Conceptual Wetland Mitigation Strategy for the Proposed Kendal 30-year ADF

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EXECUTIVE SUMMARY

Wetland Consulting Services (Pty.) Ltd. (WCS) was appointed by Zitholele Consulting to assist in the compilation of a conceptual wetland offset strategy for the Kendal 30-year ADF Project in the Mpumalanga Province.

The broad objectives of this report are:

1. To quantify the required wetland offset targets as per the requirements of the SANBI & DWS (2016) guidelines;
2. To identify and assess suitable target wetlands for implementation of the offset;
3. To identify rehabilitation opportunities within the selected target wetlands and develop conceptual rehabilitation and management interventions to address these; and
4. To compile a conceptual wetland offset strategy report for submission to the authorities.

The wetland offset calculations using the SANBI & DWS (2016) have indicated the following targets as being applicable to the Kendal 30-year ADF:

- The required Water Resources offset target for impacts associated with the proposed Kendal 30-year ADF Project would be ***63.5 hectare equivalents*****.**
- ***78.6 hectare equivalents*** would be required for the Ecosystem Conservation offset target.

It had been decided during a project team workshop that the wetlands immediately adjacent and downstream of the proposed Kendal 30-year ADF should form the focus of the proposed wetland offset strategy. Such an approach has numerous advantages, including the following:

- Rehabilitation gains will be realised in the same wetland systems and, thus, by the same water users as are likely to be impacted by the proposed Kendal 30-year ADF;
- Target wetlands will share the same characteristics as the impacted wetlands, allowing for a like-for-like offset; and
- Proximity of the offset wetlands to the Kendal 30-year ADF will allow for easier management and monitoring of the offset.

A rapid baseline assessment of the selected target wetlands was undertaken, which included a desktop delineation of wetlands on aerial imagery with rapid, limited field verification of boundaries, as well as a PES (WET-Health Level 1) and IS assessment.

Four different hydro-geomorphic (HGM) wetland units were identified:

- Channelled valley bottom
- Unchannelled valley bottom
- Pan/depression

- Seep

The identified wetlands cover a total of 927.31 hectares, which includes 67 hectares of dams. The bulk of wetland habitat (roughly 71 %) has been typed as Seep wetlands, with most of the remainder consisting of channelled and unchannelled valley bottom wetlands. Only a single Pan/Depression wetland of 4.77 hectares was identified. The wetlands were found to be in a moderately modified (PES category C) to largely modified (PES category D) condition and of Moderate to High importance and sensitivity.

Opportunities for rehabilitation and improving wetland habitat identified within the wetlands indicate the wetlands as suitable targets for such a wetland offset strategy. In terms of the water resources and ecosystem services target requirement of 71 ha-eq., **the 4 wetland systems identified adjacent to the proposed Kendal 30-year ADF have the potential to realise 47.3 ha-eq. in gains, resulting in achieving approximately 75% of the target**. These calculations include an adjustment factor of 0.66 to account for inherent risk of failure in rehabilitation interventions, as per the requirements of the wetland offset guidelines (SANBI & DWS, 2016). In terms of the ecosystem conservation target of 78.6 ha-eq, it is clear that the four (4) wetlands systems identified adjacent to the proposed Kendal 30-year ADF, together, would far exceed this target, potentially realising almost 470 ha-eq. if these wetlands can be adequately secured and conserved.

The predicted gains are dependent on the full implementation of recommended rehabilitation interventions and management measures. A number of the proposed management measures required to improve wetland habitat in the selected target wetlands (e.g. withdrawing cultivation, fire management, livestock management, etc.) impose landuse limitations that might not be acceptable to land owners. Failure to implement such measures will result in reduced rehabilitation gains. A number of further possible risk and challenges are identified and highlighted in the report, the most significant of which is the need to secure land for the offset from Third Parties.

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1. BACKGROUND AND SCOPE OF WORK

Wetland Consulting Services (Pty.) Ltd. (WCS) was appointed by Zitholele Consulting to compile a conceptual wetland offset strategy for the Kendal 30-year ADF Project in the Mpumalanga Province.

WCS was also previously involved with environmental authorisation processes for the Kendal 30-year ADF Project and undertook the specialist wetland delineation and assessment study as part of the EIA/IWULA process run by Zitholele Consulting. The possible need for a wetland offset strategy was initially highlighted in the wetland baseline assessment (WCS, 2013) undertaken as part of the site selection process for the Kendal 30-year ADF, although the reference was made in relation to an alternate site. During discussions with the Department of Water and Sanitation (DWS) and presentations to the Department on the selected site for the Kendal 30-year ADF, the need for a wetland offset strategy was again highlighted and requested by the DWS. Subsequent to the request by the DWS, two further reports have been produced by WCS in attempting to identifying possible target wetlands for the offset strategy, though in both cases the wetlands investigated were found not feasible due to various reasons. This report therefore represents the continuation and culmination of a number of wetland studies.

The wetland types that are to be affected by the proposed Kendal 30-year ADF footprint include hillslope seepage wetlands and pan/depression wetlands. Each hydro-geomorphic (HGM) type is characterised by particular dominant hydrological drivers, and these translate into the provision of varying sets of ecological goods and services, at a range of different levels. The required offset strategy should ideally aim to target the same type, or similar, wetland systems to ensure equitable compensation for the loss of wetland habitat and functionality on site, as well as targeting wetlands in close proximity to the impacted wetlands. This strategy attempts to achieve the above by, as a first option, targeting wetlands downstream and adjacent to the impacted footprint of the Kendal 30-year ADF and selecting wetlands that are broadly similar to the impacted wetlands.

The broad objectives of this report are:

1. To quantify the required wetland offset targets as per the requirements of the SANBI & DWS (2016) guidelines;
2. To identify and assess suitable target wetlands for implementation of the offset;
3. To identify rehabilitation opportunities within the selected target wetlands and develop conceptual rehabilitation and management interventions to address these; and
4. To compile a conceptual wetland offset strategy report for submission to the authorities.

2. IDENTIFICATION OF TARGET WETLANDS

2.1 Summary of Previous Work

Considerable work had already been undertaken towards the realization of an offset strategy for the proposed Kendal 30-year ADF prior to the commencement of this current study. Two previous reports were compiled, that detailed attempts to identify suitable target wetlands for the required offset strategy, namely:

2016 – The initial study focussed on quantifying offset targets and identifying possible target wetlands. The main criteria used to identify target wetlands were that the target wetlands had to include pan/depression wetlands and hillslope seepage wetlands (to ensure a like-for-like offset), and that target wetlands had to be located within either of the affected quaternary catchments, within a 10km radius of the proposed Kendal 30-year ADF, or within land owned by Eskom on the Mpumalanga Highveld. Four pan wetland systems/clusters were identified and investigated in the field for rehabilitation opportunities and possible offset gains quantified. One of the selected sites was found to be fatally flawed, with the other three sites providing various opportunities for rehabilitation gains. The site providing the most gains, in terms of both water resources and ecosystem conservation targets, was, however, located on privately owned land, and therefore deemed not suitable for the practical implementation of the offset, as security of tenure could not be assured and the risk was deemed high. The remaining two sites, although located, for the most part, at different power station properties, on Eskom-owned land, provided insufficient gains to meet the required offset target, and could potentially also, in future, be targeted for further infrastructure development associated with their respective existing Power Stations. The outcomes of this study were presented to the DWS but rejected based on the mentioned concerns.

2018 – Upon rejection of the first draft conceptual report, a further site selection process to identify possible additional target wetlands for the offset was undertaken in early 2018. To avoid the difficulties experienced previously relating to landownership, it was decided to focus purely on Eskom-owned land on the Mpumalanga Highveld. Numerous land holdings were investigated at a desktop level for extent and type of wetlands. The focus was on identifying a single larger cluster of wetlands rather than a number of smaller fragmented systems, and this strategy would assist in sustainable maintenance of the offset. Although a possibly suitable area was identified, it was subsequently determined that future mining activities within and adjacent to the wetlands would render the wetlands unsuitable as a sustainable offset.

Thus, both attempts at producing a feasible wetland offset strategy did not yield positive results, hence this further study was undertaken.

2.2 Selection of Target Wetlands

An important criterion for offset site selection is that the candidate wetlands are situated in the same catchment and, ideally, in the same quaternary catchment or sub-catchment as the wetlands that will be lost. The rationale being that the ecological benefits added to the landscape by rehabilitation efforts will manifest themselves on the same water resource that has been affected by the lost wetlands. At the same time, given the extensive mining activities within the Mpumalanga Highveld, the risk associated with rehabilitating wetlands within these mining areas must be recognised and considered in the site selection process, and consideration of sites further afield, away from mining activities and other risks that could undermine the long-term sustainability of offset activities, can also be considered and motivated for.

