CONTRIBUTIONS TO AN ENVIRONMENTAL ASSESSMENT
of the
TREKKOPJE URANIUM PROJECT
PROPOSED WATER SUPPLY PIPELINES

Specialist Contribution: Biophysical

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1. Introduction

Uramin is proposing to initiate mining tests in the near future as part of their current exploration activities of the Trekkopje Uranium Project. These tests involve heap leaching, which requires 1,000,000 m^3 water per year during the test phase. The temporary pipeline will be used for two years before being removed again. If full-scale mining proceeds, up to 8,000,000 m^3 water per annum will be supplied to Trekkopje via a permanent pipeline.

Uramin is proposing to install a temporary water pipeline from the Rössing Uranium Mine reservoirs, via Arandis, to Trekkopje. Later on Uramin is planning to install a permanent pipeline from Wlotskas Baken across the West Coast Recreational Area to Trekkopje.

2. Scope of work

An environmental assessment of the two pipelines along the proposed routes is required. The scope of work includes identification of sensitive sites along or close to the routes and sites, advising on alternative routes or sites, an assessment of expected impacts and proposed measures to mitigate them. The assessment will include vegetation, biological soil crusts, fauna, and how these pipes will affect movements of wildlife. Consideration will be given to existing infrastructure in the area and the need to integrate present proposals with other developments that are expected.

The consultancy includes an Environmental Assessment covering the above, an Environmental Management Plan for implementation during

construction and commissioning activities, and recommendations for future rehabilitation with special attention to the temporary water pipe.

3. Technical Requirements
   - 3.1 **Temporary Water Pipe**
     - 3.1.1 Lifespan: 2 years
     - 3.1.2 Water volume delivered: 1 million m^3/annum
     - 3.1.3 Pipe diameter: 250 mm
     - 3.1.4 Planned width of servitude corridor: 15 m
   - 3.2 **Permanent Water Pipe**
     - 3.2.1 Lifespan: same as mine
     - 3.2.2 Water volume delivered: 7-8 million m^3/annum
     - 3.2.3 Pipe diameter: 700 mm
     - 3.2.4 Planned width of servitude corridor: 15 m

4. Description of areas, impacts, mitigation and potential rehabilitation
   - 4.1 **Temporary Pipeline Route Rössing-Arandis-Trekkopje**
     - 4.1.1 **Topography and Zones**

From the Rössing Reservoir to Arandis, the pipe could either closely follow the tar road or follow the route of the telephone line between the Rössing Mine and Arandis. From a point 1.6 km east of Arandis, the route goes in an overall direction of 338° towards Trekkopje (the current reconnaissance route ended at S22.19253 E14.89186). A recent reconnaissance by Uramin and a team of experts established and mapped this track from Arandis onwards. This route is evidently located partly over an older track. As the crow flies, the distance is 29 km; following the route it is 39 km.

The route crosses uneven terrain across ranges of low hills and rocky ridges and across numerous large to small washes (drainage lines). The rocky ridges and washes follow a direction at right angles to the route, which is consequently very undulating (Fig. 1). Several pump stations may be required to overcome obstacles. Although the route evidently is as straight as possible, it does make numerous turns around topographic features such as kopjes or rocky ridges and through most convenient passes.

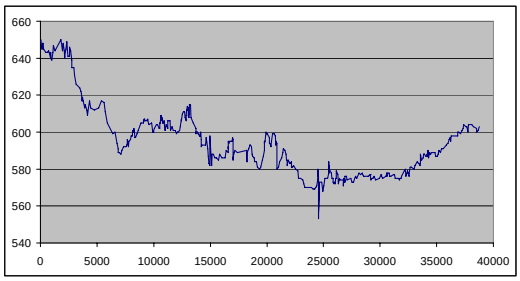

Fig. 1: Altitude profile (meters above mean sea level) of the proposed temporary pipeline route from the Rössing Reservoir (left, 0m) to Trekkopje (right, 39000m).

