Proposed Construction of a New 400 kV Line From Bravo Power Station to Lulamisa (Kyalami) Substation (Bravo 3)

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

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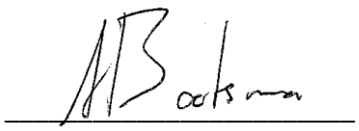
Declaration of Independence

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

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1 INTRODUCTION

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 rehabilitation assessment is focused on the **Bravo 3** component of the Bravo Integration Project and is based on the wetland delineation and functional assessment presented in the accompanying report (Limosella, 2016)

The proposed 400KV powerline from the Lulamisa substation in Kyalami Gauteng and runs east to the Bravo substation at the Kusile Powerstation southwest of Balmoral in Mpumalanga (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 (19-20th 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.

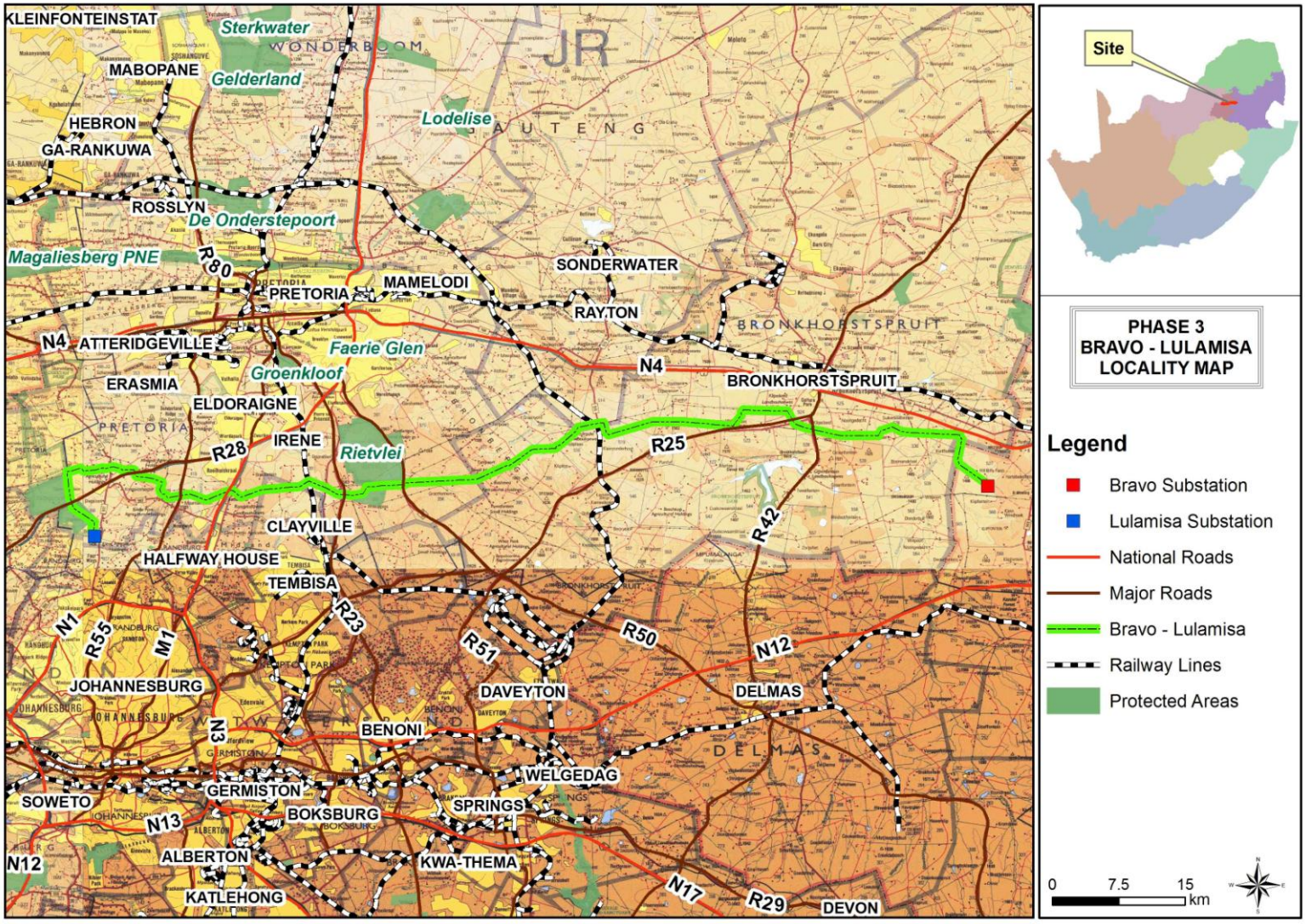

Figure 1: Locality Map

1.2 Objective and aims

This wetland rehabilitation and monitoring plan is specific to the construction of the pylons / towers within the watercourses or within the protective buffer thereof, pylons within close proximity to watercourses (within 500m) and pylons that are situated on slopes that could impact on watercourses down slope or drainage lines. In addition, the rehabilitation plan also applies to disturbances in wetlands where absolutely necessary to complete construction. As the current degraded state of the watercourses 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 watercourses that could be impacted on. However, this document aims to limit localised impacts relating to the construction and refurbishment, and to prevent further degradation of the watercourses in the catchment.

