixing zones, or stormwater quality". NTMO has adopted the 95% ecosystem protection GVs and SWGs (where applicable) at all other creek monitoring locations (URSW sites) and the 80% ecosystem protection GVs and SWGs at all other surface monitoring sites. This provides a good understanding of the site water quality, seasonal variations and enables an assessment of potential environmental impacts in the event of discharge.

All wastewater generated by NTMO operations is contained onsite, no active water treatment or discharge currently occurs at the URPA. There are passive discharges occurring off-site during the wet season only, from historical dam structures - Sediment Traps 3, 4A and 5B, Dam A and the Decant Pond. Water quality at sites downstream of the URPA are similar quality to the upstream site indicating that the passive discharges from the URPA have minimal impact on the McKinlay River downstream water quality.

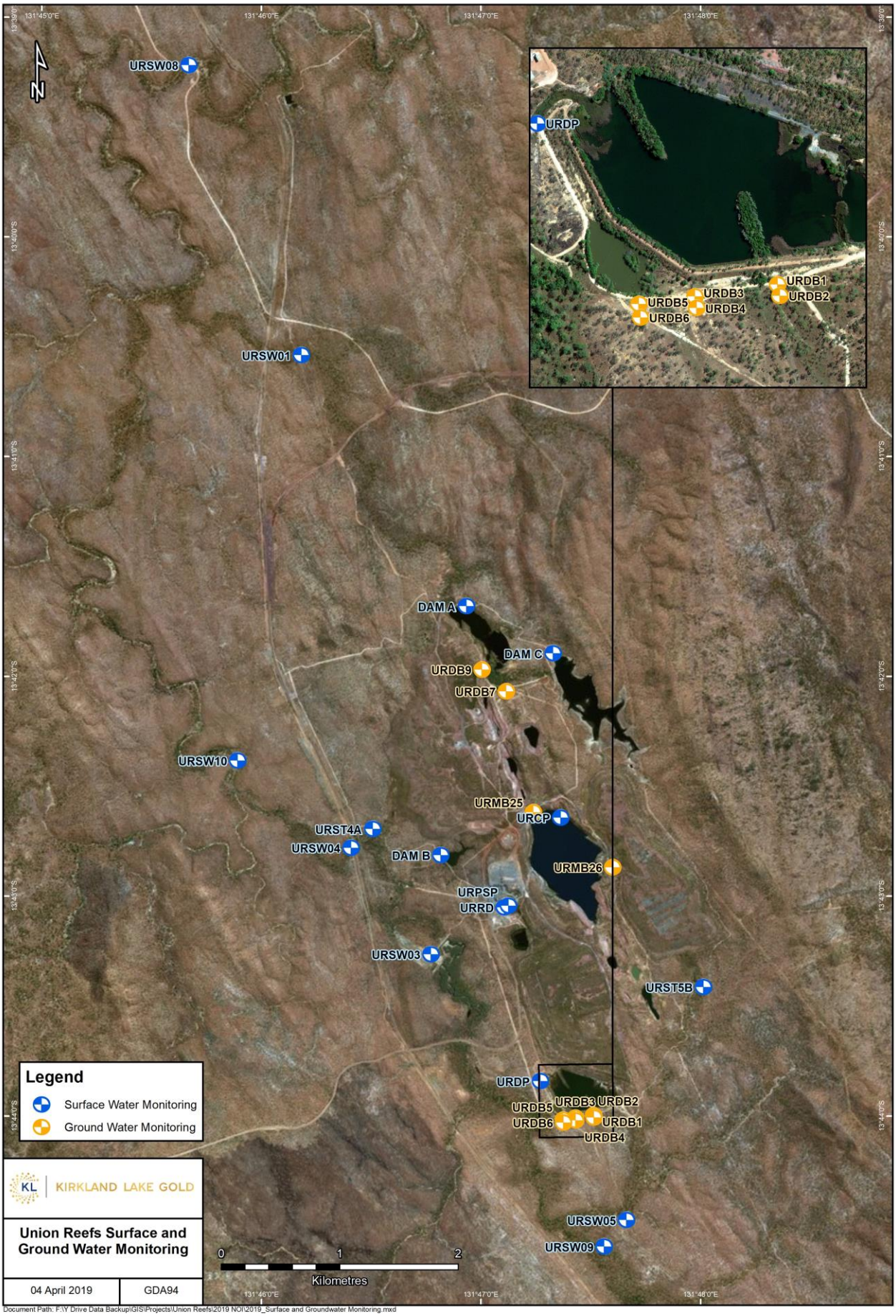

FIGURE 16: URPA SURFACE AND GROUNDWATER MONITORING LOCATIONS

There are no current GVs for groundwater ecosystem protection, however ANZECC 2000 provides values for stock drinking and agricultural irrigation – both of which have been identified as beneficial uses of groundwater. It is also appropriate to consider the connectivity between groundwater and surface water ecosystems and so groundwater data is compared to the 80% ecosystem protection GVs and SWGs (where applicable).

Groundwater in the URPA generally continues to be of reasonable quality with most monitoring sites indicating circumneutral pH and reduced solute concentrations within 80% species protection GVs. Pyrite, arsenopyrite, galena and spalerite are associated with the rock type found at URPA and are evident in water quality monitoring results.

Arsenic was recorded at bores north of Crosscourse Pit and south of Dam A (URDB25 and URDB9). This may correspond with mineralisation that lies in line with the location of all the existing pits that are found from north to south. Overall, the site demonstrates consistently elevated EC and iron concentrations that are also considered likely to be a key component of the parent rock.

Elevated zinc concentrations were found at URDB4, URDB7 and URDB25. Bores south of the Decant Pond recorded high cobalt although the Pond itself showed no high cobalt readings during surface water sampling events. Over time cobalt, DO and EC have been the main contributor to long-term groundwater quality values above GVs.

It must be noted that groundwater is reflective of local mineralization and in the event of levels above the GVs, a review of the longer-term monitoring data is undertaken. This aims to determine whether higher concentrations reflect background levels or whether a change has occurred as a result of the operational processes. Dissolved metals from 2013-2018 have been compared for each groundwater monitoring site and confirm that the recorded levels in 2017-18 are consistent with long term trends.

While extensive surface and groundwater monitoring is undertaken across a number of locations at the URPA only some areas are directly relevant to the proposed Union Reefs North Underground Mine proposal. It is considered that the applicable surface water locations are the Prospect and Crosscourse Pits and groundwater sites URDB7 (North of Lady Alice Pit), URDB9 (Union North Monitoring Bore), URMB25 (Crosscourse Pit Monitoring Bore) and URMB26 (Historical Monitoring Bore East of Crosscourse Pit). A summary of water quality data for these sites from the 2017-18 wet season is provided in Table 9.

TABLE 9: URPA 2017-18 SURFACE AND GROUNDWATER QUALITY MONITORING RESULTS

ANALYTE	Prospect Pit N	Prospect Pit S	URCP	URDB7	URDB9	URMB25	URMB26
Dissolved Oxygen (%)	90 - 120	90 - 120	90 - 120	90 - 120	90 - 120	90 - 120	90 - 120
Minimum	59.5	51.8	29.4	3.7	1.2	8.2	0.9
Maximum	86.5	82	87.7	41	28.1	20.3	64.6
Average	73.32	73.36	60.27	16.14	8.5	14.3	20.
Median	76.8	75.6	60.3	10.6	6.4	14.25	14.2
Standard Deviation	9.31	9.55	16.	13.45	9.42	8.6	23.6
Sample Size	9	9	15	7	7	2	7
Non-Detects	0	0	0	0	0	0	0
> GV	9	9	15	7	7	2	7
Electrical Conductivity (µS/cm)	20 - 250	20 - 250	20 - 250	20 - 250	20 - 250	20 - 250	20 - 250
Minimum	218.8	274.7	2,150	280	293.3	355.7	550
Maximum	279.6	334.4	2,939	327.4	516	399.4	617
Average	251.2	312.9	2,570	305.3	376.829	377.6	587
Median	255	316.7	2,577	307.5	328	377.55	589
Standard Deviation	18.522	18.9	238	14.75	98.361	30.9	26
Sample Size	9	9	15	7	7	2	7
Non-Detects	0	0	0	0	0	0	0
> GV	5	9	15	7	7	2	7

ANALYTE	Prospect Pit N	Prospect Pit S	URCP	URDB7	URDB9	URMB25	URMB26
pH	6 - 8	6 - 8	6 - 8	6 - 8	6 - 8	6 - 8	6 - 8
Minimum	7.27	6.88	6.55	5.87	6.06	6.57	6.67
Maximum	8.16	7.87	7.98	6.5	7.46	6.74	7.54
Average	7.73	7.37	7.43	6.13	6.62	6.66	7.06
Median	7.73	7.38	7.44	6.04	6.5	6.655	6.96
Standard Deviation	0.36	0.32	0.42	0.22	0.46	0.12	0.3
Sample Size	9	9	15	7	7	2	7
Non-Detects	0	0	0	0	0	0	0
> GV	3	9	0	3	0	0	0
Dissolved Aluminium (Al) (µg/L)	150	150	150	150	150	150	150
Minimum	10	10	20	10	10	10	10
Maximum	10	90	60	10	10	10	10
Average	10	27	37	10	10	10	10
Median	10	20	35	10	10	10	10
Standard Deviation	0	25	16	0	0	0	0
Sample Size	9	9	6	4	4	2	4
Non-Detects	9	2	0	4	4	2	4
> GV	0	0	0	0	0	0	0
Dissolved Arsenic (As) (µg/L)	140	140	140	140	140	140	140
Minimum	75	50	800	62	450	180	1
Maximum	95	69	1,200	100	820	200	17
Average	83	55	958	80	665	190	7
Median	83	54	930	79	695	190	4
Standard Deviation	5	6	137	18	158	14	7
Sample Size	9	9	6	4	4	2	4
Non-Detects	0	0	0	0	0	0	0
> GV	0	0	6	0	4	2	0
Dissolved Cadmium (Cd) (µg/L)	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Minimum	0.1	0.8	0.1	0.1	0.1	0.1	0.1
Maximum	0.2	2.4	0.7	0.1	0.2	0.2	0.1
Average	0.1	1.5	0.5	0.1	0.2	0.2	0.1
Median	0.1	1.6	0.55	0.1	0.15	0.15	0.1
Standard Deviation	0.	0.4	0.3	-	0.1	0.1	-
Sample Size	9	9	6	4	4	2	4
Non-Detects	3	0	0	4	2	0	4
> GV	0	8	0	0	0	0	0
Dissolved Chromium (Cr) (µg/L)	40	40	40	40	40	40	40
Minimum	1	1	1	1	1	1	1
Maximum	1	1	1	1	1	1	1
Average	1	1	1	1	1	1	1
Median	1	1	1	1	1	1	1
Standard Deviation	0	0	0	0	0	0	0
Sample Size	9	9	6	4	4	2	4
Non-Detects	9	9	6	4	4	2	4
> GV	0	0	0	0	0	0	0