Factors contributing to the selection of candidate offset wetlands are as follows (SANBI & DWS, 2016):

- Identify areas with similar characteristics in terms of wetlands and landuse to those being lost by development according to the following hierarchical categories:
  a. The same quaternary and sub-catchment areas as the wetlands to be offset. This is aimed at ensuring that the restoration of wetland functioning is kept as close to the development as possible, so that the people and ecosystems directly affected may also gain the benefits of the rehabilitation measures;
  b. The same geological formations as those underlying the wetland areas to be offset. The rationale behind this is that wetland types which share similar landscape settings and geological formations tend to respond in the same way to changes in the catchment characteristics. They also perform similar ecological functions in the landscape;
  c. The same vegetation types i.e. have similar species compositions as those of the wetlands to be lost. This is likely to ensure that the requirements in terms of wetland biodiversity are met;
  d. The extent of similar wetland types, according to their hydro-geomorphic (HGM) classification, as those to be lost within the proposed development, i.e. to maintain the principle of a like for like offset. There is evidence that wetland function can be linked to wetland type (Kotze *et. al*., 2004), with the biophysical characteristics of the different wetland types, together with conditions in the surrounding catchments, determining the magnitude and importance of the various wetland functions they are able to perform. With different wetland types being more effective at performing certain ecological functions than others, the removal of one wetland type from the landscape, and its replacement with another, may result in a change in the types of important eco-services provided to the landscape. It was assumed that the rehabilitation and protection of required areas of similar wetland types within selected catchments would be most likely to appropriately compensate for the loss of functionality of the wetlands in the proposed Kendal 30-year ADF footprint.
  e. Landownership. Rehabilitating and securing wetlands in the long-term is most easily achievable on land owned by the development proponent. Where offset target wetlands are located on land owned by private individuals, lengthy negotiations might be required to secure access and management of the wetlands, and outright land purchases could also be required, adding considerably to the cost of implementation.

In light of the above criteria and the prior work already undertaken, it was decided, during a project team workshop, that the wetlands immediately adjacent and downstream of the proposed Kendal 30-year ADF should form the focus of the proposed wetland offset strategy. This decision is in line with provisions of the SANBI Wetland offsets guideline (2016). Such an approach has numerous advantages, including the following:

- Rehabilitation gains will be realised in the same wetland systems and thus by the same water users as are likely to be impacted by the proposed Kendal 30-year ADF;
- Target wetlands will share the same characteristics as the impacted wetlands, allowing for a like-for-like offset, with opportunities for trading-up; and

- Proximity of the offset wetlands to the Kendal 30-year ADF, and hence Kendal Power Station, will allow for easier management and monitoring of the offset by the proponent.

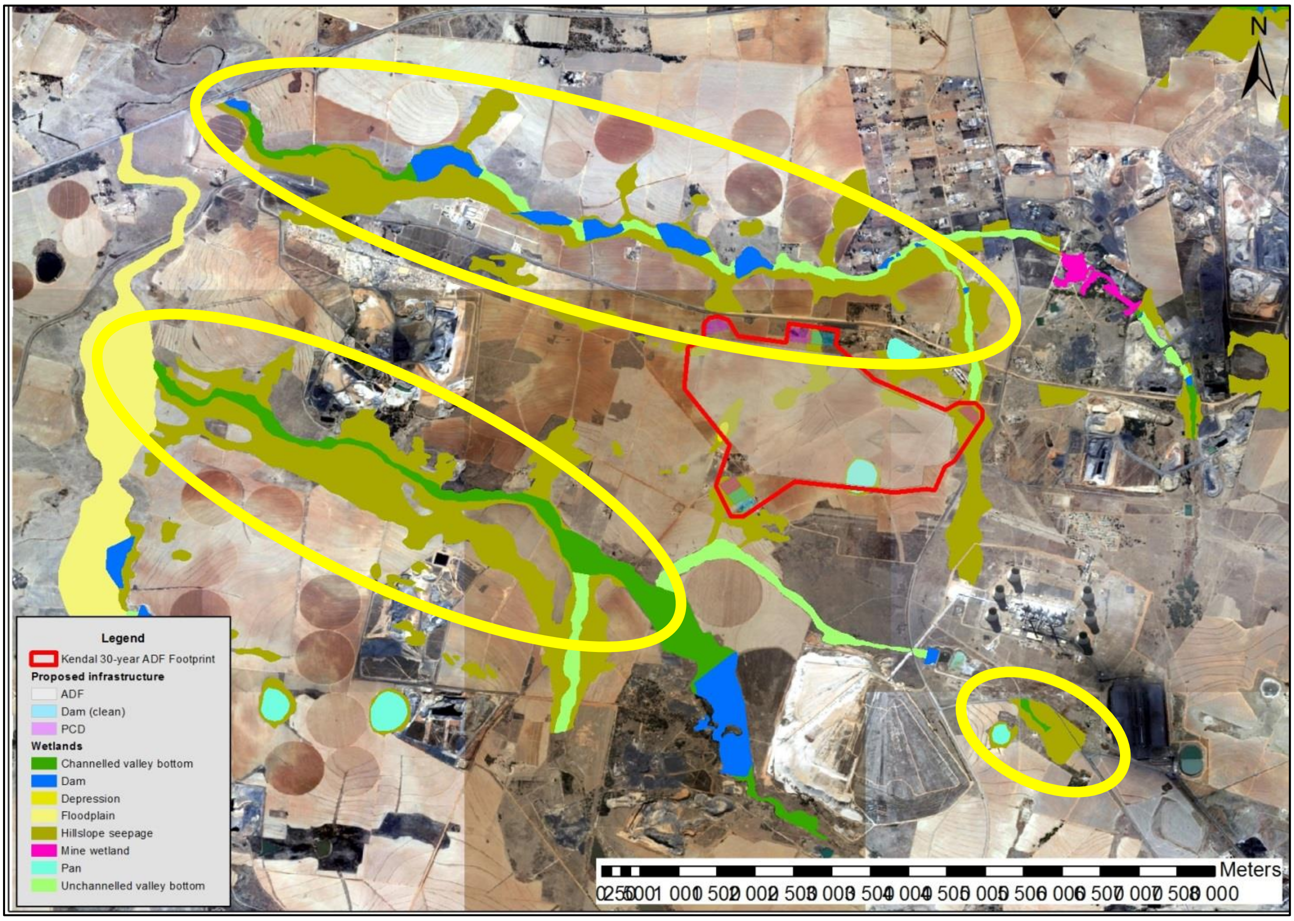


Figure 1. Map showing the proposed development footprint of the Kendal 30-year ADF as well as the selected target wetland systems.

3. APPROACH

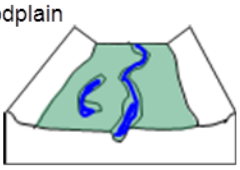
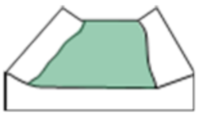
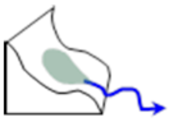
3.1 Wetland Delineation

Wetland mapping was done by digitizing wetlands in ArcGIS at a desktop level using the most recent available aerial imagery (1:10000 NGI imagery, ESRI World Imagery Basemap, and Google Earth imagery). Mapping was carried out at a scale of approximately 1:5 000 or finer, and was based on visible wetness and greenness signatures and available 5m contours of the area. Due to the extent of the area and the mapping scale used, the actual extent of the boundaries of these wetland systems is likely to be underestimated or overestimated in places. This may range from metres to tens of metres but generally is regarded as being of sufficient accuracy for the purposes of this conceptual wetland offset strategy.

Identified wetlands were then typed according to the hydro-geomorphic classification systems originally proposed by Brinson (1993), and the one most recently modified for use in South African conditions by Ollis *et al*. (2013). Table 1 provides a description of the HGM classification system.

During targeted site visits to the wetlands some limited verification of wetland boundaries was undertaken using the delineation methodology described by DWAF (2005). However, not all wetland boundaries were verified in the field.

Table 1. HGM Wetland Classification system (taken from Kotze, Marneweck, Batchelor, Lindley, and Collins, 2007, modified from Brinson, 1993, Kotze, 1999, and Marneweck and Batchelor, 2002)

Hydro-geomorphic types	Description	Source of water maintaining the wetland	
		Surface	Sub-surface
Floodplain 	Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to the net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel 	Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/***
Valley bottom without a channel 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/***
Hillslope seepage linked to a stream a stream channel 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from subsurface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from subsurface flow and outflow either very limited or through diffuse subsurface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans) 	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/***	*/***

[1] *Precipitation is an important water source and evapo-transpiration an important output in all of the above settings*

Water source: * *Contribution usually small*

*** *Contribution usually large*

*/ *** *Contribution may be small or important depending on the local circumstances*

3.2 Wetland Ecological Integrity Assessment

PES and IS assessments were undertaken for all of the identified target wetlands using the WET-Health Level I methodology (Macfarlane *et. al*, 2007) and the scoring system as described in the document "*Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0)*" (Rountree *et. al,* 2013), respectively.

Wetlands are an expression of water moving through the landscape, and occur in the landscape where water is slowed down and appears close enough to, or on the surface of, the land for a sufficiently long time to enable wetland conditions to develop. Activities that alter the movement or quality of water moving through the landscape will thus undoubtedly have a significant influence on the wetlands. The PES assessment assisted in identifying the current impacts that are undermining the integrity of each wetland HGM unit, and in so doing directing the objectives of the subsequent rehabilitation plan. The PES categories for each of the wetlands were used to assign the wetlands a score out of 10 as per the scoring used in the WET-Health tool (Macfarlane et. al, 2007, Table 2). These scores were then used to calculate the current functional area, or number of hectare equivalents, of the wetlands in the target area. Rapid assessments were also undertaken of the wetlands under a hypothetical post-rehabilitation scenario, and the gain in hectare equivalents calculated to estimate whether or not candidate sites and the rehabilitation measures proposed will achieve the hectare equivalent targets.

Table 2. Present Ecological State categories used to define health of wetlands

Description	Combined impact score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	F

The "ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The categories used to define wetland EIS are shown in Table 3 below.

Table 3. The scoring system used for the EIS assessment.

Ecological Importance and Sensitivity categories	Range of Median	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1	D

3.3 Development of the Wetland Mitigation Strategy

The development of the wetland mitigation strategy was guided by the latest version of the wetland offset guidelines and calculator, as detailed in the document:

> SANBI and DWS, 2016. *Wetland Offsets: A best practice guideline for South Africa*. South African National Biodiversity Institute and the Department of Water and Sanitation. First Edition. Pretoria. 53 pages.

