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# Mantra Tanzania

December 2020



## Mkuju River Pilot Mineral Extraction Operation Feasibility Study (Rev 1)

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# CHAPTER 1: EXECUTIVE SUMMARY

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*This Feasibility Study on the Mkuju River Demonstration Plant is based on data and designs presented in DRA DFS III of 2013 report. Paulsam / METC and the consultants have relied on the work from the previous feasibilities. Only Chapters from the DFS III which had to change for this Demonstration Plant have been modified, however the sections that are taken unchanged from the previous feasibility study are included in this report for the sake of completeness and ease of reference. Paulsam / METC and our consultants do not take liability for the content of these Chapters*





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# 1 Executive Summary

## 1.1 Key Outcomes

Mantra Tanzania commissioned PaulSam to develop a feasibility study for the development of the Mkuju River Nyota resource, which is in the north west of the Mkuju River lease area. The project will develop the resource into an operating entity with a demonstration plant capable of producing uranium yellowcake. The key outcomes from the December 2020 Feasibility Study ('the study' or 'the FS') are:

- The 2020 FS confirms robust technical viability of the project
- Nyota can be developed as a low-cost producer, by industry standards, capable of near-term Uranium production
- The 2020 FS estimate of Proven and Probable Mineral Reserves is based on the July 2012 CSA Global Mineral Resource Estimate
- Annual production of Uranium from the processing facility averages approximately 5 metric tons of  $U_3O_8$  per year
- Initially the life of the facility is 5 years (including ramp up and ramp down at the end of the facility), with potential to lengthen the operational life if further mine development is contemplated.
- Total steady state operating cost of the demonstration plant is USD 62 per ore tonne treated
- A lower estimated price was achieved by using cost saving measures that reduced the capital expenditure without compromising the project engineering standards. Costs were saved through modularisation as well as designing fit for purpose infrastructure. In addition, the TSF was designed for dry stacked tailings and scats stored in a full containment cells base lining, leak detection and storm water diversion systems in compliance with Tanzanian regulations.
- Hot commissioning will commence 8 months after start of construction if detailed engineering and procurement commence at least 5 months prior to construction starting

The December 2020 demonstration plant Feasibility Study (FS) is based on the March 2013 DFS prepared by DRA which in turn was based on the updated CSA Mineral Resource Estimate (MRE) dated July 2012 which focused on the Nyota Prospect.

The December 2020 demonstration plant FS is based on an owner operated process plant, contractor mining and contractor operated TSF. The staffing compliment required to operate the plant mine and TSF facilities was developed by PaulSam/METC. The non-operating staff compliment required for G&A, management and service were developed by the client using their operational experience.

The overall risk of the demonstration plant is reduced by designing a simple acid leach and conventional Resin-in Pulp (RIP) plant similar to the Mkuju River Project (MRP) 2013 DFS report. The risk is reduced because each process step uses proven unit operations such as agitated leaching, RIP, elution, and precipitation that are well known and well understood and for which test work exists. No novel process units have been used.

The initial capital cost (an AACE 18R-97 class 3 study) for the demonstration plant project is estimated at USD 26.07 million. This includes all associated infrastructure set out by Mantra Tanzania's definition of capital and working capital costs. It further has provision for two years Owner's costs as well as for three Owner managed infrastructure projects.

The detailed Implementation Plan, presented in Chapter 13, is achievable if the key milestones for project commencement and engineering are met and the capital is deployed to allow orders to be placed on long lead and early need packages.



## 1.2 Introduction and Background

Mantra Tanzania commissioned Paulsam to develop a Feasibility study for the development of the Mkuju River Nyota resource into an operating entity with a demonstration plant capable of producing uranium yellowcake. This Feasibility Study on the Mkuju River Demonstration Plant is based on data and designs presented in DRA DFS III of 2013 report. Paulsam / METC and the consultants have relied on the work from the previous feasibilities. Only Chapters from the DFS III which had to change for this Demonstration Plant have been modified such as mining, processing plant, engineering development, tailings dam design, CAPEX and OPEX development.

The key considerations for the Feasibility Study were:

- to define the preferred mining method,
- optimise the processing route,
- select the operational throughput rate,
- determining the project life cycle
- developing the associated infrastructure taking due cognizance of the community and environmental Impacts.
- The minimum life of the project is five years. (Note this excludes periods after the mine operations has ceased).

The study was initiated in June 2020 based on the requirement to produce 5 t/a of  $U_3O_8$  in yellowcake uranium product. On this basis of required product, the process plant required a feed stock of 15,367 t/a with which the mining facility is to produce

The Study has been managed by Paulsam of Tanzania with portions of the work undertaken by METC Engineering of South Africa and supported by various industry recognised consultants. A list of contributing specialists is provided in Chapter 15. This study is suitable for making internal business decisions on the project providing a high level of confidence on the technical aspects of the demonstration plant that have been systematically reviewed and verified by METC's QP consultants.

The project sponsor for the Paulsam team is Russell Bradford whose in-depth knowledge of the project provided valuable insight to the team. Russell Bradford is a qualified metallurgist with over 30 years of experience in both operations and project development. He was appointed as project director for the Mantra resources project in Tanzania from 2007 until 2012, prior to the purchase of the mine by Uranium 1. During this time Russell was instrumental in developing the project from Scoping study through to DFS and detailed design.

A number of other Qualified Consultants have been involved in the development of this report. Each consultant has reported on their area of competence and expertise and this is highlighted in each chapter of the study. Where Paulsam / METC has relied on information provided by others this is stated clearly in the relevant chapter or in the project disclaimer.

## 1.3 Infrastructure

The layout of the demonstration plant and mine facilities have been designed taking advantage of the natural topography and to minimise impact on the environment. After a review of the safety, capital, operational and environmental impacts, the demonstration plant will be located within the same footprint as the 2013 DFS III footprint shown in Annexure A

Power for the demonstration plant will be self-generated on site by diesel fuelled generators. Power shall be distributed at 400/230 V around the plant and site infrastructure facilities.

The first 30 kilometres of the 56km mine access road runs to the village of Likuyu and is a public road with geometry suitable for average heavy vehicles. This section of the road only requires minor maintenance to reinstate the wearing course and improve drainage in certain sections. This work needs

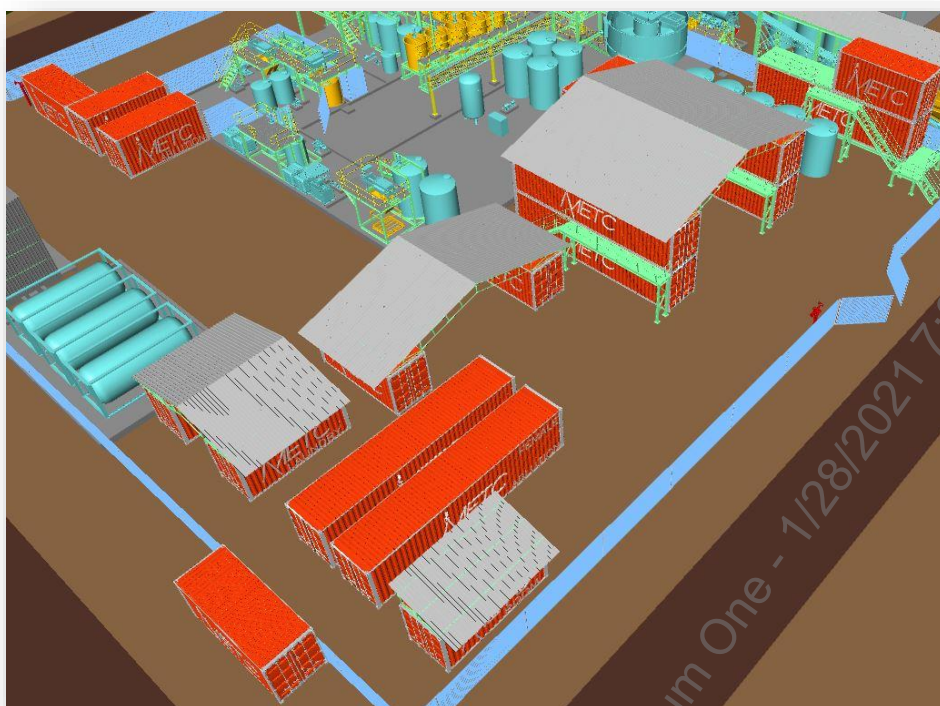


to be completed prior to the start of civil constructor mobilization. This is an important area of focus for the Mantra Management Team as no capital cost has been included in the study for this scope of work.

Due to the remote location of the demonstration plant it was decided that containerised buildings will be used where possible. The Control Budget Estimate (CBE) build-up was based on fully accessorised containers including insulation, power connection points, air conditioning and lighting. However, some of the containers used to transport the equipment to site may be converted into offices, workshops and stores by Mantra Tanzania. Figure 1-1 Illustrates the containerised infrastructure buildings.

The demonstration plant infrastructure (containerised buildings) consists of the following:

1. Access Control: 6m container
2. First Aid Room: 6m container
3. Male and Female Ablutions: 2 off 12m containers
4. Messing and Laundry Facilities: 2 off 6m containers
5. Workshops: 2 off 12m containers
6. Small Spares Store: 12m container
7. Plant Office: 12m container
8. Laboratory: 2 off 6m containers
9. Controlled Area Ablutions: 6m container
10. Yellowcake Product Dryer: 6m container
11. Yellowcake Product Store: 6m container
12. MCC and Control Room: 12m container and 6m container
13. Generators: 2 off 6m containers



*Figure 1-1 - Containerised Offices, Ablutions, Messing and Laboratory Facilities, Laboratory, Workshops and Stores*

Borehole water will be pumped to the demonstration plant for use as domestic potable water. The two diesel powered boreholes pumps are located close to the mining area identified as BH22b and BH22c, the two borehole positions are shown in Figure 1-2. The project capital cost includes a potable water treatment plant similar to the proven design utilised in the current accommodation camp. In addition to domestic use, the process plant requires raw water feed at 0.3 m<sup>3</sup>/h to balance the process plant water demand due to critical operational water balance around the process plant. The boreholes will be run individually to allow the standby borehole to regenerate. The project will monitor ground water levels during operations to pre-empt the need for developing and/or fitting of additional bore fields to secure raw water supply to the demonstration plant.

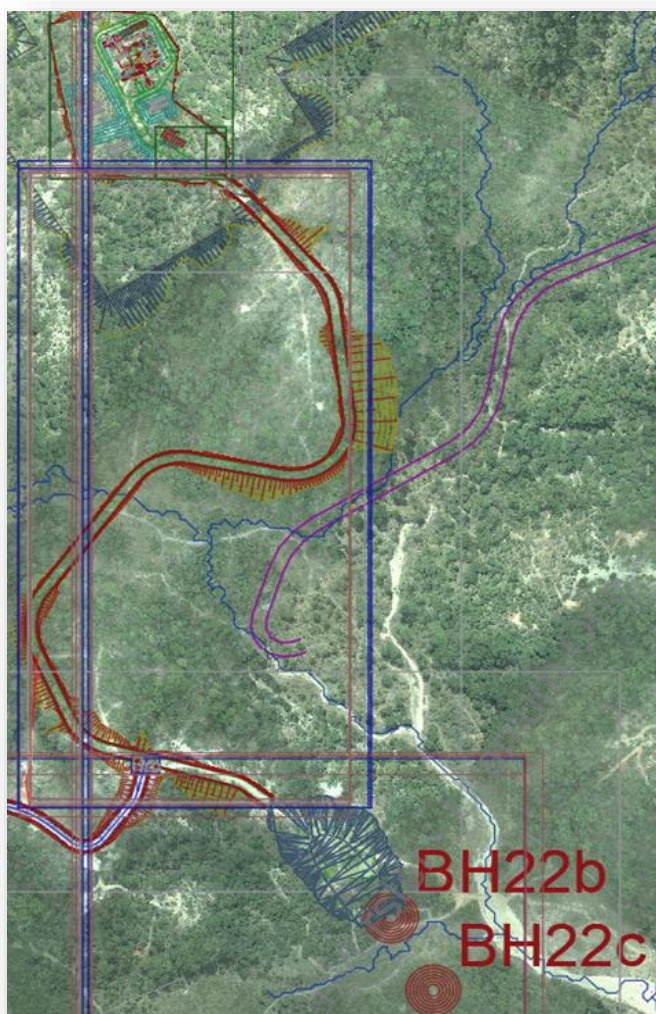


Figure 1.2 - Boreholes BH22b and BH22c

## 1.4 Project Location

The Mkuju River Project is located in Southern Tanzania, approximately 470 km South West of Dar es Salaam in the Mtwara Development Corridor.

Tanzania is located in Eastern Africa, bordering the Indian Ocean between Kenya and Mozambique. Tanzania shares internal borders with Kenya, Rwanda, Burundi, Uganda, Democratic Republic of Congo, Zambia, Malawi and Mozambique.



Figure 1-3 - Project Location on Regional Scale

Access to the MRP from Dar es Salaam is by tar road to the regional administrative centre of Songea (980 km) and then a further 140 km North East along a regional road passing through Namtumbo and Likuyu. Air access is by charter flight from Dar es Salaam to Likuyu (approximately 2-hour flight time). In the North-Western portion of the MRP lies the Nyota Prospect, with access from Likuyu restricted to forest tracks, with the intension to upgrade to a gravel access road upon permit approval.

The special Mining Licence is at Mkuju River area in Namtumbo District, QDS 278/3 and 289/1 defined by the following corner co-ordinates (Arc. 1960).