Overall, the area around this route can be subdivided into two zones which separate at S22.31503 E14.95484. The southerly zone is more rocky with numerous marble and dolerite ridges and the northerly zone comprises more open plains with numerous drainage lines and only occasional rocky outcrops. The composition of vegetation communities differs somewhat between the southern and northern zones, while the assessment of fauna was too brief to be able to make a meaningful distinction between these zones.

Southern Ridges and their Slopes: In the southern zone the route crosses or passes very close by several ridges of marble or of dolerite. From first impression, marble ridges appear to be more heavily vegetated and bear more plant species than dolerite ridges. The plants of these ridges differ somewhat from the surrounding areas and damage to perennial plants (e.g. shrubs) needs to be avoided. *Sarcocaulon marlothii* (bushman's candle) are particularly abundant on the slopes of these ridges and in one case an extensive dense field about 100 m wide and over 1 km long (in east-west direction) was crossed; extensive damage will be unavoidable by the pipeline. Besides in washes, low to high densities of *S.marlothii* occurred along most of the route in the southern zone. There is potential for Lithops, Larryleachia and other succulents of special significance to occur on these ridges, although none of these inconspicuous plants were seen during the reconnaissance trip. A single stone tool chert was seen on a dolerite ridge, indicative of some degree of archaeological sensitivity.

These ridges do not have well-developed soils and the biological soil crust and Fensteralgae are sparse, albeit present, particularly where there are quartz outcrops. Lichen cover is patchy and light on top of the ridges, absent or very spares on the slopes. This implies that the biological impact of tracks is not so severe at the soil level. However, the physical

structure of substratum, especially where it is loamy, is easily transformed to loose dust, which is susceptible to wind erosion. This can cause erosion trenches and covers plants in excessive dust, reducing photosynthesis. All driving and formation of new tracks should therefore be reduced to a bare minimum.

It is possible to reduce damage by crossing these ridges at their lowest part at places where the perennial shrubs are least dense or by deviation of the route around them. Much of the existing route already does this as best as possible, although the actual crossing points of the pipeline need to take into account the wider servitude corridor (wider than the width of the current single ORV track).

Southern Washes: Between the ridges there is a network of drainage lines or washes running east to west. These are relatively narrow (compared to the northern zone) and most have sandy channels, with the remainder having rocky and stony channels. These washes bear relatively dense fringes of perennial vegetation, with *Acacia reficiens* and *Zygophyllum stapfii* dominating. The channels are usually bare and show signs of having been flooded during the past year. To avoid damage to the pipeline and to surrounding vegetation by damming in the case of flash floods it will be necessary to bury the pipe at least 0.5 m into sandy channels or to put it onto pedestals in rocky channels. The plants include Namib endemics, but all are also common elsewhere. Nevertheless, woody vegetation is decades to centuries old and should only be removed with caution as regrowth (and rehabilitation) can be a very slow process. The biological soil crust was patchy and thin (1 mm), and the occurrence of Fensteralgae sporadic.

Northern Washes: An extensive and close network of broad washes with sandy channels crosses the plains from east to west in the northern zone. Associated with these are large fields of perennial and annual species of plants, sometimes in high densities. The pipeline and its associated servitude corridor will cut through these fields and removal of many dwarf shrubs is unavoidable. These are often decades to centuries old and it will rapid rehabilitation of the route will be difficult.

In this area, there are also the only few trees (*Acacia erioloba, Lycium tetrandum, Euclea pseudebenus, Salvadora persica*) that occur far and wide (trees are extremely scarce north and south of this zone). These trees are invaluable resources for many animals, such as birds nesting,

mammals feeding or shading, and insects feeding and sheltering. Rare lappetfaced vultures crucially depend on isolated trees for nesting without disturbance. Trees should therefore not be damaged at all. Furthermore, the pipeline route should not come close to them so as to avoid disturbance; likewise, the construction crews should not visit trees. No wood, dead or alive, should be collected.