ANALYTE	Prospect Pit N	Prospect Pit S	URCP	URDB7	URDB9	URMB25	URMB26
Dissolved Cobalt (Co) (µg/L)	13	13	13	13	13	13	13
Minimum	1	1	160	2	7	5	1
Maximum	1	4	270	3	11	6	1
Average	1	1	197	3	9	6	1
Median	1	1	180	2.5	8	5.5	1
Standard Deviation	0	1	45	1	2	1	0
Sample Size	9	9	6	4	4	2	4
Non-Detects	9	8	0	0	0	0	4
> GV	0	0	6	0	0	0	0
Dissolved Copper (Cu) (µg/L)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Minimum	1	2	1	1	1	1	1
Maximum	1	3	14	1	1	1	1
Average	1	2	5	1	1	1	1
Median	1	2	3	1	1	1	1
Standard Deviation	0	1	5	0	0	0	0
Sample Size	9	9	6	4	4	2	4
Non-Detects	9	0	0	4	4	2	4
> GV	0	3	4	0	0	0	0
Dissolved Iron (Fe) (µg/L)	300	300	300	300	300	300	300
Minimum	10	75	10	1,300	710	3,900	330
Maximum	11	160	27	1,600	1,200	4,700	3,100
Average	10	105	14	1,400	963	4,300	1,533
Median	10	100	10	1,350	970	4,300	1,350
Standard Deviation	0	25	7	141	227	566	1,157
Sample Size	9	9	6	4	4	2	4
Non-Detects	8	0	4	0	0	0	0
> GV	0	0	0	4	4	2	4
Dissolved Lead (Pb) (µg/L)	9.4	9.4	9.4	9.4	9.4	9.4	9.4
Minimum	1	1	1	1	1	1	1
Maximum	1	1	1	1	1	1	1
Average	1	1	1	1	1	1	1
Median	1	1	1	1	1	1	1
Standard Deviation	0	0	0	0	0	0	0
Sample Size	9	9	6	4	4	2	4
Non-Detects	9	9	6	4	4	2	4
> GV	0	0	0	0	0	0	0
Dissolved Manganese (Mn) (µg/L)	3600	3600	3600	3600	3600	3600	3600
Minimum	5	6	10	430	550	300	28
Maximum	7	120	81	440	1,100	350	35
Average	6	32	45	438	838	325	31
Median	5	16	45	440	850	325	30.5
Standard Deviation	1	36	35	5	304	35	3
Sample Size	9	9	6	4	4	2	4
Non-Detects	4	0	0	0	0	0	0
> GV	0	0	0	0	0	0	0

ANALYTE	Prospect Pit N	Prospect Pit S	URCP	URDB7	URDB9	URMB25	URMB26
Dissolved Nickel (Ni) (µg/L)	17	17	17	17	17	17	17
Minimum	1	8	4	1	1	5	1
Maximum	1	15	8	1	2	5	1
Average	1	12	6	1	1	5	1
Median	1	12	5	1	1	5	1
Standard Deviation	0	2	2	0	1	0	0
Sample Size	9	9	6	4	4	2	4
Non-Detects	9	0	0	4	2	0	4
> GV	0	0	0	0	0	0	0
Dissolved Selenium (Se) (µg/L)	34	34	34	34	34	34	34
Minimum	1	1	5	1	1	1	1
Maximum	1	1	7	1	1	1	1
Average	1	1	6	1	1	1	1
Median	1	1	6	1	1	1	1
Standard Deviation	0	0	1	0	0	0	0
Sample Size	9	9	6	3	3	2	3
Non-Detects	9	9	0	3	3	2	3
> GV	0	0	0	0	0	0	0
Total Cyanide (mg/L)	18	18	18	18	18	18	18
Minimum	0.004	0.004	0.036	0.004	0.004	0.004	0.004
Maximum	0.004	0.004	0.14	0.004	0.006	0.004	0.004
Average	0.004	0.004	0.071	0.004	0.005	0.004	0.004
Median	0.004	0.004	0.058	0.004	0.005	0.004	0.004
Standard Deviation	-	-	0.041	-	0.001	-	-
Sample Size	1	1	5	3	3	2	4
Non-Detects	1	1	0	3	1	2	4
> GV	0	0	0	0	0	0	0
Total Suspended Solids (mg/L)							
Minimum	10	10	10	10	10	12	27
Maximum	12	14	15	10	10	29	48
Average	10	10	11	10	10	21	33
Median	10	10	10	10	10	20.5	28.5
Standard Deviation	1	1	2	0	0	12	10
Sample Size	9	9	6	4	4	2	4
Non-Detects	7	8	3	4	4	0	0
> GV	-	-	-	-	-	-	-
Turbidity (NTU)	2 - 15	2 - 15	2 - 15	2 - 15	2 - 15	2 - 15	2 - 15
Minimum	0.8	0.5	0.8	6.32	4.7	31.9	36.5
Maximum	1.1	3.2	0.8	9.5	10	38	79.7
Average	1.	1.9	0.8	7.78	7.05	34.95	55.2
Median	0.95	1.85	0.8	7.65	6.76	34.95	52.35
Standard Deviation	0.2	1.9	-	1.41	2.42	4.31	18.
Sample Size	2	2	1	4	4	2	4
Non-Detects	0	0	0	0	0	0	0
> GV	2	1	1	0	0	2	4

ANALYTE	Prospect Pit N	Prospect Pit S	URCP	URDB7	URDB9	URMB25	URMB26
Dissolved Zinc (Zn) (µg/L)	31	31	31	31	31	31	31
Minimum	15	330	22	12	2	260	1
Maximum	39	820	160	33	330	300	3
Average	23	587	66	19	156	280	2
Median	21	620	59.5	14.5	146	280	1.5
Standard Deviation	7	154	51	10	179	28	1
Sample Size	9	9	6	4	4	2	4
Non-Detects	0	0	0	0	0	0	2
> GV	1	9	4	1	2	2	0
Total Aluminium (Al) (µg/L)	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Minimum	10	10	30	10	10	10	10
Maximum	20	100	510	30	10	10	20
Average	11	48	123	15	10	10	13
Median	10	40	50	10	10	10	10
Standard Deviation	3	31	190	10	0	0	5
Sample Size	9	9	6	4	4	2	4
Non-Detects	5	0	0	3	4	2	3
> GV	0	0	0	0	0	0	0
Total Arsenic (As) (µg/L)	500	500	500	500	500	500	500
Minimum	80	52	890	62	440	240	5
Maximum	100	77	1,200	110	840	290	24
Average	87	59	995	83	670	265	12
Median	85	56	945	79.5	700	265	10
Standard Deviation	6	8	131	22	170	35	8
Sample Size	9	9	6	4	4	2	4
Non-Detects	0	0	0	0	0	0	0
> GV	0	0	6	0	3	0	0
Total Cadmium (Cd) (µg/L)	10	10	10	10	10	10	10
Minimum	0.1	1.1	0.2	0.1	0.2	0.5	0.1
Maximum	0.2	4.1	0.8	0.1	0.2	1.2	0.1
Average	0.1	1.9	0.5	0.1	0.2	0.9	0.1
Median	0.1	1.7	0.55	0.1	0.2	0.85	0.1
Standard Deviation	0.1	0.9	0.3	-	-	0.5	-
Sample Size	9	9	6	4	4	2	4
Non-Detects	2	0	0	4	0	0	4
> GV	0	0	0	0	0	0	0
Dissolved Calcium (mg/L)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Minimum	11	13	200	13	11	18	28
Maximum	13	15	290	14	27	19	30
Average	12	14	260	13	19	19	29
Median	12	14	270	13	19	18.5	28.5
Standard Deviation	1	1	35	1	9	1	1
Sample Size	9	9	6	4	4	2	4
Non-Detects	0	0	0	0	0	0	0
> GV	0	0	0	0	0	0	0

ANALYTE	Prospect Pit N	Prospect Pit S	URCP	URDB7	URDB9	URMB25	URMB26
Total Chromium (Cd) (µg/L)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Minimum	1	1	1	1	1	1	1
Maximum	1	2	1	1	1	1	2
Average	1	1	1	1	1	1	1
Median	1	1	1	1	1	1	1
Standard Deviation	0	0	0	0	0	0	1
Sample Size	9	9	6	4	4	2	4
Non-Detects	9	8	6	4	4	2	3
> GV	0	0	0	0	0	0	0
Total Cobalt (Co) (µg/L)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Minimum	1	1	160	2	8	5	1
Maximum	1	4	280	3	11	7	1
Average	1	2	213	3	9	6	1
Median	1	1	220	2.5	8	6	1
Standard Deviation	0	1	44	1	2	1	0
Sample Size	9	9	6	4	4	2	4
Non-Detects	9	5	0	0	0	0	4
> GV	0	0	0	0	0	0	0
Total Copper (Cu) (µg/L)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Minimum	1	3	2	1	1	1	1
Maximum	1	6	17	1	1	4	1
Average	1	4	7	1	1	3	1
Median	1	3	4	1	1	2.5	1
Standard Deviation	0	1	6	0	0	2	0
Sample Size	9	9	6	4	4	2	4
Non-Detects	7	0	0	4	4	0	4
> GV	0	0	0	0	0	0	0
Total Lead (Pb) (µg/L)	100	100	100	100	100	100	100
Minimum	1	1	1	1	1	1	1
Maximum	1	3	5	1	1	1	1
Average	1	1	2	1	1	1	1
Median	1	1	1	1	1	1	1
Standard Deviation	0	1	2	0	0	0	0
Sample Size	9	9	6	4	4	2	4
Non-Detects	9	8	5	4	4	2	4
> GV	0	0	0	0	0	0	0
Total Nickel (Ni) (µg/L)	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Minimum	1	8	5	1	1	5	1
Maximum	1	16	9	2	2	6	3
Average	1	12	6	1	1	6	2
Median	1	13	5.5	1	1	5.5	1
Standard Deviation	0	3	2	1	1	1	1
Sample Size	9	9	6	4	4	2	4
Non-Detects	8	0	0	3	2	0	1
> GV	0	0	0	0	0	0	0

ANALYTE	Prospect Pit N	Prospect Pit S	URCP	URDB7	URDB9	URMB25	URMB26
Total Selenium (Se) (µg/L)	20	20	20	20	20	20	20
Minimum	1	1	5	1	1	1	1
Maximum	1	3	7	1	1	1	1
Average	1	1	6	1	1	1	1
Median	1	1	5.5	1	1	1	1
Standard Deviation	0	1	1	0	0	0	0
Sample Size	9	9	6	3	3	2	3
Non-Detects	9	7	0	3	3	2	3
> GV	0	0	0	0	0	0	0
Sulphate (mg/L)				1,000	1,000	1,000	1,000
Minimum	-	-	-	44	2	2	6
Maximum	-	-	-	50	74	110	22
Average	-	-	-	47	48	56	13
Median	-	-	-	48	67	56	12
Standard Deviation	-	-	-	3	40	76	8
Sample Size	-	-	-	3	3	2	3
Non-Detects	-	-	-	0	0	0	0
> GV	-	-	-	0	0	0	0
Total Zinc (Zn) (µg/L)	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Minimum	21	390	26	12	83	430	1
Maximum	53	900	240	31	340	620	4
Average	28	627	86	18	201	525	3
Median	26	660	55	14.5	189.5	525	2.5
Standard Deviation	10	162	79	9	134	134	1
Sample Size	9	9	6	4	4	2	4
Non-Detects	0	0	0	0	0	0	0
> GV	0	0	0	0	0	0	0

7.3.1.3 Potential Impacts

For the Union Reefs North Underground Mine an estimated 104,000m^3 of waste rock will be progressively brought to the surface over a period of 13 months. Initially, decline waste will be hauled up to the portal and tipped into the centre of the Prospect Pit to extend the portal bench for mine access. The portal bench will require an estimated 20,000m^3 of waste material and will remain for the LOM. The remaining 84,000m^3 of waste rock will be temporarily stockpiled in the southern end of the Prospect Pit until it is progressively returned underground as backfill.

NTMO engaged Environmental Geochemistry International Pty Ltd (EGi) to assess the potential for acid and metalliferous drainage (AMD) from the waste rock generated from the Union Reefs Underground Mine. EGi has undertaken previous work at the URPA (Crosscourse and Union Reef North) from 1993 to mid 2011. The objectives of the assessment by EGi were to provide an initial indication of the potential for development waste to generate AMD, salinity and elemental solubility, provide guidance on likely materials management requirements, and outline a follow up test work programme to address gaps and uncertainties in information available to date.

Static test work results from previous investigations suggested that oxide/weathered waste rock was non-acid forming (NAF) and generally with negligible sulphur (S) concentrations and low acid neutralising capacity (ANC), whereas transitional and fresh materials had variable potential to generate AMD. It was noted that waste rock close to ore intervals was more likely to be acid producing compared to fresh waste rock away from ore horizons.

Similar conclusions were reached for ore and low-grade ore, whereby oxide ore was unlikely to be acid generating, while primary ore had the potential to oxidise and generate AMD. Kinetic test work confirmed the potential for arsenic (and zinc) leaching from marginal ore and tailings. None of the columns produced low pH leachates.

These static and kinetic studies concluded that the key environmental hazard for the deposits at the URPA was arsenic (and metal) leaching, rather than AMD, due to the elevated arsenic in waste rock and ore, relatively low S in the samples tested, and moderate ANC in fresh waste rock. However, these conclusions were preliminary due to the limited number of samples tested.

