Proposed Construction of a New Kusile-Vulcan Loop (Duvha By-Pass) (Bravo 5) Mpumalanga Province

DEA REF NO - 12/12/20/1097

General wetland rehabilitation- and monitoring plan to mitigate the construction and operational related impacts

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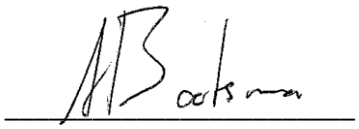
Drafted by
Limosella Consulting Pty Ltd
Reg No: 2014/023293/07
Email: antoinette@limosella.co.za
Cell: +27 83 4545 454
www.limosella.co.za

Prepared for:
Envirolution Consulting
223 Columbine Avenue, Mondeor, 2091
Tel: 0861 44 44 99
Fax: 0861 626 222
Email: info@envirolution.co.za
ww.envirolution.co.za

Declaration of Independence

I, **Antoinette Bootsma**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement.



2016.05.26

Antoinette Bootsma (PrSciNat) Date

Ecologist/Botanist

SACNASP Reg. No. 400222-09

Indemnity

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information at the time of study. Therefore, the author reserves the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although the author exercises due care and diligence in rendering services and preparing documents, she accepts no liability, and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of this document.

Qualification of Specialists

Report writing assistance and review	Antoinette Bootsma Ecologist/Botanist/Wetland specialist SACNASP Reg. No. 400222-09
Field work and data analysis	Rudi Bezuidenhoudt Wetland specialist / Ecologist SACNASP Reg. No. 500024/13

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1 INTRODUCTION

Eskom has been experiencing a growing demand for electricity with increasing pressure on the current existing power generation and transmission capacity. Eskom aims to improve the reliability of electricity supply to the country, and in particular to provide for the growth in electricity demand in the Gauteng and Mpumalanga provinces. To this end the Bravo Integration Project was launched. This project was broken down into smaller individual Environmental Impact Assessments for which alternatives were evaluated during a previous phase of the project. Current assessments are evaluating the environmental impact of the final alignments, including tower positions. This rehabilitation assessment is focused on the **Bravo 5** component of the Bravo Integration Project and is based on the wetland delineation and functional assessment presented in the accompanying report (Limosella, 2016)

The studied area includes a powerline that bypasses the Duvha Power Station and connects the line to the existing grid. (Figure 1).

1.1 Assumptions and limitations

- This document is based on information as received by Envirolution Consulting as well as during the collective site visit (25th of May 2016).
- Pylon positions were not available to the specialists at the time of the study and as such are not discussed.
- The document takes into account the likely impacts that can arise during construction of the powerline, as well as impacts that could arise as a result of the completed construction and operation. However, some unique impacts may arise that must be recorded during monitoring and appropriate corrective actions taken.
- Engineering drawings and the specification of rehabilitation structures falls outside of the scope of this general rehabilitation plan.
- This rehabilitation plan does not include specific reference to fauna and flora.
- This report understands that construction includes that of the actual pylon structure, as well as the stringing of the conductors and that the time lapse between these two phases of construction depends on the contactor's work plan.
- The specialist cannot be held accountable if a water use license is not granted.