SANBI and the DWS have compiled and released the Wetland Offset Guidelines (SANBI & DWS, 2016) to guide wetland offsets in South Africa. The guidelines have, in the recent past, undergone numerous iterations and revisions, with the most recent version (2016) having been approved by the Department of Water and Sanitation as an official guideline to aid the development of appropriate wetland offsets in situations where an offset is required. The guideline provides an approach and methodology to wetland offsets in South Africa. The SANBI & DWS (2016) guideline document is available from the DWS website (www.dwa.gov.za).

According to the above document, the offset target is separated into three subparts, namely:

- The *Water Resources and Ecosystem Services* target, which represents the gain in wetland functional area that is required to ensure a "no net loss of wetland" functioning from the landscape. This employs the risk of failure multiplier and the temporal risk multiplier;
- The *Ecosystem Conservation* target, which incorporates the conservation, threat status or protection multiplier, which ensures that there is a "no net loss" or ensures a gain in biodiversity value for the local landscape following the development;
- The *Species of Conservation Concern* target, which considers the presence of threatened or other important species associated with the wetlands.

This guideline document as it currently stands recommends a range of mitigation ratios, or multipliers, for the various offset targets that are closely tied to the following:

- Ecological integrity of the wetland itself (wetland conditions);
- Threat status of vegetation types;
- Habitat and vegetation conditions;
- National and regional conservation plans and targets; and
- Wetland biodiversity.

The multipliers are then determined based on area weighing all the above components and, thus, give a variety of multipliers based on these attributes.

The broad wetland offset policy goals proposed by the SANBI offset guidelines (SANBI & DWS, 2016) are as follows:

1. **Formally protecting** wetland systems in a good condition so as to contribute to **meeting national conservation targets** for the representation and persistence of different wetland and wetland vegetation types;
2. **No net loss in the overall wetland functional area** by providing gains in wetland area and / or condition equal to or greater than the losses due residual impacts;
3. **Providing appropriate and adequate compensation for residual impacts on key ecosystem services;** and
4. **Adequately compensating** for residual impacts on **threatened or otherwise important (e.g. wetland-dependent) species** through appropriate offset activities that support and improve the survival and persistence of these species.

3.4 Calculation of Hectare Equivalents

The 'hectare equivalent' is used as the common currency to evaluate gains and losses in regulating and supporting ecosystem services provided by wetlands. 'Hectare equivalents' can be seen as a measure of the functional area of a wetland (e.g. in effect, a 10ha wetland that has been moderately modified – PES score of 3 – can be seen to only perform the functions of a 7 ha wetland). Hectare equivalents are determined by converting the PES score to a level of intactness score (10 – PES score) and multiplying this by the wetland area.

Hectare equivalents were calculated according to the formula detailed in the SANBI Guidelines:

(10 – PES)/10 x Area = Hectare equivalent

As an example, for a 107ha wetland with a PES score of 3.2 (PES category CD), the equation would be as follows:

(10 – 3.2)/10 x 107 = 72.76 hectare equivalents

The above calculations are generally done for affected wetland systems before development and then again for the assumed condition after development, and the difference in hectare equivalents becomes the target value for the offset project.

3.5 Determining Wetland Losses

Both direct and indirect wetland losses were considered in the offset calculations. In the case of Kendal 30-year ADF, the wetlands falling within the direct footprint of proposed surface disturbances will be permanently destroyed, and the assumed post-development hectare equivalent for these wetlands is thus 0. These are the direct wetland losses and were determined by overlaying the proposed ADF footprint and surface infrastructure plans with the delineated wetland habitat and assuming complete and permanent loss of all wetland habitat falling within the proposed development footprints.

Indirect losses refer to the loss in wetland functional area occurring in adjacent wetland areas (generally downslope of the proposed development) due to degradation of habitat and changes in wetland drivers. These wetlands remain in the landscape, but in an altered form. Hectare equivalents of adjacent wetlands are determined before commencement of proposed developments to provide the baseline scenario. Projections are then made on the likely changes to the wetland habitat and the likely hectare equivalents post-development determined, with the difference between these figures equaling the indirect wetland losses. Given the need to project wetland conditions into the future, there can be a fair amount of uncertainty regarding the indirect wetland losses, the quantification of these indirect losses can, at best, be considered to be of low to medium confidence.

The following assumptions and limitations are applicable to the determination of wetland losses on site:

- Current PES scores as captured in the specialist wetland report compiled for the EIA (Wetland Consulting Services, 2013. Baseline Wetland Delineation and Assessment for the Kendal 30-Year ADF Project. Report reference: 1032-2013) were utilised to determine hectare equivalents. Although it is unlikely that PES scores would have changed significantly over the last 4 years, the PES scores were not verified or updated as part of this study.

- All wetlands within the direct development footprint of the proposed ADF and surface infrastructure are assumed to be permanently lost. Should the development footprint be altered or not fully developed, these calculations will need to be revised.
- Indirect losses were calculated for all wetland systems within *500m downslope* of the proposed ash disposal areas and infrastructure.
    - Adjacent wetland systems have been assumed to drop by 1-2 PES categories as a result of catchment exclusion and changes in flow, based on individual circumstances. Wetlands with a high PES score pre-development were considered more likely to drop by 2 categories, while wetlands with a low PES score were considered likely to drop by 1 category; and
    - Wetland habitat intactness, a measure of the vegetation condition of the wetland, was assumed to drop by 1 PES category for adjacent wetland systems, with the exception of wetlands rated PES category A or B, which were expected to drop by 2 categories.
- It has been assumed that the ADF will eventually be re-vegetated as part of on-going rehabilitation activities and will drain clean surface runoff back into adjacent wetlands.
- Any potential water quality impacts will be successfully mitigated.
- All mitigation recommendations made within the wetland specialist report (WCS, 2013) will be fully implemented.

4. ASSUMPTIONS AND LIMITATIONS

- This report has been prepared for the particular purpose outlined in the Background and Scope of Work above and no responsibility is accepted for the use of this report, in whole or in part, in any other context or for any other purpose.
- Wetlands were mapped at a desktop level from available aerial imagery (1:10 000 NGI imagery, ESRI World Imagery Basemap, and Google Earth imagery) at a scale of approximately 1:5 000. Due to the extent of the area and the mapping scale used, the actual extent of the boundaries of these systems may be underestimated or overestimated in places. This may range from metres to tens of metres but is regarded as being of sufficient accuracy for the purposes of this study.
- Only limited field verification of wetland boundaries was undertaken for the offset target wetlands assessed in this report.
- Rehabilitation recommendations contained in this report are of a conceptual nature only.

5. WETLAND OFFSET REQUIREMENTS

5.1 Expected Wetland Losses and Impacts

The proposed Kendal 30-year ADF Project will result in the permanent loss of all wetland habitats located within the direct footprint of the proposed ADF and associated infrastructure. A total of 86.5 ha of wetland falls within the direct development footprint and will be permanently lost. Added to this direct loss is a further 1.5 ha of pan/depression wetland habitat in which all functionality is expected to be lost as more than 50 % of each of the two identified pan/depression wetlands will be permanently lost due to the proposed ADF, with the remaining sections unlikely to remain functional.

It is, however, expected that some of the remaining adjacent wetlands will also be impacted due to the development of the ADF within their catchments or upper reaches, resulting in altered flow characteristics of these wetlands. Although an extensive list of mitigation measures has been proposed and is detailed in the full EIA/IWULA documentation, some residual impact is likely to remain, resulting in further wetland degradation. These are referred to as indirect impacts and refer to the loss of wetland functionality that can occur due to habitat degradation, although the wetlands themselves will remain post-development.

Even though the ADF will be continuously rehabilitated and vegetated as part of the facility's rehabilitation processes, no wetland habitat is expected to reform on the ADF and the direct loss of wetland habitat within the ADF footprint can thus not be mitigated. The loss of this wetland habitat will thus require a wetland offset.

With regards to the indirect impacts, the mitigation hierarchy was followed in an attempt to first avoid impacts, then minimise impacts, and finally mitigate impacts. The reader is refer to the full EIA/IWULA reports for more details in this regard, but measures included a detailed site selection process, design revisions and incorporation of mitigation measures recommended by specialists.

Despite the mitigation measures, some residual impact to the immediate adjacent wetlands is expected to remain as a result of loss in catchment yield and changes in flow characteristics. The Department of Environmental Affairs' (DEA) draft policy on Environmental Offsets requires that only <u>residual impacts quantified as significant</u> are required to be offset. "Significant Impact" is defined in the draft policy as "*an impact that may have a notable effect on one or more aspects of the environment or may result in non-compliance with accepted environmental quality standards, thresholds or targets*". The Wetland Offset Guidelines (SANBI & DWS, 2016), which are referenced in the DEA draft policy on Environmental Offsets, adopt the principle of "No Net Loss", which requires that a "*project's impacts are balanced or outweighed by measures taken to avoid, minimise, rehabilitate on-site and offset, so that no net loss remains*" (BBOP, 2012, as referenced in SANBI & DWS, 2016).

Figure 2, below, shows the delineated wetlands on site as well as the extent of expected direct and indirect wetland losses that have been considered in this report.