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 watercourses 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.

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 1):

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 1: 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 3 component of the Bravo Integration Project.

3.2 Delineated Water Courses

A total of 31 watercourse are crossed by the proposed line. The total amount of wetlands can be broken down into 8 floodplain wetlands, 20 unchannelled valley bottom wetlands, 2 depression wetlands and one riparian area.

All of the wetlands/riparian areas recorded on site have been impacted to some degree. PES scores calculated in this assessment ranged from B – High to D – Low/Marginal. The predominant land use is generally small holdings and related activities as well as some small scale farming. Urbanisation is the main cause of vegetation and hydrological degradation and thus changes in the run-off characteristics of the landscape and thus the hydrology characteristics of wetlands in this region. The majority of the wetlands continue to support hydrological and biodiversity functions to varying degrees. It is important to note that in general wetlands and riparian areas are important ecological corridors and breeding habitats utilized by numerous faunal species.

The main impacts recorded during the site visits include farming and related impacts, anthropogenic activities such as urbanisation including infrastructure and exotic vegetation. Erosion and sedimentation was abundant in the unchannelled valley bottom wetlands as well as the river. Figures 2 to 5 and Table 2 below indicate wetland and riparian boundaries and functional assessment scores.

Refer to the accompanying wetland assessment report for details regarding the status of wetlands along the proposed Bravo 3 line (Limosella, 2016).