Mammals frequent these washes. During the time of the visit, springbok were very common, and it was evident that they move along these washes, which serve as a corridor for their movements from east to west and vice versa. Signs indicated that other large animals, such as gemsbok and ostrich, are also present, and these, too, would tend to move along the washes which provide forage. The ability to cross this landscape unhindered is important for desert populations faced with very variable resources. The pipeline should be buried in sandy washes so as to minimise interference with the movements of these animals (besides allowing flood water to flow unhindered and avoiding damage to plants and the pipe).

A relatively high abundance of insects occurs in these washes. Bees are abundant and a potential risk to people (e.g. construction or maintenance crews) when the bees come to collect water (from drinking vessels or sweat). These bee populations are crucial for the pollination of the rich vegetation in the washes and the bees must not be destroyed to protect people (also, honey should not be collected); remedies against bee stings should be kept close at hand.

Northern Plains: The plains between the washes tend to be relatively bare, with only occasional minor drainage lines and sparse vegetation (ephemeral or multiseasonal). However, it is here that the biological soil crust and Fensteralgae are well developed, and lichen patches occur more frequently. Dried up mushrooms and ephemeral grasses are indicative of the productivity of these plains after rainfall. Occasional burst of productivity after rainfall are a crucial basis for populations of the high diversity of small animals on the plains (e.g. lizards, beetles, silverfish, spiders, scorpions, solifugids) for which the Namib is so famous. For instance, based on taxonomic literature, we expect some 60 species of tenebrionid beetles to occur in the vicinity of Trekkopje. While rainfall drives their population explosions, detritus, lichen and Fensteralgae sustain them through the lean years.

The surface substratum on the plains is very slow to recover from damage. Besides the long-term physical damage (and negative aesthetic effects), it severely changes natural soil processes and reduces productivity. For the route of the pipeline and its servitude corridor to reduce damage and maintain best potential for rehabilitation, the area of the impact must be reduced to a bare minimum by narrowing the width across the plains (maximum 6 m).

4.1.2 **Impacts**

- The route crosses somewhat complex terrain (going "across the grain"), and cannot avoid sensitive features such as ridges and washes.
- It will cause severe local damage at many places in a currently little-disturbed area.
- Many long-lived shrubs, with slow population turnover, will need to be removed and most of these will die. Some plants have special conservation status (e.g. *S.marlothii)* and some of these may be damaged unwittingly (e.g. *Lithops* are cryptic).
- The Biological Surface Crust on the plains will be damaged and is slow to recover. Here and on slopes to the south, the soil will be loosened which will speed up wind erosion.
- The few trees are rare resources for many animals. These will be frequently disturbed by activities along the pipeline. Wood may not be collected.
- The route crosses the natural direction of movement of game and will interfere with this to some degree (less if the pipeline is buried).
- Access by trespassers may increase along the route, which could increase game poaching. This can be avoided by blocking access to trespassers. Poaching by construction and maintenance crews mut be prevented.

4.1.3 **Sensitive Features and Mitigation of Impacts**

- Marble and dolerite ridges: pipeline, service tracks, construction crew must avoid upper sections of ridges
- Fields of bushman's candle *(Sarcocaulon marlothii):* route to cross areas with least densities and narrowest fields; reduce width of servitude corridor across fields (6 m); transplant all individuals of *S.marlothii* where damage is unavoidable (obtain advice from NBRI)
- Occurrences of *Lithops, Larryleachia,* and other protected plants: report all sightings to NBRI; avoid such areas by at least 20 m
- Archaeological items: leave in place exactly as found; report all sightings to the National Heritage Council