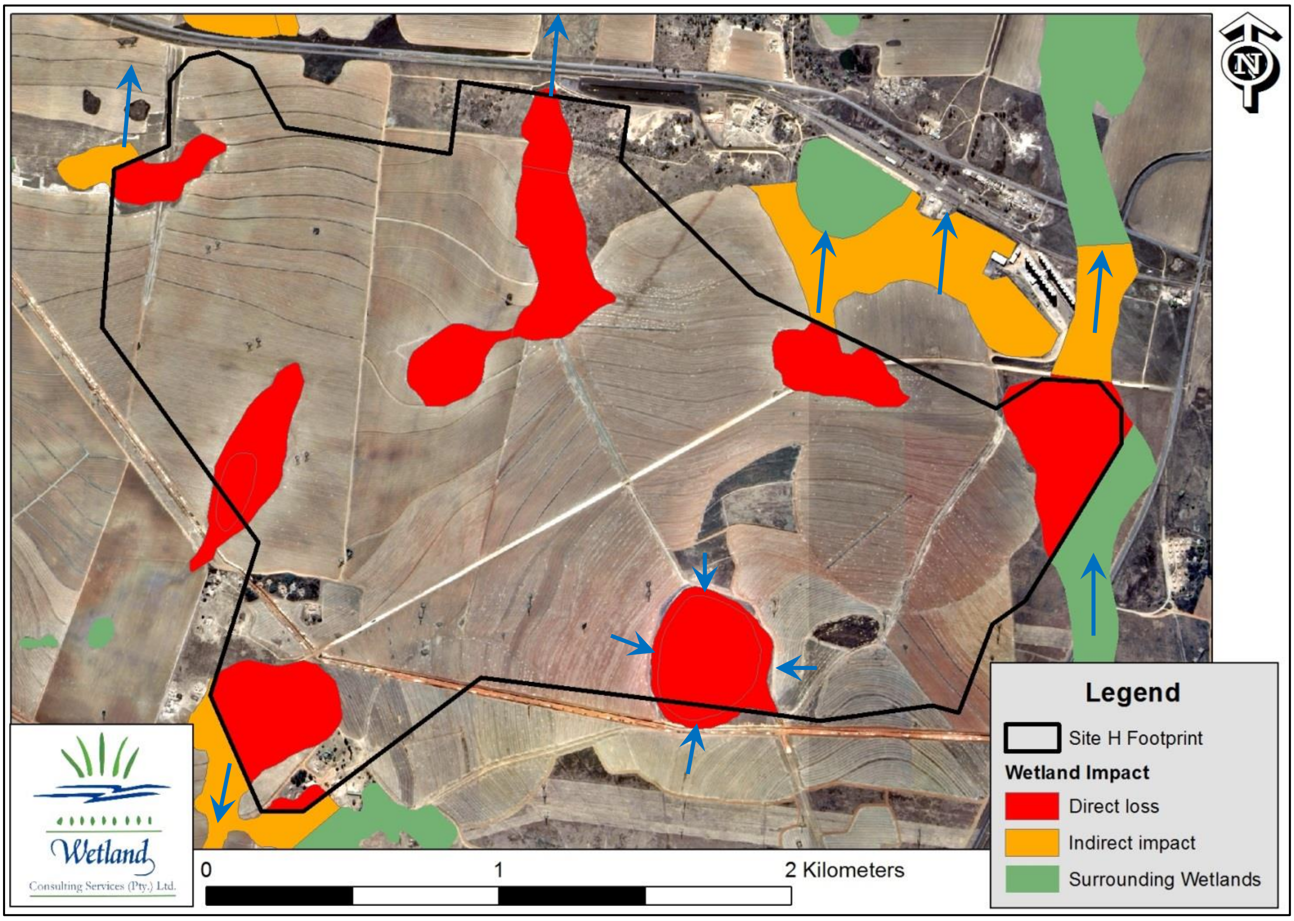


Figure 2. Map showing the extent and location of direct and indirect impacts considered in the wetland offset calculations. Flow direction is indicated by blue arrows.

5.2 Required Offset Targets

Offset targets were determined as per the methodology detailed in the wetland offset guidelines (SANBI & DWS, 2016). The wetland offset guidelines detail an approach aimed at quantifying offset requirements that consider and define targets for three aspects:

- Water Resources and Ecosystem Services
- Ecosystem Conservation
- Species of Conservation Concern

Only the first two targets are of relevance to this current study, though some measures to address species of conservation concern (in this case the Greater Flamingo) have also been included (refer to Section 9.1 below).

A wetland offset calculator has been developed as part of the wetland offset guidelines (SANBI & DWS, 2016) to simplify the calculations required to determine offset targets and which was used as part of this study. For the Water Resources and Ecosystem Services target, "*change in wetland* *area and condition are used to provide a surrogate measure for the impact on indirect services provided by wetland ecosystems*" (SANBI & DWS, 2016). As condition of wetland habitat is also a primary determinant of the capacity of a wetland habitat to support biodiversity, change in wetland area and condition are again used to determine the Ecosystem Conservation Targets, with the basic hectare equivalent determination then modified based on a number of further criteria:

- Ecosystem threat status and protection levels
- Regional and National Conservation Context
- Local Site Context:
    - Uniqueness and importance of biota
    - Integrity of adjacent terrestrial areas and local catchment
    - Local connectivity

5.2.1 Water Resource and Ecosystem Conservation Targets

The results of the wetland offset calculations using the SANBI & DWS (2016) offset calculator are represented in summarised form in Table 4 below.

***The required Water Resources offset target for impacts associated with the proposed Kendal 30-year ADF Project would be 63.5 hectare equivalents*.**

***In total, 78.6 hectare equivalents would be required for the Ecosystem Conservation offset target for impacts associated the proposed Kendal 30-year ADF*.**

Table 4. Required wetland offset targets as determined based on the expected direct and indirect wetland losses.

Year	Wetland Unit	Wetland Type	Loss (ha)	PES	EIS	Integrity	Functional Offset Target	Habitat hectare equivalent	Ecosystem Conservation Ratio	Ecosystem Conservation Target
0 - 5	1	Pan	11.62	D	D	50%	5.81	5.81	7.59	44.1
0 - 5	2	Hillslope seepage	4.44	D	D	60%	2.66	1.73	0.50	0.9
0 - 5	7	Hillslope seepage	8.03	D	D	59%	4.74	4.02	0.49	2.0
0 - 5	7	Hillslope seepage	25.42	D	D	59%	5.08	2.54	0.49	1.3
0 - 5	8	Hillslope seepage	15.68	D	D	73%	11.45	10.66	1.07	11.5
0 - 5	11	Hillslope seepage	8.32	D	D	56%	1.66	0.83	0.79	0.7
5 - 10	6	Hillslope seepage	3.83	D	D	60%	2.30	1.53	0.50	0.8
5 - 10	9	Hillslope seepage	13.83	D	C	45%	6.22	4.15	0.53	2.2
5 - 10	9	Hillslope seepage	10.81	D	C	45%	2.16	1.62	0.53	0.9
10 - 15	6	Hillslope seepage	12.51	D	D	60%	7.51	5.01	0.50	2.5
15 - 20	6	Hillslope seepage	6.26	D	D	60%	3.75	2.50	0.50	1.2
20 - 27	3	Depression	2.45	C	C	70%	1.72	1.72	5.06	8.7
20 - 27	4	Hillslope seepage	8.47	D	D	58%	4.91	2.12	0.50	1.1
20 - 27	5	Hillslope seepage	4.72	D	D	44%	0.94	0.94	0.50	0.5
20 - 27	5	Hillslope seepage	2.80	D	D	44%	1.23	0.00	0.50	0.0
20 - 27	10	Hillslope seepage	7.17	D	D	50%	1.08	0.72	0.50	0.4
20 - 27	10	Hillslope seepage	2.89	D	D	50%	0.29	0.29	0.50	0.1
		TOTAL	**149.26**				**63.52**			**78.6**

Table 5. Table providing a summary of the wetland area affected by direct and indirect wetland losses, as well as the associated offset targets that have been determined.

	Wetland Impact	Water Resources Offset Target	Ecosystem Conservation Target
Direct Loss	89.9	52.3	74.8
Indirect Loss	59.3	11.2	3.7
Total Loss	**149.3**	**63.5**	**78.6**

The Water Resources offset target would need to be achieved through rehabilitation activities (Section 7) within suitable target wetlands that result in a total hectare equivalent gain of 63.5 hectare equivalents. Ideally the rehabilitation aspect of the functional offset target should take place as close as possible to where the wetland functional area is being lost, i.e. within the direct vicinity of the Kendal 30-year ADF Project so that the impacted systems benefit from the realised gain in eco-services. Undertaking the rehabilitation activities on land already owned by Eskom would also aid in avoiding potential delays and pitfalls in terms of obtaining landowner consent to undertake rehabilitation activities. Alternatively, should the rehabilitation aspect of the functional offset target not be possible close to the impact area, Eskom would liaise with DWS regarding other suitable offset receiving areas.

The Ecosystem Conservation offset target wetlands should ideally be located within the same quaternary catchment as the wetland systems that are being lost, and should be undertaken on a like-for-like basis as far as possible, i.e. the loss of hillslope seepage wetlands should, ideally, be offset through the protection of hillslope seepage wetlands.

6. BASELINE WETLAND ASSESSMENT

6.1 Wetland Delineation & Typing

Wetlands were identified and delineated on aerial imagery (Google Earth, ESRI Basemap and 1:10 000 NGI colour imagery), with rapid field verification undertaken over two days in August 2018.

Four different hydro-geomorphic (HGM) wetland units were identified:

- Channelled valley bottom
- Unchannelled valley bottom
- Pan/depression
- Seep

The identified wetlands cover a total of 927.31 hectares, which includes 67 hectares of dams. The bulk of wetland habitat (roughly 71 %) has been typed as Seep wetlands, with most of the remainder consisting of channelled and unchannelled valley bottom wetlands. Only a single Pan/Depression wetland of 4.77 hectares was identified. More detail is provided in Table 6.