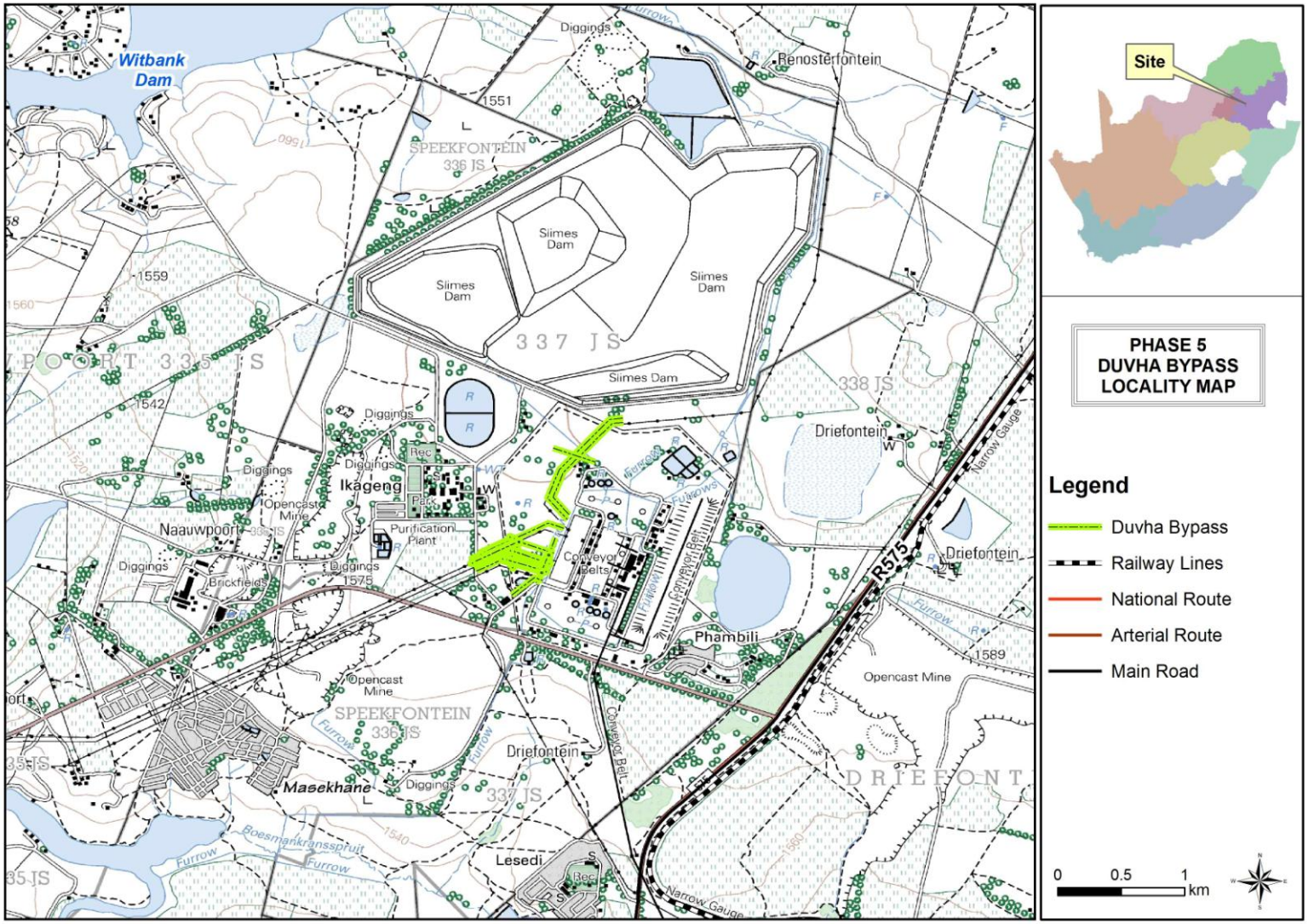

Figure 1: Locality Map

1.2 Objective and aims

This wetland rehabilitation and monitoring plan is specific to the construction of pylons / towers within the wetland or within its protective buffer, pylons within close proximity to wetland (within 500m) and pylons that are situated on slopes that could impact on the wetland down slope. In addition, the rehabilitation plan also applies to disturbances in wetlands where absolutely necessary to complete construction. As the current degraded state of the wetland is a symptom of the lack of management of the hydrology in the catchment, the rehabilitation efforts that form part of the proposed construction, are unlikely to improve the PES or EIS of the wetland that could be impacted on. However, this document aims to limit localised impacts relating to the construction and refurbishment.

The overall objective is to return the environment in and around the pylon / tower positions to a state as close to the state prior to construction and to limit or negate any construction associated impacts by:

- Ensuring the footprint of the impact on the wetland is as small as possible;
- Providing guidance on rehabilitation of areas that may be temporarily disturbed during construction and operation;
- Reducing the likelihood of erosion and subsequent sedimentation during construction and operation; and
- Recommending monitoring and corrective actions in order to mitigate negative impacts as soon as they become apparent.

Table 1 below shows the five towers that are located within wetland area, or associated buffer zones. Figure 2 shows the wetland areas relative to the proposed line.

Table 1: Affected Wetlands and Pylons along the proposed line.

Affected Pylons Number	Affected Area	Proposed Action
KuVu1	20m Buffer	Move the pylon 15m east
KuVu2	Seepage wetland	Move pylon 37m west or 45, east
KuVu3	Seepage wetland	Move pylon 40meast
Exist 4	Riparian Area	Mitigate possible disturbance
Exist 5	Unchannelled Valley Bottom	Mitigate possible disturbance