- washes: cross these by the shortest possible route and least damage to vegetation; reduce width of servitude corridor (6 m); bury pipeline 0.5 m deep in sandy channels, raise 0.5 m on pedestals in rocky channels
- game movements: these need to be able to follow an E-W axis, particularly in washes, and the pipeline should be buried to avoid being a barrier
- Plains: damage to the surface causes long-term interference of ecological processes such as the biological soil crust and Fensteralgae. This is difficult to mitigate, but raking of the **inside** of tracks to raise the depressed stones may help in areas that are subsequently not driven over again (surrounding surface material must not be raked as this would widen the impact). The servitude corridor should be reduced in width.
- Servitude corridor: it will be important to minimise the width almost along the entire length. The maximum width should be 6 m. All driving must be strictly confined to this corridor only (in EPL2214, we observed that track management and adherence to regulations are partly poor to irresponsible). To improve condition of the track, facilitating driving discipline, the service road should be lightly graded with a road grader (not caterpillar or front-end loader as partly done in EPL2214).

4.1.4 Rehabilitation

- Removal of pipeline and all associated infrastructure.
- Raking by hand the entire servitude corridor on plains and slopes so as to remove the edges of the graded track and to again raise the lichen- and Fensteralgen-bearing stones within the track.
- Replant temporarily transplanted *S.marlothii* and other species within fields of their species so as to close the gaps.
- Block off the route at crucial access points on the northern and southern sides so as to reduce ORV trespassers along this route.

4.2 Pipeline Route Wlozkasbaken-Trekkopje

4.2.1 Topography and Zones

The location of the proposed desalination plant has not yet been confirmed, but two alternatives were considered as the origin of the western pipeline. One is from Wlozkasbaken (this route was given with the Terms of Reference). From there the Trekkopje water pipeline would follow the Wlozkasbaken municipal water pipeline northwards up to the Omdel water pipeline to Swakopmund. The route then turns north, following the Omdel pipeline for about 5 km up to the watering point of the Stone Evolution Mine (S22.34845 E14.47752). The alternative

desalination site could be 4 km N of Wlozkasbaken, 1 km from the beach (S22.36888 E14.43863). A pipeline from there could run eastwards to the south of the *Teloschistis* lichen field up to the watering point of Stone Evolution Mine. Due to the uncertainty of location, the environmental assessment of the coastal stretch of pipeline (west of the watering point) was not done in detail here and should be done together with an EA of the desalination plant. It suffices to say here that in this area the route crosses vegetation communities not covered in the rest of the description below. It contains a prominent area of highest sensitivity (along the entire route) that must be avoided, namely the *Teloschistis capensis* lichen field.

From the watering point eastwards, the route follows the road to the Stone Evolution Mine, 34 km by road, 31 km as the crow flies. For the sake of the current reconnaissance, the site of the Stone Evolution Mine is taken as the end point. The major topographic trend is a steady increase of altitude from west to east with no pronounced dips or hills beyond the watering point (Fig. 2). The increase in altitude from the Omdel Pipe (watering point) to the end point is 350 m.

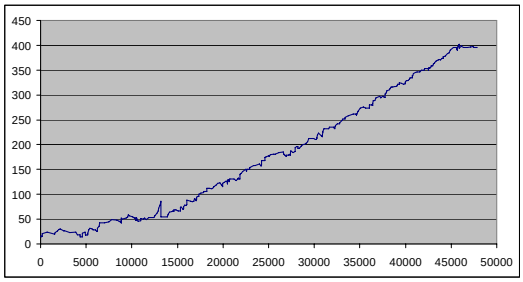

Fig. 2: Change in altitude (meters above mean sea level) of the route followed by the proposed western pipeline from Wlozkasbaken (0, left), past the watering point (14000, past the hill) up to Stone Evolution Mine (47000, right)

The road roughly follows broad, shallow valleys between dolerite ridges or crosses through wide gaps across ridges. It therefore mostly follows water courses and is usually well away from washes on open plains, crossing only one major wash.

There is a change in plant community composition along this route, but it changes gradually from being dominated by *Arthraerua leubnitziae* to the west to *Zygophyllum stapfii* to the east on the plains, washes, as well as dolerite ridges. Lichen and a well-developed biological soil crust and Fensteralgen are present along virtually the entire route except in the

flood channels of washes. Lichen is thicker and more diverse towards the coast than inland.