The wetlands were split in 4 clusters based on sub-catchments, as illustrated in Figure 3.

Table 6. Summary of the extent and type of wetland identified.

Wetland System	Total Area	Channelled valley bottom	Unchannelled valley bottom	Seep	Pan	Percentage
Wetland 1	304.85	17.90	95.39	191.56	0.00	32.87%
Wetland 2	33.03	0.00	13.89	19.14	0.00	3.56%
Wetland 3	41.57	0.00	2.60	34.21	4.77	4.48%
Wetland 4	547.85	110.79	25.02	412.05	0.00	59.08%
TOTAL	927.31	128.68	136.89	656.96	4.77	
Percentage		13.88%	14.76%	70.85%	0.51%	

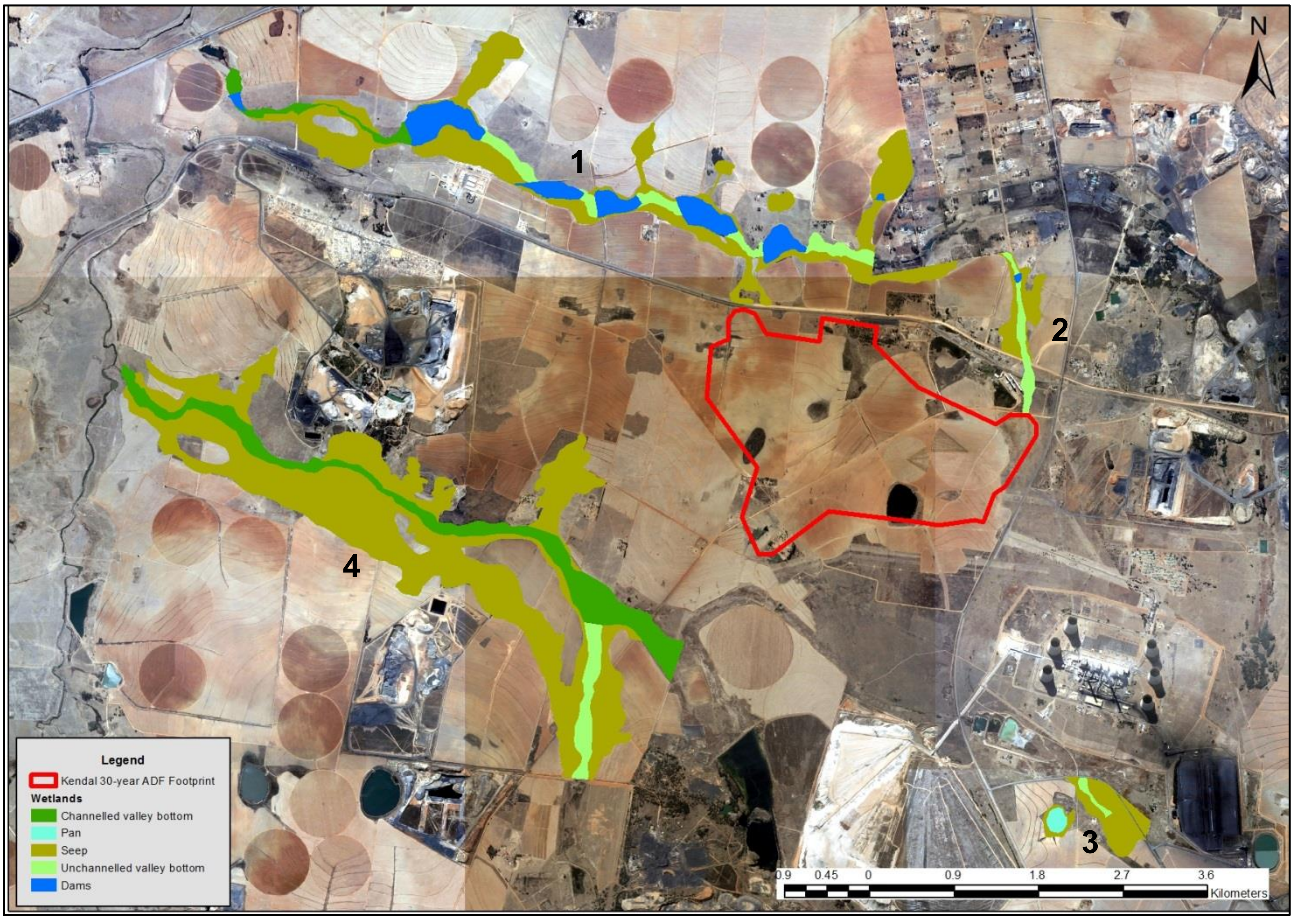


Figure 3. Map of identified and typed wetlands. Wetlands were grouped in 4 clusters numbered 1 to 4.

6.1.1 Wetland 1

This wetland system (Figure 4) is located to the north of the proposed Kendal 30-year ADF and north of the R555 public tar road. The wetland forms an unnamed tributary to the Wilge River and consists of an unchannelled valley bottom wetland with numerous large farm dams and associated seep wetlands on either side. At the time of the site visit, although it was towards the end of winter/dry season, all dams were full and the unchannelled valley bottom wetland was fully saturated, creating the impression that the wetland receives additional water inputs other than from its catchment, although this could not be verified during this study.

The wetland is located within an agricultural setting with extensive cultivation extending up to the edge of the Seep wetlands, and sometimes marginally into the Seep wetlands. A number of centre pivots point towards irrigation with abstraction from the dams. Impacts observed within the wetland include erosion (gully erosion and channel incision), alien vegetation, heavy livestock grazing and water quality impacts. Water within the wetland showed elevated electrical conductivity (EC), possible due to water quality impacts from upstream coal mining. However, a clear trend of improving water quality (in terms of EC) was observed down the length of the wetland (Figure 6). The EC values observed indicate mining related water quality impacts within the system from upstream mining. It is not clear what role dilution might play in the observed improvement in water quality.

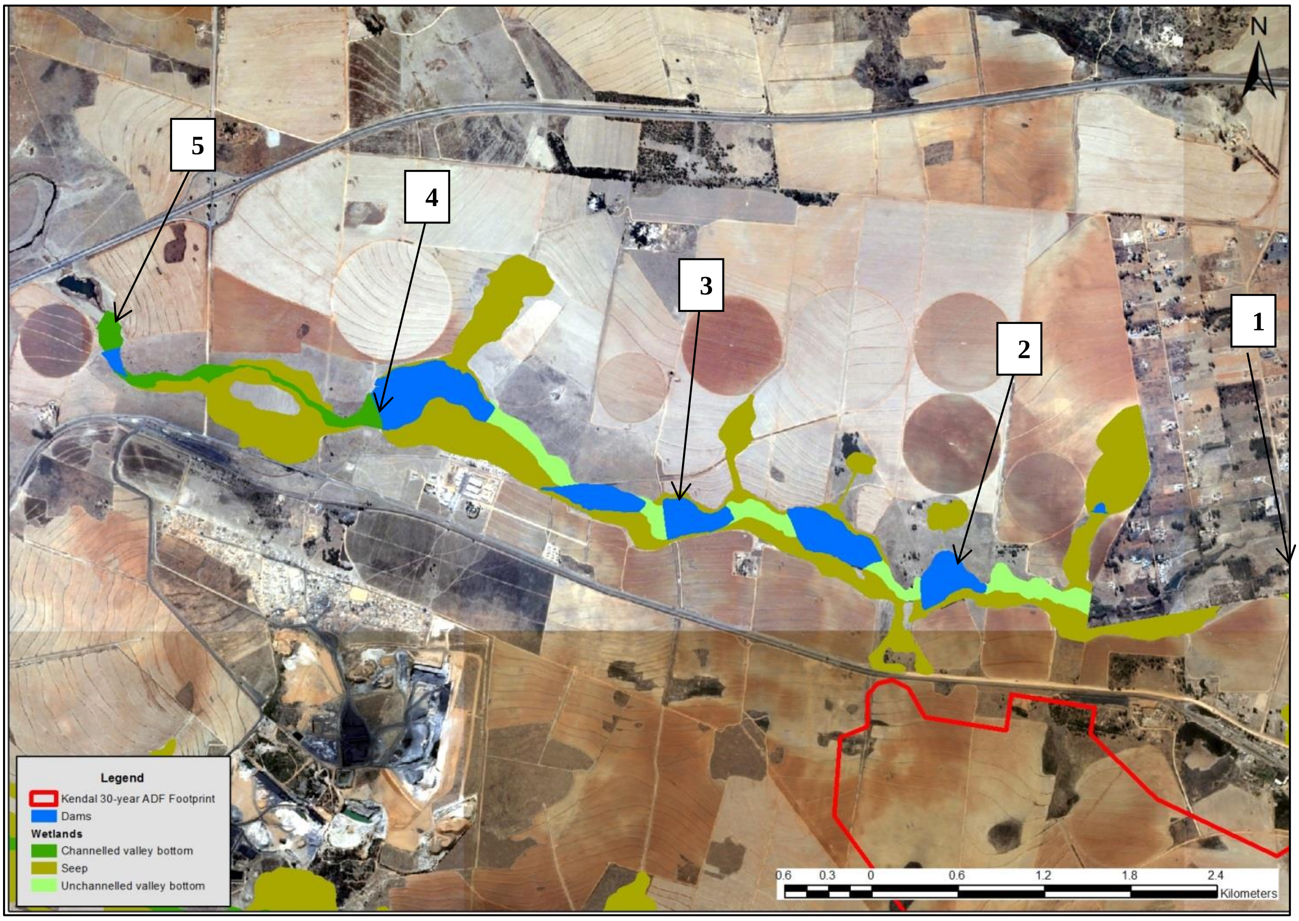


Figure 4. Map of wetland 1 showing extent and type of wetlands recorded. Numbers indicate water quality sample sites. Flow through the wetland is roughly from east to west (towards the Wilge River visible in the northwest corner of the map).

