Aquatic Biodiversity Assessment

Proposed Maintenance Management Plan for Laingsburg to Droerivier 132 kV Overhead Line, Western Cape.

Prepared for Zurtari (Pty) Ltd by Dr. Jackie Dabrowski

Confluent Environmental (Pty) Ltd

confluent
aquatic consulting & research

Tel: 083 256 3159
Email: jackie@confluent.co.za

DECLARATION OF CONSULTANTS INDEPENDANCE

I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);

• At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity;

• Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being members of the general public;

• I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse any proposed developments, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data;

• I do not have any influence over decisions made by the governing authorities;

• I undertake to disclose all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by a competent authority to such a relevant authority and the applicant;

• I have the necessary qualifications and guidance from professional experts in conducting specialist reports relevant to this application, including knowledge of the relevant Act, regulations and any guidelines that have relevance to the proposed activity;

• This document and all information contained herein is and will remain the intellectual property of Confluent Environmental. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigators.

• All the particulars furnished by me in this document are true and correct.

Jackie Dabrowski (Ph.D., Pr.Sci.Nat. *Aquatic Science*)
SACNASP Registration Number 115166
Co-director: Confluent Environmental (Pty) Ltd

Qualifications: BSc, BSc Honours (Entomology), MSc & PhD (Veterinary Science)

Expertise: > 13 years' experience working on aquatic ecosystems across South Africa, with a focus on the Southern Cape in the last 7 years. Includes research and consulting expertise, having published > 10 water-related research articles and compiled > 450 aquatic specialist reports. Research and consulting have been in a range of sectors including agriculture, urban developments, linear structures, renewable energy, conservation, and mining.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Confluent Environmental Pty (Ltd) were appointed by Zutari to provide aquatic specialist inputs to a proposed Maintenance Management Plan (MMP) required to undertake maintenance work to the 132KV distribution line between Laingsburg and Droerivier sub-stations. This covers an estimated length of 200 km and is located in the Western Cape Province.

As the line is entirely located within the Great Karoo most of the watercourses crossed are non-perennial with intermittent flows and periodic flash flooding following significant rainfall. The line is approximately 200 km in length and crosses many watercourses (Figure 1). As such the application for maintenance of the line requires the inputs of an aquatic specialist in terms of both the National Environmental Management Act (NEMA; Act 107 of 1998) and the National Water Act (NWA;Act No. 36 of 1998).

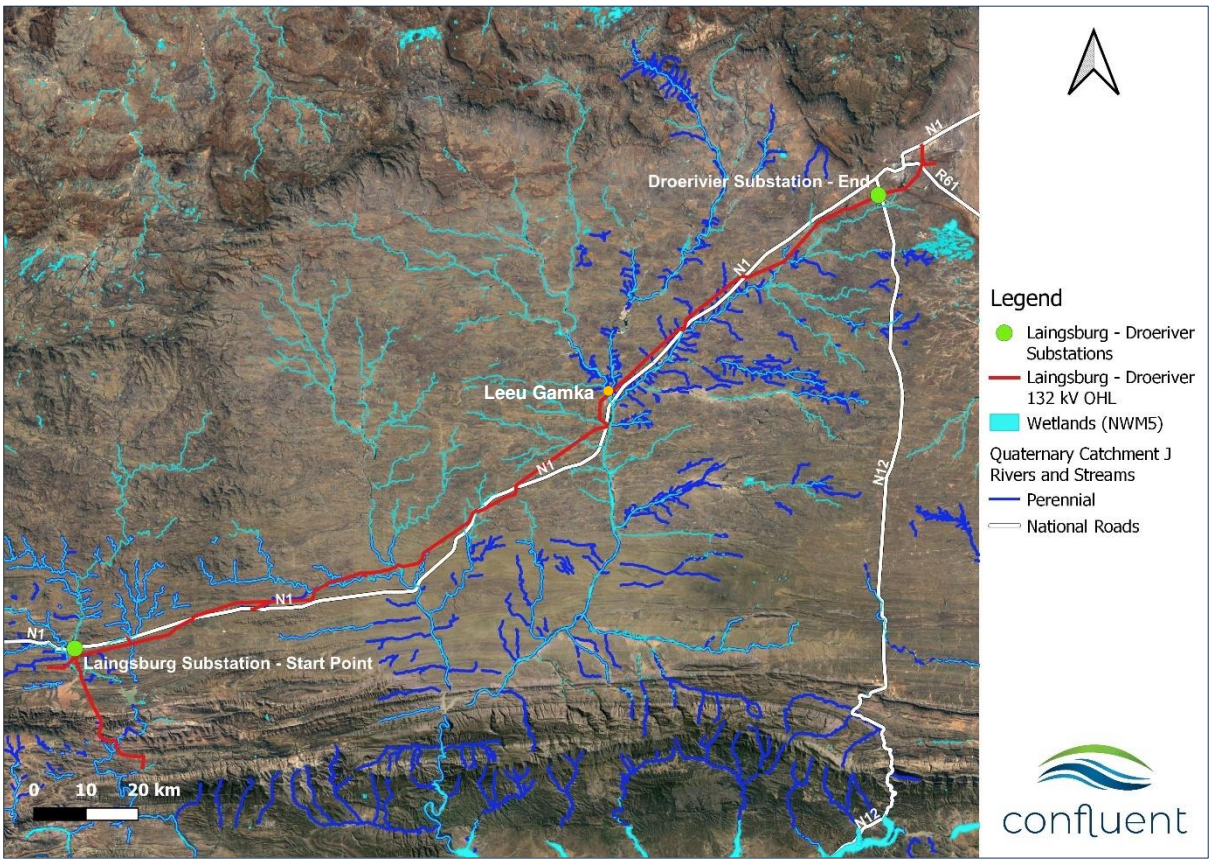

Figure 1. Overhead distribution line shown from Laingsburg (West) to Droerivier (East) Substations. The town of Leeu Gamka where significant maintenance is required is indicated.

1.1 The Proposed Maintenance

Sections of this line were commissioned in the 1960s and now require urgent maintenance in the region of the Leeu Gamka. Other sections may require similar maintenance in future as the area is prone to damaging winds and flooding. An assessment of the condition of structural aspects of the pylons indicates that the earthing (tower footing) of several pylons may require reinforcement or reconstruction (Table 1 & Figure 2). Work will take place within a 32 m servitude along the distribution line.

Table 1. Asset health index (supplied by Eskom) for pylon structures along the Laingsburg-Droerivier distribution line. Note poor scores (D) for earthing.

Smallworld Location Description	Tower (steel, concrete, woodpole)	Year commisioned	Asset health index								
			Foundation	Earthing (tower footing)	Tower (steel, concrete, woodpole)	Phase Conductor / jumpers	Line hardware (dampers etc)	Insulators and hardware	Earthwire	Score	Rating
BOTESLAND TRACTION / WELTEVREDE TRACTION 1 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B
BOTESLAND TRACTION / WELTEVREDE TRACTION 2 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B
DROERIVIER / STEINS TRACTION 1 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B
DROERIVIER / STEINS TRACTION 2 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B
LEEU GAMKA / LUTTIG TRACTION 1 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B
LEEU GAMKA / LUTTIG TRACTION 2 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B
LEEU GAMKA / WELTEVREDE TRACTION 1 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B
LEEU GAMKA / WELTEVREDE TRACTION 2 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B
LUTTIG TRACTION / STEINS TRACTION 1 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B
LUTTIG TRACTION / STEINS TRACTION 2 132kV OVERHEAD LINE	Lattice	1963	B	D	A	B	B	B	B	78.75	B

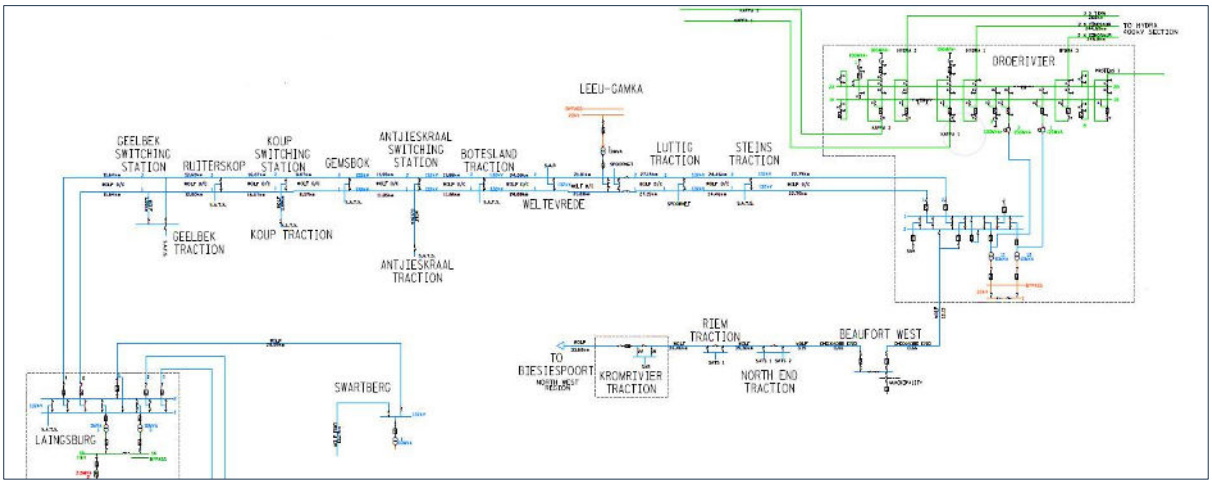

Figure 2. Schematic layout of the powerline indicating sections referred to in Table 1.