Corner	Latitude	Longitude
1	-09 deg. 59 min. 50.00 sec	36 deg. 30 min. 00.00 sec
2	-09 deg. 59 min. 50.00 sec	36 deg. 37 min. 55.00 sec
3	-10 deg. 07 min. 15.00 sec	36 deg. 37 min. 55.00 sec
4	-10 deg. 07 min. 15.00 sec	36 deg. 30 min. 00.00 sec

## 1.5 Project History

The initial impetus for systematic exploration for Uranium within Tanzania commenced with the flying of a country wide radiometric survey by Geosurvey between 1976 and 1979. Uranerzbergbau gmbh (UEB) acquired the radiometric data in 1978 and began intensive follow-up investigations, culminating in the selection of the Selous Basin Karoo Supergroup sediments as the main area for further investigation.

The initial exploration of the basin comprised:

A helicopter check of the 78 radiometric anomalies interpreted from the original data.

Ground checking of 53 anomalies that were verified from the helicopter.

Visible secondary uranium mineralisation was located at 26 of the anomalies. The highest sample value of 3.21%  $U_3O_8$  was achieved.

Two areas of main interest were outlined: Mkuju Proper (Mantra TZ's Nyota Trend Prospect) and Madaba.

Detailed work commenced at the Nyota Prospect during 1979 and included gridding, ground radiometric surveys, geological mapping, and trench sampling of three anomalies. Strongly anomalous zones, with readings over 10 times background, were up to 300m x 50m in size. Uranium mineralisation occurred over a vertical distance of 220m and within an area of about 11km x 11km. The strongest mineralisation sampled during 1979, at Anomaly 289/3I, returned 0.47%  $U_3O_8$  over 1.9m.

A geological map of the Project area is shown as in Figure 1.4 with diagrammatic geological cross-sections shown as Figure 1-5. The lines of the sections, in which the vertical scales are exaggerated, are shown on the map.

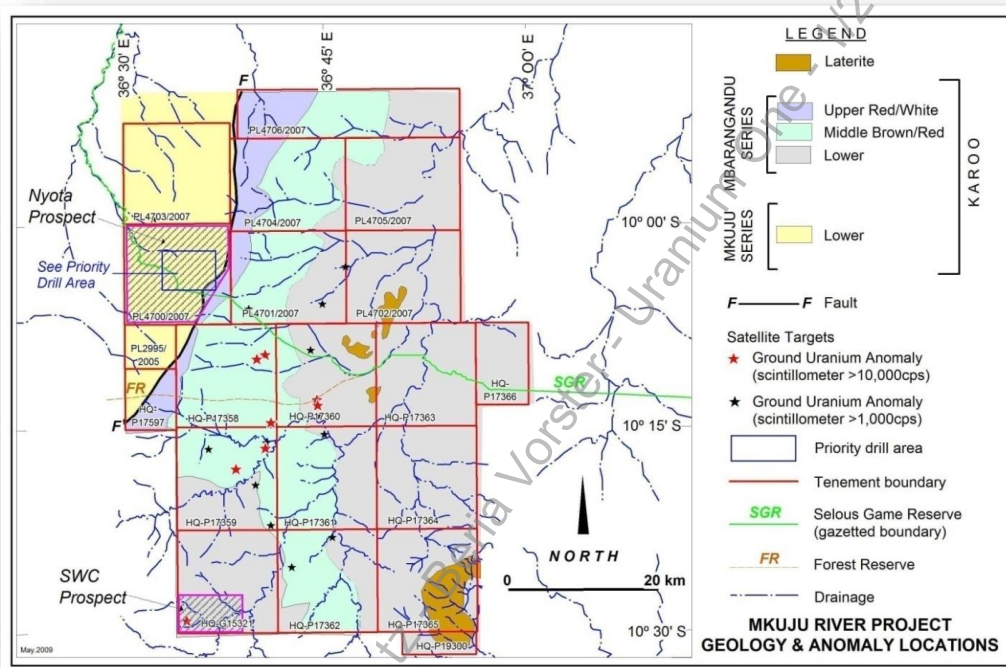


Figure 1-4 - Mkuju River Project – Geological Map

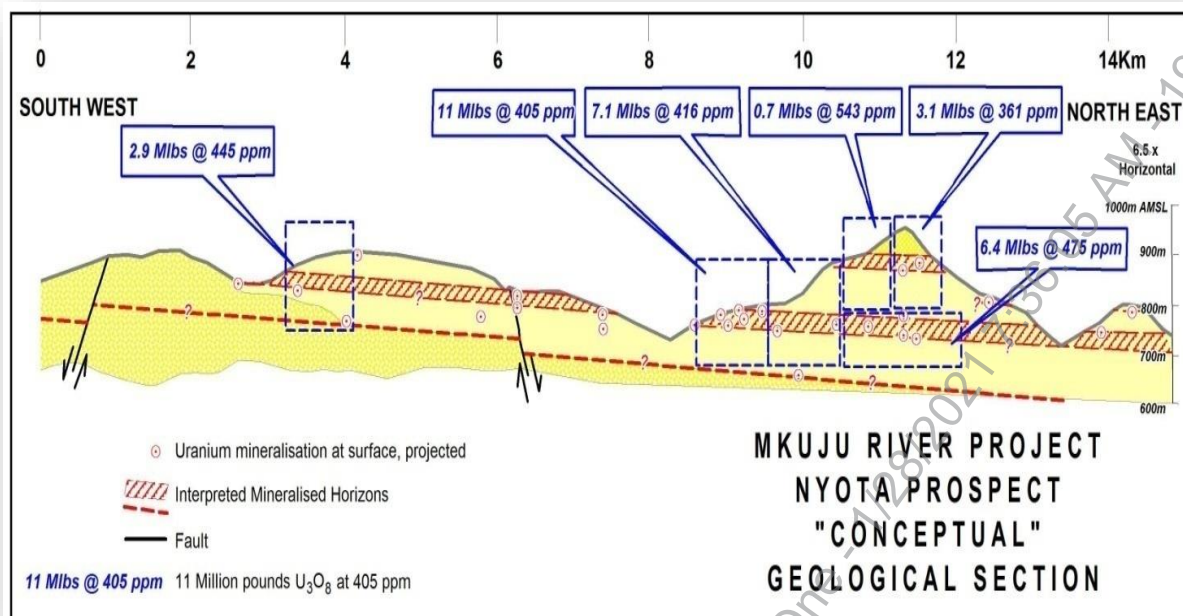


Figure 1-5 - Mkuju River Project – Geological Sections

Extensive gridding and ground radiometrics were completed during 1979 and 1980. A large number of separate anomalies are present. The greatest concentration of anomalies is over an area of six by four kilometres. It should be borne in mind that radiometric surveys employ a technique that is only able to detect uranium mineralisation that is exposed at the surface, as the gamma rays being sampled have extremely limited ability to penetrate solid material. They are effectively completely absorbed by several centimetres of soil or several millimetres of water. The lack of an anomalous response in some areas can therefore not be taken as an indication that sub-surface mineralisation is not present. A conclusion can be drawn from this work is that uranium mineralisation is widespread in the area.

During 1980 the work carried out in the MRP area included:

Helicopter supported semi-regional/semi-detailed geology and radiometry at a scale of 1:50,000.

The development of a stratigraphic framework, in which the Karoo sediments were divided into two series – the lower and strongly mineralised Mkuju Series and the overlying Mbaragandu Series. The latter was recognised as containing numerous anomalies, some of which were followed-up and were found to contain visible uranium mineralisation but was second in priority to the Mkuju Series.

Eleven anomalies were gridded and investigated by ground geology, detailed radiometry, and trench sampling.

In 1981 UEB's activities in the Mkuju River area were restricted to regional geological and prospecting activities, as its focus at this time was on Madaba area. Despite encouraging results in both areas, UEB withdrew from Uranium exploration in Tanzania in 1982. Mantra commenced systematic exploration of the MRP in 2006, commissioned the Scoping Study in 2008 and whilst engaging ANSTO to undertake extensive laboratory work on the core, completed the Pre-feasibility Study in 2009 that indicated the project viability and commissioned the DFS in 2010. Mantra Resources was purchased by ARMZ in 2011 and has undertaken a number of studies to test the best financial outcome for the Nyota Prospect. The DFS III by DRA Mineral Project (PTY) Ltd was completed in 2012. The demonstration plant FS commenced June 2020.

## 1.6 Legal Framework

Like many industrial projects, the production of minerals results in a number of environmental impacts that must be addressed during the life of the project. The actions associated with pre-construction preparations of the project, construction, installation, operation and decommissioning of the project, have various positive and negative environmental impacts. While the resulting negative impacts must be addressed to maintain the integrity of the environment, the project proprietor must also ensure compliance to various policies and/or legal regimes that govern the management of the environment. Since the execution of a project like the MRP touches on various sectors, one has to comply with a number of policies and legislation, e.g., those relevant for land, water, forestry, wildlife, mining and others. This chapter provides a summary of the various national and sectoral legal frameworks that govern the environmental and social issues pertaining to the planning and implementation of the project for updating the environmental management plan.

Mantra Tanzania Limited is aware that it is required by the legislation to, and commits to, observe and abide by the provisions of these Acts. Chapter 5 provides the details of the Sections of each law that is relevant to MRP and gives a description of how Mantra Tanzania Ltd and MRP will comply with each of the pieces of legislation.

Relevant legislation and regulations to the management of the environment include the following:

- The Constitution of the United Republic of Tanzania of 1977;
- The Environmental Management Act (No 20) of 2004;
- The Environmental Impact Assessment and Audit Regulations of 2005;
- The Wildlife Conservation Act (No. 5) of 2009;
- The Plant Protection Act of 1997;
- The Forestry Act (No. 14) of 2002;
- The Mining Act (No. 14) of 2010;
- The Mining (Mineral Rights) Regulations of 2010;
- The Mining (Environmental Management and Protection) Regulations of 1999;
- The Mining (Safety, Occupational Health and Environment Protection) Regulations of 2010;
- The Employment and Labour Relations Act of 2004;
- The Water Resources Management Act (No 11) of 2009;
- The Water Supply and Sanitation Act, (No. 12) of 2009;
- The Land Act, (No.4) of 1999;
- The Village Land Act (No. 5) of 1999;
- The Antiquities Act of 1964;
- The Occupational Health and Safety Act, (No. 5) of 2003;
- The Industrial and Consumer Chemicals (Management and control) Act (No 3) of 2003;
- The Atomic Energy Act (No. 7) of 2003;
- The Radioactive Minerals Regulation of 2018
- The Road Act of 2007;
- The Investment Act (No. 26) of 1997.

The Constitution is the fundamental law in Tanzania and is the foundation of all other legislation published in the Republic of Tanzania. In Tanzania, the right to give and receive information is enshrined in the Constitution of the United Republic of Tanzania, 1977.

## 1.7 Environmental and Social Impact

The area, in which the development of a Uranium mine by Mantra Tanzania is proposed, is known as the "Nyota Prospect". The Prospect area is covered by Prospecting Licence No PL 4700/2007. The Nyota Prospect covers an area of 197.94 km<sup>2</sup>, for which an application for a Special Mining Licence was submitted by Mantra Tanzania during 2011.



The Project area falls within the Nyerere National Park which was inscribed as a World Heritage Site (WHS) under the World Heritage Convention in 1982. The proposed mining activities are incompatible with the principals of the Convention, together with those of the International Council on Mining & Metals (ICMM). As such, a boundary change was proposed to the World Heritage Committee (WHC) in order to allow mining to continue within the Nyerere National Park but outside the WHS, ensuring compliance with all National legislation (The Wildlife Conservation Act, 2009 allows mining within a game reserve) and International commitments and Ratifications. The proposed boundary change was accepted during the UNESCO meeting of June 2012 in Saint Petersburg after obtaining key requirements for approval in Paris 2011.

The Environmental and Social Impact Assessment (ESIA) was undertaken during the period 2008/2009 and resulted in the submission of the ESIA document to the NEMC during 2009. Mantra Tanzania have re-applied for both road EIA and Project EIA and in 2016 completed the EMPU (Environmental management plan update) with NEMC.

## 1.8 Mining and Geology

The uranium mineralisation at the Mkuju River Uranium Project ('MRP'), has been drilled with the purpose of defining mineral resources by Mantra since 2006. The project is currently owned by Uranium 1 who have all appropriate mining licences and approvals granted based on the Definitive Feasibility Study ('DFS') completed in 2013. In the 7 years since the DFS, the Uranium price has been too low to make the project economically viable.

### 1.8.1 Demonstration Pit Selection

For initial project start-up, a pilot mineral extraction operation based on the DFS III criteria will produce yellowcake onsite. This plant will operate over a 5-year period, processing a minimum of 15,000 tonnes of ore each year.

The following criteria were used to select a demonstration mining area:

1. Accessible all-weather location to be mined annually for a 1 to 2-month period during the dry season, to extract at least 15,000 tonnes of ore each year at an average grade of circa 450 ppm  $U_3O_8$  grade.
2. Proximity to demonstration processing plant - 1.4 km ore haul distance.
3. Near surface high grade  $U_3O_8$  mineralisation with a low mining waste strip ratio of around 0.3.
4. Adequate close spaced drilling previously completed during the DFS suitable to provide high confidence in planned ore feed grade.
5. Area suitable for practical and simple pit design with one access ramp.

Figure 1-6 presents a view of the full Mkuju River project area showing the deposits (coded alphabetically) with the DFS drillhole collar locations. This gives an idea of the full scale of the future mining project.

The demonstration mining pit is selected from part of Area A. It is located at the end of a topographic ridge, which reduces the mining waste strip ratio. The area selected is one of the 2 areas with existing grade control close spaced drilling ('GC') on a 5 x 5m pattern completed in 2013 as part of the DFS study. The host rock is strongly weathered sandstone with minor clay which will allow mining without the need for drilling and blasting.

The GC drilling was sampled every 1m down hole and  $U_3O_8$  grade determined using off-site XRF pressed pellet assaying, on-site bench top XRF assaying (as a comparison) and a down hole gamma probe (as an alternative U determination method).