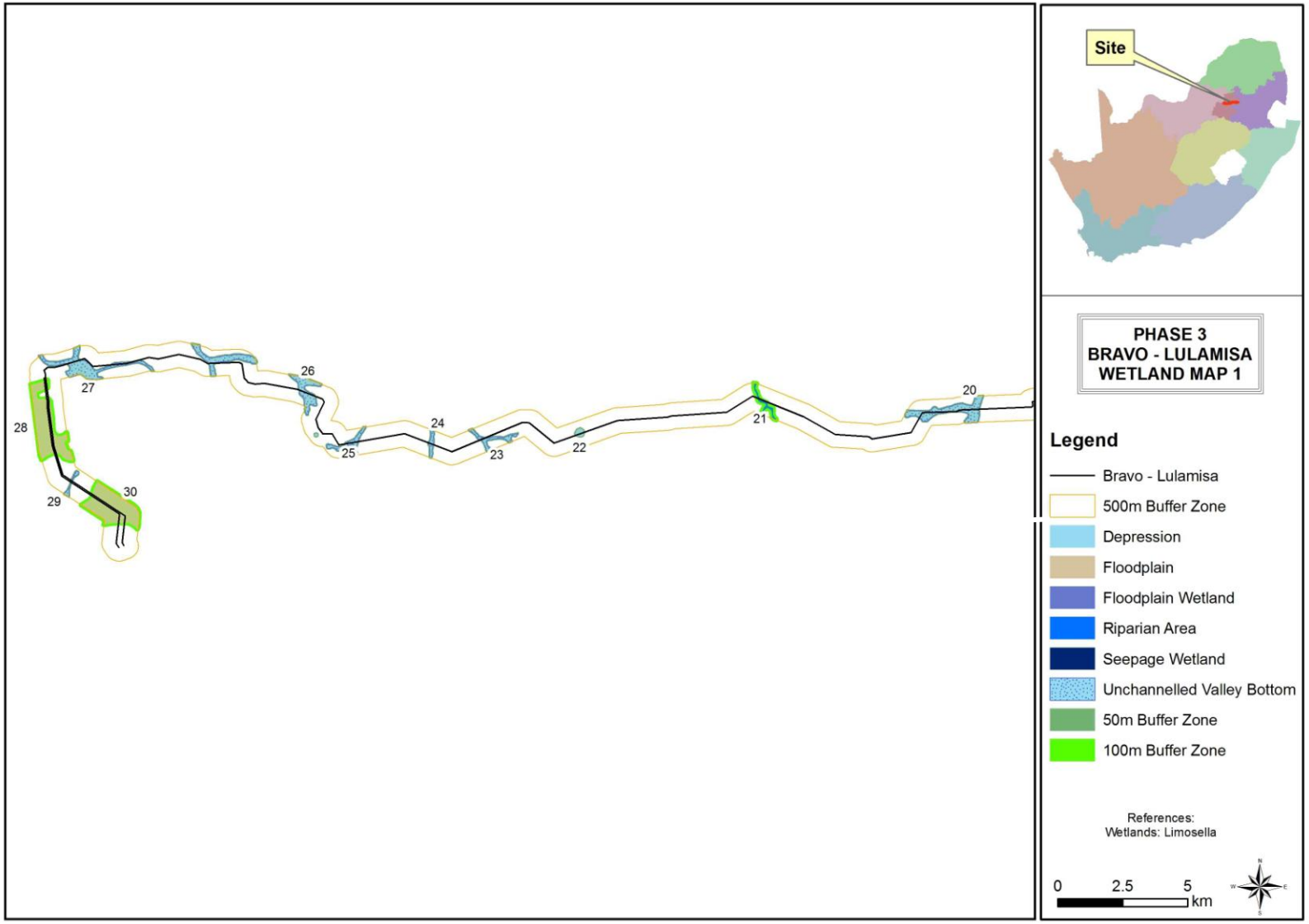

Figure 2: Wetland types and riparian areas delineated along the proposed route, including recommended buffer zones, western section