Urgent maintenance is required in the vicinity of Leeu Gamka where wind damage to pylons that were constructed over 60 years ago requires urgent maintenance. Four pylons collapsed due to high winds in February 2024 causing a power outage in the area and an emergency response to try and undertake repairs. The previous installation was not compliant with the current South African National Standards (SANS) line design requirements. Details of the proposed maintenance required involves the following steps:

- Emergency temporary pylons were erected to maintain power until permanent pylons are approved and erected.
- A section of 1.8km long with 4 pylons failed due to wind damage. This section will be replaced with 6 pylons. The increase in number of structures is to comply with current SANS standards by reducing load and the risk of failure in an area with very high winds (Figure 3).
- Lattice structures will be replaced with monopole towers which have a smaller footprint.

The work will predominantly be in the vicinity of the Koekemoer's River which is crossed by the line (Figure 3). This river joins the Leeu River approximately 300m downstream from the line crossing.

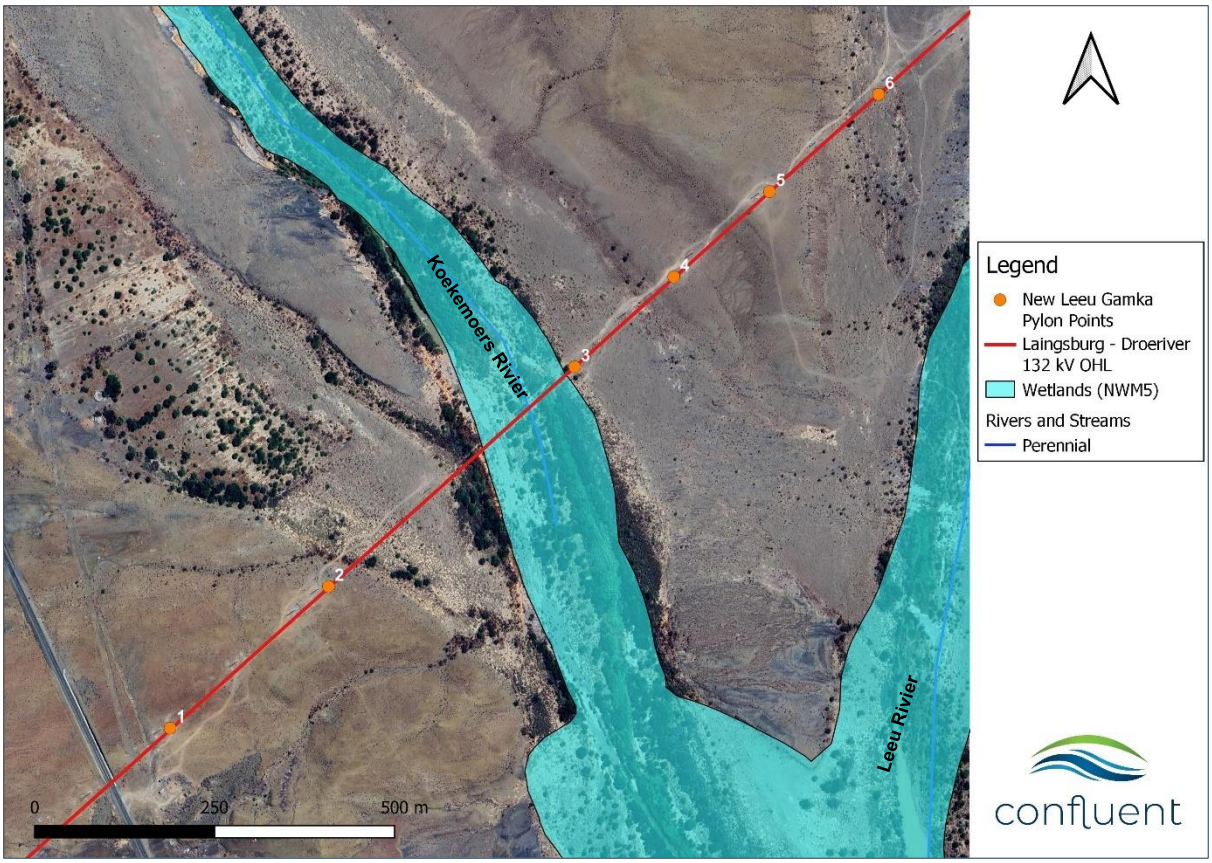

Figure 3. Location of proposed new pylon locations in Leeu Gamka with corresponding explanation in Table 2.

Table 2. Summary of proposed relocation points to replace 4 pylons with 6 pylons along the existing distribution line in Leeu Gamka. Refer to Figure 3 for the location of pylons.

Pylon Number	Description
1	New pylon located 20 m east of original foundation
2	New pylon located 5 m east of original foundation
3	New pylon located 40 m east of original foundation (out of mapped watercourse)
4	New additional tower
5	New pylon located 30 m west of original foundation
6	New additional tower

As can be seen by the example of required maintenance for the Leeu Gamka section of the line, typical work might require the replacement / addition / removal of pylon structures and associated stringing of lines. This may take place in the vicinity of watercourses or other sensitive habitat. Eskom has provided a scope of work for typical maintenance work anticipated (Appendix 1). This work is summarised as follows:

- Site establishment which may involve the clearance of trees and other vegetation.
- Operation of vehicles (trucks, bakkies) and heavy machinery at the maintenance site.
- Access to maintenance sites by vehicles (trucks and bakkies) and heavy machinery.
- Access on foot by construction / maintenance teams to the maintenance site.
- Excavations, earthworks, mixing and pouring concrete for foundations.

- Laying out, assembling, and erecting pylons / poles.
- Stringing high voltage cables.
- Dismantling would involve the above processes in reverse.
- Removal of all waste products from the site.

1.2 Guiding Principles for Maintenance Management

This MMP is prepared using the guiding principles for landowners and managers considering the development of a MMP as provided in the MMP template for a watercourse (2017). These are summarised as follows:

- Avoid and reduce unnecessary maintenance.
- The condition of physical and ecological processes that drive and maintain aquatic ecosystems in a catchment must inform a MMP relative to the desired state of the affected system.
- Management actions must aim to prevent further deterioration to the condition of affected watercourses and, overall, be guided by a general commitment to improving and maintaining ecological infrastructure for the delivery of ecosystem services; and
- Managers and organs of state must identify, address and, where feasible, eliminate the factors that necessitate intrusive, environmentally damaging maintenance.

1.3 Relevant Legislation

1.3.1 National Water Act

The authorisation of Section 21 c) and i) water use as defined in the National Water Act (Act No. 36 of 1998) is regulated in terms of Government Notice (GN) 4167 of December 2023. This legislation has a specific exclusion for maintenance required by Eskom for power lines. In Appendix D2 it is stated that certain activities qualify for a General Authorisation and do not require completion of a Risk Matrix provided the activity meets the following criteria:

ACTIVITIES
Construction of new overhead transmission and distribution power lines outside the active channel of a river and/or outside the extent of a wetland, and **minor maintenance** of roads, river crossings, towers and substations where footprint will remain the same. The maintenance or replacement of existing overhead and underground cables where it is done in terms of the Emergency Protocol. However, New underground cables and underground and overhead cables within the extent of a wetland must be subjected to the Risk Matrix and are therefore excluded from this appendix.

It is therefore anticipated that no Risk Matrix will be necessary for this assessment and that the applicant (Eskom) will be able to apply for the Section 21 c) and i) water uses under a General Authorisation.

1.4 Scope of Work

The scope of work covered by this MMP incorporates aspects assessed during both desktop and field assessments. The following points were covered for each:

Desktop Assessment

- Review of flood-prone areas in the lower reaches of the Bigai River known to cause access problems for the local community.
- Review of methods proposed to alleviate flooding by the Knysna Municipality and the Knysna Golf Club. Reports listing infrastructure requiring maintenance were provided along with proposed methods to improve flood conveyance.
- Review previous reports compiled by engineering / environmental consultants on flooding in the Bigai River.
- Desktop assessment of affected areas using spatial data such as contours, mapped watercourses, conservation plans and historical aerial images.

Field Assessment

- Visually inspect flood-prone areas and problematic infrastructure where maintenance actions are proposed.
- Collect and analyse water samples to determine baseline water quality at key points.
- Consider proposed maintenance actions in the context of existing impacts affecting watercourses.

Report Compilation

- Compile a Maintenance Management Plan which provides clear, measurable and time framed maintenance measures to address flooding within the ambit of an MMP.
- Where work in Regulated Area of a watercourse is undertaken (as defined in the National Water Act) a Risk Matrix will be compiled to determine the level of risk posed by the maintenance actions to the watercourse concerned.

This MMP excludes the expansion and/or relocation of any structures and infrastructure as per the definitions provided in NEMA.

1.5 Assumptions and Exclusions

- Specific details of all future maintenance and management actions required along the line were obviously not available for assessment. Maintenance by definition is a management action in response to an event or failure, or an action required to prevent an event or failure from occurring. While every effort was taken to anticipate a wide range of scenarios, it is possible that some maintenance actions were overlooked or not foreseeable.
- Given the extensive length (200km) and limited access to the full length of the distribution line, it was not possible to access the full line at every watercourse crossing. However, representative watercourse crossings were accessed where feasible at multiple points along the distribution line. A drone was flown at various points to gain a better aerial perspective on watercourse crossings and typical watercourses of the area. The full extent of the line to be maintained at Leeu Gamka was assessed by foot and using a drone where access was limited.

- Some sites were not accessed because the only tracks available were across private property. Landowner permission to access the powerline route over such a great distance would be an onerous task and was considered unnecessary as enough representative watercourse crossings were accessible.