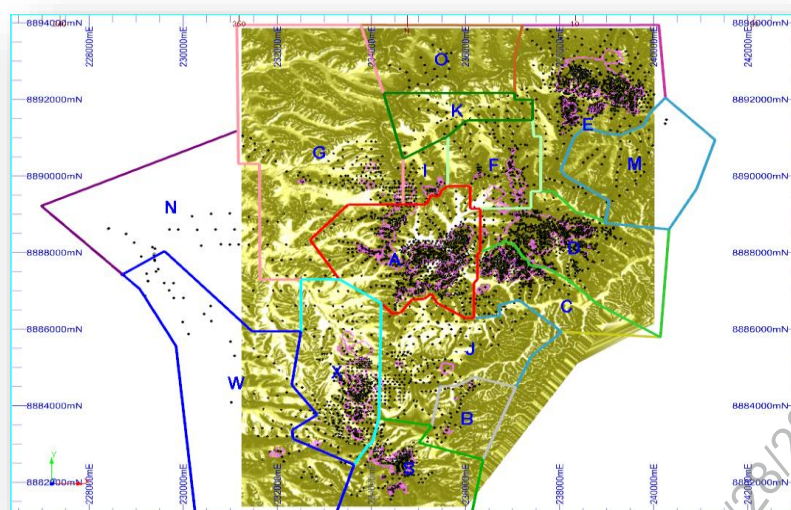


Figure 1-6 - Topography of MRP showing Area boundaries and codes, with DFS Whittle pit shell outlines in purple and drill collars in black

## 1.8.2 Demonstration Pit Design

Demonstration open pit mining will be executed by a mining contractor who will mine all the process plant feed for each year in annual batches over a 1 to 2-month period. The contractor will be supervised by a Uranium 1 consultant with both geology and mining experience. Demonstration processing is based on a minimum annual plant throughput of 15,000 tonnes per year at an average grade of 450 ppm  $U_3O_8$ . The mine plan is based on a 5-year demonstration mining pit, designed to supply a minimum of 75,000 tonnes of mill feed. The cut-off grade for demonstration mill feed has been set at 80 ppm  $U_3O_8$ .

The pit has been designed to excavate the front section of the ridge from the surface (784m) with mining carried out on 2m high benches. The average pit highwall slope will be 35 degrees. Pit walls will be constructed with a 3m berm followed by a 70-degree angled batter between each 2m mining bench. The pit will be accessed using an 8m wide ramp with an 8% gradient, suitable for 20 tonne dual axel tipper trucks. The mining contractor will construct cut of berms and drains at the end of the annual mining period to divert stormwater around the pit area and to preserve the ramp.

Prior to mining and grade control of the Stage 1 pit, all vegetation and topsoil will be removed and stockpiled according to Tanzanian mining regulations for end of mine life and continuous mining rehabilitation requirements. The surface area for vegetation and topsoil removal is roughly 2.6 hectares. This demonstration mining operation will be executed in such a manner that it will not influence the start-up of the main Mkuju River Project (MRP) based on DFS III

The demonstration mining pit has been designed in 3 stages:

1. Stage 1 - Year 1 - minimum of 15,000 tonnes of ore
2. Stage 2 - Years 2 and 3 - minimum of 30,000 tonnes of ore
3. Stage 3 - Year 4 and 5 - minimum of 30,000 tonnes of ore

## 1.8.3 Demonstration Pit Mine Schedule

ROM grade categories are:  $80 \leq LG < 300$ ;  $300 \leq MG < 500$ ;  $500 \leq HG$  ppm  $U_3O_8$

WASTE grade categories are:  $WST < 80$  ppm  $U_3O_8$

Figure 1-7 presents a 3D view looking NNW of the combined Grade Control and DFS Reserve models covering the complete area planned to be mined over a 5-year period.

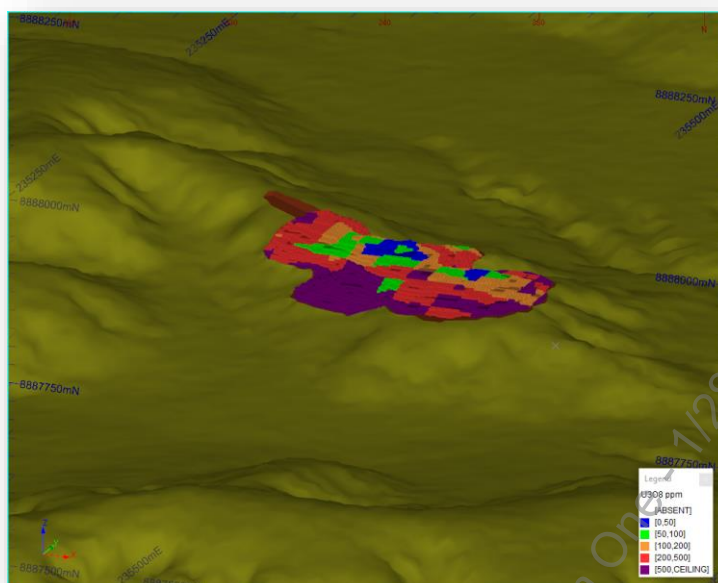


Figure 1-7 - 3D view looking NNW of combined GC and MRE model material mined as at end year 5

Tables 1-1 to 1-4 presents ore and waste mined over the five-year period, including the total volume mined and the ROM grade and tonnage estimates subdivided by Year 1, Year 2+3 and Year 4+5.

The average Waste:Ore strip ratio is 0.19 Note as discussed in the next section, some tonnes of ore are 'At-Risk' which in the worst case may mean an increase in Waste:Ore strip ratio to 0.66.

<b>MRP Demonstration Open Pit (5 year mine plan)</b>			
<b>Combine Ore + Waste Mining by Year and 2m Bench</b>			
<b>YEAR</b>	<b>2m Bench Toe</b>	<b>Vol Bcm</b>	<b>Tonnes</b>
<b>Year 1</b>	784	184	326
	782	1,308	2,315
	780	2,939	5,202
	778	4,680	8,288
	776	6,291	11,137
<b>Year 1 Total</b>		<b>15,402</b>	<b>27,268</b>
<b>Years 2 &amp; 3</b>	786	578	655
	784	2,820	4,991
	782	4,621	8,179
	780	6,029	10,671
	778	7,332	12,977
776	8,996	15,935	
<b>Years 2 &amp; 3 Total</b>		<b>30,376</b>	<b>53,408</b>
<b>Years 4 &amp; 5</b>	774	8,762	15,525
	772	8,269	14,711
	770	7,613	13,545
<b>Years 4 &amp; 5 Total</b>		<b>24,644</b>	<b>43,780</b>
<b>Grand Total</b>		<b>70,422</b>	<b>124,457</b>

Table 1-1 - Total combined Ore and Waste volume and tonnes mined

<b>MRP Demonstration Open Pit (5 year mine plan)</b>							
<b>ROM Ore by Model - Note: GC High Confidence, DFS Reserve - lower confidence</b>							
<b>Model Source</b>		<b>Close Spaced GC</b>		<b>DFS Reserve</b>		<b>Combined GC + DFS</b>	
<b>YEAR</b>	<b>Ore Type</b>	<b>Tonnes</b>	<b>U3O8 ppm</b>	<b>Tonnes</b>	<b>U3O8 ppm</b>	<b>Tonnes</b>	<b>U3O8 ppm</b>
<b>Year 1</b>	HG	6,317	1,265	818	1,416	7,135	1,282
	MG	2,213	380	172	411	2,384	383
	LG	13,756	182	159	226	13,916	183
<b>Year 1 Total</b>		<b>22,286</b>	<b>509</b>	<b>1,149</b>	<b>1,101</b>	<b>23,435</b>	<b>538</b>
<b>Years 2 &amp; 3</b>	HG	5,246	1,196	3,659	771	8,905	1,021
	MG	2,414	439	10,009	376	12,424	388
	LG	5,462	175	17,514	186	22,976	184
<b>Years 2 &amp; 3 Total</b>		<b>13,123</b>	<b>632</b>	<b>31,182</b>	<b>316</b>	<b>44,305</b>	<b>409</b>
<b>Years 4 &amp; 5</b>	HG	11,167	1,041	8,574	880	19,741	971
	MG	5,326	383	1,834	403	7,160	388
	LG	8,579	178	1,267	236	9,847	186
<b>Years 4 &amp; 5 Total</b>		<b>25,072</b>	<b>606</b>	<b>11,675</b>	<b>735</b>	<b>36,747</b>	<b>647</b>
<b>Grand Total</b>		<b>60,481</b>	<b>576</b>	<b>44,006</b>	<b>448</b>	<b>104,487</b>	<b>522</b>

Table 1-2 - Summary of potential ROM feed by grade bin and mining period

<b>MRP Demonstration Open Pit (5 year mine plan)</b>									
<b>Ore by 2m Mining Bench and Model Source - Note: GC High Confidence, DFS Reserve - lower confidence</b>									
Data Source - Model Type			Close Spaced GC		DFS Reserve		Total Combined Models		
YEAR	2m Bench Toe	Ore Type	Tonnes	U3O8 ppm	Tonnes	U3O8 ppm	Tonnes	U3O8 ppm	
Year 1	784	MG	34	336			34	336	
		LG	53	137			53	137	
	<b>784 Total</b>			<b>87</b>	<b>214</b>			<b>87</b>	<b>214</b>
	782	HG	336	694	30	617	366	688	
		MG	464	344	4	318	467	344	
		LG	1,108	135	159	226	1,267	146	
	<b>782 Total</b>			<b>1,908</b>	<b>284</b>	<b>193</b>	<b>289</b>	<b>2,101</b>	<b>285</b>
	780	HG	145	891			145	891	
		MG	372	382			372	382	
		LG	3,820	192			3,820	192	
	<b>780 Total</b>			<b>4,337</b>	<b>232</b>			<b>4,337</b>	<b>232</b>
	778	HG	504	682	340	1,380	844	963	
		MG	287	369	168	413	455	385	
		LG	5,468	181			5,468	181	
	<b>778 Total</b>			<b>6,259</b>	<b>230</b>	<b>508</b>	<b>1,060</b>	<b>6,767</b>	<b>292</b>
776	HG	5,331	1,366	448	1,497	5,779	1,376		
	MG	1,057	400			1,057	400		
	LG	3,308	189			3,308	189		
<b>776 Total</b>			<b>9,696</b>	<b>859</b>	<b>448</b>	<b>1,497</b>	<b>10,144</b>	<b>887</b>	
<b>Year 1 Total</b>			<b>22,286</b>	<b>509</b>	<b>1,149</b>	<b>1,101</b>	<b>23,435</b>	<b>538</b>	
Years 2 & 3	786	HG			99	668	99	668	
		MG			23	391	23	391	
		LG			389	177	389	177	
	<b>786 Total</b>					<b>512</b>	<b>282</b>	<b>512</b>	<b>282</b>
	784	HG			161	757	161	757	
		MG			841	345	841	345	
		LG	234	138	1,878	154	2,112	152	
	<b>784 Total</b>			<b>234</b>	<b>138</b>	<b>2,880</b>	<b>243</b>	<b>3,113</b>	<b>235</b>
	782	HG			55	757	55	757	
		MG	81	346	1,151	371	1,232	369	
		LG	685	132	3,464	171	4,149	165	
	<b>782 Total</b>			<b>766</b>	<b>154</b>	<b>4,669</b>	<b>227</b>	<b>5,436</b>	<b>217</b>
	780	HG	1,115	803	143	797	1,258	802	
		MG	846	452	2,244	373	3,090	394	
		LG	1,028	168	3,878	205	4,906	198	
<b>780 Total</b>			<b>2,990</b>	<b>485</b>	<b>6,266</b>	<b>279</b>	<b>9,255</b>	<b>346</b>	
778	HG	1,501	1,000	338	826	1,839	968		
	MG	1,133	431	2,464	367	3,597	387		
	LG	1,395	180	4,669	200	6,064	195		
<b>778 Total</b>			<b>4,029</b>	<b>556</b>	<b>7,471</b>	<b>283</b>	<b>11,500</b>	<b>379</b>	
776	HG	2,630	1,474	2,862	768	5,492	1,106		
	MG	354	451	3,287	393	3,641	399		
	LG	2,120	194	3,236	181	5,356	186		
<b>776 Total</b>			<b>5,105</b>	<b>871</b>	<b>9,385</b>	<b>434</b>	<b>14,489</b>	<b>588</b>	
<b>Years 2 &amp; 3 Total</b>			<b>13,123</b>	<b>632</b>	<b>31,182</b>	<b>316</b>	<b>44,305</b>	<b>409</b>	
Years 4 & 5	774	HG	4,636	1,319	2,659	1,044	7,294	1,219	
		MG	1,074	413	848	425	1,922	418	
		LG	3,552	204	366	260	3,919	209	
	<b>774 Total</b>			<b>9,262</b>	<b>786</b>	<b>3,873</b>	<b>834</b>	<b>13,135</b>	<b>800</b>
	772	HG	3,451	865	2,937	782	6,388	826	
		MG	2,140	376	602	390	2,742	379	
		LG	2,652	157	439	218	3,091	166	
	<b>772 Total</b>			<b>8,243</b>	<b>510</b>	<b>3,978</b>	<b>660</b>	<b>12,221</b>	<b>559</b>
	770	HG	3,081	821	2,978	832	6,059	826	
MG		2,112	375	384	377	2,496	375		
LG		2,374	164	462	233	2,836	175		
<b>770 Total</b>			<b>7,567</b>	<b>490</b>	<b>3,824</b>	<b>714</b>	<b>11,391</b>	<b>565</b>	
<b>Years 4 &amp; 5 Total</b>			<b>25,072</b>	<b>606</b>	<b>11,675</b>	<b>735</b>	<b>36,747</b>	<b>647</b>	
<b>Grand Total</b>			<b>60,481</b>	<b>576</b>	<b>44,006</b>	<b>448</b>	<b>104,487</b>	<b>522</b>	