Figure 5. Photographs of wetland habitat associated with Wetland 1: views across the unchannelled valley bottom wetland.

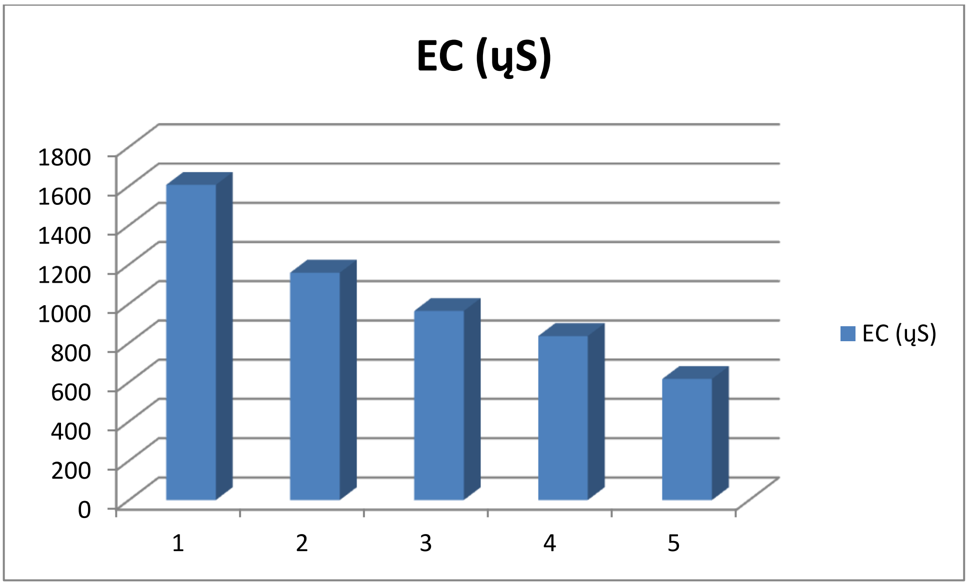


Figure 6. Results of water quality sampling (Electrical Conductivity) along wetland 1, showing a clear decreasing trend along the wetland. Sample sites correspond within those indicated in Figure 4.

6.1.2 Wetland 2

Wetland 2 is a small system consisting of an Unchannelled Valley Bottom wetland and associated Seep wetlands. The wetland drains away from the proposed Kendal 30-year ADF, with the upper reaches of the system likely to be directly impacted by proposed infrastructure developments.

Numerous linear infrastructures (roads, railways etc) traverse the wetland, and the maize silos are located just to the west of the wetland. The valley bottom wetland has, however, remained unchannelled and is, therefore, considered mostly intact, while the Seep wetlands have been impacted by cultivation.

Figure 7. Photographs of wetland habitat associated with Wetland 2.

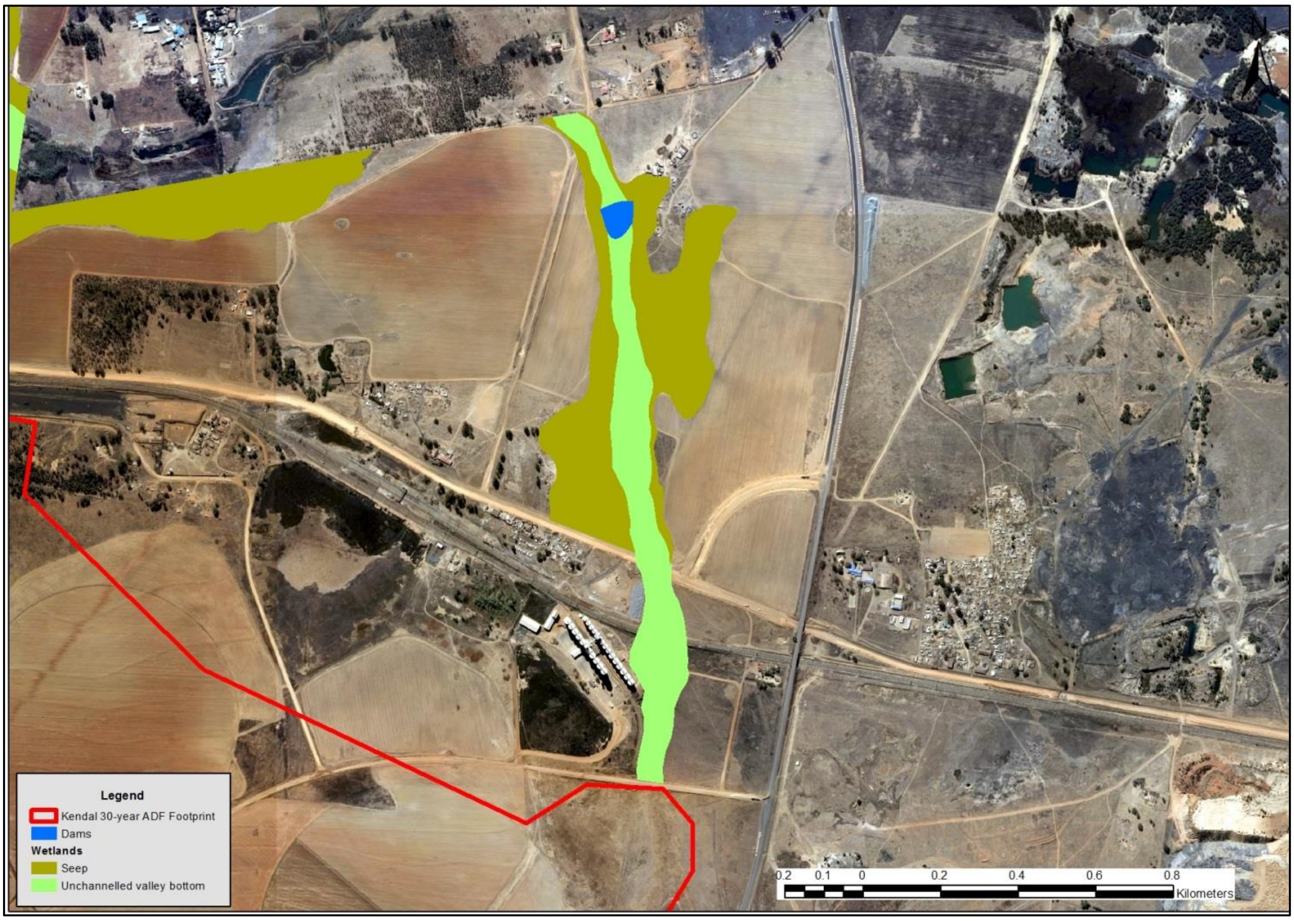


Figure 8. Map of wetland 2 showing extent and type of wetlands recorded.

6.1.3 Wetland 3

Wetland 3 consists of a pan wetland and adjacent Seep and Unchannelled Valley Bottom wetland. Total wetland area identified was 41.5 ha.

The Pan wetland was extensively inundated at the time of the site visit (end of winter 2018) and supported patches of open water amongst areas of emergent vegetation. Large numbers and diversity of waterbirds were observed on site, including the ***Endangered*** African Marsh Harrier. The Pan basin is considered mostly intact, although historical excavations (possibly sand mining) extend right to the pan shoreline, with possible occasional overflow from the pan into the excavations.

The Pan is surrounded by a fairly narrow Seep wetland characterised by a mix of grass and some sedge species. Stands of alien Populus canescens and Arundo donax occur within the Seep and along tis margins.

The adjacent Seep and Unchannelled Valley Bottom wetland forms the headwaters of a tributary to the Leeufonteinspruit that further downstream forms Wetland 4. The Seep had extensive areas of saturated soils at the time of the site visit – somewhat unusual for the area given the timing of the site visit towards the end of the dry season, but an indication of the importance of the Seep wetland in regulating flow within the downstream wetland systems. The wetland had unfortunately been burnt just prior to the site visit.