2. CATCHMENT CONTEXT

2.1 Catchment Features

The distribution line crosses multiple quaternary catchments between Laingsburg and Droefontein which are mostly located in Secondary catchment J2 with some towards Laingsburg in J1 (Figure 4). The entire distribution line is located in the Breede-Olifants Water Management Area (WMA). For the most part the gradient is very flat with some areas of low, undulating hills. The power line runs parallel to the N1 highway for most of the route, crossing the highway at various points. Mean Annual Rainfall is around 120 mm/a which can fall in isolated thunderstorms predominantly during summer with a minor peak in March (Figure 5). According to the wind rose for Leeu Gamka the predominant wind direction is from a south-easterly direction which is also where the strongest winds come from (Figure 6).

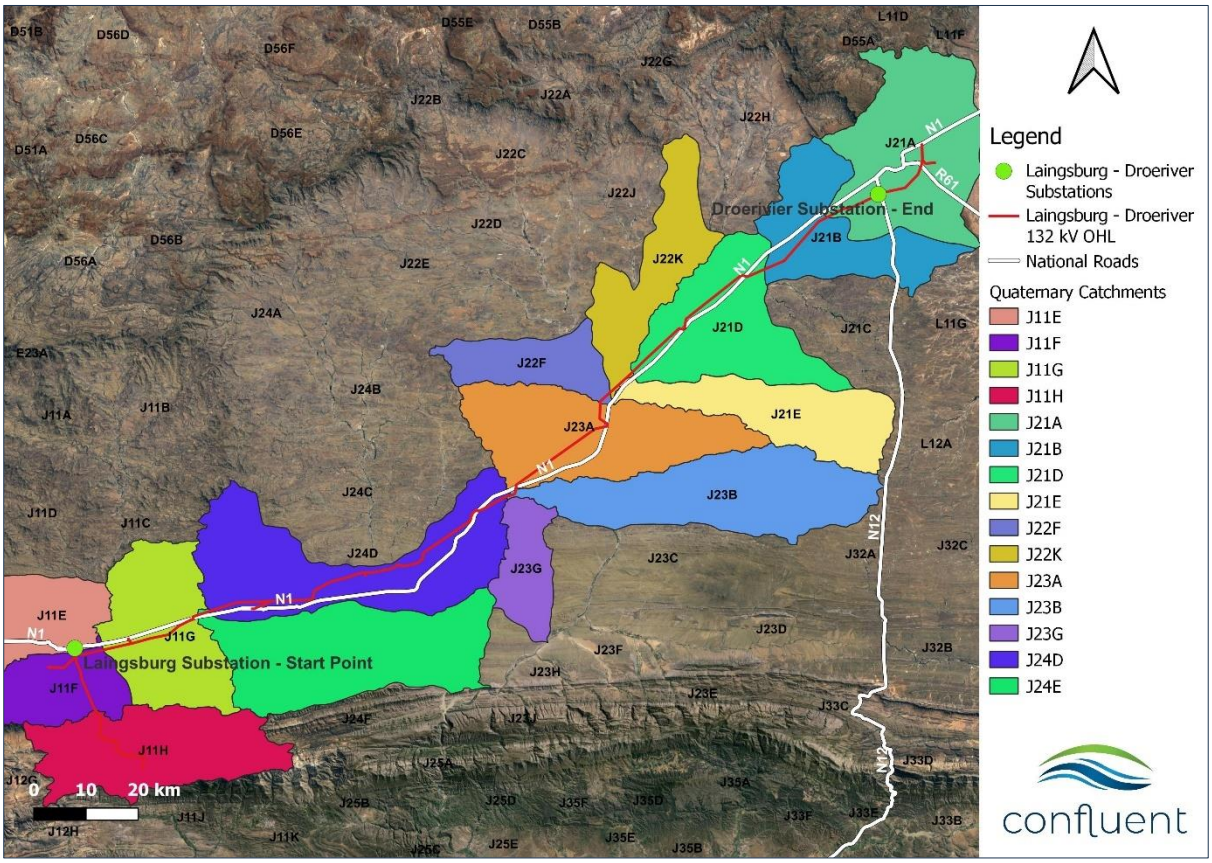

Figure 4. Quaternary catchments crossed by the power line between Laingsburg and Droefontein Substations.

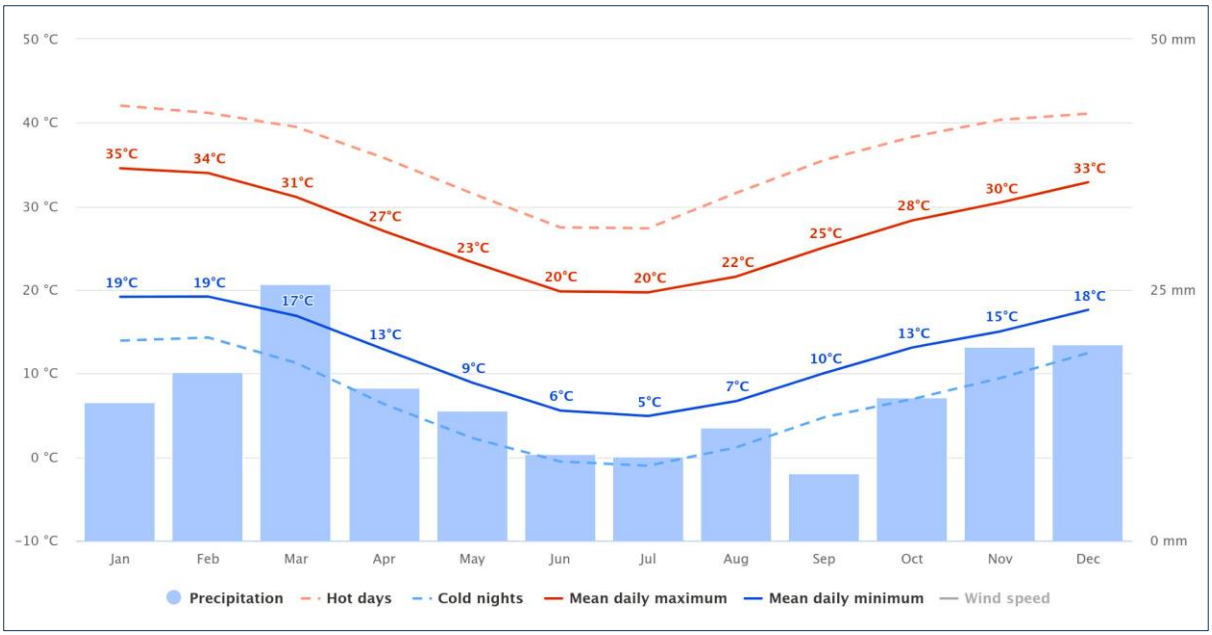

Figure 5. Monthly average temperatures and rainfall for Leeu Gamka (meteoblue).

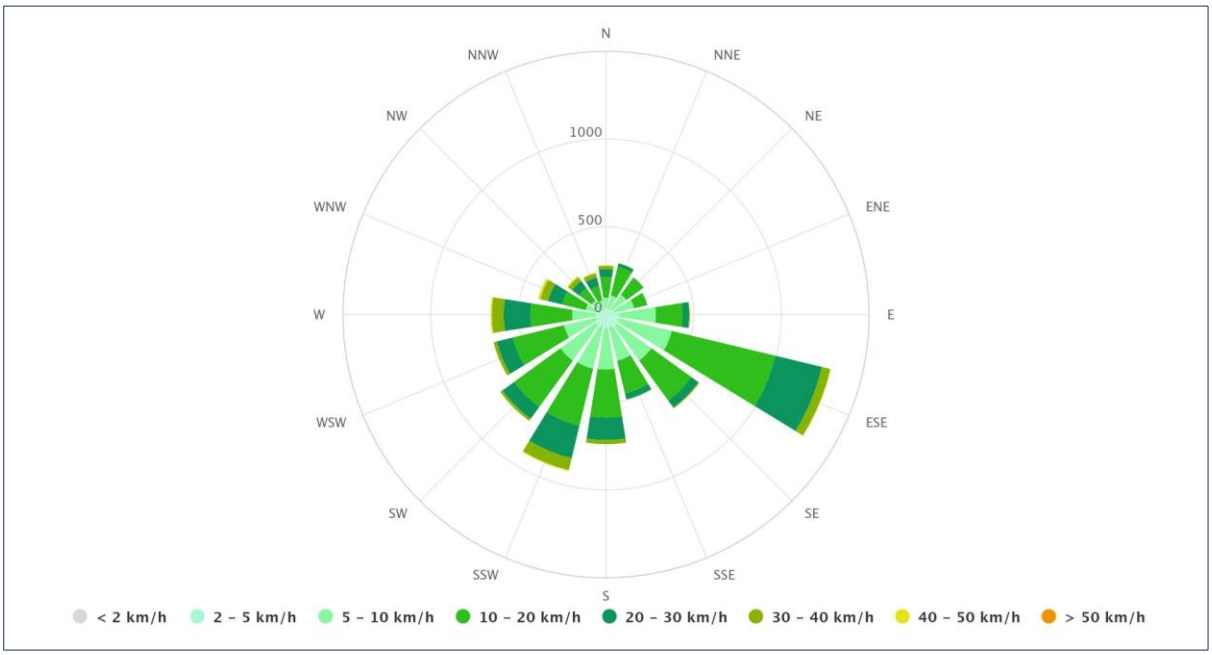

Figure 6. Wind rose for Leeu Gamka showing how many hours per year the wind blows from the indicated direction and predominantly at what speeds (meteoblue).

2.2 Vegetation

Mapped vegetation types are relatively uniform across the length of the distribution line with only four different types. The most common type is Gamka Karoo, and the larger watercourses area associated with Southern Karoo Riviere vegetation. Towards Laingsburg the vegetation is mapped as Kodoesberge-Moordenaars Karoo (Figure 7). None of the mapped vegetation types are considered threatened ecosystem types according to GN 4727 of 2022, The Revised National List of Ecosystems that are Threatened and in Need of Protection.