Table 1-3 - Ore minded by model type, period, 2m mining bench

197.185.108.156

<b>MRP Demonstration Open Pit (5 year mine plan)</b>							
<b>Waste by 2m Mining Bench and Model Source - Note: GC High Confidence, DFS Reserve - lower confidence</b>							
Data Source - Model Type		Close Spaced GC		DFS Reserve		Combined Models	
YEAR	2m Bench Toe	Tonnes	U3O8 ppm	Tonnes	U3O8 ppm	Tonnes	U3O8 ppm
Year 1	784	239	71			239	71
	782	214	76			214	76
	780	866	56			866	56
	778	1,522	59			1,522	59
	776	993	54			993	54
<b>Year 1 Total</b>		<b>3,833</b>	<b>59</b>			<b>3,833</b>	<b>59</b>
Years 2 & 3	786			143	49	143	49
	784	1,793	44	85	65	1,878	45
	782	2,262	48	481	70	2,744	52
	780	1,062	54	354	57	1,416	54
	778	1,082	54	395	59	1,477	55
776	1,446	54			1,446	54	
<b>Years 2 &amp; 3 Total</b>		<b>7,645</b>	<b>50</b>	<b>1,458</b>	<b>61</b>	<b>9,104</b>	<b>52</b>
Years 4 & 5	774	2,389	54			2,389	54
	772	2,490	60			2,490	60
	770	2,154	58			2,154	58
<b>Years 4 &amp; 5 Total</b>		<b>7,033</b>	<b>57</b>			<b>7,033</b>	<b>57</b>
<b>Grand Total</b>		<b>18,512</b>	<b>54</b>	<b>1,458</b>	<b>61</b>	<b>19,970</b>	<b>55</b>

Table 1-4 - Waste mined by model type, period, 2m mining bench and Waste grade category

Around 40% of ROM material is derived from the DFS Reserve model. Due to the panel size of the Reserve model grade estimate (20 x 20 x 8 m) and the wide spaced drilling (roughly 20 x 40 m) used to estimate grade, the local tonnage and grade of this material at the small mining scale of the demonstration open pit is 'At-Risk', with much lower confidence limits than the GC model created using a 5 x 5 m drill spacing.

To compensate for the potential 'At-Risk' ore in the DFS reserve model, additional tonnes have been added to the mine plan for each period. A total of 60,481 tonnes of ore out of the 75,000 tonnes of ore required has been defined by the GC model. An additional 44,006 tonnes of 'At-Risk' ore has been defined from the DFS Reserve model. The shortfall from the GC model is around 15,000 tonnes, which means that in a worst case scenario 65% of the 'At-Risk' DFS Reserve model ore can be converted to Waste before the total Ore available drops below 75,000 tonnes.

In this worst case scenario where 65% of the 'At-Risk' DFS Reserve ore is converted to waste the Waste:Ore strip would increase from 0.19 to 0.66.

In summary the current mine plan targets 104,487 tonnes of ore compared to the minimum of 75,000 tonnes of ROM ore required. As well as the potential loss of the 'At-Risk' DFS Reserve ore, this planned excess also allows for ore losses during mining and potential issues related to topography accuracy and recovery of near surface ore on the edges of the open pit.

#### 1.8.4 General Layout – Plant, Rom, Tailings + Waste, DFS Waste Dump

Figure 1- presents an oblique 3D plan view of the demonstration mining and processing layout. Open Pit mine (green), Ore haul road, Plant site and ROM (red), Waste and tails haul road (blue), Waste and Tails dam (blue).

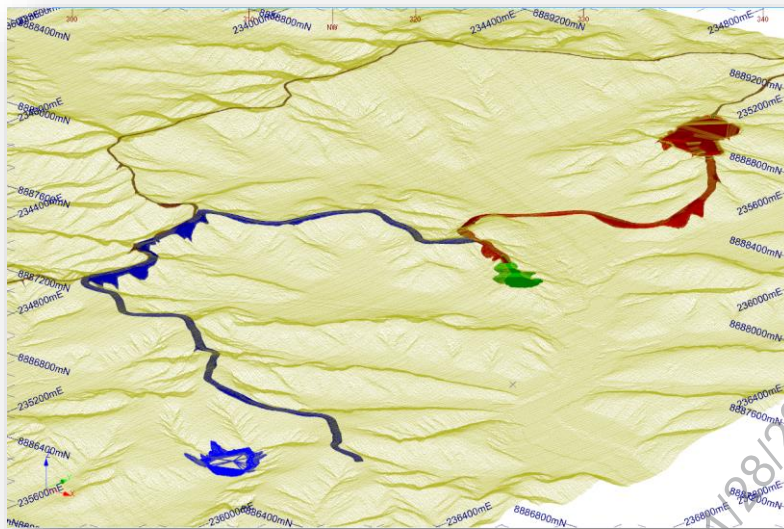


Figure 1-8 - 3D plan view of demonstration mining and processing layout

The demonstration mining and processing project has a number of restrictions related to the historical DFS document and Mantra interpretation of the current government approval process. Current project decisions are:

1. The demonstration plant must be located within the footprint on part of the property originally defined for the processing plant in the DFS document (red). The terrace servicing the demonstration plant, ROM pads and the mining contractor's infrastructure covers a footprint of 2,75 ha
2. The scats mixed with filtered plant tailings must be deposited in part of the area designated for tailings in the DFS study (blue) within a lined facility
3. Marginal ore must be dumped within the DFS III tailings storage facility footprint
4. Pit waste rock can be used in haul road maintenance and construction.

### 1.8.5 Ore Haulage and ROM Stockpiles

Total ore hauled to the plant site ROM pad is expected to be a minimum of 75,000 tonnes (15,000 tonnes each year for 5 years). This may increase to a total of 104,000 tonnes depending on the amount of mineralised material currently outside the GC model but within the mine design and defined by the DFS Reserve model which converts to Ore.

The Ore haul road to the plant has been designed by METC based on single lane traffic with passing bays. Input from the mining contractor relating to passing bay spacing and location of passing bays is required. The distance from Pit to ROM tip is 1.4 km.

A 3D view of the ore pit to ROM haul road is presented in Figure 1-.

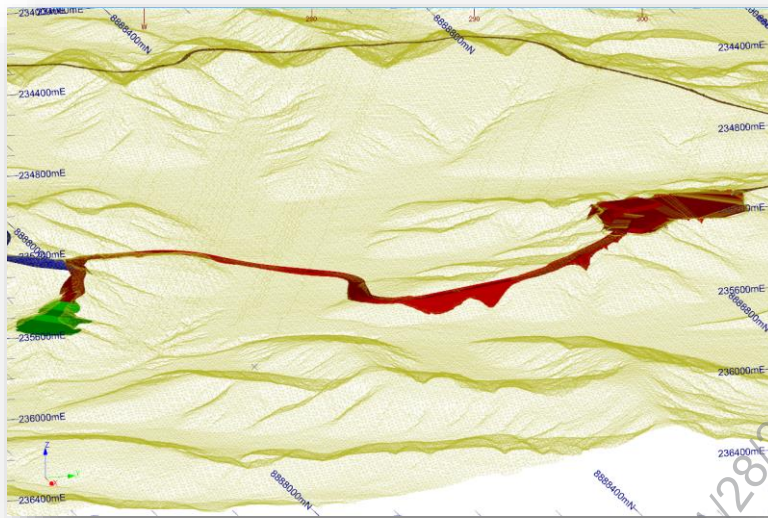


Figure 1-9 - 3D view of Pit to ROM haul road

### 1.8.6 Waste Stockpiles

Total combined waste ('WST') mined over the five-year mining period is estimated to be around 25,000 tonnes at an estimated combined average  $U_3O_8$  grade of 55 ppm. The tonnage of WST may increase to around 50,000 tonnes depending on the proportion of 'At-Risk' DFS Reserve model ore converted to WST after completion of grade control drilling.

Storage of WST will be in the Tailings impoundment footprint area, but will not be stored in the lined dry tailings storage paddock. As the tonnages are small and a haul road needs to be constructed to move plant scats and tailings, the decision is to utilise the tailings haul road and tailings impoundment area. Arguably some of the mine waste can be used in the construction/maintenance of the haul road and tailings impoundment. Figure 1-10 presents a 3D view of the proposed tailings haul road and tailings impoundment relative to the demonstration mining pit. The distance from pit to tailings dam is 3.01 km. Distance direct from Plant (ROM) to tailings dam is 3.95 km.

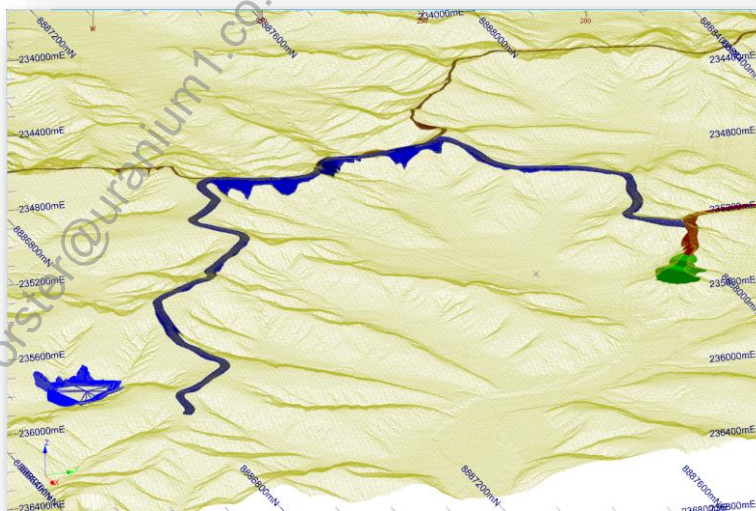


Figure 1-10 - Pit (green) and tailings + waste + MO haul road (blue) with tailings impoundment (blue)

### 1.8.7 Demonstration Pit OPEX

#### Discussion:

1. Six-wheel drive ADT's are not cost effective for demonstration mining, due to the cost of mobilisation and demob required each year. ADT's need to be trucked in using low loaders which will be expensive and cannot be justified due to the short period of 1 – 2 months of mining each year. Dual axel drive 20 tonne tipper trucks will be suitable as mining takes place in the dry season and haul roads will be constructed with a maximum slope of 8 to 9%. There may be some down time during unseasonal rainstorms, but this should have minimal impact on productivity and OPEX.
2. A small 20 tonne excavator will be suitable for mining. This size excavator will give maximum flexibility to the mining operation. The mining material which is highly weathered 80% sand/ 20% clay does not require blasting, dozer ripping or high breakout strength. The excavator can be fitted with a sand bucket, resulting in around 6 to 9 swings to load each truck, which is not unreasonable for a small scale mine. The excavator can also be used to clean-up berms and batters and will be capable of highly selective mining which may be required on the pit contours.
3. The equipment indicated in points 1 and 2 above should be able to mine between 1,000 to 1,500 tonnes per day. This means on average mining for each year should be completed in one to two months, after allowing for minor delays due to weather and technical grade control requirements.
4. Grade control drilling will be required for part of the mining area as this has not been covered by the 2013 DFS GC drilling. A tractor mounted fence post auger to drill 5 x 5 m spaced 2 m deep holes (mining flitch height), which can be sampled and analysed using a bench top XRF (available on-site at the plant) ahead of mining. The mining contractor will provide the mechanical auger, samplers and associated equipment.
5. Topsoil clearance and storage will be required even though most of the area designated for mining was cleared 5 to 6 years ago. This 'new topsoil' and vegetation will still need to be captured stored in a stockpile near the mine. This may require the use of a bulldozer - but could also be done with excavator and trucks depending on the thickness of the regrowth.
6. A bulldozer should not be required on-site during mining, however, one will be required for initial road construction during start-up. All levelling during mining will be done using a grader.
7. Haul road maintenance during mining will require a grader, a pad foot roller and a smooth roller
8. ROM feed to the processing plant would be best achieved by using a TLB (A self loading tipper truck) to both feed the plant and manage the tailings/scats stacking on the ROM pad. This has advantages for blend management as 20 tonne batches can be blended from the ROM stockpiles into the truck. The batch can then be transferred to the plant hopper bin using the onboard excavator. This may be more cost effective than using a front-end loader.
9. The mining contractor will provide a small 7 to 10 tonne 4WD tipper truck for transporting mixed filtered plant tails and Scats from the plant to the tailings dam to operate all year round. This will be more cost effective than a 6WD ADT.
10. METC will provide the mining contractor with a SOW for construction and site access road maintenance.

Tables 1-5 to 1-7 present estimated mining OPEX and diesel fuel consumption based on a draft  $\pm 25\%$  quote from Mining Contractors based in Tanzania.