The AMD test results for 71 waste rock samples compiled as part of the 2011 EGi report showed that NAGpH provided a reliable discriminator of NAF and Potentially Acid Forming (PAF) AMD types for the URPA, and site criteria based on NAGpH was developed in which samples with NAGpH ≥ 4.5 were classified NAF, and those with NAGpH < 4.5 were classed as PAF. Note that the results also show that S can also be used to classify samples, and although it is not as discriminating, it is suitable as a first pass classification in the absence of more detailed geochemical test data.

The previous EGi assessments also provided arsenic criteria, in which only NAF materials with <100mg/kg arsenic were deemed suitable for placement in the outer 10m of the waste rock dump. Again, these arsenic criteria were applied to the ICP results as a preliminary guide to arsenic mobilisation potential.

The initial AMD assessment for the Union Reefs North Underground Mine was based on historical information and ICP multi-element testing of cored holes URNDD0100 and URNDD0105, and reverse circulation (RC) hole URNDD0114 (Figure 17). Preliminary S and arsenic criteria based on previous EGi work were applied to the ICP test results to classify the samples as follows:

NAF-Low As = S ≤ 0.3% and As < 100 mg/kg

NAF-Elevated As = S ≤ 0.3% and As ≥ 100 mg/kg

PAF= S > 0.3%

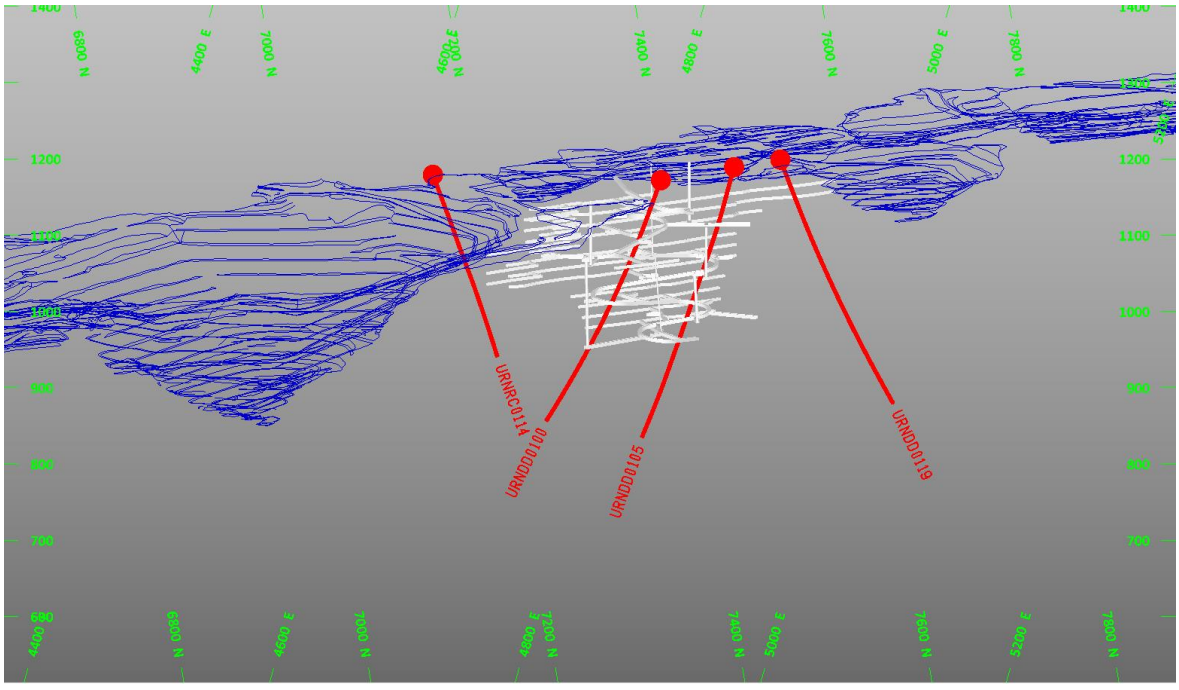

FIGURE 17: UNION REEFS NORTH UNDERGROUND MINE DEVELOPMENT RELATIVE TO TRACE DRILL HOLES

Geology descriptions were merged with S and arsenic results for samples from URNDD0100, URNDD0105 and URNDD0114 together with preliminary classifications. Those intervals considered representative of the mine development envelope were split into ore and development waste. Results show that the majority of S values are 0.3% and less, with the elevated S in distinct zones both associated with the ore and away from the ore. It is expected that the higher S zones should be readily identifiable in the core.

A full set of arsenic results were available for hole URNDD0100, with selected intervals of arsenic results available URNDD0105 and URNDD0114. The elevated arsenic zones generally correspond to elevated S zones, so that management of elevated S materials would be expected to mainly account for elevated arsenic also.

The proportions of geochemical rock types (based on sample interval length, and only for samples where both S and arsenic assays were available) for development waste and ore materials are provided in Table 10. These preliminary results suggest that the majority of development waste materials to be extracted from the Union Reefs North Underground Mine will be benign, with potentially problematic materials only accounting for approximately 20% of materials using the conservative criteria applied. Note that these proportions are indicative only, and do not take into account the spatial distribution of AMD rock types in the development zone.

TABLE 10: UNION REEFS NORTH UNDERGROUND MINE WASTE ROCK GEOCHEMICAL ROCK PROPORTIONS

Material Type	NAF-Low As	NAF-Elevated As	PAF
Development Waste	79%	11%	10%
Ore	12%	24%	64%

Comparison of S and arsenic distribution with geological descriptions indicates that potentially problematic materials should be readily segregated based on geological observation, with vein materials showing the highest S and As. The low proportion of potentially problematic materials indicated from these preliminary results indicates considerable flexibility in selective waste handling. The portal pad materials are expected to remain on the surface, and should be restricted to NAF-Low As materials so that further management is not required for long term AMD control.

The majority of waste rock will be temporarily stockpiled on the surface and will be returned underground as back fill, providing an opportunity to manage any potential for long-term impacts on the groundwater system through blending waste rock types, addition of neutralising materials, and/or treatment as required. Much of the underground workings will be benign, but there are likely to be significant sulphides in the mined out stopes, and hence these are a potential source of AMD. Noting that the underground workings and backfilled waste rock are only a potential AMD issue during exposure to atmospheric oxidation conditions. Ultimately the underground workings are expected to be flooded, reducing oxidation of sulphides to negligible rates and providing long term effective control of AMD.

NTMO continue to work with EGi regarding further geochemical investigations and the development of an appropriate AMD sampling and testing programme. This will assist in addressing any remaining uncertainties in the AMD and metal/metalloid leaching potential of the development materials.

7.3.1.4 Mitigation

The NTMO ESRMS includes a Waste Rock Management Plan, the purpose of this plan is to effectively control and manage of waste rock to ensure the ongoing protection of land and waterways from waste rock extracted during NTMO operations. Through implementation of this plan, NTMO aims to meet the following objectives:

- Assess the AMD potential of mined waste rock; and
- Effectively manage AMD seepage from ore or waste stockpiles.

The following waste rock mitigation and management measures will be implemented as applicable:

- Placement of waste rock within landforms so that long-term generation of potential AMD is controlled to a level that does not adversely impact on downstream water quality;
- The portal pad materials will be restricted to NAF low arsenic materials so that further management is not required for long term AMD control;
- Ongoing waste rock geochemical characterisation and investigation programme for future and current mining operations;
- Identification and marking out geochemical waste rock types to be mined including - Non Acid Forming (NAF), Potentially Acid Forming (PAF), NAF-High Arsenic (As) or NAF-Low As; to enable appropriate segregation and management;
- Segregation and selective placement of potential AMD or NAF-High As waste rock types to minimise the exposure of PAF rock to atmospheric oxygen and leaching;
- Where practicable, backfill any PAF characterised waste rock material into underground or open pit voids; and
- Only NAF-Low As waste rock will be used for general construction fill, engineering works or road base. Pending the findings of the geochemical investigations only NAF materials with less than 100mg/kg As should be used for these purposes.

NTMO has specific Water Management Plans developed for each site considering the existing environment, activities and risks as part of the MMP. The purpose of the Water Management Plans are to protect the beneficial use of water ecosystems from the release of low quality mine impacted water from NTMO Sites. Through implementation of the Water Management Plans, NTMO aims to meet the following objectives:

- Implement management systems to reduce the generation of low quality mine impacted water;
- Reduce the risk of uncontrolled discharges of low quality mine impacted water from NTMO sites; and
- Reuse, recycle, treat and discharge (if necessary) mine impacted water to control the onsite water inventory.

The following water mitigation and management measures will be implemented as applicable:

- Dewater the Prospect Pit and maintain in a dry condition to reduce inflow into the underground mine workings;
- Maximise the reuse and recycling of water and minimise water inputs into the onsite storage inventory; and
- Continue surface and groundwater monitoring programmes.

7.3.1.5 Assumptions

The key assumption made for this proposal is that 84,000m^3 of waste rock will be returned underground as backfill. Current mine designs confirm that there is adequate storage capacity for this material.

7.3.1.6 Relevant Policy and Guidance

Guidelines applicable to the Waste Rock Management Plan include:

- *NT EPA Environmental Assessment Guidelines: Acid and Metalliferous* Drainage - Defines the information requirements of an Environmental Impact Statement (EIS) relating to assessment of potential AMD from mining and mineral processing materials.
- *NT DPIR MMP Structure Guide - Mining Operations* – Outlines the requirements for the assessment and management of waste rock, in the context of the potential for AMD to be generated.
- *WA DMP Draft Guidance Materials Characterisation Baseline Data Requirements for Mining Proposals* – Provides guidance for materials characterisation sampling, data collection and analysis programmes.

Guidelines applicable to the Water Management Plan include:

- *Australian and New Zealand Environmental and Conservation Council (ANZECC) Water Quality Guidelines 2000* - Provide authoritative guidance on fresh and marine water quality management issues.

7.3.1.7 Potential Cumulative Impacts

Groundwater near the Union Reefs North Underground Mine exhibits evidence of arsenic (and metal) leaching through elevated arsenic, iron and zinc levels in URDB25 and URDB9. This may correspond with the parent rock mineralisation that lies in line with the location of all the existing pits that are found from north to south.

Water quality monitoring of the Crosscourse Pit TSF also indicates elevated levels of dissolved arsenic, cobalt and zinc in the pit lake. While this water is not discharged to surface, there is some hydraulic connection with the main aquifer system through both the Union and Lady Alice Line lodes and structures.

7.3.2 Hydrological Processes

7.3.2.1 NT EPA Factor Objective

Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

7.3.2.2 Receiving Environment

7.3.2.2.1 Groundwater

The URPA groundwater assessment undertaken by AQ2 indicates that the main aquifer system at the URPA is an elongated north-south trending fractured and weathered rock system associated with the Union Reefs shear zone. It is around 300m to 500m wide and extends over many kilometres to the north and south. Within the main aquifer system, there are two aquifers:

- A deep aquifer comprising fresh but fractured and mineralised rock. Within the deep aquifer, there will be further enhanced permeability associated with the main lode systems (Union Line and Lady Alice Line). The deep aquifer will extend to the base of mineralisation, but permeability will decrease with depth as a result of geostatic load and reduced mineralisation.
- A shallow aquifer associated with weathered (partially to lightly weathered) basement rock. The mapped/logged depth of weathering (and therefore the base of the shallow aquifer) is around 40m below surface (at around 1150mRL). Permeability will be associated with relic fractures/mineralisation and residual rock and will be comparatively more evenly distributed than in the deep aquifer.

The main aquifer system is bounded to the east and west by low permeability, weakly fractured, fresh and weathered basement rocks. These would be more appropriately termed aquitards or aquicludes. The permeability of the shallow aquifer system, derived from historical investigations, is reported to be in the range 0.1 to 0.3m/d. Outside of the main aquifer system, the permeability of the shallow aquifer will be much lower. There will be a strong “x-y anisotropy” in the permeability with higher permeability and preferential flow in a north-south direction aligned with the geological and structural strike.