From an aquatic perspective, the Southern Karoo Riviere vegetation is most significant. In riparian thickets dominant tree species are *Vachellia karroo* and *Searsia lancea* with shrubs dominated by thicket species such as *Diospyros lycioides, Tamarix usneoides, Euclea undulata, Grewia robusta* and *Gymnosporia buxifolia*. Where grasses are dominant the typical species is Stipagrostis namaquensis and reed beds are dominated by *Phragmites australis*.

Where disturbance occurs, this vegetation type is vulnerable to alien invasion by *Agave americana, Opuntia sp., Prosopis sp., Salix babylonica* and *Schinus molle.*

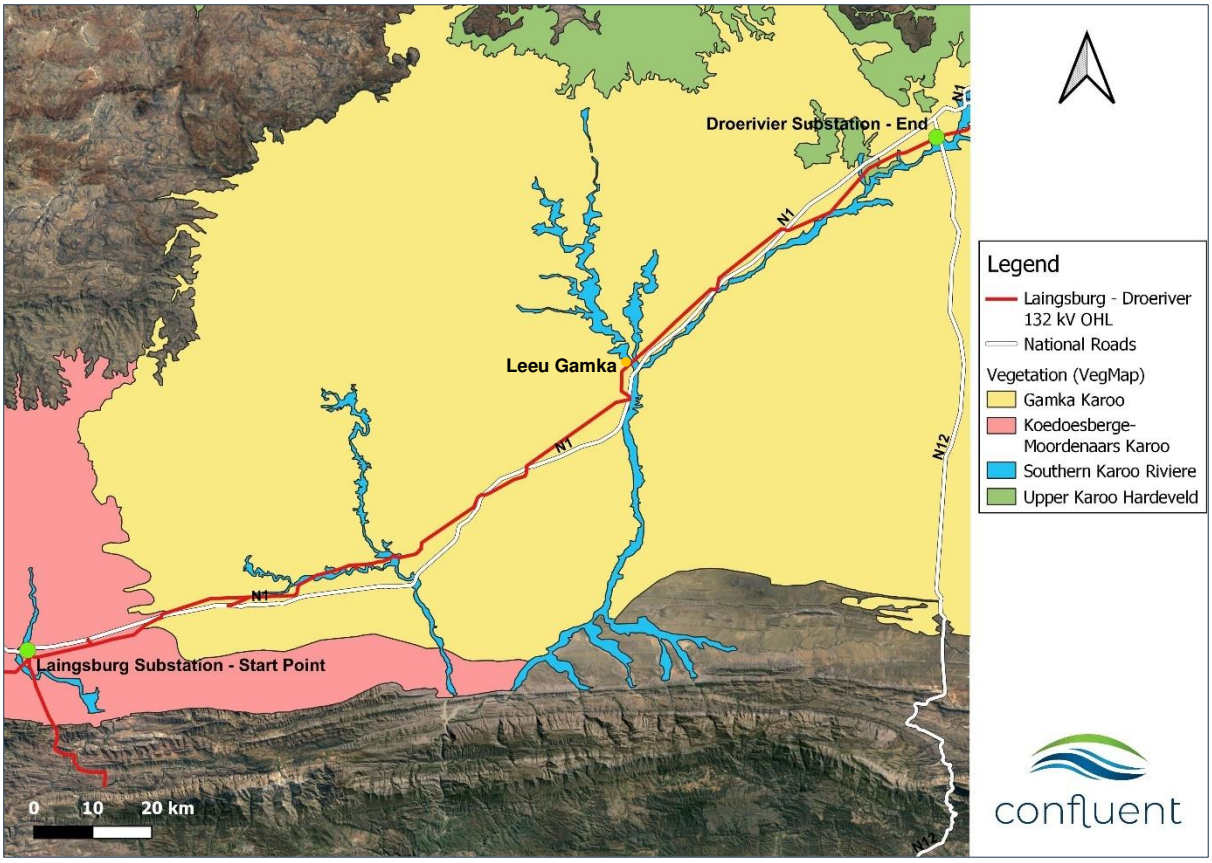

Figure 7. Mapped vegetation along the distribution line according to VegMap (2018).

2.3 Conservation and catchment management

2.3.1 WCBSP

The Western Cape Biodiversity Spatial Plan (WCBSP; 2017) indicates the majority of larger watercourses (wetlands and more significant rivers), including the watercourses through Leeu Gamka, as Critical Biodiversity Areas (CBA1).

Necessary actions in relation to the WCBSP are to ensure that maintenance actions at these sites do not result in negative impacts to ecological structure and function of watercourses in close proximity. It is important to note that the management objective for CBA 1 areas is to rehabilitate any degraded areas in order to maintain them in a natural or near-natural state (Table 3).

Table 3. Definitions and objectives for conservation categories identified in the Western Cape Biodiversity Spatial Plan (WCBSP, 2017).

WCBSP Category	Definition	Management Objective
Critical Biodiversity Area 1 (CBA1)	Areas in a natural condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of natural habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land uses are appropriate.

2.4 Mapped Watercourses

Mapped watercourses were restricted to wetlands and perennial flow paths because once the non-perennial flow paths were added to the map it was impossible to distinguish any of the more significant watercourses (Figure 1). This is because small flow paths (1-2 m wide) are extremely prevalent in the Karoo. Many of these small flow paths interconnect to form larger paths, but may also never join any other significant watercourse, disappearing instead into the groundwater system via infiltration through well drained soils.

Approximately five significant watercourses are crossed by the line. From west to east these are the Bloed, Dwyka, Klip, Koekemoers and Leeu Rivers (Figure 8). These crossings are highlighted because these flow paths drain catchments of a significant area and are will likely carry higher flows at a greater frequency than smaller systems. Their channel widths and riparian zones are also substantially larger than typical watercourses crossed by the line.

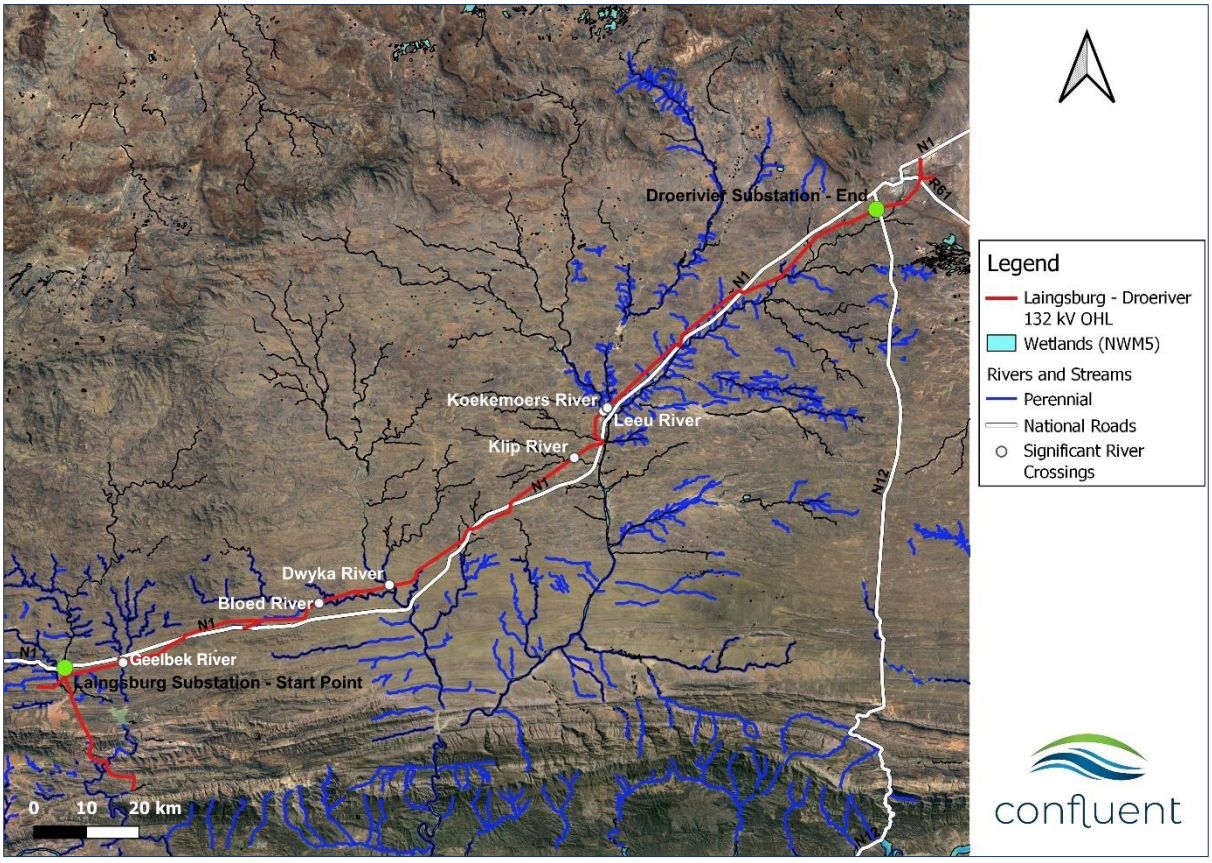

Figure 8. Mapped perennial flow paths and wetlands indicating significant river crossings along the distribution line route.

2.5 Historical Assessment

Historical aerial imagery was not available from CD:NGI as this service had been offline for several months at the time of writing. Google Earth was therefore used to view the impact of maintenance actions to date at Leeu Gamka as a reasonable indication of the future impacts of maintenance. The comparison between 2021 and 2024 is mainly distinguished by the creation of a new dirt track along the power line, with circular sections around each of the temporary power lines that needed to be erected (Figure 9). What is also highly noticeable in these two images is the increased density of vegetation along the Leeu River in 2024, highlighting the dynamic nature of the riparian zone. This could be related to encroachment by aliens, but the Koekemoer's River had very little alien vegetation, so is more likely to be fast-growing *Vachellia Karoo* and/or *Searsia Lancea*.