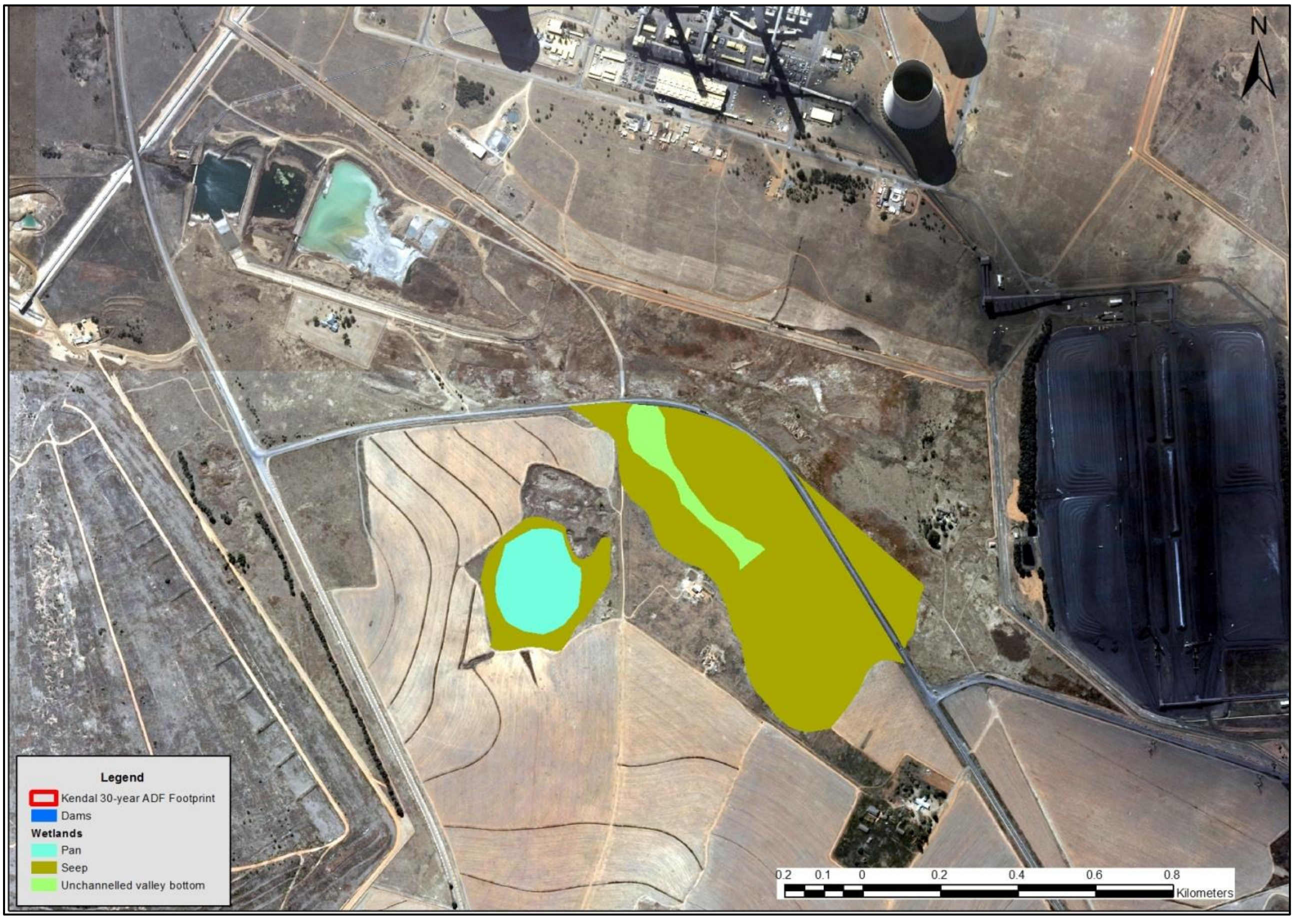


Figure 9. Map of wetland 3 showing extent and type of wetlands recorded.

Figure 10. Photographs of wetland habitat associated with Wetland 3: pan wetland (left), unchannelled valley bottom and seep wetland (right)

6.1.4 Wetland 4

Wetland 4 consists of the Leeufonteinspruit Channelled Valley Bottom wetland and associated Seep wetlands. The selected reach stretches from just downstream of the proposed confluence of the stream diversion (Kendal Continuous Ashing Project) with the Leeufonteinspruit up to its confluence with the Wilge River. As is clear from the map in Figure 11 below, active mining operations are located in close proximity to the wetland on either side of the wetland. The existing Kendal Ash Dam is also located within the catchment of this wetland.

Extensive Seep wetlands occur on either side of the valley bottom wetland, especially to the south. These Seep wetlands have been extensively cultivated along their margins, with roughly 70ha of Seep wetland currently under cultivation and extensive areas of Seep wetland characterised by secondary vegetation due to past cultivation.

Figure 11. Map of wetland 4 showing extent and type of wetlands recorded.

Figure 12. Photographs of wetland habitat associated with Wetland 4.

6.2 Present Ecological State (PES)

A present ecological state (PES) assessment was undertaken using the WET-Health Level 1 methodology to provide a rapid assessment of the health of the wetlands under current conditions. The assessment revealed that the wetlands are all moderately (PES category C) to seriously (PES category D) modified. This is a result of landuse changes within the wetlands' catchments as well as changes within the wetlands themselves.

Catchment landuse changes have resulted in changes in water inputs to the wetlands (increased surface runoff, decreased infiltration) as well as changes in water quality (related to surrounding mining impacts and agricultural runoff). Within wetland activities that have changed water retention and distribution patterns within wetlands include dam building (especially in the case of Wetland 1), linear infrastructure crossings, channel incision and gully erosion, and changes in vegetation cover that alter surface roughness.

All of the wetlands assessed are located within agricultural settings. Direct transformation of wetland habitat due to cultivation occurs especially in the Seep wetlands of Wetland 4, but affects the margins of many of the Seeps. Livestock grazing is also focussed within the wetland areas, especially during the summer months while crops are growing, resulting in heavy grazing and significant livestock trampling that exacerbates erosion.

Alien vegetation is fairly limited within the wetlands on site, being restricted to several fairly small but dense stands of alien trees, typically *Populus canescens* or *Eucalyptus*.

Table 7. Summarised results of the WET-Health assessment indicating PES categories for the various wetland types recorded.

Wetland Type	PES C		PES D		TOTAL
	Area(ha)	%	Area(ha)	%	Area(ha)
Channelled valley bottom	110.79	12.48%	17.90	2.02%	128.68
Unchannelled valley bottom	41.50	4.67%	95.39	10.74%	136.89
Pan	4.77	0.54%		0.00%	4.77
Seep	395.12	44.50%	222.35	25.04%	617.46
TOTAL	552.17	62.20%	335.64	37.80%	887.81

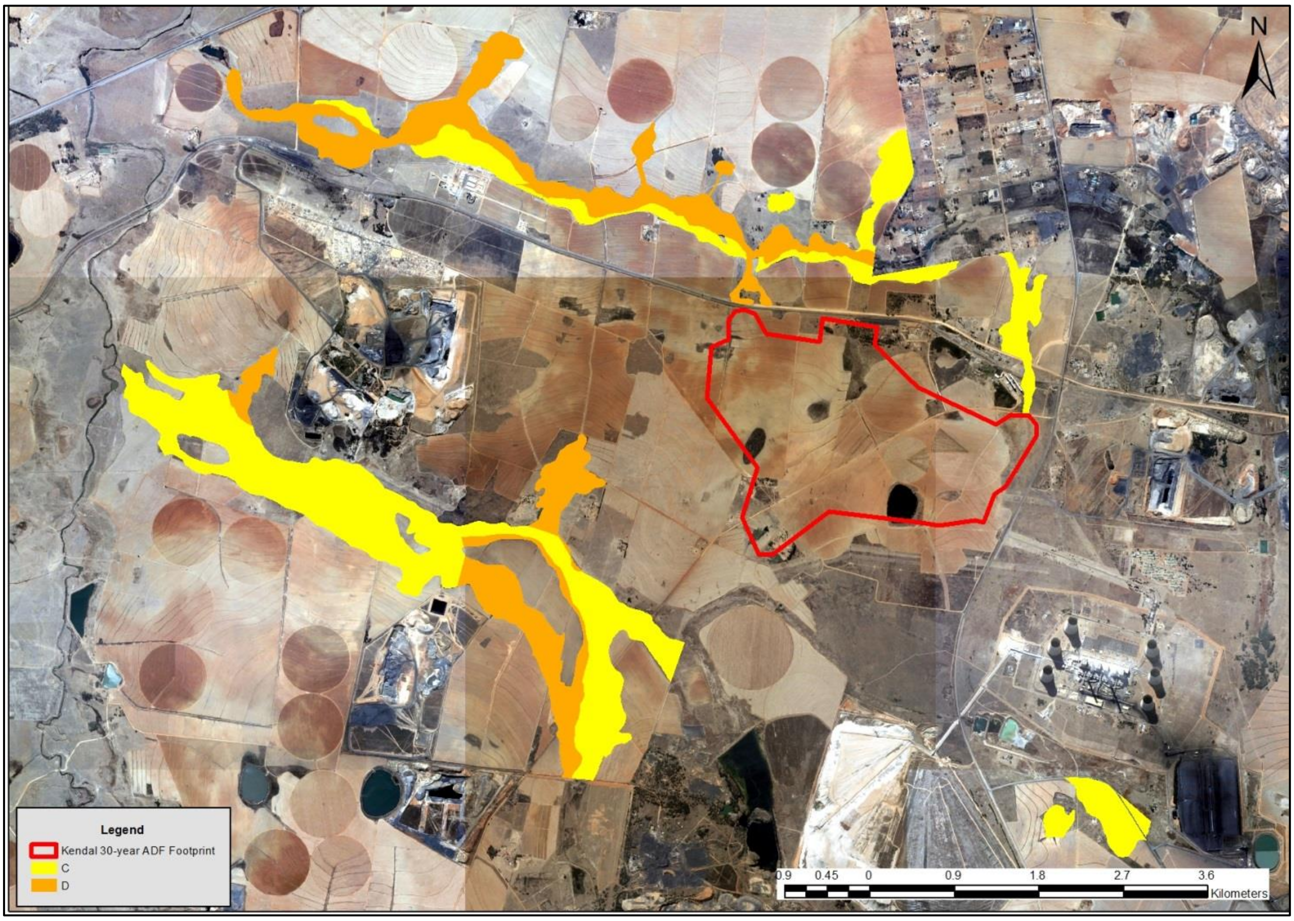


Figure 13. Map showing the results of the PES assessment.

6.2.1 Trajectory of Change

The current condition of the wetlands on site, as summarised by the PES assessment results above, is a consequence of existing activities and landuse changes that have taken place within the wetlands and their catchments. The activities and landuses changes are predominantly associated with agricultural activities, coal mining and linear infrastructures such as roads and powerlines. All of these activities are likely to persist into the future, so the continued deterioration of many of the wetlands could be expected, though the wetlands are likely to persist into the future.