U1 MRP - Fixed Mining costs per year	USD	Mining Contractor Comments:										
<b>Mobilisation and De-Mobilisation</b>	Year 1 \$77,050 Years 2 to 5 \$25,000	Contractor will establish a tented camp Partial yearly mobilisation/demob of mining equipment assumed for mining equipment only.										
<b>Provision of Mine Surveyor</b>	\$7,850	Overhaul of waste and ore included for haul distances 3km and 1.4km one way respectively.										
<b>Preliminaries and General - includes:</b>	\$45,174	Yearly mining activities to be completed in less than 2 months during dry season. No allowance has been made for gov fees, permits and officials for working in the reserve. Client to provide access to the reserve and project work areas. Environmental and Safety permits to be supplied by client Game scouts to be provided by client if required Prices exclude VAT										
<b>Supply of Fuel for Mining Equipment</b>	<p>Fuel supplied by U1 and deducted from Contractor based on Interim Payment Certificate - contractor equipment unit costs per hour include fuel - ensures contractor has a fuel conservation focus.</p> <table border="1"> <thead> <tr> <th>Assume 8 hr shifts</th> <th>19 num holes</th> <th>455</th> <th>time per hole</th> <th>20 minutes</th> </tr> </thead> <tbody> <tr> <td>\$9,575</td> <td>\$503.95</td> <td>shifts</td> <td></td> <td></td> </tr> </tbody> </table>		Assume 8 hr shifts	19 num holes	455	time per hole	20 minutes	\$9,575	\$503.95	shifts		
Assume 8 hr shifts	19 num holes	455	time per hole	20 minutes								
\$9,575	\$503.95	shifts										
<b>Grade Control Auger drilling and sampling:</b>	\$30,376	\$1,255.65 shifts 24										
'Doughnut' sample collection device												
Scales and 10kg and 1 kg sample bags												
Sampling 50% riffle splitter												
Labour to dry, hand crush and split samples from 10kg to 500g												
<b>Road Maintenance during Mining</b>												
<b>Tailings and Scats (assume &lt; 10% moisture)</b>												
ADT hire for full year with 20tonne payload capacity	\$98.00	hr 750 Loads per year 30 Assume avg ADT speed in km/h For comparative purposes only										
Distance from Plant to Tailings	\$71,424	8 Km round trip 15 Minutes + Load and unloading time 30										
Tipper 8 tonne capacity - 4 wheel drive		3875 Loads per year 20 Assume avg tipper speed in km/h										
Distance from Plant to Tailings		8 Km round trip 24 Minutes + Load and unloading time 30										
<b>Tailings Management - all year</b>		211 Days required for Tipper truck to move all Tailings and Scats										
LDV for the operators	\$43,200	\$150.00 day 24										
CAT D3 dozer (D6 Dozer)		\$646.00 day 24 Not required - believe a 4 WD / CB will be more effective										
12-tonne smooth drum roller		\$94,464 \$328.00 day 24										
Mobile water bowser (15,000 litre)		\$104,832 \$364.00 day 24										
JCB to replace D3/D6. See comments		\$112,320 \$390.00 day 24 Light dozing, backhoe, front end loader. Removing build up on tipper trucks, haulroad maint										
<b>Total Fixed Cost Year 1</b>	<b>\$597,275</b>											
<b>Total Fixed Cost Years 2 to 5</b>	<b>\$545,225</b>											
<b>Total Fixed Cost for 5 Years</b>	<b>\$2,778,173</b>											

Table 1-5 - Year 1 and Year 2 to 5 fixed cost estimate

<b>U1 MRP - Mining Equipment list and estimate fuel consumption</b>							
<b>Proposed Equipment List for Mining, Haul road Maintenance and Tailings Dam management</b>							
<b>Equipment List and Fuel Required</b>	<b>Qty</b>	<b>Fuel/h</b>	<b>Hrs/shift</b>	<b>Shifts/mth</b>	<b>Fuel/mth</b>	<b>Fuel/Year</b>	<b>Comments</b>
ADT 20	1	21	8	24	4032		Not recommended - replaced with 8t 6WD tipper truck
Mining Excavator 20 ton	1	23	8	24	4416	8832	Assume 2 month fuel
Mining Tipper Trucks 12/15m3	5	12	8	24	11520	23040	Assume 2 month fuel
Road maintenance during mining - claw foot roller	1	10	8	24	1920	3840	Assume 2 month fuel
Tailings and Haulroad Roller 12 ton Smooth drum	1	10	8	24	1920	23040	Required all year
Tailings and Scats 8 tonnes 6 WD tipper truck	1	9	8	24	1728	20736	Required all year
Haulroad Maintenance Grader 140M/H or equivalent	1	20	8	24	3840	7680	Assume 2 month fuel
Dozer D6	1	30	8	24	5760		Not recommended - replaced with 4WD JCB for tailings dam maintenance
GC Tractor + Auger	1	9	8	24	1728	3456	Assume 2 month fuel
Tailings Dam Watertruck 15kl/16kl	1	12	8	24	2304	27648	Required all year
Tailings dam JCB	1	11	8	24	2112	25344	Required all year
<b>Total Fuel per Year</b>						<b>143,616</b>	<b>litres</b>

Table 1-6 - Year 1, Year 2+3 and Year 4+5 Load and Haul cost estimate

<b>U1 MRP - Unit Mining costs per year</b>	<b>USD</b>			
<b>Ore and Waste Mining Year 1 (One 20 tonne Excavator, 5x 20 tonne Tipper Trucks)</b>				
HG, MG and LG to ROM pad distance		km	1.4	
Pit Waste/MO to Tailings impoundment round trip distance		km	3	
<b>Year 1 only - Topsoil stripping and stockpile</b>	\$5,330.00	\$2,050.00	ha	26,000 sq m
Ore to ROM pad separated in HG, MG and LG stockpiles	\$54,236.16	\$4.28	bcm	12,672
Waste and MO to Tailing/Scats impoundment	\$13,377.00	\$4.90	bcm	2,730
<b>Total Load and Haul Mining Cost Year 1</b>	<b>\$72,943.16</b>	Total Bcm	15,402	
Ore to ROM pad separated in HG, MG and LG stockpiles	\$100,494.40	\$4.28	bcm	23,480
Waste and MO to Tailing/Scats impoundment	\$33,790.40	\$4.90	bcm	6,896
<b>Total Load and Haul Mining Cost Years 2+3</b>	<b>\$134,284.80</b>	Total Bcm	30,376	
Ore to ROM pad separated in HG, MG and LG stockpiles	\$85,163.44	\$4.28	bcm	19,898
Waste and MO to Tailing/Scats impoundment	\$23,255.40	\$4.90	bcm	4,746
<b>Total Load and Haul Mining Cost Years 4 + 5</b>	<b>\$108,418.84</b>	Total Bcm	24,644	
<b>Total Load and Haul Costs for Years 1 to 5</b>	<b>\$315,646.80</b>			
<b>Average Load and Haul Costs per Year</b>	<b>\$63,129.36</b>			

Table 1-7 - Mining Equipment list and estimated annual diesel fuel consumption

Total average mining cost per year is approximately \$619k. The mining load and haul component based on unit rate averages \$63k per year, running at approximately 10% of the total mining cost. Fuel cost for the mining and TSF operation runs at approximately \$110K per annum.

There are advantages in having a sole mobile equipment contractor responsible for mining, haul road maintenance, tailings and waste management as the opportunity to have less equipment on-site with multi-tasking of activities will result in both fixed and operating cost savings.

## 1.9 Demonstration Plant Process Development

The demonstration plant flowsheet has been developed to maintain all the significant recovery steps which were followed in the DFS flowsheet and are denoted by a Yes (Y) block in figure 2 below. This includes scrubbing of fresh ore, ore acid leaching, recovery of uranium through RIP to address preg-robbing by clay, discard and neutralisation of RIP tailings, resin elution, gypsum and iron-phosphorus precipitation followed by hydrogen peroxide based uranium precipitation. The process steps omitted from the demonstration plant flowsheet are indicated by a No (N) block in Figure 1-11 below.

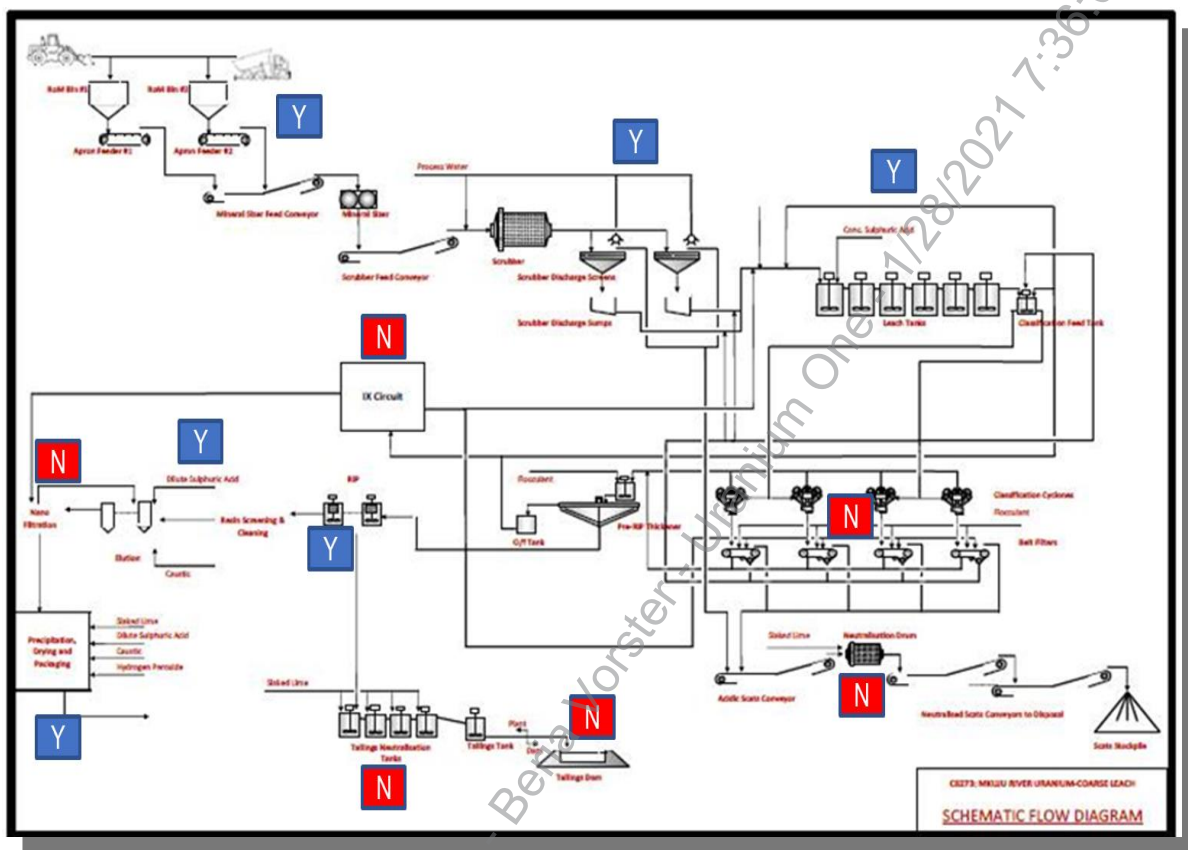


Figure 1-11 - DFS III Demonstration plant flowsheet selection

The DFS process flowsheet was optimised to reduce milling costs by allowing a milled coarse product of -1mm which necessitated the inclusion of additional mechanical equipment downstream to manage coarse ore handling. This mechanical equipment includes:

- Leach cropping pumps used to minimise settling of solids in the leach tanks
- Leach product classification cyclones and belt filters
- Scats neutralisation drum

The demonstration plant is designed to operate at a finer particle size to avoid inclusion of this additional equipment with capital savings and operating benefits.

In addition, the demonstration flowsheet is further simplified to remove the following stages which formed part of the feasibility study flowsheet.

- RIP slurry tailings stream neutralisation tanks
- Slurry tailings dam
- Ion exchange
- Nano filtration



The complexity, capital costs and operational management of this mechanical equipment/processing stages is not ideal to include in the demonstration plant flowsheet.

The demonstration plant flowsheet filters the RIP tailings due to low tonnages treated.

- This allows less water to report to the tailings and eases neutralisation requirements
- It also simplifies the tailings storage management as dry tailings can be stacked in the plant area and moved at a later stage
- The recovered acidic solution from the filter can be recirculated to the leach allowing a reduced acid consumption

No additional test work was conducted for the demonstration plant design as the previous DFS test work information is extensive and readily available. The demonstration plant flowsheet was developed in consultation with ANSTO Metallurgy to benefit from their historic knowledge of the project.

The demonstration plant has been designed with the following design basis and criteria:

1. Identify ore feed grade which is chosen as 450 ppm  $U_3O_8$ .
2. Utilise pilot plants 60% feed mass fraction removal to scats with the associated 20% uranium.
3. Maintained the pilot plants declared uranium recovery of 84%
4. Designed plant with 90% utilisation to manage planned and non-planned maintenance
5. Allow prolonged plant shutdown/stoppage with an overall plant availability of 75%
6. Design for some sections to operate for 12 hours which increases their operating throughput

Mass balance requires 2.6 t/h ROM feed on a 24-hour basis. However, by operating scrubber on 12-hour basis requires the plant to handle 5.2 t/h ROM ore which amounts to 15,367 t/a feed ROM ore.

The demonstration plant flowsheet comprises of ore receiving and scrubbing, ore acid leaching, recovery of leached uranium through resin in pulp (RIP), neutralisation and disposal of filtered RIP tailings, resin elution, gypsum and iron-phosphorus precipitation followed by hydrogen peroxide based uranium precipitation as per the block flow diagram Figure 1-12.