The main aquifer system will naturally recharge by the infiltration of runoff where surface water drainages cross outcropping or sub-cropping fractures or mineralised zones. The aquifers will naturally discharge as base flow to local and regional creeks downstream of the mining area. The URPA has been considerably disturbed by historical mining activities and there will be enhanced recharge from flooded pits, TSFs and mine water ponds where these overly the main aquifer system. The pit lakes in the Crosscourse, Lady Alice, Prospect and Union North Pits are currently around 1173 to 1175mRL. At present, these pits are likely to be groundwater sinks and surrounding groundwater levels will be slightly higher.

7.3.2.2.2 Surface Water

The two main McKinlay River sub-catchments that drain from the URPA include Esmeralda Creek to the south and Wellington Creek to the north. Regional hydrology of the McKinlay River sub-catchment is shown in Figure 11 and the URPA local hydrology and catchment areas are shown in Figure 18. Within the vicinity of the Union Reefs Underground Mine, local catchments have been modified by historical mining activities and drain into the existing open pits and dams.

Surface water infrastructure at the URPA utilised by NTMO operations include:

Crosscourse Pit

Crosscourse Pit is the large open pit in the centre of the URPA site. It receives surface rainfall, groundwater ingress, seepage from the East WRD and little to no runoff as the pit is fully bunded. Since 2002, Crosscourse Pit has been used as the site TSF and water is extracted and recycled for use by the URPA Processing Plant.

In 2010, a second pipeline and pump was installed to increase the water volume being returned to the processing plant. This system is designed to increase water recycling, reduce the requirement for processing additives and aims to extend the operating life of Crosscourse Pit TSF.

NTMO maintains a water account for the Crosscourse Pit that is updated monthly to determine the life expectancy of the pit under operational conditions as a TSF. Water quality is sampled at the URCP monitoring point and tailings quality is sampled at the URRD monitoring point during tailings deposition.

Dam B

Dam B is located to the west of the URPA ROM pad, fuel bay and wash-down areas. It acts as a sediment trap and settling pond for runoff from these areas, as well as surface water runoff and seepage from the southern end of the West WRD.

Dam B passively discharges during the wet season via a constructed drainage line into Sediment Trap 3 and into the McKinlay River. Water quality is sampled at the Dam B monitoring point and passive discharge at URST3 and URSW04.

Dam C

Dam C is situated in the northeast of the URPA. It receives surface rainfall and catchment runoff from the hilly ridges to the east of the dam, as well as runoff and seepage from the East WRD. In above average wet seasons, Dam C discharges into Dam A via a constructed weir.

Dam C is used as a raw water source and provides supplementary water for the URPA Processing Plant. A pipeline runs from the northwest dam wall via gravity feed, to a pumping station near the southwest corner of Dam A that pumps the water to the processing plant. Water quality is sampled at the Dam C monitoring point.

Plant Spill Pond

The Plant Spill Pond is a small rectangular pond, which captures runoff from the processing plant and is a contingency sump to contain any large chemical or processing spills. This pond is the water source for dust suppression around the processing plant and ROM areas and for the wash-down water/wash-bay. Surface flows from this usage report back to the pond. A standpipe is in place and water is used as required during the dry season. Water quality is sampled at the URPSP monitoring point.

The storage capacity and current volumes of major storage infrastructure in the URPA is provided in Table 11. The Lady Alice Pit, Dam A and Decant Pond are historical infrastructure which are not utilised as part of the NTMO surface water management system.

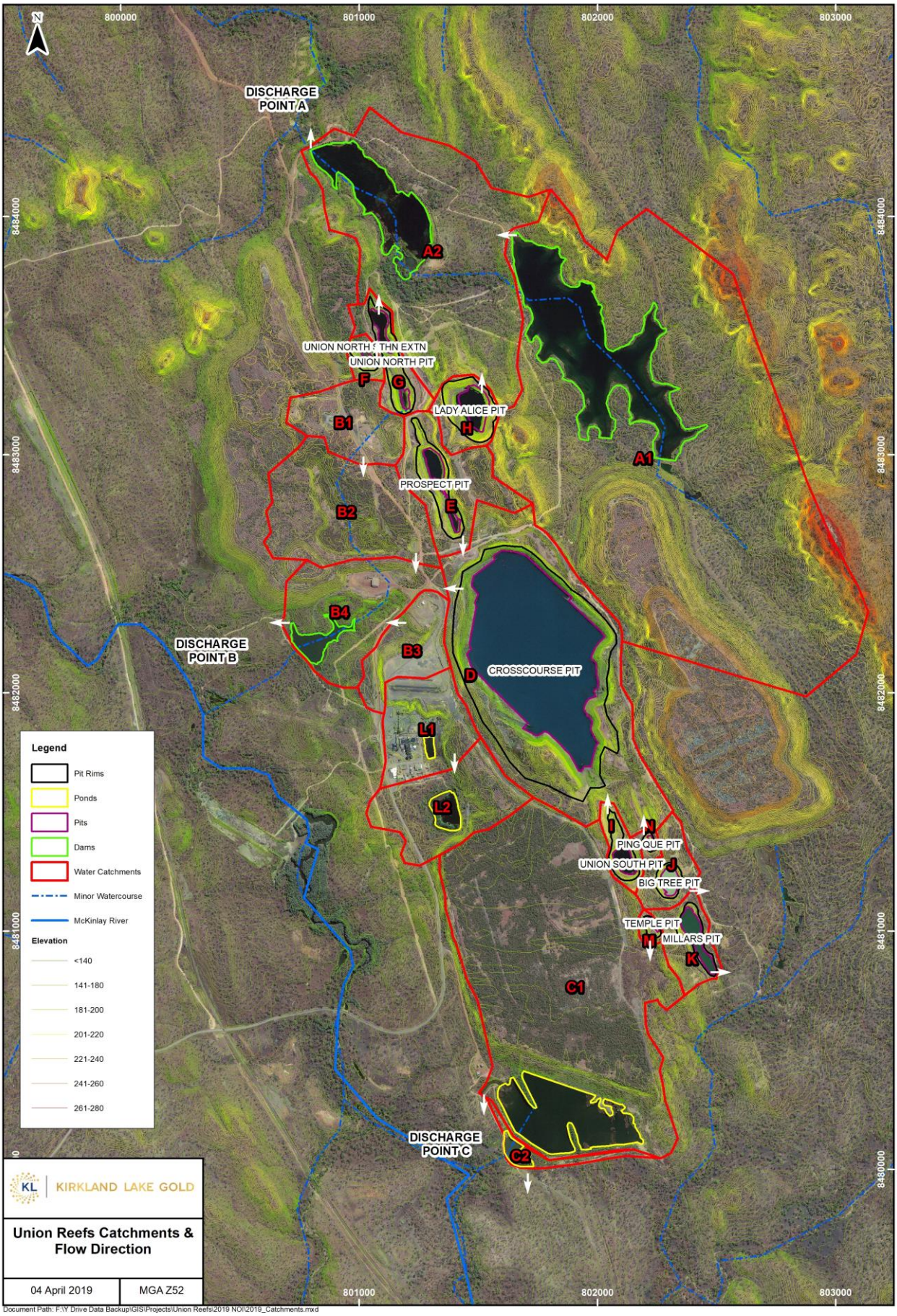

FIGURE 18: URPA LOCAL HYDROLOGY AND CATCHMENT AREAS

TABLE 11: URPA WATER STORAGE AND VOLUMES (AS AT 31 MAY 2018)

Infrastructure	Surface Area (ha)	Total Capacity (ML)	Current % Full	Current Volume (ML)	Remaining Capacity (ML)
Dam A	11	507	90%	455	52
Dam B	1.9	38	100%	38	0
Dam C	27	1,495	81%	1,213	282
Crosscourse Pit	31.9	19,092	72%	12,533	6,559
Decant Pond	12.2	328	100%	328	0
Lady Alice Pit	4.5	648	46%	300	348
Prospect Pit	4.1	424	20%	85	339
Total	**92.6**	**22,532**	**66%**	**14,952**	**7,580**

7.3.2.3 Potential Impacts

7.3.2.3.1 GROUNDWATER

The pit lakes in the Union North and Prospect Pits will have direct hydraulic connection with the main aquifer system and the underground mine workings via the Union Line lodes and structures. The pit lake in the Lady Alice Pit will have direct hydraulic connection with the eastern part of the main aquifer system, but the degree of cross strike hydraulic connection to the Union Line lodes will likely be limited.

The Crosscourse Pit lake will have some hydraulic connection with the main aquifer system through both the Union and Lady Alice Line lodes and structures. It is interpreted that the degree of hydraulic connection will be limited by the presence of tailings and the reported permeability of the tailings ranges from 0.007 to 0.01m/d, which is similar to the surrounding deep aquifer but much lower than the surrounding shallow aquifer.

The key interpreted characteristics of future mine groundwater inflows by AQ2 are as follows:

- Inflows to the decline and upper stope development will be mostly through the shallow aquifer. As the underground mine develops, proportionally more inflow will be derived from the deep (basement) aquifer.
- While the shallow and deep aquifers are in hydraulic connection, it is possible that the deep aquifer could be dewatered while the shallow aquifer remains saturated, especially if there is enhanced recharge from nearby pits.
- Once the underground mine drawdown is below the level of the pit lake in the Crosscourse Pit, the pit lake will likely provide a source of constant head recharge to the shallow aquifer. It may also provide a constant head source of recharge to the deep aquifer, until tailings fills the pit to the top of the deep aquifer. Once the pit has been further filled with tailings, it will still be in hydraulic connection with the shallow and deep aquifers, and some seepage will occur, but it will behave as flow through a low permeability aquifer (the tailings) rather than a constant head source of recharge.
- Any water in the Prospect and Union North Pits will also provide a source of recharge to the underground mine workings until they empty, although the contribution from Union North Pit would be less than from Prospect (and Crosscourse) Pit as it is further away.
- Any water in the Lady Alice Pit could possibly provide a source of recharge although the degree of hydraulic connection will likely be limited.

Analytical modelling by AQ2 indicated that the Base Case predictions (best estimate of likely mine inflows) dewatering rates increase from around 1 to 2L/s (31.5 – 63ML/year) during initial decline development, up to 8 to 11L/s (252 – 347ML/year) over the remaining 2 year LOM. This case includes active recharge from the Crosscourse Pit and Union North Pit lakes through the shallow aquifer. Inflows could be higher if active recharge from the Crosscourse Pit and Union North Pit lakes occurs through the deep aquifer as well, with High Case predictions of around 13L/s (410ML/year).

7.3.2.3.2 Surface Water

Given the location and nature of the Union Reefs North Underground Mine, there are no impacts anticipated to the existing surface hydrology of the site. However, the project will use and generate wastewater which will add to the current surface water storage inventory. To effectively manage potential safety risks for the underground mine, the Prospect Pit is required to be completely dewatered within 7 months of commencing the portal and for the duration of the underground mining activities.

The Prospect Pit currently contains around 85ML and has an estimated additional wet season input from the catchment of 148ML. Given the good quality of this water, it will be utilised underground (47-63ML/year), for dust suppression or transferred directly to the URPA Processing Plant (offsetting some of the 1,300ML/year of water sourced from Dam C).

NTMO intends that all recovered underground mine water will be transferred to the Crosscourse Pit for reuse in the URPA Processing Plant. Annual wastewater estimates (including water used for underground drilling and dust suppression) range between 78.5 – 473ML, averaging around 276ML. The Crosscourse Pit currently has a capacity of 6,559ML indicating that it can adequately contain this additional volume (not discounting the likely underground inflows from the Crosscourse Pit lake).

7.3.2.4 Mitigation

NTMO has specific Water Management Plans developed for each site considering the existing environment, activities and risks as part of the MMP. The purpose of the Water Management Plans are to protect the beneficial use of water ecosystems from the release of low quality mine impacted water from NTMO Sites. Through implementation of the Water Management Plans, NTMO aims to meet the following objectives:

- Implement management systems to reduce the generation of low quality mine impacted water;
- Reduce the risk of uncontrolled discharges of low quality mine impacted water from NTMO sites; and
- Reuse, recycle, treat and discharge (if necessary) mine impacted water to control the onsite water inventory.