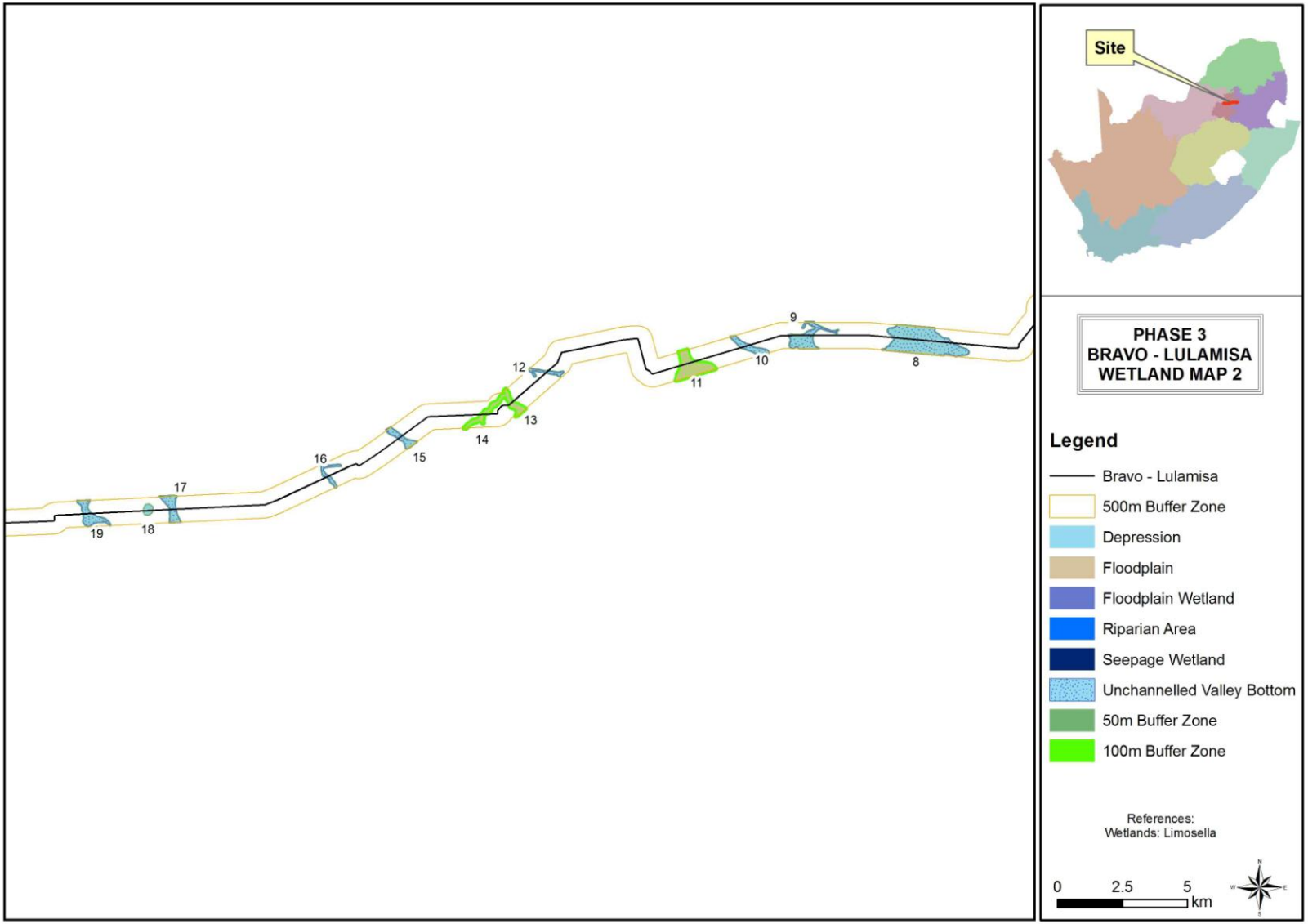

Figure 3: Wetland types and riparian areas delineated along the proposed route, including recommended buffer zones, middle section