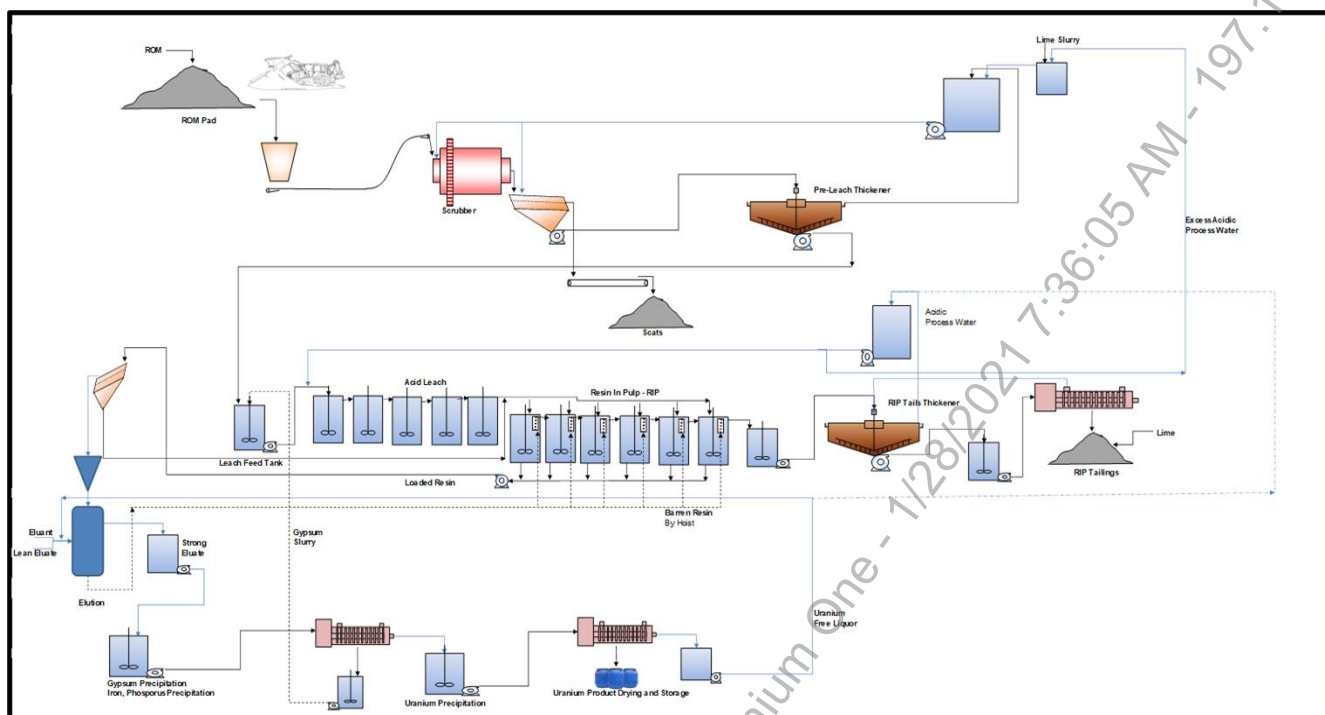


Figure 1-12 - Demonstration plant flowsheet

## 1.10 Engineering Development

The engineering design was developed from the approved flowsheets, piping and instrumentation diagrams and respective discipline design criteria. The designs adopted Tanzanian standards and regulations where available or recognised international standards where Tanzanian standards do not exist. The engineering design included the infrastructure, the process plant with the associated utility services and laboratory.

The plant position was selected within the footprint selected in DFS III. The plant design followed the requirements of the EMP, and the principals established in the DFS III design. The layout was optimised to reduce overall footprint. The complete process unit has been placed under roof to prevent the ingress of water into the process banded areas and thus dramatically reduce the volume of process contaminated stormwater. The demonstration process plant utilises the basic and acid process water systems in which the water balance around the basic process water system demands top-up from the acidic water system and the raw water system. The clean rainwater will be collected from the TSF area and the process plant roof into LDPE plastic tanks will be used to supplement and reduce the raw water top-up to the plant basic process water system.

The plant layout was developed to allow for pre-assembled modular process units in the detail design phase thereby reducing site construction works. Where possible, similarly sized equipment was standardised for easier operations and reduced spares holding. The plant has been split and fenced off into Low and High control areas with dedicated access control to each of the areas.

The reagent distribution and three months storage areas have specifically been designed to prevent contact between the sulphuric acid and hydrogen peroxide and any spillages from these two respective reagents will be contained separately. The sulphuric acid and hydrogen peroxide are currently proposed to be transported in liquid form to site in IBC tanks, however the option to transport sulphuric acid in tank containers should be reviewed during execution to accommodate high sulphuric acid consumption. These two reagents will be required to be transported and stored separately. The

remainder of the reagents will be delivered in powder form in 25 kg bags and 1-ton bags for hydrated lime.

Common access staircases, walkways and platforms have been utilised throughout the plant for ease of maintenance of the equipment.

Rotomolded plastic tanks have also been proposed where possible. Alternatively, rubber lined mild steel tanks or stainless-steel tanks were specified. Tanks that were required to be similarly sized were standardised and chemical storage type tanks were specified to ensure that they are suitable for acidic slurries and water.

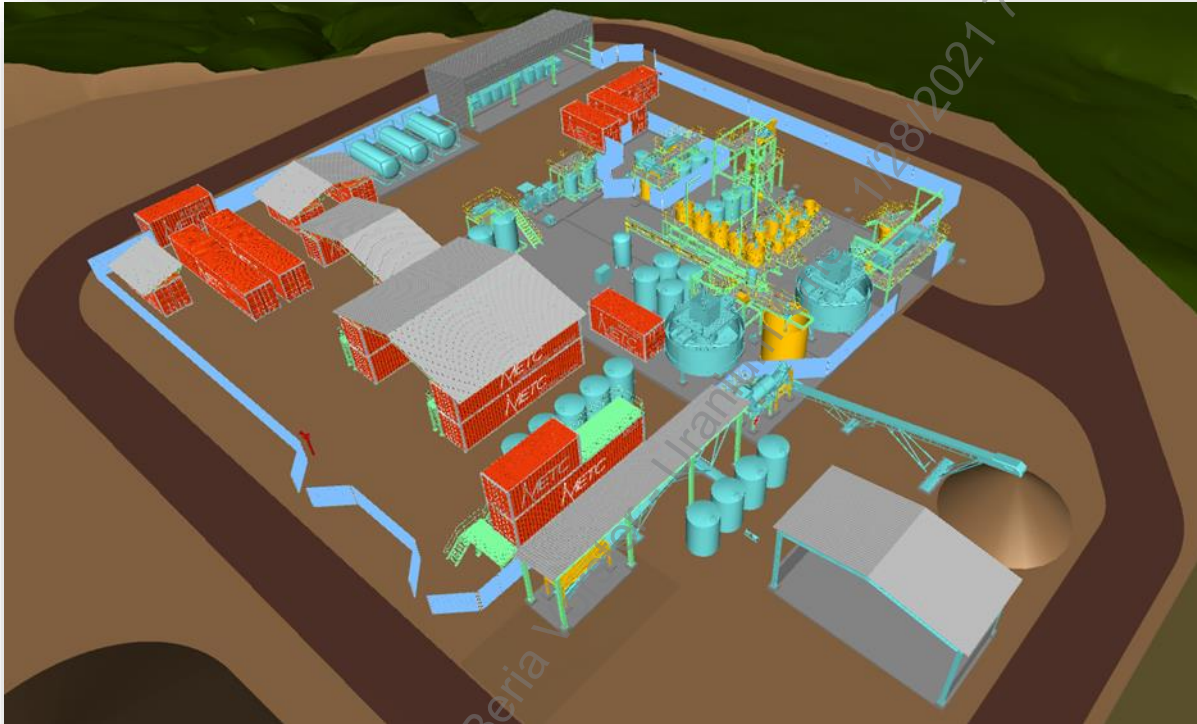


Figure 1-13 - Ore Receiving, Processing Plant and Infrastructure

## 1.11 Tailings Storage Facilities (TSF)

The construction of the TSF for the demonstration plant will follow the design principals established in DFS III and will be constructed within the footprint of the TSF approved for DFS III. The demonstration plant TSF will be constructed such that it will not impact on the future construction of the large TSF envisaged in DFS III.

Tailings deposition will depart from DFS III principals and will be dry stacked tails from a plate and frame filter press operating at the process plant opposed to the slurry deposition of tail adopted in DFS III. Dry tails stacking is feasible for the demonstration plant as the tails tonnages are relatively low. Dry stacking presents the following advantages to the demonstration project, capital cost reduction, reduced environmental risks and it aids in the overall site wide water balance.

The demonstration plant TSF will utilise 5 small full containment paddocks opposed to the single full containment paddock envisaged for the DFS III design. The 5 small paddocks were selected to reduce the active tailings footprint with each paddock servicing tailings for a one year period and being closed and rehabilitated at the end of the one year operational cycle. This again reduces environmental risks



and further aids the site wide water balance in reducing the catchment of rain water on a single large facility with the associated handling of such contaminated water.

It is envisaged that the Mkuju River project TSF develops as a series of cut-to-fill constructed full containment paddocks. Each paddock provides approximately one year of storage capacity and the successive paddocks developing downstream of the former. The expected Life of Mine (or the life of the proposed demonstration plant) is five years; thus, it is envisaged that a minimum of five paddocks are developed. Each paddock is expected to comprise of the following:

1. A cut-to-fill constructed containment wall
2. A 1 500 micron (1.5 mm) HDPE lined basin
3. A network of finger drains comprising of a 160 mm slotted drainage pipe encased in a coarse stone matrix and wrapped in a geotextile
4. A watertight drainage collection HDPE manhole
5. A stormwater diversion system comprising of:
  - A reinforced concrete-lined stormwater diversion channel, and berm providing overflow capacity
  - A silt collection trap at the prominent inlet section of the stormwater diversion channel
  - Stormwater spillways diverting the run-off back into the natural watercourse downstream of each respective paddock; and
  - An HDPE lined stilling basin and associated overflow spillway, reducing the erosion potential of the run-off water released back into the natural watercourse. In successive phases, the stilling basin forms part of the deposition basin to prevent reworking.

The subsequent development of the Mkuju River project TSF down the proposed north-eastern limb of the EMPR approved TSF footprint and enlargement of the run-off catchment area over the five years is illustrated at a concept level in Figure 1-14 to Figure 1-19.