Figure 9. Comparative satellite image of the Koekemoer and Leeu Rivers at Leeu Gamka showing the landscape before maintenance (2021, left) and during maintenance when a dirt track became evident along the line (Feb 2024, right).

At the Geelbek River the western pylon is on the edge of the riparian zone, while the eastern pylon is located in dense vegetation in a drainage line with limited access (Figure 10). There are an additional 2 or three pylons in this drainage line. Should these pylons ever need replacement, they should be moved out the drainage line to a more accessible alignment and out of the drainage line. It must be noted that while the drainage line wasn't inspected during the site visit, it is more than likely that it seldom (If ever) experiences flowing surface water. Water movement is likely via interflow, but this can still impact pylon foundations. There is some minor soil disturbance around the substation near the western pylon in 2003, but apart from altered channel morphology and sediment deposition the site appears similar in 2024 to 2003.

Figure 10. Pylons at the crossing for the Geelbek River located showing the eastern pylon in a densely vegetated watercourse in 2003 (left) and 2024 (right).

Pylons that support the crossings of the Bloed and Dwyka Rivers are located outside of any channels or riparian vegetation. Apart from slight alterations in the river meanders, these points have remained relatively unchanged in recent years (Figure 11 and Figure 12).

Figure 11. Comparative image of the distribution line crossing at the Bloed River indicating closest pylons (yellow pins) in 2005 (left) and 2024 (right).

Figure 12. Photos of the Dwyka River indicating pylons (yellow pins) in 2018 (left) and 2024 (right). Infrastructure crossing the riverbed is the railway line.

The crossing at Klip River, southwest of Leeu Gamka, is the only one of the larger drainage lines where the pylons could be better located. The southern one is in the riparian zone although not close to the channel, and the north-eastern pylon is possibly located in an overland wash zone, although these are not defined as a watercourse in terms of the NWA.

This may however render the pylon more susceptible to erosion or destabilisation of the foundations.

Figure 13. The Klip River indicating the two nearest pylons at the crossing (yellow pins) in 2003 (left) and 2024 (right).

3. SITE ASSESSMENT

3.1 Site Visit

The site assessment was completed on 5 September 2024 which is considered Spring. The direction of travel was from Laingsburg to Droerivier travelling mostly on the N1 with detours wherever feasible to access the distribution line, mainly using secondary roads and farm tracks. As the focus was on watercourse crossings specifically, attempts were made to view at least each of the major watercourse crossings either at the point of the distribution line crossing or upstream / downstream from points where the N1 crossed the watercourse. The weather was sunny but fairly windy which prohibited the use of the drone in some areas.

A series of photos is provided in this section as an indication of key points along the power line route and to demonstrate relevant impacts or features related to watercourses at present.

At every point the power line was observed crossing watercourses the pylons were located outside of channels or direct flow paths and for the most part were not located in riparian zones (Figure 14). This was also observed in the satellite imagery for most of the larger river crossings, except for the Klip River (Figure 13). Vehicle access to the line and pylons is difficult or impossible in many areas, meaning that any maintenance would require the creation of new tracks (Figure 14).

Figure 14. Typical power line route (dashed line) approximately 50 km east of Laingsburg across an unnamed tributary of a medium-sized drainage line. Pylons are indicated outside of watercourses and riparian zones and access is very limited for maintenance with no clear existing tracks (Coordinates: 33° 4'31.23"S, 21°25'42.52"E)

The Geelbek River had some minor flow streams at the time of the site visit and has a wide river bed of mobile sands. The riparian zone is extensive and dominated by *Vachellia Karoo* trees (Figure 15).

Figure 15. River channel (left) and typical riparian zone (right) of the Geelbek River. Photos taken about 1km upstream of the actual power line crossing which was only accessible across private land.

Figure 16. Examples of minor to moderate drainage lines crossed by the power line (Coordinates: 33° 6'43.81"S, 21°16'36.62"E (left) and 33° 5'39.34"S, 21°22'1.67"E (right)).

Figure 17. Bloed River crossing point showing the river bed which had minor streams of flowing water containing tadpoles, and numerous animal tracks along the bed. This highlights the importance of river beds for wildlife movement and habitat in the broader landscape.

At Leeu Gamka the only pylon proposed near the edge of the riparian zone is Pylon 3 and the location is located further beyond (east) of the riparian vegetation, which is a positive factor as it will mean reduced habitat disturbance. The Koekemoer's River had the strongest flowing water of all the rivers assessed during the site visit with clear water that appeared to have minimal impacts. A new track created to access the line for emergency repairs has a minimal impact at small drainage line crossings but there is evidence that tracks could be further minimised by ensuring only a single track is used, instead of creating additional unnecessary tracks (Figure 18).

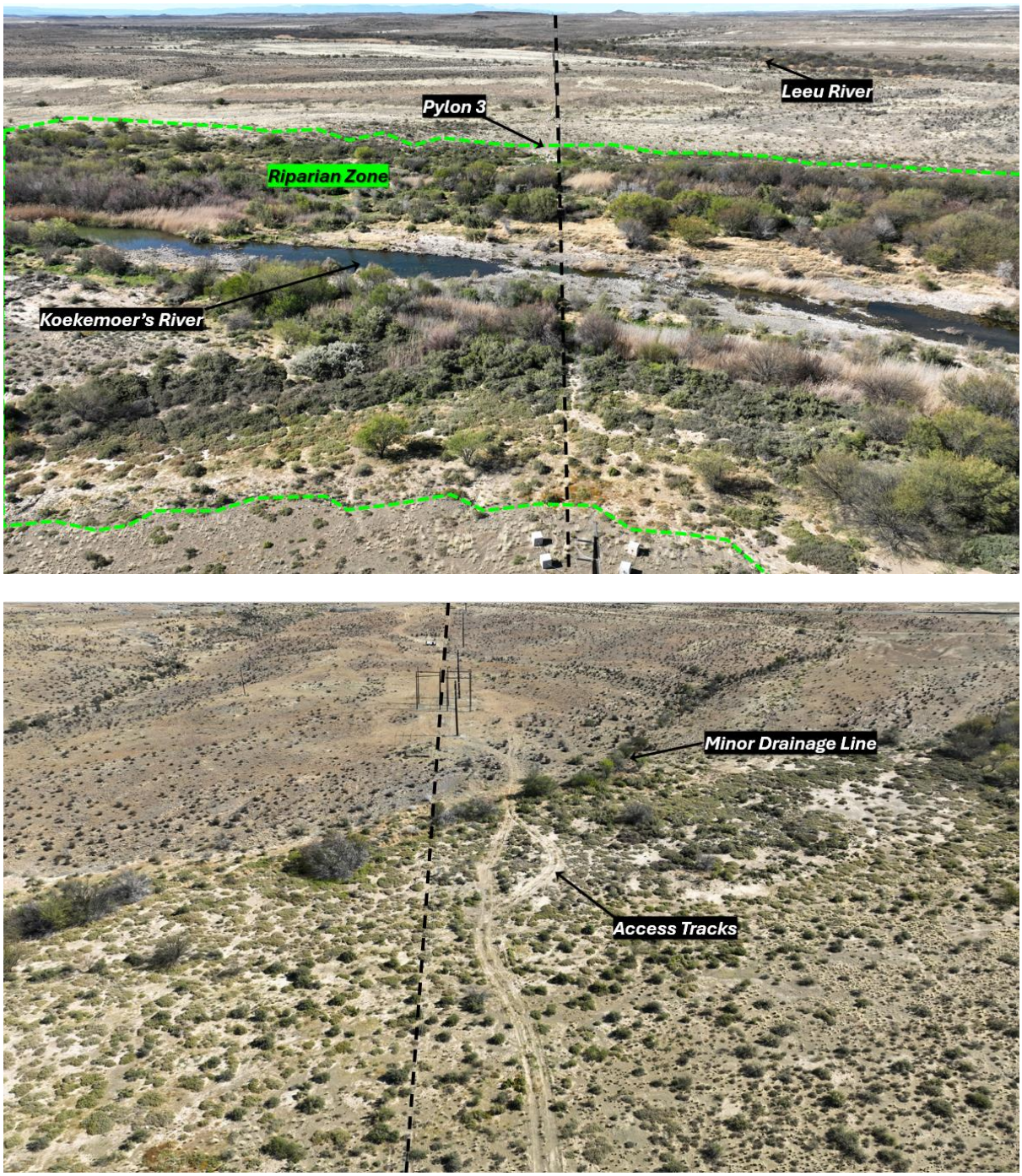

Figure 18. Annotated drone photos of relevant points at Leeu Gamka. Dashed black line indicates the power line in all photos.

Although not located in the riparian zone, the disturbance footprint to erect a temporary pylon on the edge of riparian vegetation was checked in terms of its extent (Figure 19). The width of the servitude is 32 m and the extent of vehicle tracks around the pylon was 36 m wide. Therefore, steps must be taken to ensure the disturbance footprint is kept within the servitude area and minimised as far as possible.