The following water mitigation and management measures will be implemented as applicable:

- Installation of an underground dewatering system including mobile underground sump pumps and permanent pumping stations established at key locations;
- Dewater the Prospect Pit and maintain in a dry condition to reduce inflow into the underground mine workings;
- Investigate the relocation of the tailings deposition area to the northern end of the pit. This aims to develop a subaqueous tailings beach at the closest point to the underground mine and shift the recharge boundary further to the south to potentially reduce hydraulic gradient and inflows;
- Undertake cover drilling ahead of new development into “unknown” areas to reduce the risk of burst inflows from intersecting a fault/joint zone that has a high groundwater head. Drilling will assist to identify difficult ground conditions and water inflow zones ahead of development and provide a means of draining (or at least depressurising) the fault ahead of development;
- Maximise the reuse and recycling of water and minimise water inputs into the onsite storage inventory;
- Maintain the water account for the Crosscourse Pit, updated monthly to determine the life expectancy of the pit under operational conditions as a TSF; and
- Annually review the URPA water balance model to assist in developing appropriate management strategies through the estimation of predicted site water volumes.

7.3.2.5 Assumptions

The key assumption made for this proposal is the restart of the URPA Processing Operations in June 2019, once ore stockpiles are re-established.

7.3.2.6 Relevant Policy and Guidance

Guidelines applicable to the Water Management Plan include:

- *Australian and New Zealand Environmental and Conservation Council (ANZECC) Water Quality Guidelines 2000* - Provide authoritative guidance on fresh and marine water quality management issues.
- *Minerals Council of Australia (MCA) Water Accounting Framework (WAF)* – Allows sites to account for, report on and compare site water management practices in a rigorous, consistent and unambiguous manner that can easily be understood.

7.3.2.7 Potential Cumulative Impacts

At the URPA, tailings and wastewater is also generated and disposed into the Crosscourse Pit TSF as part of the mineral processing activities. The URPA Processing Plant is the only gold processing facility for NTMO. The historical performance of the plant indicates that it is a reliable, efficient and low cost ore processing facility. This plant will treat ore from the Cosmo Underground Mine and the Union Reefs North Underground Mine starting in June 2019, once ore stockpiles are re-established.

Tailings generated from the URPA Processing Plant are deposited into the Crosscourse Pit, which has been utilised as the site TSF since August 2002. The Crosscourse Pit is the largest open pit at the URPA, between 1994 to 2002 more than 80 million tonnes (Mt) of material was mined to a depth of around 265m. The Crosscourse Pit is a large void with significant tailings storage capacity and a large pit lake.

The tailings is piped and discharged from a single point on the western perimeter into the Crosscourse Pit TSF. Tailings discharge rates are up to 300 tonnes/hour during normal processing conditions. Water for the processing plant is also reclaimed from the TSF and also supplemented by raw water. Some processing activities (i.e. elution) require a higher quality water and this is sourced from Dam C when needed (where possible this water will be offset from water recovered from the Prospect Pit).

Water stored above the in-pit tailings will continue to be used by the URPA Processing Plant. Over the planned LOM this inventory of water may need to be reduced to store more tailings, while maintaining a “wet cover” or layer of water at closure. The Crosscourse Pit TSF is currently estimated to have 6 years of remaining capacity (Table 12) and has adequate capacity to also store the additional inputs from wastewater recovered from the Union Reefs North Underground Mine.

TABLE 12: CROSSCOURSE PIT TSF LOM ESTIMATED WATER BALANCE (2019-2023)

Year	Processing Tonnes	Total Inputs (ML)	Remaining Capacity (ML)
2019	420,000	661	5826
2020	850,000	899	4927
2021	1,100,000	1038	3889
2022	1,200,000	1094	2795
2023	1,300,000	1149	1645

7.4 Air Factors

7.4.1 Air Quality and Greenhouse Gases

7.4.1.1 NT EPA Factor Objective

Maintain air quality and minimise emissions and their impact so that environmental values are protected.

7.4.1.2 Receiving Environment

7.4.1.2.1 Dust emissions

The severity and extent of dust emissions is largely influenced by climate. Hot, dry conditions result in more favourable conditions for dust generation, while dust deposition is strongly influenced by wind strength and direction. The climate of the Darwin-Katherine region is broadly classified as tropical monsoonal. It is characterised by seasonal shifting of the prevailing winds and consequently marked changes of air mass properties. Two distinct seasons can be identified – the dry and wet season, with two subsidiary transitional periods between them.

The dry season occurs from May to September and is characterised by prevailing south-easterly winds (Figure 19). The transition period from dry to wet season occurs in October and November and has high humidity and variable winds. The wet season occurs from December to March with dominant northwest to westerly winds. The second transition period, from wet to dry season, occurs in April and has variable winds, with dominant easterlies.

Most rainfall in the Darwin-Katherine region occurs in the wet season. Rainfall generally decreases with distance from the coast, for example, the average annual rainfall for Darwin is 1,700mm, compared to 970mm for Katherine. Rainfall intensities are high, which is typical for areas located in the tropical north of Australia.

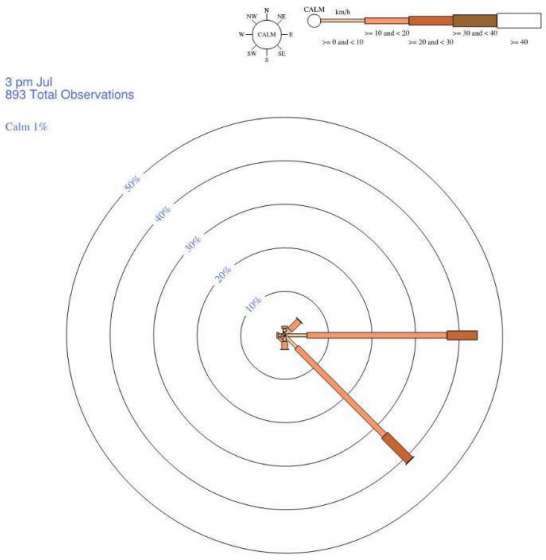

FIGURE 19: AVERAGE JULY WIND DIRECTION AND SPEED (1985 TO 2016)

Source: (BoM, Tindal RAAF Station 014932)

During the wet season, dust is effectively controlled by rainfall wetting the ground surfaces. Particular attention is required for dust management during the dry season, where dry soils and lengthy periods of high winds enhance the potential for dust generation. The removal of vegetation and stable soil that would normally form a seal against wind dispersion can also contribute to this process. While previous operators have extensively mined the URPA, it has also been progressively rehabilitated reducing the potential contribution of dust emissions from cleared areas. The current URPA site disturbance and rehabilitation inventory (not including exploration) is provided in Table 13.

TABLE 13: URPA CURRENT DISTURBANCE AND REHABILITATION INVENTORY

MLN1109 Summary	Total Area (ha)	Progressively Rehabilitated (ha)	Remaining Disturbance (ha)
NTMO Managed Areas	**153**	**13.5**	**139.5**
ROM Pad	9	0	9
Crosscourse Pit TSF	57	0	57
Dam B / Plant Spill Pond	3	0	3
Dam C	23	0	23
Processing Plant	4	0	4
Other Infrastructure	1	0	1
Administration / Stores	6.5	0	6.5
Workshop / Fuel Bay	3.5	0.5	3
Haul / Access Roads	46	13	33
Legacy Rehabilitated Areas	**340.2**	**340.2**	**0**
East Waste Rock Dump	92	92	0
North Waste Rock Dump	88	88	0
Togar Tailings Dam	10	10	0
Old Tailings Dam	81	81	0
Alta Pit (Backfilled - Waste Rock)	2	2	0
Dam A Pit	1.5	1.5	0
Union North Pit (Backfilled - Tailings)	7	7	0
Union North Pit	11	11	0
Union North/South Pit	3	3	0
Lady Alice Pit	6.5	6.5	0
Prospect Pit	8	8	0
Ping Que Pit	3	3	0
Union South Pit	1	1	0
Big Tree Pit	1.5	1.5	0
Temple Pit	0	0	0
Millars Pit	2	2	0
McKinlay River Weir Wetlands	0.7	0.7	0
Dam A	12	12	0
Decant Pond	10	10	0
Total	**493.2**	**353.7**	**139.5**

In 2016, NTMO established a dust monitoring programme at the URPA to determine if dust is being generated downwind from activities at the site, when compared to an upwind control site. Dust monitoring is conducted only in the dry season for a minimum of three months to ensure that adequate data is collected to determine dust contributions from the URPA.

The URPA dust monitoring programme consists of a two dust deposition gauges - one on the north-western end of the URPA (downwind of activities) and one on the south-eastern end, up-wind of the URPA (acting as a 'control' site). The dust monitoring locations are shown in Figure 20. NTMO devised a set of criteria to determine appropriate areas to monitor for dust deposition including:

- Nearby sensitive receptors;
- Location of activities where excessive dust may be generated;
- Prevailing wind direction during the dry season; and
- Ecological communities or threatened flora and fauna species requiring dust monitoring.

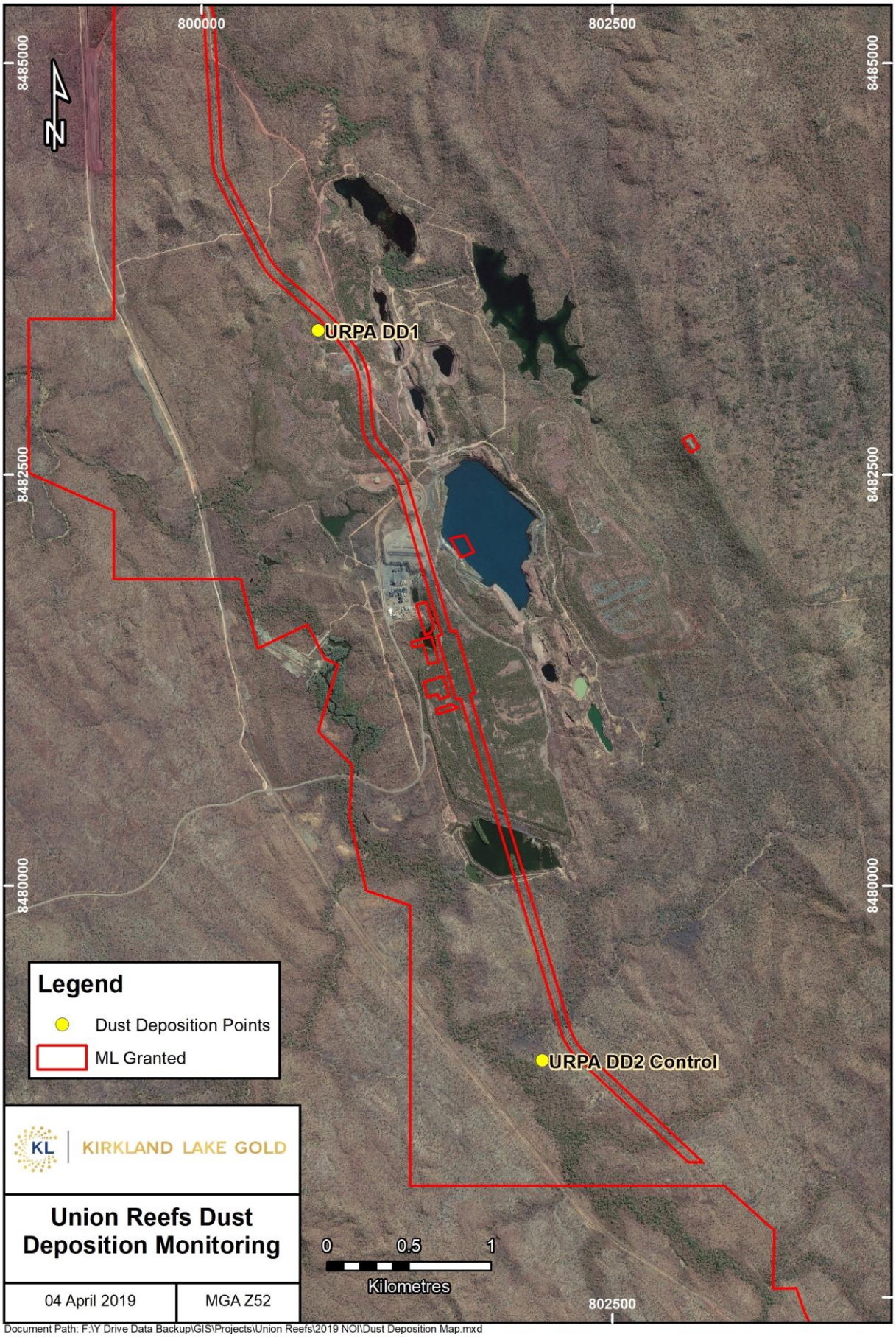

FIGURE 20: URPA DUST DEPOSITION MONITORING LOCATIONS

There are no national air quality guideline values for the nuisance dust effect that can be used to assess the impact of dust on the receiving environment. However, there are a number of criteria commonly used by regulatory agencies in Australia. Generally, the criteria have been derived from subjective observations and investigation of dust levels and nuisance effects.