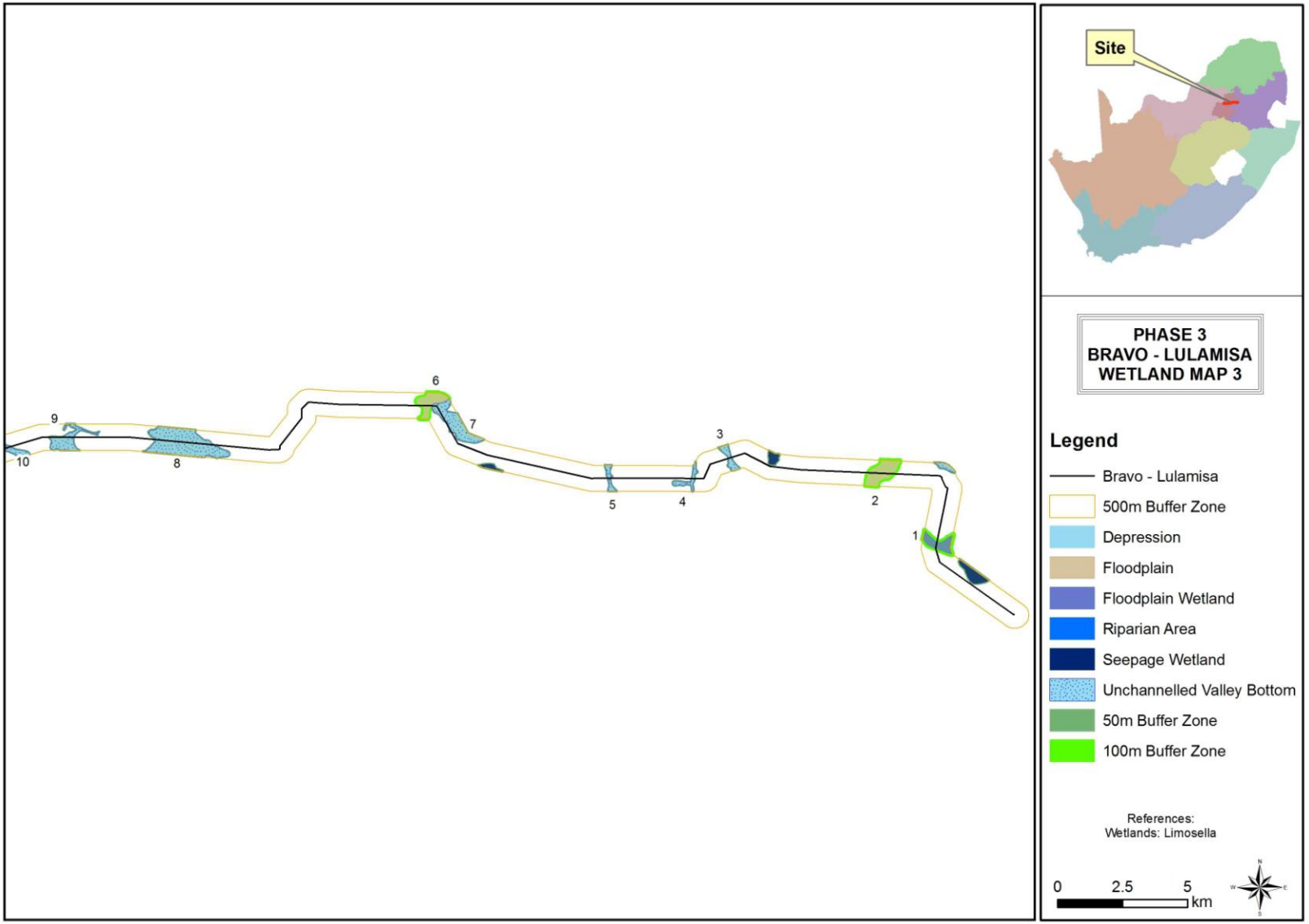

Figure 4: Wetland types and riparian areas delineated along the proposed route, including recommended buffer zones, eastern section

Table 2: Summary of the PES, EIS scores and impacts obtained for each ffected watercourse (Limosella, 2016)

Nr	Affected Watercourse	PES/VEGRAI Score	EIS/QHI Scores
1	Floodplain Wetland	**C - Moderately modified**	**B - High**
2	Floodplain Wetland	**B - Largely natural with few modifications**	**B - High**
3	Unchannelled Valley Bottom Wetland	**D - Largely modified**	**C - Moderate**
4	Unchannelled Valley Bottom Wetland	**C - Moderately modified**	**C - Moderate**
5	Unchannelled Valley Bottom Wetland	**D - Largely modified**	**C - Moderate**
6	Floodplain Wetland	**C - Moderately modified**	**B - High**
7	Unchannelled Valley Bottom Wetland	**D - Largely modified**	**C - Moderate**
8	Unchannelled Valley Bottom Wetland	**E – Greatly modified**	**D - Low/Marginal**
9	Unchannelled Valley Bottom Wetland	**B - Largely natural with few modifications**	**C - Moderate**
10	Unchannelled Valley Bottom Wetland	**C - Moderately modified**	**C - Moderate**
11	Floodplain Wetland	**B - Largely natural with few modifications**	**B - High**
12	Unchannelled Valley Bottom Wetland	**D - Largely modified**	**C - Moderate**
13	Floodplain Wetland	**C - Moderately modified**	**C - Moderate**
14	Floodplain Wetland	**C - Moderately modified**	**C - Moderate**
15	Unchannelled Valley Bottom Wetland	**C - Moderately modified**	**C - Moderate**
16	Unchannelled Valley Bottom Wetland	**C - Moderately modified**	**C - Moderate**
17	Unchannelled Valley Bottom Wetland	**C - Moderately modified**	**D - Largely modified.**
18	Depression Wetland	**B - Largely natural with few modifications**	**B - High**
19	Unchannelled Valley Bottom Wetland	**D - Largely modified**	**B - High**
20	Unchannelled Valley Bottom Wetland	**C - Moderately modified**	**C - Moderate**