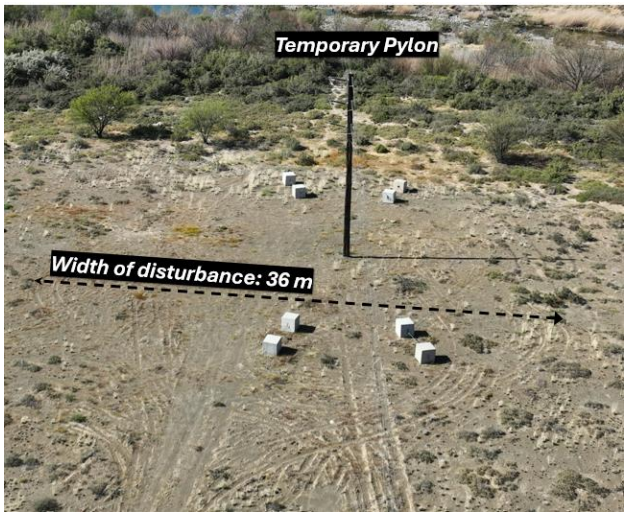

Figure 19. Temporary pylon adjacent to the riparian zone of the Koekemoer's River showing the width of disturbance (vehicle tracks and disturbed/cleared vegetation).

3.2 Watercourse Classification & Delineation

The classification of each watercourse at every crossing of the power line is an impossible task given the length of the powerline and the high number of mapped watercourses. However, given the author's experience in this region along with observations of satellite imagery and observations during the site visit, the majority of watercourses would be classified as **rivers/streams with intermittent flows** (Ollis *et al.,* 2013). In most cases therefore, the extent of the regulated area of the watercourse would be defined by the edge of the riparian zone, or the 1:100 year floodline, whichever is greater (NWA). In the absence of floodline data which was not available to the author and may never have been calculated even for larger rivers along the power line, the riparian zone can be used to guide when work is being undertaken in the regulated area of the watercourse.

According to Ollis *et al*. (2013), the active channel is the portion of a river that is inundated regularly enough to maintain channel form and keep the channel free of terrestrial vegetation. The riparian zone is the area of land directly adjacent to the active channel which has notably more dense vegetation of a different species composition to surrounding land. Even river beds containing beds of *Phragmites australis* may not be classified as wetlands. It is not uncommon for river channels to become vegetated in the arid regions of South Africa. This is due to non-perennial or weakly perennial flow regimes. Ollis *et al*. (2013) state that while these systems at first glance may appear to be unchannelled valley-bottom wetlands, the presence of channel banks and evidence of periodic, concentrated water flow within the channel distinguish them as rivers.

As observed from historical imagery, the larger rivers can have braided channels which are dynamic due to sediment movement and deposition during floods. It is therefore important that all powerlines be kept out of any active channels or floodplains (Figure 20).

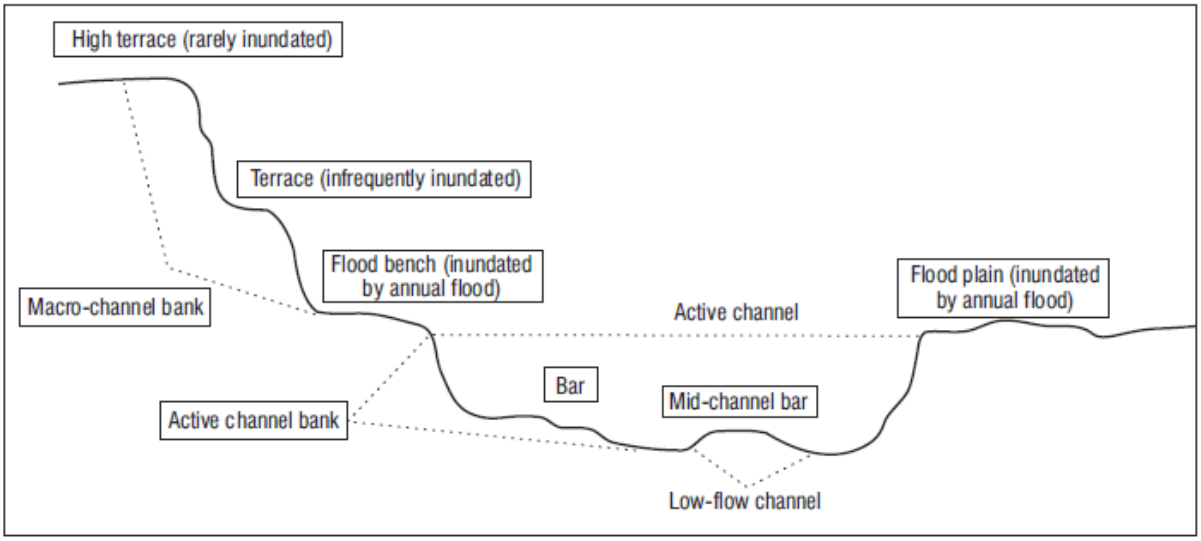

Figure 20. Cross-section of a river channel showing typical features of channel morphology.

An example of delineated riparian zones from various watercourses in the study area is provided in Figure 21. Watercourse A has multiple small braided channels while B has a more distinctive large channel. Delineation of the riparian zone in both A and B included areas of distinctly lighter coloured soils which are discoloured due to water movement. Watercourse C is more like an alluvial wash because it doesn't have a distinct channel but is not a wetland either. It is and area where water moves rapidly through and across the soil surface as sheet flow but does not form a channel until sufficient flow downstream creates a concentrated flow path. It is also preferable to minimise work and structures in alluvial washes as the movement of water makes them prone to erosion.

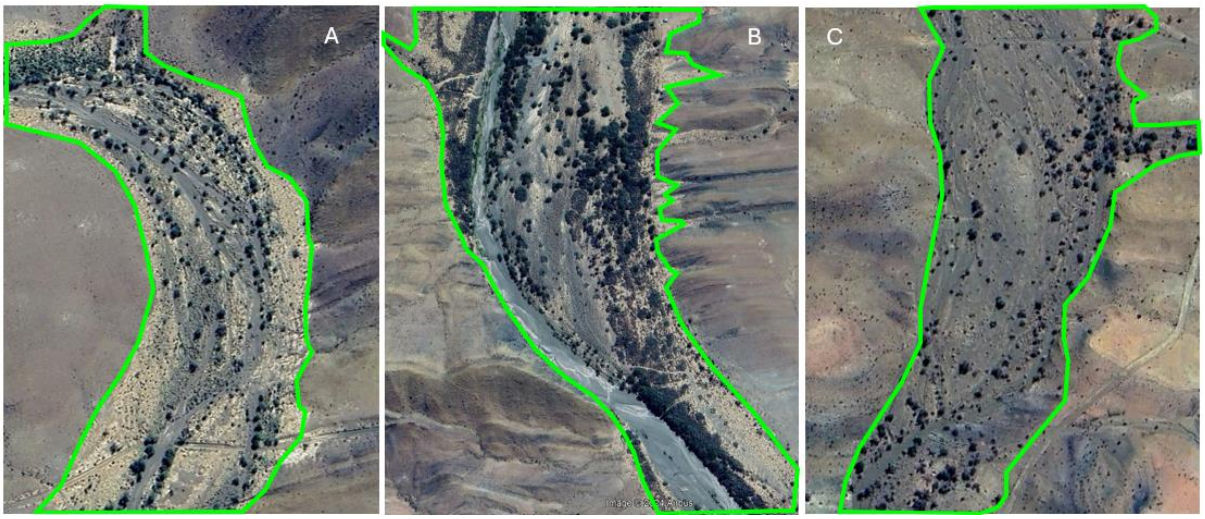

Figure 21. Examples of delineated riparian zones determined as the regulated area of the watercourse.

3.3 Watercourse Buffers

Buffers are not recommended in this instance because their primary function is to minimise the impacts of diffuse surface runoff from surrounding land uses that could impact water quality. This is typically related to agricultural land use. As far as possible, all work should be

kept out of the riparian zone, and any structures that must be moved or replaced (for maintenance) should be removed from the riparian zone.

3.4 Present Ecological State

All of the drainage lines and rivers assessed were in a good to excellent condition and would be rated as **A/B which is in a Natural to Largely Natural** condition according to the Index of Habitat Integrity. There are minor impacts such as alien vegetation, but only two species were observed during the site visit. One was an individual *Prosopis sp*. tree (Mesquite) and *Arundo donax* (Spanish reed) was observed at the Bloed River in a small area. Areas of more significant invasion including other species are likely present, but were not observed during the site visit. Additional impacts are mainly related to existing linear infrastructure including the N1 highway (and other road crossings) and the railway line which includes bridge crossings over the larger rivers. Given the remoteness of most of the rivers there is very little rubbish dumping and most litter is windblown. As there is no permanent water in most watercourses there are no alien invasive aquatic animals or macrophytes (aquatic plants) expected. In most cases the riparian vegetation is in a natural state and little to no erosion is evident.

Figure 22. Photos of some impacts typically affecting the Present Ecological State of watercourses crossed by the powerline.

4. MAINTENANCE & MANAGEMENT RECOMMENDATIONS

4.1 Aims and Objectives

The aim of this MMP is to ensure that any essential maintenance and management actions required along the Laingsburg-Droerivier powerline do not result in excessive, unnecessary or preventable impacts to aquatic ecosystems. Maintenance and management of the powerline must not result in a decline of the Present Ecological State of watercourses, many of which are almost pristine at present.

The objectives of this MMP are to provide contractors, Environmental Control Officers (ECO), regulators and managers with measurable, practical, and meaningful methods to reduce the impacts and risks associated with necessary maintenance of the powerline.

4.2 Maintenance Actions and Recommended Mitigation Measures

Typical maintenance actions were described in Section 1.1. Here, we describe the possible negative impacts associated with each of these actions (there may be some overlap) and provide mitigation measures which must be implemented to ensure negative impacts are avoided or minimised (as per the mitigation hierarchy).

It should be noted that mitigation measures are note merely suggestions or recommendations, they are required to ensure risks and impacts are minimised and must form part of the conditions of approval of the MMP. Their implementation becomes compulsory unless site-specific motivation can be provided that would render a mitigation measure impractical or impossible to implement. In that case an alternative mitigation measure that achieves the same outcome is acceptable and should be determined in consultation with the ECO and regulating authority.