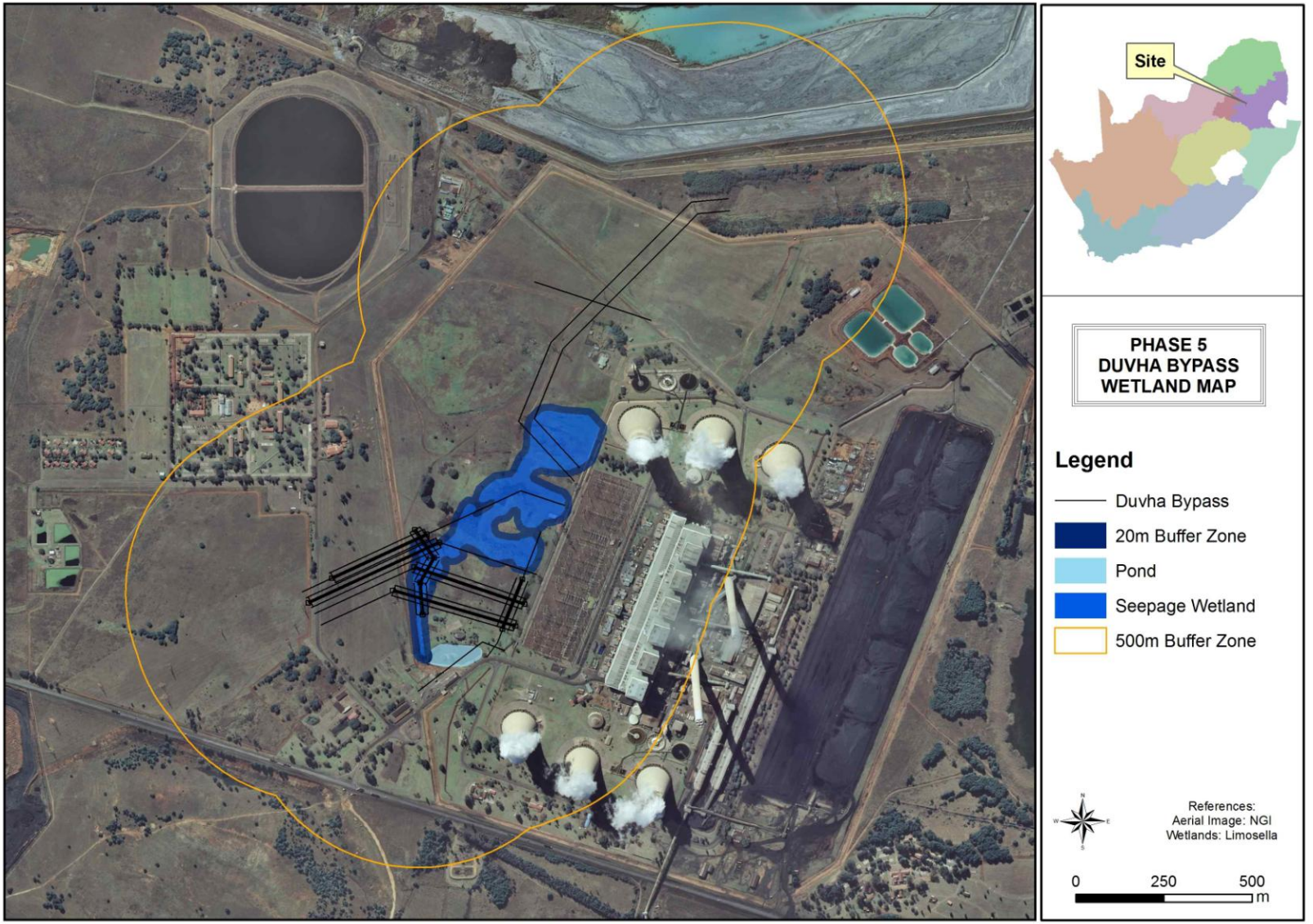

Figure 2: Indicating the proposed pylons relative to proposed infrastructure.

2 METHODOLOGY

In order to realise the objective of the rehabilitation plan, it is necessary to limit the impact as much as possible to reduce the need for costly rehabilitation and corrective action. Therefore, mitigation should already start in the planning phase in order to direct the proposed activities to have the least impact possible, reducing follow-up rehabilitation and corrective actions. Therefore, this rehabilitation document comprises of three plans (Table 2):

1. Mitigation Plan: to focus pre-construction planning and activities on limiting the possible impacts that can arise during construction.

2. Rehabilitation Plan: aimed at rehabilitating the areas temporarily disturbed by the construction. This document recognises that construction takes place in two phases:
    - The construction of the pylon structure, as well as
    - The stringing of the conductors.

3. Monitoring Plan: aimed at monitoring the success of rehabilitation as well as recording any impacts that may arise during the operational phase of the powerline line, for which corrective action is needed.

Table 2: Plans in relation to the relevant project phases

Plan	Project Phases
1. Mitigation plan	• Pre-construction planning and activities. • Construction: Pylon. • Construction: Stringing.
2. Rehabilitation plan	• Construction: Pylon. • Construction: Stringing. • Operation.
3. Monitoring and corrective action	• Construction: Pylon. • Construction: Stringing. • Operation.

3 DESCRIPTION OF ENVIRONMENT AND WATERCOURSES AFFECTED

3.1 Background

Eskom has been experiencing a growing demand for electricity which increasing pressure on the current existing power generation and transmission capacity. Eskom aims to improve the reliability of electricity supply to the country, and in particular to provide for the growth in electricity demand in the Gauteng and Mpumalanga provinces. To this end the Bravo Integration Project was launched. This project was broken down into smaller individual Environmental Impact Assessments for which alternatives were evaluated during a previous phase of the project. Current assessments are evaluating the environmental impact of the final alignments, including tower positions.

This report addresses the Bravo 5 component of the Bravo Integration Project. This report focuses on mitigation and rehabilitation of the five towers that are located in sensitive areas as reported in Limosella 2016.

3.2 Delineated Water Courses

One wetland and one dam were recorded on the study area. The wetland area was classified as a seepage wetland. Historical aerial imagery was consulted and it was determined that a depression wetland existed where the current dam is located. The current wetland is however significantly larger than what was in 1977. The reason for the increased wetness is unknown although it could be caused by seepage from several ash dams and other dams likely to seep some water into the surrounding soil profile or from drains adjacent to the study area.

From the seepage wetland a drain was found that drains into the dam/pond south of the seepage wetland. This dam is currently used for aesthetic purposes and is stocked with many avifaunal species although mainly exotic. It is likely that the dam/pond was originally the original depression wetland observed in historical aerial imagery. Some potential water input areas were recorded.

The combined PES scores for the wetlands on the study site is an **E – Largely modified.** The EIS score for the seepage wetland is **1.2** and falls into the **Moderate** ecological importance and sensitivity category. The Recommended Ecological Management Class for these wetlands is thus a **C.**

Refer to the accompanying wetland assessment report for details regarding the status of wetlands along the proposed Kyalami to Lulamisa transmission line (Limosella, 2016).

3.3 Buffer Zones

In order to limit the impact on the hydrology and biodiversity of the area, the current assessment finds that a 20m buffer zone should be recognised from the edge of all the wetland. However, linear developments such as the proposed powerline, are rarely able to avoid crossing any watercourses whatsoever. Where construction of access roads and the construction activities within the 1:100 year floodline or the riparian area (whichever is the greatest), as well as within wetlands and associated buffers is unavoidable and a Water Use License granted, the buffer areas should still be respected as an area where impacts must be kept to an absolute minimal. The buffer areas should be clearly marked during construction and workers must be informed that activities and traffic beyond the buffer zone must be limited to only that which is necessary. In addition, it is important to note that construction within 500m of a wetland area can also only take place as authorised by the DWS.