Plains: The lichens near the watering point comprise a complex community dominated by *Lecidea sp. and Combea mollusca*. East of that along the entire route (from about 15 km inland), a lichen community of *Caloplaca elegantissima-Xanthoparmelia walteri* cover the open plains between patches or sometimes larger fields of *Arthraerua leubnitziae* shrubs. Their abundance decreases eastwards. The biological soil crust and Fensteralgae follow this pattern. On the plains along the entire track, off-road tracks are a significant impact in terms of physical, aesthetic and ecological effects, the severity being most pronounced towards the west. If the proposed pipeline is placed close to the road, no new servitude corridor needs to be constructed and the pipe would be situated in an already disturbed area at the road margin.

Washes: The substratum is saline and only suitable for succulents. Drainage lines are characterised by high densities of *Arthraerua leubnitziae* and *Brownanthus kunzii* and presence of a few other small shrubs but no trees. *Zygophyllum simplex* traces minor drainage lines, including across the road. The road only crosses one major wash at S22.28530 E14.57372 where there is rather little vegetation. The channel flooded in the past year and the pipeline should be buried where it crosses the wash, or else be suspended high enough to prevent damming.

Dolerite Ridges: Dolerite ridges border the entire route, but the road only comes close to them at a few places. These ridges capture more fog water than the surrounding areas, particularly on their north-westerly slopes, thus supporting a higher abundance and higher diversity of plants than the surrounding areas (or the south-easterly slopes). The plant community is dominated by the common shrubs *Pelargonium otaviense*, *Zygophyllum stapfii*, *Arthraerua leubnitziae*, and other plants include *Sarcocaulon marlothii* (no large fields were seen), *Aloe asperifolia,* and *Commiphora saxicola*. Small trees *Lycium tetrandum* have been recorded on these ridges. Many of the rocks and stones are extensively covered with lichen. These ridges represent complex and rich habitats for a variety of animals, particularly insects. The road only crosses a few low, wide gaps in ridges and the pipeline (and construction/maintenance crew) would likewise cross only at these gaps. Crews should not tamper with organisms on ridges.

4.2.2 **Impacts**

- The coastal part of the pipeline will have least ecological impact if it follows the Wlozkasbaken municipal pipeline and the Omdel pipeline, with existing impacts.
- Extreme care needs to be taken in the selection of the route and restricting the width of the servitude corridor if the coastal part of the pipeline runs south of the *Teloschistis* lichen field (a separate EA is required for that).
- Nearly all of the pipeline east of the watering point will run across lichen-covered plains. New impacts are minimised by running the pipeline close to the road.
- Construction and maintenance crews could damage habitats in washes and ridges that are within easy walking distance of the road.
- The road and its margin, damaged by road-construction machinery (and sometimes uncompleted distribution of road surface material), is an already existing impact that will not be greatly enhanced in terms of ecological damage by the pipeline.
- The construction of the pipeline can be done with a minimum effect on shrubs and only very few may need to be removed.
- Low densities of game are present, and it is estimated that their natural movement patterns would tend to be along a west-east axis (following washes and ridges), rather than north-south. We therefore believe that impact on game will be minimal.

4.2.3 **Sensitive Features and Mitigation if Impacts**

- Washes and ridges are sensitive. Construction and maintenance crews should not venture there. The route only crosses one wash at a sandy place with little vegetation where the pipe can either be buried or raised.
- Extensive areas of lichen and biological soil crust will be damaged, but this is across an already partly disturbed area and merely widens the footprint of the road. The pipeline should be laid as close as possible to the road and the disturbance should not extend further than 1 m beyond the pipe on the side away from the road. All off-road areas around the pipeline should be contoured and raked immediately after construction, as the road will serve as access route for maintenance crews.
- Tourists using this road will be affected by the pipe blocking part of their view. Burial of the entire pipeline should be considered and would only marginally increase the impacts described above provided that the

surface is rehabilitated immediately after pipe construction is completed.