Nr	Affected Watercourse	PES/VEGRAI Score	EIS/QHI Scores
21	Riparian Area	**C - Moderately modified**	**C - Moderate**
22	Depression Wetland	**B - Largely natural with few modifications**	**B - High**
23	Unchannelled Valley Bottom Wetland	**D - Largely modified**	**C - Moderate**
24	Unchannelled Valley Bottom Wetland	**D - Largely modified**	**C - Moderate**
25	Unchannelled Valley Bottom Wetland	**E – Greatly modified**	**C - Moderate**
26	Unchannelled Valley Bottom Wetland	**D - Largely modified**	**C - Moderate**
27	Unchannelled Valley Bottom Wetland	**E – Greatly modified**	**D - Low/Marginal**
28	Floodplain Wetland	**D - Largely modified**	**C - Moderate**
29	Unchannelled Valley Bottom Wetland	**E – Greatly modified**	**C - Moderate**
30	Floodplain Wetland	**E – Greatly modified**	**B - High**
31	Unchannelled Valley Bottom Wetland	**E – Greatly modified**	**D - Low/Marginal**

3.3 Buffer Zones

In order to limit the impact on the hydrology and biodiversity of the area, the current assessment finds that a 50m buffer zone should be recognised from the edge of all the wetlands and 100m from the edge of the riparian area and floodplain. 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

Due to the large extent of watercourses that will be traversed by the proposed route alignment, it is unlikely that pylon / tower positions will be able to span the extent of watercourses. In the event that this is possible, stringing is likely to impact on the watercourses. Consequently, the recommendation is to avoid or minimise direct impacts on the watercourses delineated as much as possible. This will ensure that the proposed construction activities could have reasonably contained impacts on vegetation, wetlands and riparian areas and can successfully be mitigated to limit the potential negative impacts. If remedial and mitigation measures are correctly employed (e.g. ESKOM's erosion guidelines, environmental policies and rehabilitation as set out by this report), the areas impacted on by the construction activities could

rehabilitate very well over time, and long term impacts could thus be minimal. The impacts of the access roads or servitudes, when compared with extensive agriculture, rural settlements or urbanisation, can be considered as medium – especially if existing roads or servitudes can be employed (Limosella Consulting, 2016).

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 erosion and sedimentation of proximate watercourses. Since erosion already appears to be a problem in the watercourses associated with the alignment, this risk should be highlighted throughout the planning and construction phase. 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 and on riverbanks are vital for preventing erosion. They play a role in the purification of water, reducing the severity of floods and regulating water, especially during droughts. When vegetation cover is destroyed, these valuable functions disappear. In addition, vegetation around watercourses, especially upslope, holds soil in place and slows down water runoff during rainy events. Vegetation along wetlands contributes to increased surface roughness which contributes to a decrease in sedimentation, erosion and a loss of topsoil.

Compaction of soils – Construction and maintenance: Construction and operational maintenance activities may compact soils from heavy equipment access which could inhibit seed germination, reduce water infiltration, inhibit root establishment, and result in bare soil exposure. In particular, soil compaction can lead to an increase in runoff during rainy events, which in drainage lines and slopes could result in erosion of the servitudes. Soil compaction is expected to occur within the servitude and around the tower bases.

Exposure to erosion - Construction: Removal of vegetation against slopes or close to watercourses and the compaction of expose the resulting bare soils to erosion during rainfall events. Erosion removes the top soil layer, thereby preventing the successful establishment of indigenous vegetation on eroded soils. Eroded areas are likely to be colonised by alien invasive and pioneer plants, or in severe cases, no vegetation will establish causing high velocity runoff during rainfall events and continuous erosion.