4 EXPECTED IMPACTS

The wetland relevant to this project is largely artificial and isolated from the regional hydrological network. It does however provide habitat to birds. The impact of the powerlines on birds should be assessed by an avifauna specialist. Wetland conditions on the site are relatively easy to rehabilitate and temporary loss of these conditions should not have a significant impact (Limosella Consulting, 2016). The recommendation is to avoid or minimise direct impacts on the wetland as much as possible and to rehabilitate the impacts where pylons cannot be moved outside of the sensitive area.

The most important impact is the deterioration of vegetation and compaction of soil around all the pylon / tower footprints during construction, as well as along the servitude and access roads. If not remediated, these impacts can result in sedimentation of the wetland. The following main impacts are expected to be associated with the construction of towers within or in proximity to watercourses.

Clearing/removal of natural vegetation –Construction: The plants that grow in wetlands on the study site create habitat that is utilized by bird species. Removing this vegetation cover negatively impacts on the biodiversity component of the site and also allows for the potential establishment of alien invasive plant species.

Compaction of soils – Construction and maintenance: Construction and operational maintenance activities may compact soils from heavy equipment access which could inhibit seed germination, inhibit root establishment, and result in bare soil exposure. Soil compaction is expected to occur within the servitude and around the tower bases.

Mobilisation of pollutants –Construction and maintenance: Accidental pollution or illegal disposal and dumping of construction / maintenance material such as cement, paint or oil, as well as disposal or discharge of human (including partially treated and untreated sewage) into the wetland or dam will influence the water quality, thereby influencing its functionality and the persistence of vegetation and fauna species.

Invasion by alien invasive vegetation – Construction: During construction, vegetation will be destroyed and soil disturbed. The seeds of alien invasive species that occur on and in the vicinity of the studies area could spread into the disturbed soils.

5 MITIGATION PLAN:

On site mitigation can limit the impact of construction activities and reduce the need for expensive rehabilitation and the need for corrective action. Table 3 lists the mitigation measures that should be implemented during the planning, construction and operational phase in order to limit the need for rehabilitation.

Table 3: Mitigation plan

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
Pre-construction planning	Limit the footprint of *access roads and constructing camps*, thereby reducing compaction and destruction of natural vegetation	• Where possible, Pylon positions should be moved outside of the wetland and its buffer zone • Project engineers should compile a method statement, outlining the construction methodologies. The required mitigation measures to limit the impacts on the wetland and associated buffers should be contained within the method statement. The method statement must be approved by the ECO and be available on site for reference purposes • Plan access roads in such a way as to minimise impact on the wetland • Plan construction activities that necessitate water crossings to only cross the wetland at designated points • Plan construction camps to be placed outside of wetland its their associated buffer zone • Planning of construction site must include eventual rehabilitation / restoration of indigenous vegetative cover
	Limit the footprint of *construction* thereby reducing compaction and destruction of natural vegetation	• Where possible, plan the final route alignment to have no structures within wetland or its associated buffer zone- especially where sensitive fauna species occur • Should the wetland be affected by construction, the edge / boundary of this wetland must be clearly demarcated in the field with poles, sticks, or any solid structure that will last for the duration of the development. • Access roads must be restricted in wetland area and buffer. These access areas must be designated in the planning phase to prevent contractors taking "short-cuts" through the wetland area and buffer. • Plan construction phases in such a way as to disturb as little of the vegetation and soils as possible • Ideally plan construction and stringing to take place simultaneously as to minimise the construction time in wetlands / wetland buffer and to be able to start rehabilitation of the affected areas as soon as possible. • Construction within wetlands and buffers must be planned to take place in the drier winter months • Plan construction activities to have the smallest possible footprint • No stockpile areas should be located within wetland boundaries, or within the associated buffer zone • No vehicles and access of persons should be allowed through any wetland, except where approved by the relevant authority

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
	Limit the footprint of stringing thereby reducing compaction and destruction of natural vegetation	• Consider the various methods of stringing and select whichever method(s) that will have the least impact on wetland e.g. shooting a pilot cable and pull cables with a winch • Stringing should preferably not make use of vehicles in the wetland • If unavoidable, plan stringing activities in wetlands areas to take place within the drier winter months • Plan to use equipment with the smallest possible footprint • Plan stringing through the wetland to take place at pre-determined points such as where the wetland width (and thus area to be impacted) is the smallest • Where possible, plan stringing to take place upon completion of the new structures, thereby limiting the time that the wetland is exposed to impacts
	Preventing spread of alien invasive	• Alien invasive species that were identified within servitudes should be removed prior to construction related soil disturbances. This will prevent seed spreading into disturbed soils • Manual removal methods are preferred to chemical control
Construction phases	Limit the construction footprint and related impacts	• Only use access roads as designated during the planning phase • Crossings to be undertaken with only one vehicle that have the minimum footprint as decided on during planning • Limit the removal of indigenous vegetation around the construction footprint • Limit compaction by not working in wet conditions and limiting vehicular access • Do not permit vehicular or pedestrian access into natural areas or into seasonally wet areas during and immediately after rainy periods, until such a time that the soil has dried out (DAWF, 2005) • Wetland boundaries and buffers must be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete • Only necessary traffic should be allowed within these demarcated areas • Limit clearing of vegetation between servitude and construction camps • Demarcate each construction area around the pylon footprint, before the contractors begin construction • Contractors should refrain from impacting areas beyond the demarcated construction area • Minimise disturbance and loss of soil • No structures are allowed to be stored on wetlands or wetland buffer areas • The contractor must avoid traffic or storing of equipment and material in vegetated areas that will not be cleared
	Prevention of pollution	• Contractors responsible for construction in close vicinity to wetland areas along the route must sign a declaration stating that they will adhere to all stipulations of the Environmental Management Plan relating to wetland crossings