4.2.4 **Rehabilitation**

- After removal of the pipeline, the area should be contoured and raked only in the newly disturbed areas affected by the activities of removing the pipe. In places where the pipe is completely buried, it should be considered to leave it buried and not to renew the damage to the surface.
- If the temporary pipeline follows this route and the permanent pipeline will follow the same route, no rehabilitation will be required after removal of the temporary pipeline besides the post-construction levelling and mitigation of the permanent pipe.

5. Summary of impacts, mitigation and rehabilitation

Southern Pipeline Route (Temporary): Rössing-Trekkopje

Factor	*Nature*	*Intensity*	*Duration*	*Extent*	*Phase*	*Probability*	*Significance*	*Mitigation potential*
Plants on Ridges	-	***M***	***L***	***L***	***CON/O/C***	***D***	***M***	***M***
Plants in Washes	-	***M***	***L***	***L***	***All***	***D***	***L***	***L***
Lichens and BSC on plains	-	***H***	***L***	***L***	***All***	***D***	***M***	***L***
Trees	-	***L***	***S***	***L***	***Con/O/C***	***P***	***L***	***L***
Game migration	-	***L***	***S***	***L***	***Con/O/C***	***P***	***L***	***H***
Game poaching	-	***L***	***L***	***L***	***All***	***L***	***M***	***H***

Western Pipeline Route (Permanent): Wlozkasbaken-Trekkopje

Factor	*Nature*	*Intensity*	*Duration*	*Extent*	*Phase*	*Probability*	*Significance*	*Mitigation potential*
Lichens and BSC on plains	-	***H***	***L***	***L***	***All***	***D***	***M***	***L***
Plants on Ridges	-	***L***	***L***	***L***	***CON***	***L***	***M***	***L***
Plants in Washes	-	***L***	***L***	***L***	***CON***	***L***	***L***	***L***

6. Discussion and recommendations

In comparing the two routes for water pipelines, we are much in favour of establishing only one of these two routes, i.e. that the permanent pipeline is along the same route as the temporary pipeline. We suggest this because of the considerable damage even a temporary pipeline causes. In comparing the two routes, the western route (Wlozkasbaken to Trekkopje) is very favourable to the southern route (Rössing to Trekkopje). The western route avoids most areas of high sensitivity, while the southern route crosses many of these. The most pronounced impact of the western route is the area of biological surface crust, including lichen, affected by the pipeline, but this merely slightly widens the existing impact of the road. If the temporary pipeline follows the same route as the permanent pipeline, no new impact will be incurred. By contrast, there are many problems associated with the southern route and a very strict environmental management programme will be required to mitigate and rehabilitate a complexity of factors. The damage is considerable and long-term, and we consider unwarranted for such a temporary project.

We therefore strongly recommend against the use of the southern route for a temporary pipeline. We recommend that a temporary and a permanent pipeline follow the same route from the west (Wlozkasbaken to Trekkopje).

Another alternative that should be seriously considered during the mining test phase is not to locate the leaching pad within EPL2214, but to locate it at a place closer to a source of water, e.g. east of the Rössing reservoir. This would increase traffic across one of the existing access routes to Trekkopje, and would require selection of another 15-ha area as a leaching pad (a separate EA should cover this). However, it would avoid the dual impact of a temporary pipeline and of a leaching pad at a sensitive place inside the EPL (the latter is covered by a separate report). While we currently do not have enough information to firmly recommend this alternative, we do recommend that it be considered in the planning.

7. <u>Environmental management programme (to be written)</u>

- Selection of precise route of pipe (in detail together with technical experts)
- Dealing with plants of special significance
- Dealing with archaeological items

- Construction crews: toilet, remove all rubbish, no collection of wood, plants, animals, artefacts, camps to be off-site (e.g. Arandis/Wlozkas)
- ORV discipline
- Pump houses, including toilet, waste management.
- Inspection and compliance during construction, operation and post-closure (of pipeline).

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