NTMO compare dust deposition results to the New South Wales (NSW) Department of Environment and Conservation's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*. The dust deposition criteria allow a mine to add a certain amount of dust to the atmosphere. A mine may increase deposited (background) dust levels by up to 2g/m^2/month (annual average). However, the total deposited dust level should not exceed 4g/m^2/month (annual average).

Based on this, an internal dust deposition guideline value of 2 g/m^2/month plus the control level is applied as a guide only to determine the risk and effectiveness of dust management strategies. Consistent results showing dust deposition levels below the internal trigger value will confirm whether monitoring can be decommissioned after sufficient data has been collected (i.e. 3 years) and a risk assessment has been completed.

Dust deposition monitoring results for the 2016 and 2017 dry seasons are shown in Figure 21 and to date have been below the NTMO internal guideline value. This is not unexpected for 2017 given that operations at the URPA were suspended during the monitoring period.

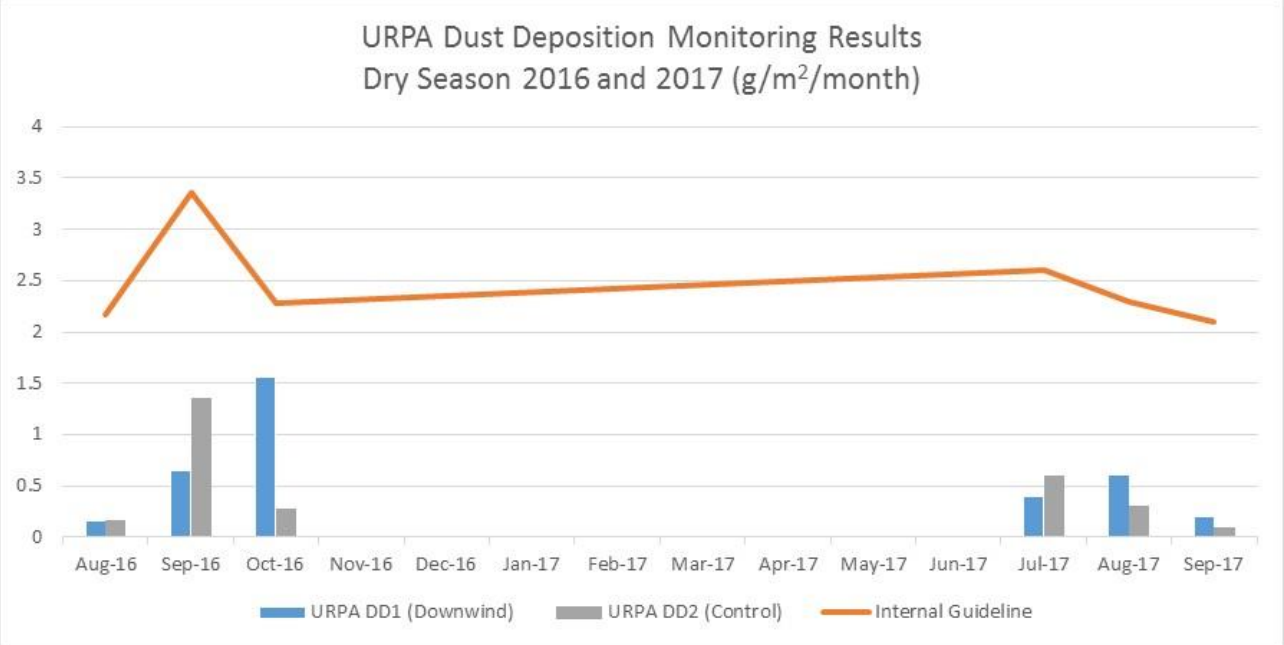

FIGURE 21: URPA DUST DEPOSITION MONITORING RESULTS 2016 AND 2017

The URPA 2016/17 National Pollutant Inventory (NPI) report was submitted on 23 September 2017. As part of this report, estimates of fugitive emissions of Particulate Matter 10.0 µm (PM_{10}) and Particulate Matter 2.5 µm ($PM_{2.5}$) are calculated for the URPA. The calculated fugitive dust emissions were slightly higher but similar to previous reporting periods. A review of the NPI 2016/17 website data for Australian Metal Ore Mining indicates that PM_{10} and $PM_{2.5}$ data was reported for 196 facilities and the URPA emissions ranked at 191 for PM_{10} and 111 for $PM_{2.5}$.

7.4.1.2.2 GREENHOUSE GASES

NTMO undertakes annual reporting for the URPA in accordance with the requirements of the National Greenhouse and Energy Report (NGER) Scheme. The NGER Scheme is a national framework for corporations to report greenhouse gas (GHG) emissions, energy consumption and energy production. The reported annual URPA GHG emissions and energy calculations from 2010/11 to 2016/17 are provided in Table 14.

GHG emissions are measured as carbon dioxide equivalence ($CO_{2\text{-}e}$) used to express the impact of each different greenhouse gas in terms of the amount of CO_2 that would create the same amount of global warming. Emissions are divided into Scope 1 and Scope 2 types. Scope 1 are emissions released to the atmosphere as a direct result of an activity at a facility (i.e. burning of diesel fuel in trucks). Scope 2 are emissions released to the atmosphere from the indirect consumption of an energy commodity (i.e. purchase of electricity generated at another facility).

TABLE 14: ANNUAL URPA GREENHOUSE GAS EMISSIONS AND ENERGY CONSUMPTION 2010-2017

Reporting Year	Greenhouse Gas Emissions			Energy		Ore Milled (tonnes)
	Scope 1 (t CO_2-e)	Scope 2 (t CO_2-e)	Total (t CO_2-e)	Energy Consumed (GJ)	Energy Produced (GJ)	
2010/11	15,244	26,285	41,529	413,463	0	1,891,433
2011/12	16,837	38,463	55,300	449,920	0	1,662,727
2012/13	5,193	20,825	26,018	180,303	0	652,025
2013/14	4,282	24,510	28,792	189,598	0	852,956
2014/15	4,461	22,213	26,674	181,954	0	807,165
2015/16	3,853	21,514	25,367	170,777	0	548,958
2016/17	3,852	21,514	25,366	170,759	0	541,058

7.4.1.3 Potential Impacts

7.4.1.3.1 DUST EMISSIONS

While the majority of activity for the Union Reefs North Underground Mine will occur underground, some dust will be generated from the following activities:

- Light and heavy vehicle movements over unsealed surfaces;
- Ore handling and transport to the ROM Pad;
- Waste handling within the Prospect Pit; and
- Clearing for surface infrastructure.

Impacts from the dust emissions are usually localised and depend on the size of the dust particles, the strength of winds and can decrease rapidly with separation from the source. Under adverse weather conditions, however, dust can travel considerable distances, potentially resulting in its deposition off the tenement boundary.

In the immediate vicinity of the source, dust can stress fauna or vegetation through blocking stomata (adversely affecting gas exchange) and reducing light availability (reducing photosynthetic ability and limiting plant growth). Depending on the type and size of dust particles, it can also pose a human health risk through inhalation.

The potential for dust generation from the additional surface clearing required for the Union Reefs North Underground Mine is considered to be low. Where possible, surface activities will be contained within existing disturbance areas however some clearing of regrowth vegetation, less than 1ha will be required for:

- Underground Ventilation = 0.013ha;
- Haul Road = 0.224ha;
- Explosives Magazine = 0.51ha; and
- Infrastructure Area = 0.003ha.

7.4.1.3.2 GREENHOUSE GASES

Activities at the Union Reefs North Underground Mine will require the consumption of both electricity and diesel, which will generate additional GHG emissions. Electricity requirements are estimated at between 750,000 – 1,000,000kWh/month or around 9,000,000 – 12,000,000kWh/year. Diesel requirements will be around 60,000L/month or 720,000L/year. The calculated annual GHG emissions from the proposed Union Reefs North Underground Mine are provided in Table 15.

TABLE 15: UNION REEFS NORTH UNDERGROUND MINE GREENHOUSE GAS EMISSIONS AND ENERGY CONSUMPTION

Period	Greenhouse Gas Emissions			Energy	
	Scope 1 (t CO_2-e)	Scope 2 (t CO_2-e)	Total (t CO_2-e)	Energy Consumed (GJ)	Energy Produced (GJ)
Annual	1,959	7,680	9,639	70,992	0

7.4.1.4 Mitigation

7.4.1.4.1 DUST EMISSIONS

The NTMO ESRMS includes a Dust Management Plan, the purpose of this plan is to prevent and minimise dust emissions through management and controls of NTMO activities. Through implementation of this plan, NTMO aims to meet the following objectives:

- Manage activities which generate dust and identify if additional controls are required to minimise emissions.

The following dust mitigation and management measures will be implemented as applicable:

- Undertake identified dust deposition monitoring during the dry season for a minimum of 3 months.
    - Monitoring results will be reviewed to determine if high volumes of dust generated by NTMO operations are leaving the tenement boundary.
    - Consistent results showing dust deposition levels below the internal trigger value (2 g/m^2/month plus the background value for insoluble solids) will confirm whether monitoring can be decommissioned after sufficient data (i.e. 3 years) has been collected and a risk assessment has been completed.
- Regular watering using water carts across ROM pads, access and haul roads during operation;
- Minimise exposed subsoil through progressive clearing and reinstatement/re-vegetation on areas no longer required;
- Employees and Contractors are educated in dust management during inductions.
- Defined access roads and haul routes to be used and speed restrictions applied;
- Retention of vegetation around site boundaries as a buffer, and to limit potential wind-blown dust sources;
- Regular watering during any clearing, scraping, excavation, loading or dumping activities;
- Avoid conducting dust generating activities during high wind speeds, where practical; and
- Material drop heights during loading and unloading to be reduced as far as practical.

7.4.1.4.2 Greenhouse Gases

The NTMO ESRMS includes an Energy Management Plan, the purpose of this plan is to understand and minimise energy use and to ensure that energy use is appropriately reported. Through implementation of this plan, NTMO aims to meet the following objectives:

- Understand energy use to identify where savings can be made to minimise emissions and manage costs.

The following energy mitigation and management measures will be implemented as applicable:

- Mobile and stationary equipment will be used in a planned manner and regularly maintained and appropriate energy saving devices fitted to ensure efficient fuel and electricity use;
- Energy use (fuel and electricity) per tonne of ore milled and ore mined will be compared with previous periods to determine fuel efficiency trends and improvement opportunities;
- Appropriate fuel storage and handling practices implemented to minimise fuel spillages and wastage; and
- Minimise greenhouse gas emissions through recycling of materials, rehabilitation and fire management.

7.4.1.5 Assumptions

The key assumption made for this proposal is the restart of the URPA Processing Operations in June 2019, once ore stockpiles are re-established.

7.4.1.6 Relevant Policy and Guidance

7.4.1.6.1 Dust emissions

Guidelines applicable to the Dust Management Plan include:

- *National Environment Protection (Ambient Air Quality) Measure 1998* – Aims for ambient air quality that adequately protects of human health and well-being.
- *Australian Standard 2922:* Ambient Air-Guide for the siting of sampling units.
- *Australian Standard 3580:* Methods of sampling and analysis of ambient air. Method 10.1: Determination of particulate matter – Deposited matter – Gravimetric method.

7.4.1.6.2 Greenhouse Gases

Guidelines applicable to the Energy Management Plan include:

- *National Environment Protection (Diesel Vehicle Emissions) Measure 2001* - Aims to reduce exhaust emissions from diesel vehicles.
- *National Environment Protection (NPI) Measure 1998* - Aims to improve the sustainable use of resources.
- *National Greenhouse and Energy Reporting (Measurement) Technical Guidelines* - Assists corporations to understand and apply the NGER (Measurement) Determination 2008.