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
Construction phases		as well as measures as set out by this report • The contractors must provide and maintain a method statement for "cement and concrete batching". The method statement must provide information on proposed location, storage, washing & disposal of cement, packaging, tools and plant storage • Cement should only be mixed within mixing trays. Washing and cleaning of equipment should also be done within a bermed area, in order to trap any cement or plaster and avoid excessive soil erosion. These sites must be rehabilitated prior to commencing the operational phase • The mixing of concrete should only be done at specifically selected sites on mortar boards or similar structures to contain run-off into drainage lines, streams and natural vegetation • Materials such as fuel, oil, paint, herbicide and insecticides must be sealed and stored in bermed areas or under lock and key, as appropriate, in well-ventilated areas • These substances must be confined to specific and secured areas within the contractor's camp, and in a way that does not pose a danger of pollution even during times of high rainfall • Storage of materials as described above may not be within the 1:100 floodline, watercourses or associated buffer areas • In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water and Sanitation (DWS) must be informed immediately and corrective action taken • All equipment should be parked overnight and/or fuelled at least 500 meters from a watercourse • Drip trays (minimum of 10cm deep) must be placed under all vehicles that stand for more than 24 hours. Vehicles suspected of leaking must not be left unattended, drip trays must be utilised. • Drip trays must be utilised during repairs and maintenance of all machinery. The depth of the drip tray must be determined considering the total amount / volume of oil in the vehicle. The drip tray must be able to contain the volume of oil in the vehicle. • Provision of adequate sanitation facilities located outside of the wetland/riparian area or its associated buffer zone • Remove all construction equipment and material on completion of construction • No water should be abstracted from any river / wetland • Run-off from the camp site must not discharge into neighbors' properties or into adjacent wetlands, rivers or streams • Management of on-site water use and prevent stormwater or contaminated water directly entering the wetland or

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
		dam • Management of point discharges
	Prevent/limit sedimentation	• Contractors responsible for construction in close vicinity to wetland areas along the route must sign a declaration stating that they will adhere to all stipulations of the Environmental Management Plan relating to wetland crossings as well as measures as set out by this report • Increased run-off during construction must be managed using soft options such as grass bales and other suitable structures as required to ensure flow velocities are reduced; this must be done in consultation with the ECO • Storm water, wherever possible, should be allowed to soak into the land and natural attenuation areas. Special care must be given to ensure velocity is slowed before reaching the attenuation area • The contractor shall ensure that excessive quantities of sand, silt and silt-laden water do not enter watercourses. Appropriate measures, e.g. erection of silt traps, or drainage retention areas to prevent silt and sand entering drainage or watercourses must be taken • Where wetlands are adjacent to the construction areas and these areas slopes toward the wetland, install sediment barriers along the edge of the construction areas as necessary to prevent sediment flow into the wetland • Sediment barriers must be properly maintained throughout construction and reinstalled as necessary until replaced by permanent erosion controls or restoration of adjacent upland areas is complete • It is important that topsoil should be conserved in areas where bedrock is shallow to avoid sedimentation • Run-off from the camp site must not discharge into neighbors' properties or into adjacent wetlands, rivers or streams • No development, or activity of any sort associated with camp, is allowed below the 1:100 year flood line of any water system • Excavated soils may not be placed within wetland buffer zones and stockpiled soils may not exceed 3m in height
	Preventing spread of alien invasive	• Construction equipment must be cleaned prior to site access. This will prevent alien invasive seed from other sites to spread into disturbed soils • Alien invasive species that were identified within servitudes should be removed prior to construction related soil disturbances. This will prevent seed spreading into disturbed soils • Manual removal methods are preferred to chemical control
	Limit the impact on the wetland and associated buffer during stringing	• Contractors responsible for constructing the line rebuilds in close vicinity to wetland areas along the route must sign a declaration stating that they will adhere to all stipulations of the Environmental Management Plan relating to

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
		wetland crossings as well as measures as set out by this report • If vehicles are used for stringing: only cross the wetland at designated points, with dedicated vehicle that have the least possible impact (as determined during the planning phase) • The vehicle could cross over timber riprap, prefabricated equipment mats, or terra mats to reduce soil impact and soil turning. • Crossings should preferably be undertaken during the dry season, where feasible and as soon after construction of the structures as possible • Limit the removal of indigenous vegetation, compaction of soils and damage to already rehabilitated areas • Remove all project-related material upon completion of stringing and prepare for rehabilitation • Where any damage to watercourses / rehabilitated areas are noted during stringing, follow the rehabilitation and monitoring steps as per the tables below

6 REHABILITATION PLAN

Rehabilitation in this document refers to the *reinstatement of the temporarily disturbed areas affected by the construction or due to construction related activities, to a state that resemble the conditions prior to the disturbance*s. It therefore does not address the rehabilitation of the watercourses situated along the proposed powerline route from for example a management category D to a C (Kleynhans, 1996 & Kleynhans, 1999). In order to improve the management category, the current impacts due to historic activities should be address and these fall outside the scope of this document and are not part of Eskom's mandate.

This rehabilitation plan recognises that the construction will likely take in two phases and therefore rehabilitation on areas affected by construction will need to take place in two phases:

- Phase 1: Construction of the pylon; and
- Phase 2: Stringing of the conductors (electrical cables).

Due to the uncertainty of the time lapse between construction and the stringing of the conductors, this document recommends that rehabilitation around the pylon / tower footprint takes place immediately after construction in order to limit detrimental effects resulting from for example, rainfall events prior to stringing. In addition, stringing could have direct impacts on the watercourses not necessarily affected by construction of a pylon e.g. if stringing takes places by vehicle through watercourses.