Sedimentation of wetlands and rivers- Construction: Soil erosion could lead to increased sedimentation and turbidity in nearby watercourses, which in turn reduce the water storage capacity thereof, smother vegetation, and decrease oxygen concentration. If sedimentation is allowed to continue, wetlands will lose their function and likely become invaded by alien invasive plant species.

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 water resources will influence the water quality of watercourses, thereby influencing its functionality and the persistence of vegetation.

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. A number of alien invasive plant species was observed in the watercourses and should ideally be destroyed to prevent them spreading during construction and rehabilitation.

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. In addition, sedimentation is very difficult and sometimes impossible to rehabilitate without further impacting on watercourses. Therefore, sedimentation should be prevented through mitigation. 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	• Project engineers should compile a method statement, outlining the construction methodologies. The required mitigation measures to limit the impacts on the watercourse 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 • Avoid linear disturbances that run parallel to a watercourse • Plan access roads in such a way as to minimise impact on watercourses • Plan construction activities that necessitate water crossings to only cross watercourses at designated points • Plan construction camps to be placed outside of watercourses and their associated buffer zones • 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 wetlands or their associated buffer zones- especially where protected plant species occur • Avoid linear disturbances that run parallel to a watercourse • Should a watercourse be affected by construction, the edge / boundary of this wetland or riparian area must be clearly demarcated in the field with poles, sticks, or any solid structure that will last for the duration of the development. These indicators should be coloured as follows and communicated to workers: • Access roads must be restricted in wetland or riparian areas and buffers. These access areas must be designated in the planning phase to prevent contractors taking “short-cuts” through wetland areas and buffers. • 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

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
		• Plan construction activities to have the smallest possible footprint • No stockpile areas should be located within river / 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
	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 watercourses e.g. shooting a pilot cable and pull cables with a winch • Stringing should preferably not make use of vehicles in watercourses • 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 e.g. quad bikes • Plan stringing through watercourses 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 watercourses are 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
	Limit the construction footprint and related impacts	• Only use access roads as designated during the planning phase • Should a line rebuild section be affected by a wetland, 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. • Only cross watercourses at designated points • 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) • Watercourse 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

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
Construction phases		• 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 / stream crossings 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.

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
Construction phases		• 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 neighbours' properties or into adjacent wetlands, rivers or streams • Management of on-site water use and prevent stormwater or contaminated water directly entering the watercourse • 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 / stream 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 • Sediment barriers should be installed immediately after initial disturbance of the watercourse or adjacent upland • 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(s) • 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 neighbours' 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

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
		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 watercourses and associated buffers 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 wetland / stream crossings as well as measures as set out by this report • If vehicles are used for stringing: only cross watercourses 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 Table 4 and 5 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 mining, cultivation and grazing 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. Disturbance of slopes, for example by the removal of vegetation, may result in slope instability and erosion by rain and surface runoff.	• Stripping of vegetation for construction must occur in a phased manner and must be restricted to the building footprint to reduce the risk of erosion during times of precipitation • 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 • All rehabilitated areas must be monitored for the presence of exotic and alien plant species.	• 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
	• 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	
Erosion Erosion and sedimentation is likely to occur where vegetation has been cleared and where excavated material is stored in close proximity to a watercourse. Disturbance of steep slopes by the removal of vegetation may result in slope instability and erosion by rain and surface run-off.	• The contractor shall be responsible for rehabilitating all eroded areas in such a way that the erosion potential is minimised after construction has been completed • All slopes that are disturbed during construction should be stabilised immediately to prevent erosion • Re-vegetation should be done immediately after construction, especially in sloped areas • Disturbances on site should be kept to a minimum to reduce the loss of material by erosion • Disturbed areas that require rehabilitation should be mulched to encourage vegetation re-growth. • Stockpiled soil should be protected from erosion due to water runoff • Near vertical slopes of 1(V):1(H) or 1(V):2(H) must be stabilised using hard structures, preferably with	• During and immediately after construction • Immediately after stringing where stringing resulted in erosion or damage that could lead to erosion over time • As and when monitoring indicate erosion is taking place