7.4.1.7 Potential Cumulative Impacts

At the URPA, dust and GHG emissions are also generated as part of the mineral processing activities. Given the location, small scale, underground nature and dust management measures, cumulative dust impacts are not anticipated to be significant. NTMO plans to restart processing operations in 2019 and the planned processing tonnes for 2019 and 2020 are 420,000 and 850,000 respectively. The GHG emissions from historical processing and the associated tonnages are provided in Table 14, which indicate that the planned throughput is similar to previous years between 2012/13 to 2016/17. It is likely that the URPA GHG emissions will increase by around 38% but will be below the URPA GHG emissions generated in 2010/11 and 2011/12.

7.5 People and Communities Factors

7.5.1 Social, Economic and Cultural Surroundings

7.5.1.1 NT EPA Factor Objective

Protect the rich social, economic, cultural and heritage values of the Northern Territory.

7.5.1.2 Receiving Environment

7.5.1.2.1 Social and Economic

The URPA tenements are located on the Mary River West Station (Pastoral Lease 815) and the region is dominated by pastoral land use (Figure 22) with smaller scale agricultural ventures and remote communities. The URPA is located approximately 20km north-west of the township of Pine Creek and 175km south-east of Darwin.

The nearest regional community of Pine Creek has a proud and valued history of mining, which has contributed to the community values within the region. As stated in the 2016/2017 Pine Creek Community Plan "*the mining industry is a strong asset for the town that needs to be included in the day to day running of the town as a long term member of the community*".

The 2016 Census reports that the population of the Pine Creek Region is 328 people with a median age of 39 years and 75.1% were born in Australia. Of these people, 53.2% were male, 46.8% were female and 46.0% identified as Aboriginal and/or Torres Strait Islander. In the 2011 Census, there were 380 people of these 55.5% were male, 44.5% were female and 39.5% Aboriginal and Torres Strait Islander.

The Pine Creek records indicate that there were 147 people who reported being in the labour force in the week before Census night in 2016. Of these 49.0% were employed full time, 27.9% were employed part-time and 20.4% were unemployed. In 2011, there were 177 people who reported being in the labour force in the week before Census night. Of these 66.7% were employed full time, 18.1% were employed part-time and 9.0% were unemployed. The median weekly personal income for people aged 15 years and over was $466 in 2016 and $677 in 2011.

Of the employed people in Pine Creek in 2016, 14.4% worked in Accommodation. Other major industries of employment included Beef Cattle Farming (Specialised) 11.1%, Local Government Administration 7.8%, Iron Ore Mining 5.6% and Gold Ore Mining 5.6%. Of the employed people in Pine Creek in 2011, 36.9% worked in Metal Ore Mining. Other major industries of employment included Local Government Administration 10.0%, Accommodation 5.6%, Cafes, Restaurants and Takeaway Food Services 5.0% and Architectural, Engineering and Technical Services 4.4%.

The most common occupations in 2016 included Managers 21.0%, Technicians and Trades Workers 14.3%, Community and Personal Service Workers 13.4%, Machinery Operators and Drivers 11.8%, and Labourers 10.9%. In 2011, the most common occupations were Machinery Operators and Drivers 26.9%, Technicians and Trades Workers 15.6%, Managers 14.4%, Professionals 13.8%, Labourers 13.8%, Clerical and Administrative Workers 8.8% and Community and Personal Service Workers 6.9%.

In 2016, 72.6% of private dwellings were occupied and 27.4% were unoccupied in Pine Creek. Of occupied private dwellings, 26.3% were owned outright, 11.0% were owned with a mortgage and 50.8% were rented. In 2011, 94.4% of private dwellings were occupied and 5.6% were unoccupied. Of occupied private dwellings, 24.0% were owned outright, 8.3% were owned with a mortgage and 58.7% were rented.

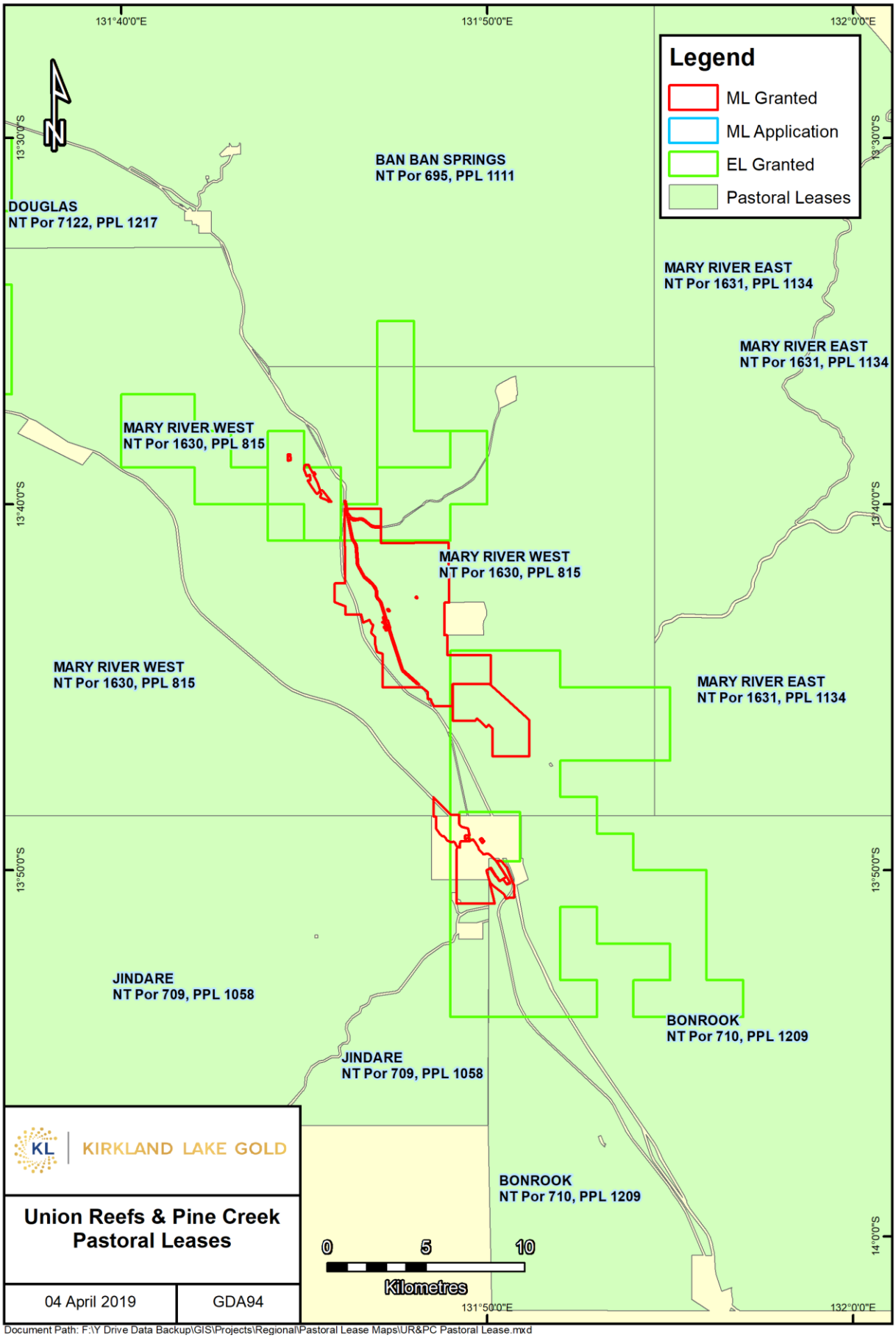

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FIGURE 22: URPA AND PCPA PASTORAL LEASES

7.5.1.2.2 CULTURAL

There have been numerous archaeological surveys and considerable research conducted and completed for the URPA since the 1990's. Sites identified during these surveys have been collated into the NTMO URPA Archaeological and Heritage Register, which includes site details, significance, declaration status and any recommendations regarding future protection. An AAPA certificate (C2009/267) for the URPA was granted on 8th October 2009. The certificate identified two RWAs and associated Sacred Sites. The location of identified URPA Heritage, Archaeological and AAPA Sites are provided in Figure 13.

7.5.1.3 Potential Impacts

7.5.1.3.1 SOCIAL AND ECONOMIC

KLG is committed to focusing on sustainable development and working with employees, their families, and local communities to improve quality of life in a way that is good for both local economic development and shareholders. The planned mining operations at the URPA will provide additional opportunities for NTMO to support local employees, businesses, contractors and community groups.

NTMO currently has around 130 employees and contractors supporting its operations. It is anticipated that with the recommencement of CHPA mining production and URPA processing and mining operations, there will be more than 300 personnel. Pressure on housing within the Pine Creek region will be managed by accommodating the primary workforce at the Cosmo Village Camp with local personnel able to reside in their existing homes where practical.

In order to increase local capacity, NTMO have dedicated training personnel to upskill local employees to meet the needs of the operation and have an apprenticeship programme for fitters and boilermakers. NTMO is also working to make available opportunities for indigenous employment and has partnered with two local indigenous employment agencies.

The NTMO operations have brought increased employment and business to Darwin, and the towns of Pine Creek, Hayes Creek, Daly River, Adelaide River and Katherine, through demand for goods and services. Since 2009, NTMO (and the previous CGAO) has spent more than $300M with NT businesses including more than $30M in the Pine Creek Region. The production of approximately 39,200 ounces of gold from this underground project will also result in the NT Government receiving royalties under the *Mineral Royalty Act*.

7.5.1.3.2 CULTURAL

There is the potential for impacts to cultural heritage sites from the additional 1ha of surface clearing required for the Union Reefs North Underground Mine. However, the required clearing is in previously disturbed areas and the location of cultural heritage sites have been considered during project planning. Based on this, it is considered that the risk of any impacts to cultural heritage sites is low.

7.5.1.4 Mitigation

7.5.1.4.1 SOCIAL AND ECONOMIC

The NTMO ESRMS includes a Consultation and Socio-Economic Management Plan, the purpose of this plan is to maintain engagement with key stakeholders and to support local employees, businesses, contractors and community groups, to benefit the local community and surrounding region. Through implementation of this plan, NTMO aims to meet the following objectives:

- Ensure appropriate and ongoing stakeholder consultation is undertaken;
- Employ locally where a local or regional workforce has the required skills or has the ability to acquire the required skills;
- Buy locally where a local or regional business has the required goods or has the ability to acquire the required goods at a competitive price; and
- Provide support to local schools and non-profit community groups.

The following consultation and socio-economic mitigation and management measures will be implemented as applicable:

- Maintain open communication relevant Government Departments through formal reports, written communications and informal contact;
- Record and appropriately respond to any complaints about NTMO activities;
- Employ locally when the opportunity and local workforce has the required skills or has the ability to acquire the required skills;
- Support local business, business initiatives and availability by:
    - Communicating supply and procurement needs and intent with local businesses on a regular basis;
    - Collating and regularly updating a local business register of local suppliers and services;
    - Providing the opportunity to local and regional businesses to tender or offer supply and procurement services; and
    - Ensuring that supply and procurement assessment processes include a criteria related to locality of the potential supplier.
- Support local schools and non-profit community groups; and
- Employees and Contractors are educated in appropriate workforce behaviour within the local communities during inductions.

7.5.1.4.2 CULTURAL

The NTMO ESRMS includes a Cultural Heritage Management Plan, the purpose of this plan is to prevent impacts to cultural heritage sites from NTMO activities. Through implementation of this plan, NTMO aims to meet the following objectives:

- Protect and avoid unauthorised impact to known cultural heritage sites; and
- Undertake cultural heritage surveys on any previously undisturbed areas prior to disturbance activities.