Therefore, the pylon footprint should be rehabilitated immediately after construction and prior to stringing activities. Stringing activities should take cognisance of the rehabilitation efforts and endeavour not to impact on it, while monitoring during this phase is crucial. After stringing, the areas affected by stringing should be rehabilitated and the pylon footprint monitored.

If stringing takes place alongside construction, the time that the watercourses are exposed to potential impacts are reduced and rehabilitation phases halved.

Table 4 list the rehabilitation measures that should be undertaken post construction as well as corrective action when monitoring has established that the listed impacts are taking place

Table 4: Rehabilitation plan

Impacts	Rehabilitation	Time frame
Removal of vegetation Areas where vegetation will be impacted include the area directly impacted on by the construction of the pylons, the temporary work area, and access roads. Areas where vegetation has been removed or destroyed should be kept to a minimum.	• Stripping of vegetation for construction must occur in a phased manner and must be restricted to the building footprint • Where possible, remove vegetation as sods that can be replanted as part of the rehabilitation of vegetation around the pylon footprint. Store sods in already cleared areas and water at least once week • Where soils are removed, the topsoil and subsoil must be stockpiled separately in low heaps (Topsoil are deemed to be the top layer of soil containing organic material, nutrients and plant grass seed. For this reason it is an extremely valuable resource for the rehabilitation and vegetation of disturbed areas) • After construction, compacted areas should be ripped and topsoil replaced from the areas where it was removed. Areas around the pylon footprint can be re-vegetated using the sods that were removed prior to construction. The sods should be placed level, or slightly deeper than surrounding vegetation, on ripped soils. Against slopes, the sods should be pegged to ensure that it does not wash away before the roots establish • Ripping shall be done to a depth of 250mm in two directions at right angles. • All sloped areas must be re-vegetated by either using removed sods or by seeding with a grass mixture containing species naturally occurring in the area. Sloped areas where vegetation has been removed or destroyed should be replanted immediately after completion of construction to avoid erosion • Badly damaged areas and areas where grazing commonly takes place, should be fenced in to allow for rehabilitation to take place without further impacting on the areas • Areas where minimal disturbances took place, can be ripped and allowed to naturally re-vegetate (take note that this excludes sloped areas) • If natural re-vegetation is unsuccessful, corrective action should be taken and includes seeding and planting by an appropriate specialist as stipulated in the EMP	• Immediately after construction • Immediately after stringing if stringing resulted in these impacts • At any time during operational phase of the transmission line, when maintenance activities might have destroyed natural vegetation • As and when monitoring indicate degradation of vegetation along the servitude

Impacts	Rehabilitation	Time frame
	• All rehabilitated areas must be monitored for the presence of exotic and alien plant species. • Should the presence of exotic/alien plant species be observed it should be removed appropriately • All disturbed areas will requiring rehabilitation must be mulched to encourage vegetation re-growth. Mulch used must be free from alien seed. These areas must be cordoned off so that vehicles or construction personnel cannot gain access to these areas • Badly damaged areas and areas where grazing, water collection or washing commonly takes place (e.g. in proximity to informal settlements), should be fenced in to allow for rehabilitation to take place without further impacting on the areas. Once rehabilitation was observed to be successful during monitoring, the fenced may be removed (at least two years). The reason for fencing must be communicated to the community using the areas and the fence should be monitored regularly • Areas where minimal disturbances took place, can be ripped and allowed to naturally re-vegetate (take note that this excludes sloped areas). Re-vegetation must be monitored to ensure that alien invasive plant species do not colonise the disturbed areas • In areas where the topsoil is shallow with underlying bedrock, it is important to ensure that erosion is kept to a minimum by encouraging rapid vegetation growth and/or to use structures approved by an engineer to all the sediment on site • Where protected plant species were removed from the development footprint, replant these species in their original habitats	
Soil Compaction Soil compaction is likely to occur on access roads, and temporary work platforms where heavy vehicles and personnel move around. Soil compaction will decrease permeability of the soil, negatively impact the sub-surface flows and compromise	• Areas where soil has been compacted should be ripped to encourage vegetation growth • Ripping shall be done to a depth of 250 mm in two directions at right angles. • Do not rip and / or scarify areas under wet conditions, as the soil will not break up and compaction will be worsened • Do not permit vehicular or pedestrian access into natural areas or into seasonally wet areas during and immediately after rainy periods, until such a time that the soil has dried out (DAWF, 2005) • Rip and / or scarify all disturbed (and other specified) areas of the construction site, including	• Immediately after construction phase (except where the next phase (stringing) follows immediately and makes use of the same construction footprint) • Immediately after stringing

Impacts	Rehabilitation	Time frame
vegetation establishment.	temporary access routes and roads, compacted during the execution of the Works. (DWAF, 2005)	where stringing resulted in compaction • As and when monitoring indicate severe compaction due to maintenance
Mobilisation of pollutants The mobilisation of sediments, excavations, removal and disturbances to vegetation, mobilisation of sulphur, hydrocarbon and pyrite compounds could have various negative impacts on wetlands and their associated functionality.	• In case of emergencies or unforeseen events (e.g. spillage of chemicals), the problem must be remediated immediately and any spillage into any watercourses be reported to the Department of Water Affairs. In addition, the soil must be stabilised (import additional topsoil if necessary) and re-vegetated as soon as possible. Re-vegetation should include seeds from the adjacent grassland and any rescued protected plants and/or plants of conservation concern that might have been impacted upon by the emergency / unforeseen event. • Remove all project-related material used to support equipment on completion of construction	• Immediately after construction • Immediately after stringing where pollution may have arisen • At any time during operational phase of the transmission line, when maintenance activities might have resulted in pollution
Spread of Alien Invasive Species	• All alien seedlings and saplings must be removed as they become evident for the duration of construction • Manual / mechanical removal is preferred to chemical control • All construction vehicles and equipment, as well as construction material should be free of plant material. Equipment and vehicles should be thoroughly cleaned other prior to access on to the construction site.	• During and after construction • Immediately after stringing if monitoring during stringing recorded alien invasive species