Impacts	Rehabilitation	Time frame
	a natural look, and with facilities allowing for plant growth. The EO / ECO will specify a solution in terms of the most appropriate approved method and technology. One or more of the following methods may be required: • Retaining walls (loffel or otherwise) (DWAF 2005) • Stone pitching. • Gabions. • Shotcrete. • Protect the slopes of all river diversions. One or more of the following methods may be used, as specified by the EO / ECO: (DWAF, 2005) • Sandbags. • Reno mattresses. • Plastic liners and / or coarse rock (undersize rip-rap) • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within work areas • Where access cannot be avoided into sensitive areas, the amount of vehicle and personnel traffic should be kept to a minimum and should make use of only one route • Where crossings of watercourses are unavoidable eco-friendly soft options (such as wooden poles) should be placed over the wet area to be driven over • Where all preventative measures have failed and erosion persists soft and hard rehabilitation options, such as eco-logs or weirs, should be considered in conjunction with an engineer and wetland specialist • Erosion control of all banks must take place so as to reduce erosion and sedimentation into river channels or wetland areas.	
Soil Compaction Soil compaction is likely to occur on	• 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.	• Immediately after construction phase (except where the next phase (stringing) follows

Impacts	Rehabilitation	Time frame
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 vegetation establishment.	• 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 temporary access routes and roads, compacted during the execution of the Works. (DWAF, 2005)	immediately and makes use of the same construction footprint) • Immediately after stringing 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

Impacts	Rehabilitation	Time frame
Sedimentation	• Sedimentation should be prevented though sufficient mitigation • If structures are used on sensitive sloped areas it is important that sediment does not pass through these structures e.g. gabions should be lined • Should sedimentation be observed to accumulate and smother vegetation, a wetland specialist should be consulted to find a suitable solution for the specific wetland and its species composition.	• 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 4). 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 and watercourse 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 arised, monitoring can take place once a year after the first seasonal rainfall.

Problems such as failed re-vegetation and erosion 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
Integrity of rehabilitations structures where used	• On-site inspection • Fixed point photography.	• After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Arresting of erosion/head cut. • Sedimentation behind structure	• Structures should be fixed where possible or new structures should be implemented
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 • Re-growth of relocated plants of conservation concern (*Crinum bulbispermum, Gladiolus papilio* and *Kniphofia ensifolia*)	• If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern • Prevent livestock from entering 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	• Fixed transect to	• Seasonal for the first	• Presence/absence of species in	• If natural re-vegetation does not occur

Variables	Methods	Monitoring Frequency	Indicator	Corrective Action
composition	determine the species composition	three years and rapidly after heavy rainfall • Thereafter annually	specified wet areas.	replanting of indigenous plants should be done at sites of concern. • If exotic plants have colonised the area the exotic plants should be removed.
Erosion	• On-site inspection • Fixed point photography • Compare to adjacent land	• After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually.	• Areas where vegetation cover is limited or nil and where soil has started to erode • Bare soil patches or ditches (see Photograph 1)	• Should erosion occur, soft options such as hay bales, eco-logs and replanting should be considered, if erosion is too great a rehabilitation method should be discussed with an engineer and wetland specialist
Sedimentation	• As determined by ECO • Visual observations and site inspections • Fixed point photography	• After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Excess sediment in wetlands and rivers	• Cause of sedimentation should be identified and dealt with appropriately • Should sedimentation be observed to accumulate and smother vegetation, a wetland specialist should be consulted to find a suitable solution for the specific wetland / river and its plant species composition.
Alien Invasive Plant Species	• Monitor the emergence of alien invasive plant species in or around rehabilitated areas • On-site inspection • Fixed point photography	• After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Establishment of alien invasive plant species in rehabilitated areas or in watercourses	• Remove emergent invasive vegetation 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

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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

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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