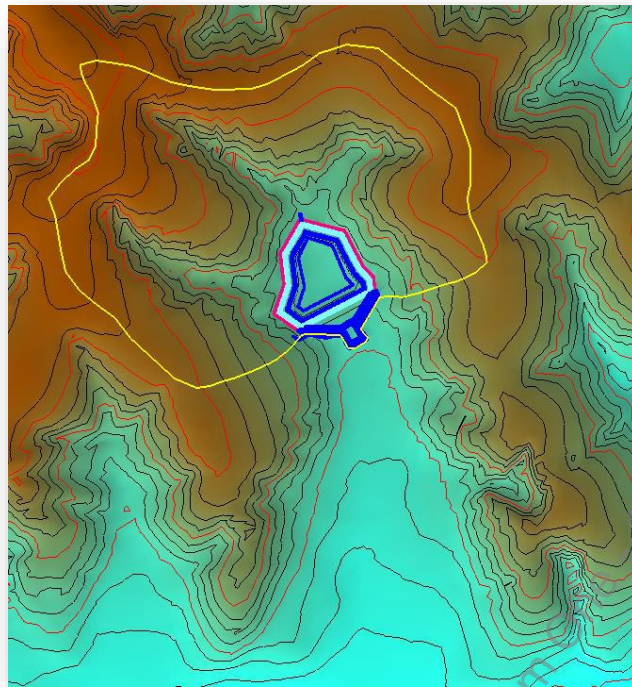


Figure 1-14 - TSF First Year of Development

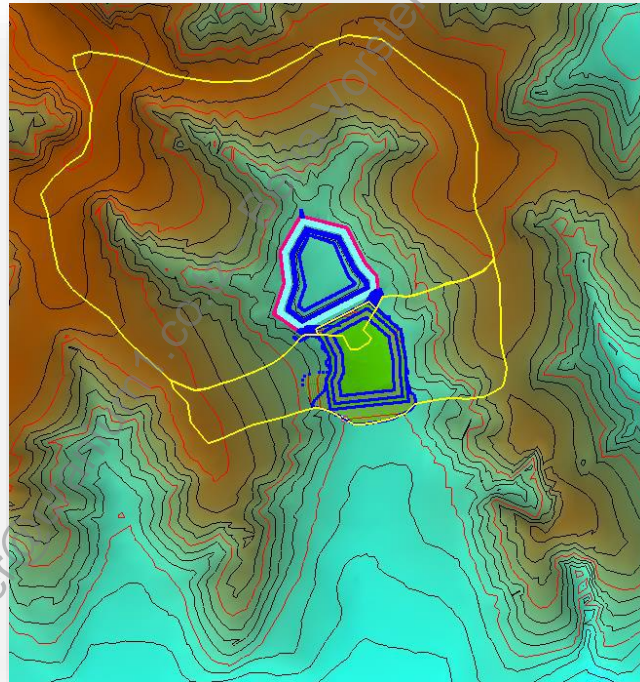


Figure 1-15 - TSF Second Year of Development

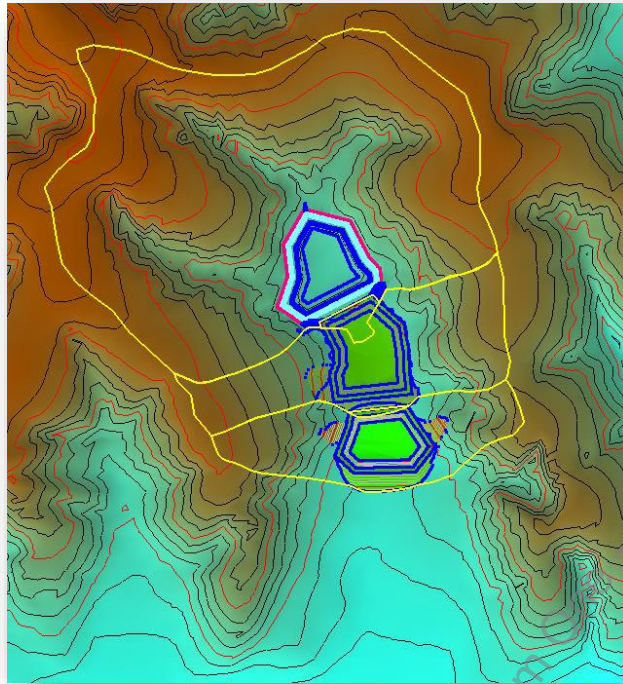


Figure 1-16 - TSF Third Year of Development

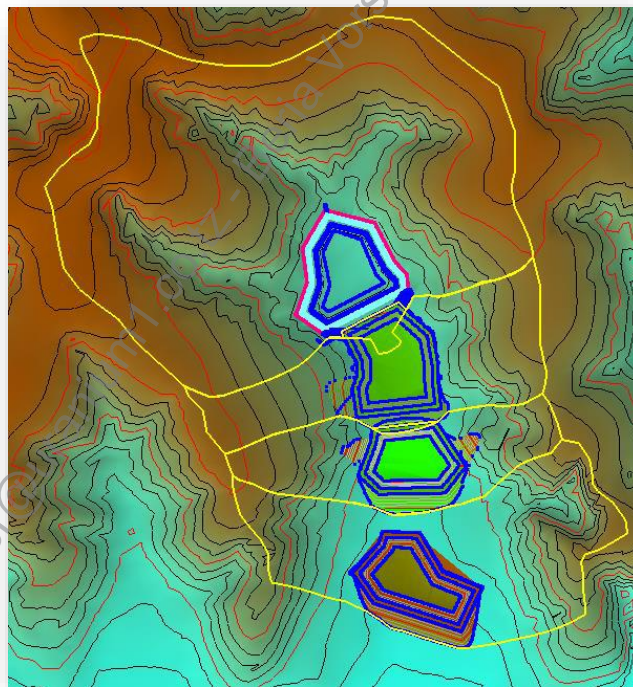


Figure 1-17 - TSF Fourth Year of Development

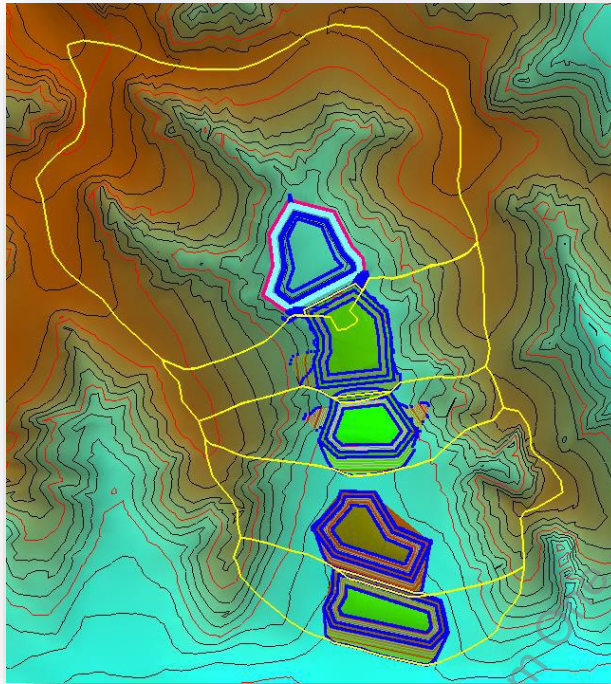


Figure 1-18 - Fifth Year of Development

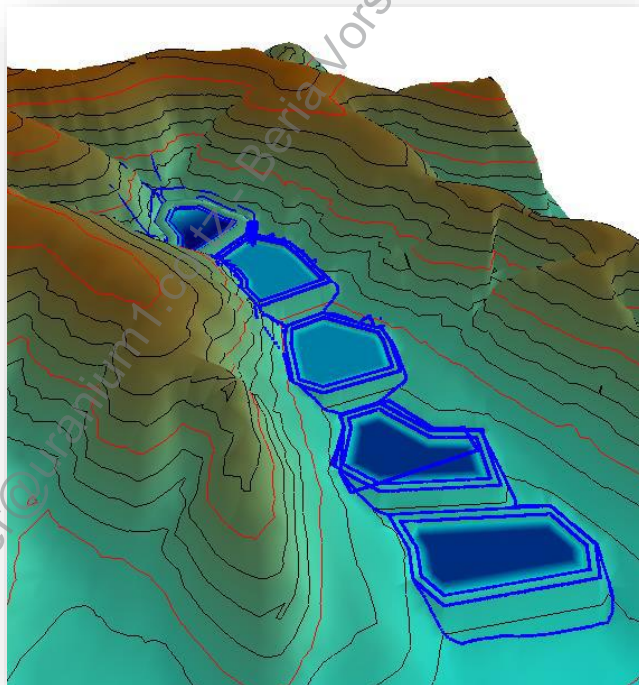


Figure 1-19 - Orthographic View of Down-Alley Development



## 1.12 Health and Safety

The work for Health and Safety was managed by Senior Management in Uranium One with specialist advice obtained from Tanzania Atomic Energy Commission (TAEC), NECSA and Doctor Barnes, a subject expert on Occupational Health and Safety.

Mantra recognises that best practice in the areas of Occupational Health and Safety is key to the delivery of operational excellence and that appropriate access control is essential if the company's people and assets are to be appropriately protected

Medical services are provided at the Project Site through the services of a fully equipped medical stations. All safety and health policies and practices have been developed in consultation with, and guidance from the Tanzanian Atomic Energy Commission. The TAEC latest surveillance report provides an effective third-party review of the company's Occupational Health and Safety (OHS) performance. The report confirms a strong emphasis on OHS with effective briefing of employees and visitors, adherence to radiation safety and environmental protection requirements, effective use of PPE, monitoring of worker exposure to radiation through personnel dosimeters, sound emergency procedures and medical evacuation, appropriate training of workers, the monitoring of vehicle and plant contamination, and the regular sampling of radiation levels at the work sites.

## 1.13 Human Resources

The Human Resources required to conduct the mining and operate the Demonstration Plant were provided to Mantra by METC. Mantra then undertook a review of the management and support services resources, indirect operators, in line with their operational philosophies and particular project requirements.

Mantra aims to as much as is possible to employ Tanzanian citizens, with emphasis on those from the local community, to work at Mkuju River. A total of 34 employees have been identified, of which 33 will be Tanzanians, based on an Owner operator model. Mantra believes this will benefit Tanzania in terms of job creation and skills development. The local workforce is cost effective and highly motivated to work at Mkuju River.

LABOUR COMPLIMENT					
Title	Number Of Shifts	On Duty	Relieving Shift	Total Staff	Remarks
<b>Plant Management</b>					
Plant Manager	0	0	0	0	Covered by process Engineer
Plant Metallurgist/Process Engineer	1	1	0	1	Also plant manager
Resident Engineer	0	0	0	0	Covered by maintenance superintendent
Maintenance Superintendent	1	1	0	1	
HSE and Training Officer	1	1	0	1	Part of owners team provided by Mantra/Uraniun 1
Clerk	1	1	0	1	Part of owners team provided by Mantra/Uraniun 1
First aide	2	1	0	2	Part of owners team provided by Mantra/Uraniun 1
Procurement Superintendent	1	1	0	1	Project procurement, Part of owners team
Owners Team - Management	1	1	0	1	Part of owners team provided by Mantra/Uraniun 1
Country Representative	1	1	0	1	Part of owners team provided by Mantra/Uraniun 1
<b>Plant Operations</b>					
Storeman	1	1	0	1	
Cleaner	1	0	0	0	Outsource
Security	2	0	0	0	Outsource
<b>Feed Ore Handling</b>					
FEL/TLB Operator	1	1	1	2	Could be contracted out
Truck Driver	1	1	1	2	Transport of tailings day shift (exclude mined ore)
<b>Ore Scrubbing, Scats Disposal and Thickening - 12h shift x 1</b>					
Scubber/Thickener Operators	1	1	1	2	
FEL/TLB Operator	0	0	0	0	Use feed ore handling operator
<b>Leaching, RIP and Tailings Handling (2 x 12h shift)</b>					
Leach/RIP/Filter supervisor	2	0	1	1	Only 3 persons on shift for leach, RIP, reagents & elution
Leach/RIP/Filter Operators	2	2	1	5	
<b>Elution</b>					
Elution Operators	2	0	0	0	Use main plant leach operators
<b>Precipitation</b>					
Precipitation Operators	1	2	1	3	Dedicated day shift team
<b>Reagents</b>					
Reagent Operators	0	0	0	0	Use main plant leach operators
<b>Services - Water</b>					
Services Operators	0	0	0	0	Use main plant leach operators
<b>Maintenance</b>					
Millwright	1	1	1	2	Covers fitting/ boilermaking
Electrical/Instrumentation Technician	1	1	1	2	Covers instrument/ electrical
Aide	1	1	1	2	Assistance to artisans
<b>Laboratory</b>					
Laboratory Technicians	2	1	1	3	Lab operators on shift.
<b>Procurement</b>					
<b>Total Staff Compliment</b>		<b>20</b>	<b>10</b>	<b>34</b>	

Table 1-8 - Human Resource Requirements and Source of Personnel

Expatriates will be briefed on local culture and norms of behaviour and will be expected to work, supervise, and manage in a way that fully respects the culture of the host nation and communities.

All vacancies with Mkuju will be advertised in the local press as well as posted on community bulletin boards and on an internal bulletin board at the site, where appropriate.

The manning levels on site will vary during construction and the annual mining periods peaking at 140 overall site occupancy. Table 1-9 below illustrates the quarterly manpower histogram over the two year construction period and 5 year operational period inclusive of the current site manpower compliment of 20 personnel.

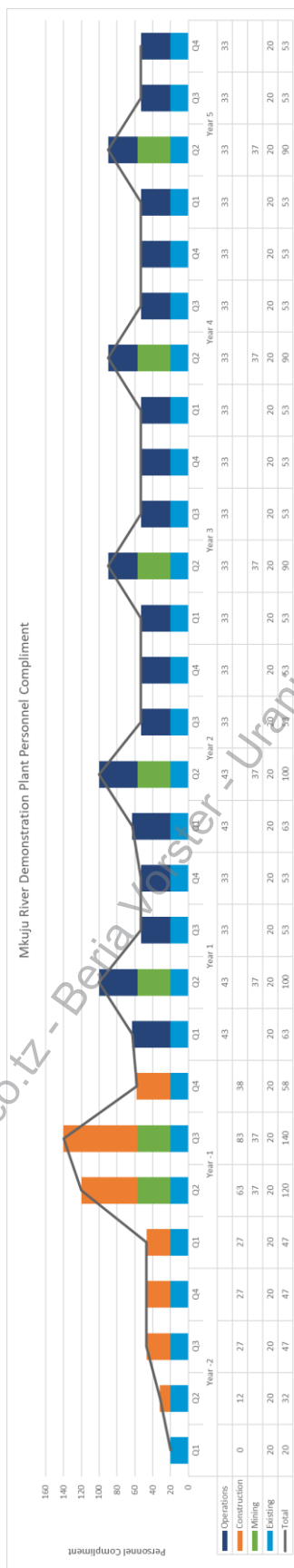


Table 1-9 - Overall Site Manpower Histogram

Mantra\_Design - beria.vorster@uranium1.co.tz - Beria Vorster - Uranium One - 1/28/2021 7:36:05 AM - 197.185.108.156



## 1.14 Transport

The primary method of transporting materials and equipment to the project site will be via road for supplies sourced from South Africa or the neighbouring countries. Imported items will arrive via the Dar es Salaam port and then by truck transport to site. Road access to site from Dar es Salaam is via the A7 through Morogoro, Makambako, Songea and Namtumbo.

Transport costs have been included in the scope of supply for all vendors and contractors with delivery terms DAP Mkuju River Project Site (Incoterms 2020).

## 1.15 Capital Cost

The initial capital cost for the mine, process plant and associated infrastructure excluding the mining fleet and ancillary equipment, is estimated at US\$26.07M (at Class 3 level of accuracy in accordance AACEI 18R-97: Cost Estimate Classification System: As Applied in Engineering, Procurement, and Construction for the Process Industries).

The engineering has been developed by a METC in conjunction with various independent consultants and suppliers to support a capital and operating cost estimate to the required accuracy for financial analysis. The detailed Capital costs are given in Chapter 13.

The capital cost estimates developed by the various QPs have been incorporated into the CBE and are inclusive of all infrastructure and indirect costs required for the project,

Working capital to start mining and support six months of operation after start-up is included within the capital requirements.

## 1.16 Operating Cost

Consumption of reagents and other consumables was estimated in conjunction with the test work, project design criteria, process flow sheets, mechanical and electrical equipment lists. Operating costs were estimated using prices obtained from proven suppliers.

The operational costs estimated and summarised in Chapter 14 are based on recovering 5 t/a of uranium ( $UO_4$ ) from treating 15,367 t/a mined ore at an average ore feed grade of 450 ppm  $U_3O_8$  through a 5-year life span.

In-country labour cost data was provided by Mantra. The staff levels for managing and servicing the operation were determined by Mantra in line with their operating practices. The operating costs are defined as the direct operating costs including Owner Operator mining, processing, tailings storage, water treatment and G&A.

The G&A cost includes administrative personnel, general office supplies, safety and training, travel (both on site and off site), independent contractors, insurance, permits, security, camp power, camp costs, ICT, relocation and recruitment.

The costs mentioned above are not directly chargeable to the mining and process areas and hence are grouped together in general and administrative costs.