Table 4. Maintenance actions and anticipated impacts with recommended mitigation measures for present and future work on the Laingsburg – Droerivier Powerline.

Maintenance Action	Potential Impacts	Mitigation Measures
PLANNING PHASE Site establishment which may involve the clearance of trees and other vegetation	- Excessive clearance/disturbance of riparian vegetation - Unnecessary access through riparian vegetation or riverbeds	- Appoint an ECO to assist with project planning. - Maintenance team and ECO to have read this entire report. - Define the maintenance area and actions required. - Delineate the extent of the Eskom servitude along the maintenance area. - Map any potentially affected watercourses (use Cape Farm Mapper to indicate wetlands and flow paths). - Delineate riparian zones as indicated in Fig. 21. - Desktop identification of an access route to the maintenance site that uses existing roads & tracks as far as possible. Use satellite imagery for this. Avoid crossing watercourses wherever possible. - If new tracks must be established, choose a route that minimises disturbance by going in a straight line underneath the power line except if driving around some vegetation instead of cutting it would be beneficial (within the servitude). - If possible, new tracks should be ground-truthed with a Light Duty Vehicle (LDV; bakkie) - Identify lay-down areas for materials outside of delineated riparian zones, floodplains or riverbeds. - The above maps, diagrams and delineations must be provided to the maintenance team manager (if different to the project manager) along with this report. - Discuss and confirm the type of vehicles that will be required for the maintenance. Select vehicles with the lightest footprint that can achieve the work required (a 4 x 4 vehicle is acceptable).
CONSTRUCTION PHASE Operation and access of vehicles (trucks, bakkies) and heavy machinery at the maintenance site.	- Excessive clearance/disturbance of riparian vegetation - Unnecessary access through riparian vegetation or riverbeds	- Check the weather report. Do not plan access that involves heavy vehicles or machinery during rainfall given the increased risk of erosion and flash flooding. Fortunately, low rainfall in the region means this is not common. - All vehicles must be checked to ensure they have no leaks and are fully operational. In rugged terrain, 4x4 vehicles may be required to ensure full mobility and to avoid vehicles getting stuck. - Prior to work commencing, the ECO/project manager must brief all drivers regarding minimising tracks, sticking to paths, avoiding watercourses and the extent

Maintenance Action	Potential Impacts	Mitigation Measures
		of the servitude. Drivers must be given copies of all maps, track routes, the servitude and watercourse delineations by the ECO. - Between pylon points a single track must be maintained with no deviation as far as possible. - At pylon points it may be necessary to work in a wider area. The extent of the Eskom servitude must be temporarily marked out (e.g. wooden pegs, not rocks as there are likely animals beneath them). - Vegetation that must be cleared should be trimmed or cut using handheld saws, clippers, or chainsaws. No soil disturbance or removal or roots using earthmoving equipment is permitted or should be necessary in the riparian zone. - Access to the maintenance site on foot is perfectly acceptable provided workers attempt to follow the same path all the time, and do not trample vegetation unnecessarily. Access on foot would be preferred to vehicles but depends on accessibility where feasible. - Vehicles such as puller-tensioners must be kept out of the riparian zone as far as possible.
CONSTRUCTION Excavations, earthworks, mixing and pouring concrete for foundations	- Pollution of water resources through sedimentation or concrete washoff.	- Excavators should work from beneath the powerline to minimise the footprint of compacting soil while digging. Ie. Work from the inside – out, not the outside in, as the latter might result in expanding the disturbance footprint beyond the Eskom servitude. - Concrete should not be mixed on bare ground. For small quantities it can be mixed in wheelbarrows, or on a piece of wooden board. - Water must not be taken from any watercourses for the purpose of concrete mixing or cleaning. - Dirty water cannot be discarded into any watercourse. - All excess concrete must be removed from the maintenance area for disposal at a registered waste site.
CONSTRUCTION Laying out, assembling and erecting pylons/poles	- Increased footprint of disturbance causing unnecessary habitat degradation in watercourses.	- Materials should be laid out beyond delineated riparian zones only. - Ensure that laying out does not extend beyond the Eskom Servitude. - Laying out should be don beneath the powerlines along the access track as far as possible to minimise additional disturbance.

Maintenance Action	Potential Impacts	Mitigation Measures
CONSTRUCTION Stringing high voltage cables	- Significant potential to disturb a large area of vegetation and increase the disturbance footprint if not contained.	- Cable reels, generators, and puller-tensioners plus associated equipment should be stored and used beneath the powerline within the Eskom servitude as far as possible. - Avoid setting up puller-tensioners in riparian zones unless undertaking restringing where this is absolutely unavoidable.
DECOMMISSIONING Dismantling of pylons and/or cables and removal of all waste products from the site	- May result in debris and materials being left in the environment causing hazards and degradation.	- If the maintenance action involves decommissioning of any equipment, all of the above mitigation measures are still applicable. - Any decommissioned equipment must be carefully removed from the site, with minimal habitat disturbance in the process, and maintaining any disturbance within the Eskom servitude. - All waste materials and litter must be removed from the site and disposed of at a waste facility at the conclusion of maintenance works. - The ECO should do a final site check to determine whether rehabilitation of any disturbed areas will be necessary, and to ensure that all waste has been removed from the site.
REHABILITATION May be required where extensive vegetation clearing (> 25 sqm) has taken place in the riparian zone.	- May result in erosion of riparian zone and/or riverbank. - Vulnerable to invasion by alien vegetation.	- The ECO must determine if rehabilitation is required. - If soil is compacted then a number of pitter basins should be dug to encourage water pooling on the soil surface which will support regeneration of vegetation. Pitter basins should be hand dug to about 20cm deep and flat bottomed, measuring about 1 sqm and spaced about 2m apart. The aim is to create an uneven surface that encourages water pooling at the site instead of runoff (see image below courtesy Esler *et al,* 2010). 

Maintenance Action	Potential Impacts	Mitigation Measures
		- If water is available, the area can be seeded with *Stipagrostis namaquensis* (steekkweek) seeded directly into and around the pitter basins which should then be watered at least once. Ideally this should take place during spring (September – October).

4.3 Leeu Gamka Maintenance

Using the recommended mitigation measures indicated in Table 4, an example planning document was developed which can be utilised for the required maintenance at this site.

4.3.1 Definition of the Maintenance Area & Actions

- An annotated image is provided in Figure 23 which indicates the extent of the work required across the six pylons as described in Section 1.1.
- The riparian zone was delineated for both he Koekemoer's river and the Leeu River.
- Pylons 2 and 3 are located on the edge of riparian vegetation of the Koekemoer's River and caution regarding vegetation and disturbance for these two pylons must be demonstrated.
- The Eskom servitude is 32 m across the width of the line (16m either side) and is indicated.
- The main access road is the R353
- The delineated watercourse will be a No-Go area for materials stockpiling and heavy machinery/vehicles for the duration of the maintenance work. This must be indicated with clear signage by the construction / maintenance manager.
- The only activity that can take place across the watercourse is stringing with as low a footprint of disturbance as possible.

Figure 23. Annotated satellite image of the Leeu Gamka site indicating the extent of maintenance actions, location of pylons to be maintained, main access road and Eskom servitude. All shown in relation to the delineated watercourse.

4.3.2 Access Routes

- Satellite imagery indicates sections where the same track has almost never been driven twice. Although this hasn't occurred in aquatic / riparian habitat, this is not good practice and increases the disturbance footprint unnecessarily.

- Access to Pylons 1 and 2 is from the R353 along the indicated track which is within the 32m servitude for the most part. Tracks are visible beyond the servitude and should no longer be used. Fortunately these are not in a watercourse, but it may be necessary to consult a botanical specialist regarding potential rehabilitation of unnecessary tracks.
- Access to Pylons 3 – 6 on the other side of the Koekemoer's River is more difficult. From tracks, it appears that vehicles undertaking emergency works on the powerline seem to have taken a substantial diversion further up the R353, crossing the Koekemoer's River further upstream and then driving beside the Leeu River back down to the power line (Figure 24). This is a substantial diversion, and there does appear to be a much shorter route to the pylons from the N1 which has been indicated.
- The final track selection must be provided to all drivers with instructions to limit their route to the track indicated only. Substantial and long-term damage can be done to the surrounding veld by driving multiple tracks, which can take years to recover.

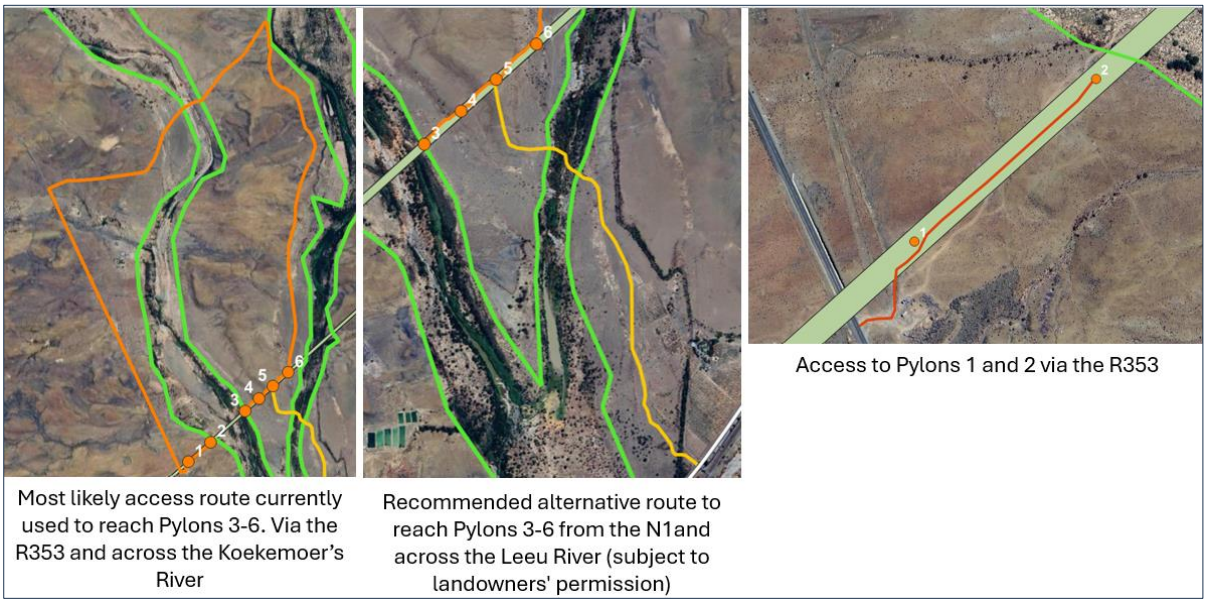

Figure 24. Indicated access routes currently in use and a recommended alternative for different parts of the power line.