7 MONITORING PLAN

Monitoring refers to the repetitive and continued observation, measurement and evaluation of environmental criteria to follow changes over a period of time and to assess the efficiency of control measures. The monitoring plan aims to establish whether rehabilitation was successful, whether maintenance or related activities have impacts and whether the constructed pylons have detrimental impacts on the watercourses after construction (Table 5). Four monitoring frequencies are recommended:

Once-off Monitoring:

1. Monitoring during stringing: Due to the uncertain time lapse between construction of a pylon and the stringing thereof, rehabilitation should take place immediately after construction (especially around the pylon footprint and areas where vegetation was removed). During stringing, rehabilitation efforts must be monitored and impacts on already rehabilitated areas monitored and corrective action taken where needed. In addition, additional impacts resulting from stringing must be rehabilitated directly after stringing at the particular pylon is completed.

2. Monitoring after stringing: Once stringing is completed, the whole line should be monitored to evaluate success of rehabilitation and to identify corrective action where needed. This monitoring activity can also provide lessons for further rehabilitation.

Routine Monitoring:

3. Seasonal monitoring: rehabilitation success, as well as signs of erosion, sedimentation and the presence of alien vegetation should be monitored twice during the summer months: once at the start and once at the end of the rainy season. This should be continued for at least three years after stringing was completed.

4. Rapid monitoring: For the first two years, monitoring should take place immediately after heavy rainfall to ensure that rehabilitated areas are intact and that no erosion and subsequent sedimentation took place.

5. Annual monitoring: after three years, provided that all rehabilitation where found to be successful and no additional problems arose, monitoring can take place once a year after the first seasonal rainfall.

Problems such as failed re-vegetation should be remediated as soon as it is recorded in the monitoring process. Corrective action should be taken and can include the re-initiation of rehabilitation in severe cases or by correction of the problem (e.g. mend broken fences). If problems arise due to the constructed transmission line that was not pre-empted in this plan, an engineer and wetland specialist should be consulted as soon as possible. It is recommended that fixed point photography is used to monitor vegetation and soil stability. This involves taking pictures of the areas monitored from the same point during each monitoring event. The images can be compared and serves as a record of the success of rehabilitation or the failure thereof.

Table 5: Monitoring plan: construction

Variables	Methods	Monitoring Frequency	Indicator	Corrective Action
Vegetation cover	• On-site inspection • Assess landscape functionality • Monitor species cover abundance and ensure that natural species cover increase(compare to vegetation study results prior to construction) • Fixed point photography	• After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Spreading and distribution of dominant plant species in specified wet zones • Wetland re-vegetation shall be considered successful if the cover of herbaceous and/or woody species is at least 80 percent of the type, density, and distribution of the vegetation in adjacent wetland areas that were not disturbed by construction	• If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern • Prevent grazing in rehabilitated areas • If re-vegetation is not successful at the end of 2 years, develop and implement (in consultation with a professional wetland ecologist) a remedial re-vegetation plan to actively re-vegetate the wetland. Continue re-vegetation efforts until wetland re-vegetation is successful • If wetland rehabilitation is successful at the end of 3 years, report on the status of the vegetation (e.g. using photographic record) and only monitor annually or if maintenance activities might have disturbed the area again • Where protected plant species are dying or no recruitment of seedlings are apparent, consult the local authority or a specialist
Plant species composition	• Fixed transect to determine the species composition	• Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Presence/absence of species in specified wet areas.	• If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern. • If exotic plants have colonised the area the exotic plants should be removed.
Alien Invasive Plant	• Monitor the emergence of	• After stringing	• Establishment of alien invasive plant	• Remove emergent invasive vegetation

Variables	Methods	Monitoring Frequency	Indicator	Corrective Action
Species	alien invasive plant species in or around rehabilitated areas • On-site inspection • Fixed point photography	• Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	species in rehabilitated areas or in watercourses	from the rehabilitated footprint and servitude as soon as it becomes apparent • Manual labour is preferred above chemical or manual removal. • Do not use herbicides or pesticides in or within 200 meters of wetland areas

8 REFERENCES

Braack A.M, Walters, D. And Kotze D.C. (unknown): Practical Wetland Management. Mondi Wetlands Programme

Cowden C, and Kotze D (2009) WET-RehabEvaluate: Guidelines for monitoring and evaluating wetland rehabilitation projects. WRC Report No.TT 342/09

Department of Water Affairs and Forestry, (2005): Environmental Best Practice Specifications: Construction for Construction Sites, Infrastructure Upgrades and Maintenance Works. Version 3

Department of Water Affairs (2010): National Water Act, 1998 (Act No 36 of 1998) S21(c) & (i) Water Uses. Version: February 2010. Training Manual.

Kleynhans, C.J. (1999): A procedure for the determination of the determination of the ecological reserve for the purpose of the national water balance model for South African Rivers. Institute for Water Quality Studies Department of Water Affairs and Forestry, Pretoria.

Kotze D C, (1999): A system for supporting wetland management decisions. Ph.D. thesis. School of Applied Environmental Sciences, University of Natal, Pietermaritzburg.