The demonstration plant is developed to operate within the following utilisation parameters:

<b>Ore Scrubbing, Classification and Pre-Leach Thickening</b>		
Plant Availability (shutdown)	%	75%
Plant Utilisation (Maintenance/ Non planned)	%	90%
Operating Hours	hrs	12
Operating Hours per Year	h	2 957
Design factor	%	100%
Design Scrubber Ore Throughput	t/h dry	5.2
<b>Acid Leaching, RIP and Elution</b>		
Plant Availability (shutdown)	%	75%
Plant Utilisation (Maintenance/ Non planned)	%	90%
Operating Hours	hrs	24
Operating Hours per Year	h	5 913
Design Leach Throughput	t/h dry	1.04
<b>Precipitation</b>		
Plant Availability (shutdown)	%	75%
Plant Utilisation (Maintenance/ Non planned)	%	90%
Operating Hours	hrs	12
Operating Hours per Year	h	2 957

Table 1-9 - Demonstration Plant Areas Utilisation Parameters

### 1.16.1 Demonstration Plant Operational Cost Summary

The overall operational cost for the overall facility associated with treating 15,367 tons of ROM to produce 5 tons of yellowcake uranium product has been estimated as \$2 916 656. The operational cost for the process plant has been estimated as \$1 175 547 per annum which equates to \$76-50 per ton of ore processed and is summarised in Table 1-10 below. The estimate includes all costs associated with reagents, labour, plant maintenance, power, laboratory water treatment and plant mobile equipment. The cost for Mining is estimated at \$14-90 per ton, for TSF Handling at \$32-60 per ton and for General & Administration costs at \$65-90 per ton. The development of these cost estimates has been detailed in the respective chapters of this study report.

<b>Demonstration Plant Opex Summary</b>			
	<b>Rate /annum</b>	<b>Rate/ton</b>	<b>Distribution</b>
	<b>US\$</b>	<b>US\$/t</b>	<b>%</b>
Consumables - Reagents	\$ 177 758	\$ 11.6	15.12%
Plant Labour	\$ 604 678	\$ 39.3	51.44%
Plant Maintenance	\$ 80 000	\$ 5.2	6.81%
Power - Diesel Powered	\$ 168 786	\$ 11.0	14.36%
Laboratory Consumables	\$ 13 541	\$ 0.9	1.15%
Water Treatment Consumables	\$ 2 890	\$ 0.2	0.25%
Plant Mobile Equipment	\$ 127 895	\$ 8.3	10.88%
<b>Total</b>	<b>\$ 1 175 547</b>	<b>\$ 76.5</b>	<b>100%</b>

Table 1-10 - Demonstration Plant Overall Operating Cost Summary

The overall split in operating costs for the demonstration plant is shown graphically in the figure 1.-10 below. The graphic indicates that the largest single contributor to operational cost is labour at 50%, followed by reagents and power which collectively contribute 30% of the total.

The balance of the cost comprises maintenance, laboratory consumables, water treatment plant consumables and plant mobile equipment, collectively contributing 20% to the total.

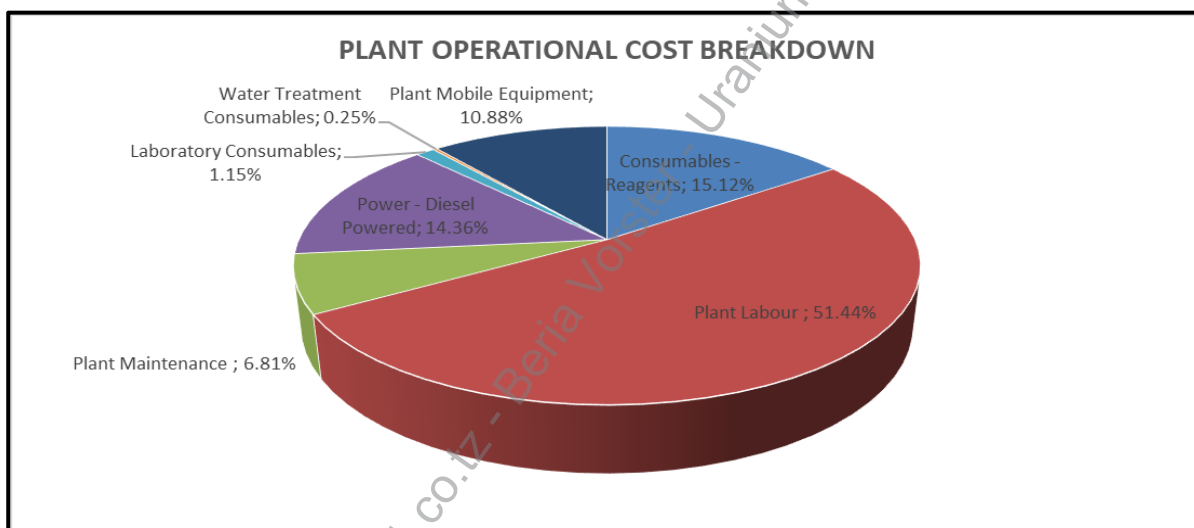


Figure 1-20 - Demonstration Plant Operational Cost Breakdown

## 1.17 Study Consultants

<b>Jem-Met</b>	Process Consultant, Project Sponsor
<b>ANSTO Metallurgy</b>	Pilot and Laboratory Testwork
<b>METC Engineering</b>	Study Management and co-ordination, Process Plant, Infrastructure Design, Capital costs and operating Reagents Consumption
<b>MAJA Mining</b>	Review of Mining design, Mining Fleet Optimisation, mining capital cost development
<b>Epoch Resources</b>	Tailings Storage Facility design, Water and Environment, Hydrogeology, and capital cost development

## 1.18 List of Acronyms

μSv	Microsievert
2D	Two Dimensional
3D	Three Dimensional
4WD	Four Wheel Drive
6WD	Six Wheel Drive
AACE	Association for the Advancement of Cost Engineering
ADT	Articulated Dump Truck
AIDS	Acquired Immunodeficiency Syndrome
ALARA	As Low as Reasonably Possible
AMSL	Above Mean Sea Level
ANSTO	Australia's Nuclear Science and Technology Organisation
AP	Action Plan
ARMZ	AtomRedMetZoloto Uranium Holding Co.
As	Arsenic
BFD	Block Flow Diagram

BFS	Bankable Feasibility Study
BH	Borehole
BOQ	Bill of Quantities
BTC	Belgian Technical Cooperation
C&I	Control and Instrumentation
C <sub>6</sub> H <sub>6</sub>	Hydrocarbon Benzene
CAPEX	Capital Expenditure
CAT	Caterpillar
CBE	Control Budget Estimate
CCD	Counter Current Decantation
CCTV	Closed-circuit television
CDM	Clean Development Mechanism
CIM	Canadian Institute of Mining
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
COP	Conference of the Parties
CSR	Corporate Social Responsibility
Cu	Copper
DAP	Delivery at Place
DB	Distribution Board
dBA	Decibel
DCP	Dry Chemical Powder
DF	Dengue Fever
DFS	Definitive Feasibility Study
DGU	Director-General of UNESCO
DoE	Division of Environment
DPM	Diesel Particulate Matter



E&I	Electrical and Instrumentation
EHA	Environmental Health Areas
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMA	Environmental Management Act
EMP	Environmental Management Plan
EMPR	Environmental Management Programme
EMPU	Environmental Management Plan Update
EPCM	Engineering, Procurement and Construction Management
EPFI	Equator Principles Financial Institution
ERB	Engineers Registration Board of Tanzania
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
E-W	East West
EWURA	Energy and Water Utilities Regulatory Authority
FAO	Food and Agricultural Organisation
FEL	Front End Loader
FGD	Focus Group Discussions
FPIC	Free, Prior and Informed Consent
FRP	Fibre Reinforced Plastic
FS	Feasibility Study
FSSR	Russian Soviet Federative Socialist Republic
G&A	Generals and Administration
GC	Grade Control
GCL	Geosynthetic Clay Liner
GGP	Gross Geographical Product



GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GMP	General Management Plan
GoT	Government of Tanzania
GRP	Glass Reinforced Plastic
ha	Hectares
HAZOP	Hazard and Operability
HDPE	High Density Polyethylene
HG	High Grade
HIV	Human Immunodeficiency Virus
HRU	Hydrological Research Unit
Hz	Hertz
I&AP	Interested and Affected Parties
I/O	Input Output
IAEA	International Atomic Energy Agency
IBC	Intermediate Bulk Containers
ICCROM	International Centre for the Study of the Preservation and Restoration of Cultural Property
ICMM	International Council on Mining and Metals
ICOMOS	International Council on Monuments and Sites
ICRP	International Commission for Radiological Protection
ICSID	The International Centre for Settlement of Investment Disputes
ICT	Information and Communications Technology
ID	Internal Diameter
IFC	International Finance Corporation
INFCRIC	International Atomic Energy Agency Information Circular
IRENA	International Renewable Energy Agency

IRR	Internal Rate of Return
ISO	International Organisation for Standardisation
IUCN	International Union for Conservation of Nature and Natural Resources
IX	Ion Exchange
JORC	Australasian Joint Ore Reserves Committee
kg	Kilograms
km	Kilometres
kt	Kiloton
kVA	Kilo Volt-Ampere
LDV	Light Delivery Vehicle
LDX	Lean Duplex Steel
LG	Low Grade
LiDAR	Light Detection and Ranging
LTIFR	Lost Time Injury Frequency Rate
M	Molar
m <sup>3</sup>	Cubic Metres
m <sup>3</sup> /h	Cubic Metres per Hour
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MCC	Motor Control Centre
MEL	Mechanical Equipment List
METC	Metallurgical Engineering Technology and Construction / METC Engineering (Pty) Ltd
MG	Medium Grade
MIGA	Multilateral Investment Guarantees Agency
Mo	Molybdenum
MRE	Mineral Resource Estimate
MRP	Mkuju River Project



mSv	Millisievert
NAAQS	National Ambient Air Quality Standards
NAWAPO	National Water Policy
NBSAP	National Biodiversity Strategy and Action Plan
NECSA	South African Nuclear Energy Corporation Ltd
NEMC	National Environment Management Council
NGO	Non-Governmental Organisation
NNW	North-North West
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Oxides of Nitrogen
NPI	National Pollutant Inventory
NPT	Non-Proliferation Treaty
NPV	Net Present Value
N-S	North South
NW	North West
OD	Outer Diameter
OHS	Occupational Health and Safety
OHSA	Occupational Health and Safety Act
OPEX	Operating Expenses / Operating Expenditure
OPRC	Oil Pollution Preparedness Response
OUV	Outstanding Universal Value
P&G	Preliminary and General
P&ID	Piping and Instrumentation Diagram
PCS	Process Control System
PDC	Process Design Criteria
PDCA	Plan, Do, Check and Act
PEP	Project Execution Plan

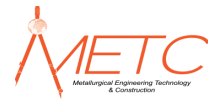
PET	Potential Evapotranspiration
PFD	Process Flow Diagram
pH	Potential of Hydrogen
PITC	Provider Initiated Testing and Counselling
PLC	Programmable Logic Controller
PMTCT	Prevention of Mother to Child Transmission
POP	Project Procurement Plan
PPAH	Pollution Prevention and Abatement Handbook
PPE	Personal Protective Equipment
ppm	Parts per Million
PRP	Prime Rated Power
PSG	Paulsam Geo-Engineering
R&D	Research and Design
RIP	Resin in Pulp
ROM	Run of Mine
RUSLE	Revised Universal Soil Loss Equation
RVF	Rift Valley Fever
RWD	Return Water Dam
SADC	Southern African Development Community
SAMREC	South African Mineral Resource Committee
SDU	Sodium Diuranate
Se	Selenium
SEA	Strategic Environmental Assessment
SEAMP	Strategic Environmental Assessment and Management Plan
SGR	Selous Game Reserve / Nyerere National Park
SHE	Safety Health and Environment
SHEQ	Safety, Health, Environment and Quality



SMPP	Steel, Mechanical, Piping and Platework
SMU	Selective Mining Unit
SNWC	Nyerere National Park-Niassa Wildlife Corridor
SO <sub>2</sub>	Sulphur Dioxide
SO <sub>4</sub>	Sulphate
SoOUV	Statement of Outstanding Universal Value
SOP	Standard Operating Procedure
SOW	Scope of Work
SPLP	Synthetic Precipitation Leaching Procedure
SS	Stainless-steel
SSF	Scats Storage Facility
STI	Sexually Transmitted Diseases
Sv	Sievert
SWD	Storm Water Dam
SX	Solvent Extraction
t/a	Metric Tons per Annum
TAEC	Tanzania Atomic Energy Commission
TAWIRI	Tanzania Wildlife Research Institute
TB	Tuberculosis
TBS	Tanzania Bureau of Standards
TCAA	Tanzania Civil Association Authority
TDHS	Tanzania Demographic and Health Survey
THMIS	Tanzanian HIV/AIDS and Malaria Indicator Survey
TLB	Tipper Loader Backhoe
TSF	Tailings Storage Facility
TSP	Total Suspended Particles
TSS	Total Suspended Solids



TZS	Tanzanian Standard
U	Uranium
U1	Uranium One
U <sub>3</sub> O <sub>8</sub>	Triuranium octoxide
UEB	Uranerzbergbau GmbH
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UO <sub>4</sub>	Uranium Oxide
UPS	Uninterruptible Power Supply
US EPA	US Environmental Protection Agency
USA	United States of America
USD	United State of America Dollar
USDA	United States Department of Agriculture
UV	Ultraviolet
V	Vanadium
VAT	Value Added Tax
VCT	Voluntary Counselling and Testing
VSD	Variable Speed Drive
WAN	World Nuclear Association
WBS	Work Breakdown Structure
WCA	Wildlife Conservation Act
WCPA	World Commission on Protected Areas
WHC	World Heritage Committee
WHO	World Health Organisation
WHS	World Heritage Site
WMA	Wildlife Management Areas



WQG	Water Quality Guidelines
WRD	Waste Rock Dumps
WRD	Water Resource Development
WST	Total Combined Waste
WWF	Worldwide Fund for Nature
XRF	X-ray Fluorescence
YF	Yellow Fever

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