The following cultural heritage mitigation and management measures will be implemented as applicable:

- Implement the NTMO Ground Disturbance SOP, which includes a cultural heritage check, prior to undertaking any ground disturbance activities and issue of a NTMO Clearing/Ground Disturbance Permit;
- Ensure that AAPA Certificates cover proposed activities, are current and all conditions met;
- Conduct cultural heritage awareness as part of the Induction so that Employees and Contractors comply with the conditions of the AAPA certificate;
- Fencing of cultural heritage sites of moderate or higher significance in the vicinity of operations. Consultation with Traditional Owners during the process of developing and installing appropriate fencing and signage. Quarterly inspections to check on any fencing protecting sites;
- Off-road driving is restricted or prohibited to avoid accidental disturbance to identified and unidentified cultural heritage sites;
- Appropriate approvals from the Minister for Heritage will be obtained prior to the disturbance of any cultural heritage site as a result of NTMO operations;
- The NTMO Archaeological Chance Find SOP will be implemented in the event that archaeological material is uncovered unexpectedly during mine operation or construction and:
    - All work will cease and the area will be demarcated;
    - The Environment Manager (or delegate) will contact the DTC Heritage Branch for advice on how to proceed; and
    - Works will not recommence in that area until advice has been received and implemented as required.

7.5.1.5 Assumptions

The key assumption made for this proposal is the restart of the URPA Processing Operations in June 2019, once ore stockpiles are re-established.

7.5.1.6 Relevant Policy and Guidance

7.5.1.6.1 Social and Economic

No identified guidelines applicable to the Consultation and Socio-Economic Management Plan.

It is noted that the NT EPA have available "*Guidelines for the Preparation of an Economic and Social Impact Assessment*". These guidelines provide a basis for proponents to prepare assessments of the economic and social impacts of development proposals, and accompanying economic and social impact management plan as part of Public Environmental Reports or Environmental Impact Statements developed under the *Environmental Assessment Act*.

7.5.1.6.2 Cultural

Guidelines applicable to the Cultural Heritage Management Plan include:

- *The Australia ICOMOS Charter for Places of Cultural Significance, 2013* – The Burra Charter and the associated series of Practice Notes provide a best practice standard for managing cultural heritage places in Australia.

7.5.1.7 Potential Cumulative Impacts

Potential social and economic cumulative impacts are outlined in Section 7.5.1.3.1. No cultural cumulative impacts have been identified.

7.5.2 Human Health

7.5.2.1 NT EPA Factor Objective

Ensure that the risks to human health are identified, understood and adequately avoided and/or mitigated.

7.5.2.2 Receiving Environment

Given the proximity of the Union Reefs North Underground Mine to community areas, potential human health impacts are considered to be applicable only to underground mine workers. While no underground mining has occurred at the URPA in recent times, NTMO has extensive experience in managing occupational health and safety risks at the Cosmo Underground Mine.

Ventilation in an underground mine is of critical importance to the occupational health and safety of underground workers. Mine ventilation systems provide a flow of air through the underground workings at a sufficient volume to dilute dust and noxious gases (typically NO_x, SO_2, methane, CO_2 and CO) and to regulate temperature. The main source of dust and gas underground is from material handling, diesel equipment exhausts and blasting.

An underground mine has limited space and creates a reverberant field exposing workers to high noise levels. Noise exposure is greater than if the same sources were in a more open surface environment. Drill rigs, jumbos, trucks, fans and other underground mining equipment are inherently noisy, and most require some form of operator attendance.

The hierarchy of hazard control is used in the mining industry to minimise or eliminate exposure to occupational health and safety hazards. Routine monitoring of worker exposure to occupational health hazards is an important part of the risk management process. It allows existing control measures to be assessed to confirm their continued effectiveness.

7.5.2.3 Potential Impacts

The occupational health and safety of workers is regulated under the *Work Health and Safety (National Uniform Legislation) Act* administered by NT WorkSafe. Mine sites in the NT must not undertake any mining or related activity unless the mine operator has submitted a certified Risk Management Plan (RMP) to NT WorkSafe.

The development of the RMP includes a systematic review of the potential impacts on occupational health and safety and includes the:

- Identification of mine site hazards, including high consequence, low probability events;
- Risks to health and safety at the mine site that could arise from those mine site hazards, including for each risk;
- Implementation of control measures and monitoring effectiveness;
- Fitness for Work programme to manage risks to health and safety that could arise from fatigue or the consumption of alcohol or drugs;
- Health Monitoring Plan;
- Emergency Plan; and
- Training provided to workers who may be exposed to a mine site hazard.

NTMO has identified the potential impacts on occupational health and safety for the proposed underground mine within the Risk Management Plan Union Reefs Mine Site and this RMP and the Certification Letter was submitted to NT WorkSafe on 30 July 2018.

7.5.2.4 Mitigation

NTMO has an existing SMS which brings together the policies, standards and procedures required to effectively mitigate the occupational health and safety risks associated with the underground mining operations. Employees and Contractors are required to understand their roles and responsibilities including following procedures, undertaking inductions and training, reporting hazards, controlling risks and participating in occupational health monitoring programmes. It is the responsibility of all personnel to promote and adhere to the KLG Policies and NTMO Management Systems as part of their duty of care and employment conditions and these requirements are regularly communicated.

7.5.2.5 Assumptions

No specific assumptions have been identified as applicable to this human health factor.

7.5.2.6 Relevant Policy and Guidance

Under the *Work Health and Safety (National Uniform Legislation) Act* a person conducting a business or undertaking must ensure, so far as is reasonably practicable, that the health and safety of workers and others is not put at risk. In addition, Chapter 10 of the *Work Health and Safety (National Uniform Legislation) Regulations* places specific obligations and duties on mine operators, including providing to NT WorkSafe a certified RMP in accordance with Part 10.3 of the Regulations.

7.5.2.7 Potential Cumulative Impacts

No potential cumulative impacts have been identified.

7.6 Consultation

Consultation with NTMO stakeholders regarding site activities is important at all operational stages from exploration to mining to mine closure. The NTMO Management Team are focused on developing relationships and maintaining regular communication with our stakeholders to ensure ongoing support for our operations.

Open communication with relevant government departments is ongoing through meetings, site inspections, approval applications, formal reports and written communications. Key government agencies include the DPIR, Department of Environment and Natural Resources (DENR), NT EPA, NT WorkSafe and Bushfires NT.

The NTMO management team maintains regular communications with community leaders and local pastoralists; and continues to develop these relationships, through both formal meetings and informal discussions. Members of NTMOs team participate in many local community groups, such as sporting club committees and local environmental teams, as well as holding positions on committees like the Minerals Council of Australia NT Branch.

Staff from NTMO, and the broader KLG group, are also active with presentations to local Northern Territory based annual technical conferences. This includes the Annual Geoscience Exploration Seminar (AGES) conference held by the Northern Territory Geological Survey (NTGS) in Alice Springs, and the Mining the Territory conference in Darwin.

NTMO maintains a Consultation and Communication Log and Complaints Register for all of its operations. Any complaints received are documented and fully investigated with communication made with the complainant (as required) to outline actions taken or gain further understanding of the nature of the complaint. A review of the complaints register and historical MMPs indicates that no formal complaints have been received since records began in 2009, regarding activities at the URPA.

To date consultation regarding the commencement of underground mining activities outlined within this NOI has primarily been through meetings, site visits and discussions with the DPIR to understand project approval requirements and any potential or outstanding issues. Key operational aspects discussed with the DPIR include the potential for Ghost Bats to inhabit historical adits and water management. NTMO has engaged independent consultants to undertake studies or provide further expert technical advice regarding these aspects and the outcomes or status of these reviews are provided in relevant sections of this NOI.

8 Matters of National Environmental Significance (NES)

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), actions that have, or are likely to have, a significant impact on a matter of National Environmental Significance (NES) require approval from the Australian Government Minister for the Environment. The Minister will decide whether an assessment and approval is required under the EPBC Act.

Listed threatened species and ecological communities are recognised as a matter of NES. On 5 May 2016, *Macroderma gigas* (Ghost Bats) were listed as vulnerable in the EPBC Act list of threatened species. Recent surveys have confirmed the presence of Ghost Bats in adits within the vicinity of the Union Reefs North Underground Mine proposal.

The Australian Government has developed the guideline "*Matters of National Environmental Significance - Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*" to assist anyone who proposes to take an action to decide whether or not they should submit a formal referral. The guidelines include 'significant impact criteria' for each matter of NES and outline a 'self-assessment' process to assist in determining whether the impacts of the proposed action are likely to be significant.

NTMO is planning to submit a referral to the Australian Government Minister for Environment for formal assessment and approval under the EPBC Act. NTMO is undertaking additional Ghost Bat monitoring to understand the use of the adits identified in the Prospect Pit and to inform the self-assessment and referral process.

9 PROPONENTS STATEMENT

NTMO has assessed the activities associated with the Union Reefs North Underground Mine to identify the NT EPA environmental factors potentially impacted by the proposal. This NOI outlines:

- the nature, scale and scope of the proposed underground mine;
- the environment in which it is located;
- the likely environmental impacts and risks; and
- NTMO measures to avoid, mitigate and minimise any potential environmental impacts and risks.

NTMO consider that the potential environmental impacts and risks are not significant and can be adequately managed taking into account the following:

- the project is located within area of extensive historical mining;
- the localised extent of the proposed Union Reefs North Underground Mine activities;
- limited duration (current mine life of two years);
- long term understanding of flora and fauna, archaeology and heritage values, water quality, mine water inventory and waste rock chemistry;
- ongoing work planned for Ghost Bat monitoring and management;
- waste rock will be backfilled underground and temporarily contained within the Prospect Pit;
- no active water discharge is required;
- utilisation of existing ore processing infrastructure; and
- an existing ESRMS management and mitigation framework for relevant environmental, heritage and socio-economic values.

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11 Abbreviations

Acronym	Description
AAPA	Aboriginal Areas Protection Authority
AGES	Annual Geoscience Exploration Seminar
AMD	Acid and Metalliferous Drainage
ANZECC	Australian and New Zealand Environmental and Conservation Council
BoM	Bureau of Meteorology
BUD	Beneficial Use Declaration
CCNT	Conservation Commission NT - now NT Environment Protection Authority
CEO	Chief Executive Officer
CGAO	Crocodile Gold Australian Operations
CGI	Crocodile Gold International
CHPA	Cosmo Howley Project Area
$CO_{2\text{-}e}$	Carbon Dioxide Equivalence
CRF	Cemented Rock Fill
DENR	Department of Environment and Natural Resources
DPIR	Department of Primary Industry and Resources
EGi	Environmental Geochemistry International Pty Ltd
EIS	Environmental Impact Statement
EMS	Ecological Management Services
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ERT	Emergency Response Team
ESR	Environment and Social Responsibility
ESRMS	Environmental and Social Responsibility Management System
GBS	GBS Gold Australia Pty Ltd
GHG	Greenhouse Gas
GV	Guideline Values
GWA	Genesee Wyoming Australia
ha	Hectares
KLG	Kirkland Lake Gold
kg	Kilograms
km	Kilometres
kWh	Kilowatt Hours
L/s	Litres Per Second
LOM	Life of Mine
MCA	Minerals Council of Australia
MCP	Mine Closure Plan

Acronym	Description
ML	Megalitres
MLN	Mineral Lease Number
mm/s	Millimetres per Second
MMP	Mining Management Plan
Mt	Million Tonnes
MW	Megawatt
NGER	National Greenhouse Energy Reporting
NOI	Notice of Intent
NPI	National Pollutant Inventory
NR	Natural Resource
NRM	Natural Resource Management
NSW	New South Wales
NT	Northern Territory
NTGS	Northern Territory Geological Survey
NTMO	NT Mining Operations Pty Ltd
oz	Ounces
PCPA	Pine Creek Project Area
$PM_{2.5}$	Particulate Matter 2.5 µm
PM_{10}	Particulate Matter 10.0 µm
ppv	Peak Particle Velocity
RMP	Risk Management Plan
ROM	Run of Mine
RWA	Restricted Works Area
SCOA	Shell Company of Australia
SMS	Safety Management System
SOP	Standard Operating Procedure
SSGVs	Site Specific Guideline Values
SWGs	Livestock Drinking Water Guidelines
TDS	Total Dissolved Solids
TPWC Act	Territory Parks and Wildlife Conservation Act
TSF	Tailings Storage Facility
URCP	Union Reefs Crosscourse Pit
URPA	Union Reefs Project Area
VU	vegetation units
WAF	Water Accounting Framework
WDL	Waste Discharge Licence
WONS	Weeds of National Significance
WRD	Waste Rock Dump