Limosella Consulting, (2016): Proposed Construction of a new Kusile-Vulcan Loop (Duvha By-Pass) (Bravo 5). Compiled for Envirolution Consulting, May 2016

Marneweck G C, and Batchelor A L, (2002). Wetland classification, mapping and inventory. In: PALMER R W, TURPIE J, MARNEWECK G C, and BATCHELOR A L. Ecological and economic evaluation of wetlands in the upper Olifants River Catchment, South Africa. WRC Report No. 1162/1/02. Water Research Commission, Pretoria

Macfarlane D.M., Kotze D.C., Ellery W.N., Walters D, Koopman V, Goodman P and Goge C. (2007). WET-Health: A technique for rapidly assessing wetland health. Water Research Commission, Pretoria

Macfarlane D.M., Teixeira-Leite A., Goodman P., Bate G and Colvin C. (2010) Draft Report on the Development of a Method and Model for Buffer Zone Determination. Water Research Commission project K5/1789. The Institute of Natural Resources and its Associates

Sieben E, Braack M, Ellery W, and Kotze D (2009). WET-RehabMethods: National guidelines and methods for wetland rehabilitation. WRC Report No. 341/09

APPENDIX A: Abbreviated CVs of participating specialists

Name:	**ANTOINETTE BOOTSMA nee van Wyk**
ID Number	7604250013088
Name of Firm:	Limosella Consulting
Position:	Director - Principal Specialist
SACNASP Status:	Professional Natural Scientist # 400222-09 Botany and Ecology
Nationality:	South African

EDUCATIONAL QUALIFICATIONS

- B. Sc (Botany & Zoology), University of South Africa (1997 - 2001)
- B. Sc (Hons) Botany, University of Pretoria (2003-2005). Project Title: A phytosociological Assessment of the Wetland Pans of Lake Chrissie
- Short course in wetland delineation, legislation and rehabilitation, University of Pretoria (2007)
- Short course in wetland soils, Terrasoil Science (2009)
- MSc Ecology, University of South Africa (2010 - ongoing). Project Title: Natural mechanisms of erosion prevention and stabilization in a Marakele peatland; implications for conservation management

PUBLICATIONS

- P.L. Grundling, A Lindstrom., M.L. Pretorius, A. Bootsma, N. Job, L. Delport, S. Elshahawi, A.P Grootjans, A. Grundling, S. Mitchell. 2015. Investigation of Peatland Characteristics and Processes as well as Understanding of their Contribution to the South African Wetland Ecological Infrastructure Water Research Commission KSA 2: K5/2346
- A.P. Grootjans, A.J.M Jansen , A, Snijdewind, P.C. de Hullu, H. Joosten, A. Bootsma and P.L. Grundling. (In Press). In search of spring mires in Namibia: the Waterberg area revisited
- Haagner, A.S.H., van Wyk, A.A. & Wassenaar, T.D. 2006. *The biodiversity of herpetofauna of the Richards Bay Minerals leases.* CERU Technical Report 32. University of Pretoria.

- van Wyk, A.A., Wassenaar, T.D. 2006. *The biodiversity of epiphytic plants of the Richards Bay Minerals leases.* CERU Technical Report 33. University of Pretoria.
- Wassenaar, T.D., van Wyk, A.A., Haagner, A.S.H, & van Aarde, R.J.H. 2006. *Report on an Ecological Baseline Survey of Zulti South Lease for Richards Bay Minerals*. CERU Technical Report 29. University of Pretoria

KEY EXPERIENCE

The following projects provide an example of the application of wetland ecology on strategic as well as fine scale as well as its implementation into policies and guidelines. (This is not a complete list of projects completed, rather an extract to illustrate diversity);

- More than 250 fine scale wetland and ecological assessments in Gauteng, Mpumalanga, KwaZulu Natal, Limpopo and the Western Cape. 2007, ongoing.
- Scoping level assessment to inform a proposed railway line between Swaziland and Richards Bay. April 2013.
- Environmental Control Officer. Management of onsite audit of compliance during the construction of a pedestrian bridge in Zola Park, Soweto, Phase 1 and Phase 2. Commenced in 2010, ongoing.
- Fine scale wetland delineation and functional assessments in Lesotho and Kenya. 2008 and 2009;
- Analysis of wetland/riparian conditions potentially affected by 14 powerline rebuilds in Midrand, Gauteng, as well submission of a General Rehabilitation and Monitoring Plan. May 2013.
- Wetland specialist input into the Environmental Management Plan for the upgrade of the Firgrove Substation, Western Cape. April 2013
- An audit of the wetlands in the City of Johannesburg. Specialist studies as well as project management and integration of independent datasets into a final report. Commenced in August 2007
- Input into the wetland component of the Green Star SA rating system. April 2009;
- A strategic assessment of wetlands in Gauteng to inform the GDACE Regional Environmental Management Framework. June 2008.
- As assessment of wetlands in southern Mozambique. This involved a detailed analysis of the vegetation composition and sensitivity associated with wetlands and swamp forest in order to inform the development layout of a proposed resort. May 2008.
- An assessment of three wetlands in the Highlands of Lesotho. This involved a detailed assessment of the value of the study sites in terms of functionality and rehabilitation opportunities. Integration of the specialist reports socio economic, aquatic, terrestrial and wetland ecology studies into a final synthesis. May 2007.

- Ecological studies on a strategic scale to inform an Environmental Management Framework for the Emakazeni Municipality and an Integrated Environmental Management Program for the Emalahleni Municipality. May and June 2007