The remainder of the work undertaken would need to comply with mitigation measures in Table 4 which relate to the actual maintenance work required.

5. CONCLUSIONS

The maintenance activities proposed by Eskom for the Laingsburg-Droerivier power line are required to address damage to pylons which has already occurred in the Leeu Gamka area, and may occur in the future along other parts of the line where pylons are aging and not aligned with SANS requirements.

The power line crosses a very high number of drainage lines, flow paths, alluvial washes and rivers in the great Karoo, covering a distance of approximately 200km. It's alignment is roughly adjacent to the N1 highway although parts of the line are very difficult to access with existing roads.

In terms of the maintenance required, access to the site of proposed maintenance may be one of the greatest challenges along this line, and care must be taken to ensure the disturbance footprint associate with access is minimised. The servitude of 32 m along the line must also be respected and any disturbance beyond the servitude should be prevented as far as possible.

Apart from stringing operations which are likely to carry some unavoidable disturbance to watercourses (where they are crossed) access through watercourses should be strictly avoided and limited by absolute necessity.

The involvement of an ECO in the planning and construction phase of maintenance is a key aspect of ensuring the mitigation measures in this MMP are strictly applied.

All of the watercourses inspected along this power line are in a good ecological condition and should not be degraded to any extent by the work required to maintain the power line.

Provided all the mitigation measures in this MMP are adhered to it is recommended that it be approved given the vital services provided by well maintained electrical infrastructure.

6. APPENDICES

6.1 Typical Maintenance Actions – Method Statement from Eskom

DESCRIPTION

Site establishment

- Site Establishment "Setup"
- Site Establishment "Dismantle"
- Site Establishment "Site Maintenance"
- Bush clearing
- Felling and removal of trees
- Setting Out Of Pegs
- Set out earth works

Walking/ Driving/Operating various vehicle types

- Driving LDV, trucks, light/heavy machinery on regional, national and formal / informal gravel roads
- Operating LDV, trucks, light/heavy machinery on regional, national and formal / informal gravel roads
- Walking on/near regional, national and formal / informal gravel roads
- Driving LDV, trucks, light/heavy machinery near wetlands, marine areas, forest areas grasslands, deserts, mountains, freshwater ecosystems, urban green spaces and special habitats
- Operating LDV, trucks, light/heavy machinery near wetlands, marine areas, forest areas grasslands, deserts, mountains, freshwater ecosystems, urban green spaces and special habitats
- Walking in/near wetlands, marine areas, forest areas grasslands, deserts, mountains, freshwater ecosystems, urban green spaces and special habitats

Excavations

- Excavations soft
- Excavations intermediate
- Excavations hard rock
- Install Earthing

Install Earthing

Backfill and Compact

- Backfill and Compact Normal
- Back/Compact Sand/Cement Mixture
- Importing Soil

Foundations

- Stub Setting
- Install Formwork
- Assemble Steel Reinforcing
- Install Steel Reinforcing
- Install Holding down bolts and template

- Placing of Ready Mix Concrete
- Placing/Mixing of Self Mix Concrete
- Sleeving (Rings)

Placing & Leveling of Base

- Placing & Leveling of Base For 4-foot Lattice Tower
- Placing and leveling of base - mono-pole
- Placing and leveling of base pre-cast - mono-pole

Layout of structures:

- Layout of Structures - Single Pole
- Layout of Structures - Segmented Single Pole
- Layout of Structures - Mono-pole
- Layout of Structures - H-pole
- Layout of Structures - Segmented H-pole
- Layout of Structures - 5/6 pole
- Layout of Structures - Concrete Pole
- Layout of Structures - Lattice Tower
- Layout of Structures - 8 pole

Assemble Structures

- Assemble Structures - Single Pole
- Assemble Structures - Segmented Single Pole
- Assemble Structures - Mono Pole
- Assemble Structures - H-Pole
- Assemble Structures - Segmented H-Pole
- Assemble Structures - 5/6 Pole
- Assemble Structures - Concrete
- Assemble Structures - Concrete Double Pole
- Assemble Structures - Lattice Tower
- Assemble Structures - 8 Pole

Erect Structures

- Erect Structures - Single Pole
- Erect Structures - Segmented Single Pole
- Erect Structures - Mono Pole intermediate (WC)
- Erect Structures - Mono Pole strain/terminal (WC)
- Erect Structures - H-Pole
- Erect Structures - Segmented H-Pole
- Erect Structures - 5/6 Pole
- Erect Structures - Concrete
- Erect Structures - Lattice Tower
- Erect Structures - 8 Pole

Install Stays:

- Install Stays (includes temporary/construction stays)
- Removal of Stays (includes temporary/construction stays)
- Stays: Make-off

- Stays: Make-off - HV

Stringing HV

- Setup Drum Station (per drum)
- Tension stringing (by machine)
- Con Tension Reg. & Terminate - Single
- Midspan Jointing/Repair
- Stringing HV (Manual)
- Conductor Run Out & Hang - Single
- Conductor Run Out & Hang - Twin
- Con Tension Reg. & Terminate - Single
- Con Tension Reg. & Terminate - Twin
- Midspan Jointing/Repair
- Jumpers, dampers, spacers & clamping
- Install Jumpers - Single
- Install Jumpers - Twin
- Install Dble. Cir. Jumpers - Single
- Install Dble. Cir. Jumpers - Twin
- Install Dampers/Spacers
- Install Bird Flight Diverters (HV)
- Install Aircraft Warning Spheres
- Installing Earth wire Insulators (retrofit)

Finishing:

- Finishing Foundation & Stub
- Finishing Anti-climbing (Lattice Tower)
- Finishing Handing Over Documentation
- Finishing Torque/Punch/Paint Nuts
- Finishing Labelling - Paint on
- Finishing Labelling - Attached
- Install Gates
- Install Gates

Test & Commissioning

- Test & Commissioning

Dismantle

- Loose/Slacking of Conductor/Earth
- Bringing down Structures
- Bringing Down Structures - Single Pole
- Bringing Down Structures - Segmented Single Pole
- Bringing Down Structures - H-Pole
- Bringing Down Structures - Segmented H-Pole
- Bringing Down Structures - 5/6/8 Pole
- Bringing Down Structures - Concrete (in soil)
- Bringing Down Structures - Lattice Tower
- Disassemble Structures
- Disassemble Structures - Single Pole

- Disassemble Structures - Segmented Single Pole
- Disassemble Structures - H-Pole
- Disassemble Structures - Segmented H-Pole
- Disassemble Structures - 5/6/8 Pole
- Disassemble Structures - Concrete
- Disassemble Structures - Lattice Tower

Removal From Site

- Removal of Structures - Single Pole
- Removal of Structures - Segmented Single Pole
- Removal of Structures - H-Pole
- Removal of Structures - Segmented H-Pole
- Removal of Structures - 5/6/8 Pole
- Removal of Structures - Concrete
- Removal of Structures - Lattice Tower
- Removal of Concrete - Off Site
- Remove Damper
- Remove and Replace Lattice Brace Member

Adhoc Items

- Assess all structure footings prior dismantling and restringing
- Repair structure footings where required to so by final design package and contractor site visit
- Re-evaluation of constructability once the contractor is on site
- Establish and maintain the necessary Site Offices and facilities
- Communicate with all landowners along applicable route advising them of work to be done
- Procure and supply material befitting and agreed to do so with Project Manager
- Procure material as per specifications and from approved vendors
- Complete all quality documentation and mark up any changes to drawings
- Clear and clean the total site upon completion of the contracted works
- Liaise with property owners to obtain Clearance Certificates on completion of the contract

7. REFERENCES

Council for Scientific and Industrial Research (CSIR; 2018). National Wetland Map 5 and Confidence Map [Vector] 2018. Available from the Biodiversity GIS website, downloaded on 30 September 2020.

Department of Water Affairs and Forestry (DWAF; 2005). A practical field procedure for identification and delineation of wetlands and riparian areas. Pretoria, South Africa.

Esler, K.J, Milton, S.J. and Dean, W.R. (2010). Karoo Veld: Ecology and Management. Briza, Pretoria.

Macfarlane, D.M. and Bredin, I. (2016). Desktop tool for the determination of preliminary aquatic impact buffer zone requirements. Version 1.0. Water Research Commission, Pretoria.

Ollis, D., Snaddon, K., Job, N., & Mbona, N. (2013). Classification system for wetlands and other aquatic ecosystems in South Africa. South African National Biodiversity Institute.

South African National Biodiversity Institute (2006- 2018). The Vegetation Map of South Africa, Lesotho and Swaziland, Mucina, L., Rutherford, M.C. and Powrie, L.W. (Editors), Online, http://bgis.sanbi.org/Projects/Detail/186, Version 2018.