An exception to this could materialize where future mining activities are proposed. Numerous active mines are located in close proximity to Wetland 4, while future mining associated with New Largo will take place to the north of Wetland 1, potentially marginally infringing on the catchment of this wetland.

Under a continuation of the status quo in terms of landuse, the trajectory of change of the wetlands is generally considered to be marginally negative, i.e. continued slow degradation of the wetland systems. This provides opportunity and motivation for the protection and rehabilitation of these wetlands.

6.3 Wetland Importance & Sensitivity

The wetlands within the study area all form part of the Olifants River Primary catchment, which is a heavily utilised and economically important catchment. Wetlands and rivers within the Olifants River Catchment upstream of Loskop Dam have been greatly impacted upon by various activities, which include mining, power stations, water abstraction, urbanization, agriculture, etc. As a result of these impacts serious water quality concerns and also water quantity concerns have been raised within the sub-catchment. Given this situation, and the fact that wetlands can support functions such as water purification and stream flow regulation, a high importance and conservation value is placed on all wetlands and rivers within the catchment that have as yet not been seriously modified. Within this context an EIS assessment was conducted for every hydro-geomorphic wetland unit identified within the study area. Further considerations that informed the EIS assessment include:

- The location of the wetlands within a vegetation type (Eastern Highveld Grassland) considered to be extensively transformed and threatened, and classed as ***Vulnerable.***
- The wetland ecosystem type of the area, Mesic Highveld Grassland Group 4 wetlands, is considered to be ***Least Threatened.***
- The location of the wetlands within the Wilge River catchment and in close proximity to the Wilge River, with the Wilge River being considered a priority water resource that plays an important role in diluting the poor quality water from the Upper Olifants River catchment.
- The presence of Red Data and protected species within the wetlands on site.
- The level of degradation observed within the wetland systems on site.

It is these considerations that have informed the scoring of the systems in terms of their ecological importance and sensitivity. The results of the assessment and rankings, based on our current understanding of the wetlands, is illustrated in Figure 14 and summarised in Table 8.

Table 8. Results of the wetland importance and sensitivity assessment.

Wetland Type	High		Moderate		TOTAL
	Area(ha)	%	Area(ha)	%	Area(ha)
Channelled valley bottom	128.68	14.49%		0.00%	128.68
Unchannelled valley bottom		0.00%	16.49	1.86%	16.49
Pan	4.77	0.54%		0.00%	4.77
Seep	120.41	13.56%	617.46	69.55%	737.87
TOTAL	253.86	28.59%	633.95	71.41%	887.81

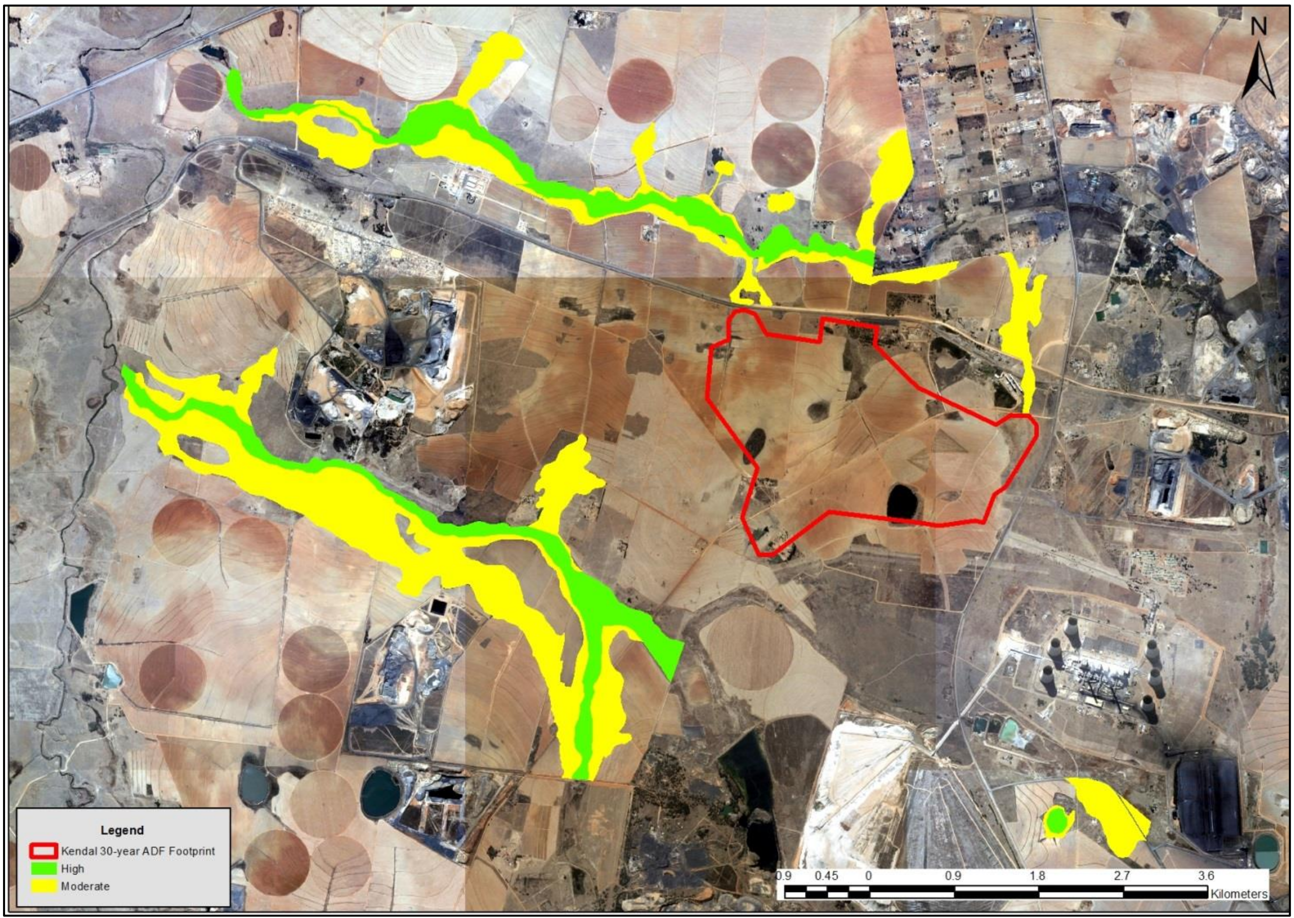


Figure 14. Map showing the results of the wetland Importance and Sensitivity assessment.

7. WETLAND REHABILITATION OBJECTIVES AND CONCEPTUAL REHABILITATION INTERVENTIONS

7.1 Rehabilitation Objectives and Conceptual Onsite Rehabilitation Strategy

A summary of the types of impacts encountered within the target offset wetlands, the rehabilitation objectives for each impact type and the rehabilitation strategy proposed to achieve the stated rehabilitation objectives are provided in the table below (Table 9). The rehabilitation objectives and proposed measures detailed here are subject to negotiations and agreements with the affected landowners and might need to be fine-tuned to meet landowner specific requirements, and could also vary between landowners.

The scope of the study did not allow for the design of interventions to be included. However the types of interventions are described, hopefully providing insights into the nature of the proposed rehabilitation of these wetlands.

A detailed investigation of these interventions would form the point of departure for a subsequent **Rehabilitation Implementation Plan** should this strategy meet with approval from the authorities.

Table 9. Nature of impacts identified in the target offset wetlands and proposed rehabilitation objectives and strategies to address the impacts. Rehabilitation objectives and strategies are subject to change based on negotiations and agreements with affected landowners.

IMPACT NAME	IMPACT DESCRIPTION	PROPOSED REHABILITATION OBJECTIVE	PROPOSED REHABILITATION STRATEGY
Cultivated Fields	Cultivation along the wetland margins and extending into the wetland habitat. Areas of bare soil associated with cultivation form a hard crust which promotes surface runoff over infiltration. Cultivated fields extending into wetland habitat reduce wetland species diversity.	• Improve wetland habitat integrity, increase species diversity, biodiversity support capacity and aesthetics. • Improve infiltration of flows into the catchment and wetland soils.	• Pull back cultivation out of both the wetland boundaries and, if possible, implement a minimum 20 metre buffer around the wetlands. • Revegetate with indigenous plant species.
Alien Vegetation	Alien, invasive vegetation (such as *Eucalyptus* sp., *Acacia mearnsii*, *Populus* × *canescens*) with higher than average water demands encroaching into wetland habitat, reducing flow to the wetlands and negatively affecting indigenous species diversity	• Increase flows into and through the wetlands. • Improve indigenous species diversity.	• Remove stands of alien, invasive vegetation within wetlands and immediately upslope of wetlands. • Revegetate with indigenous plant species.
Dams	Earthen farm dams cause flow impoundment behind the dam wall, and often, flow concentration at the outlet point. Impounding flows can lead to headcutting and channel erosion above and below the dam itself. Dams act as a focus point for livestock using them for drinking water, which leads to increased activity around the dams, trampling of vegetation and initiation or exacerbation of erosion.	• Improve wetland hydrology by removing impoundments to flow, encouraging diffuse flow through the wetland and limiting the opportunity for further headcutting and channel erosion. • Improve wetland vegetation component by reinstating a saturation regime across the wetland more similar to the natural condition.	• Removal of breached or damaged dams. • Re-engineering of certain dams to improve outflow points to encourage better distribution of flow and limit flow concentration.
Headcuts	Headcuts can form in wetlands as a result of flow concentration, livestock trampling or changes in hydraulic head caused by impoundments at dams and road crossings. They form the starting point of channel incision through a wetland and have a major, negative impact on wetlands that are not naturally channelled.	Prevent further headcut migration in order to: • Improve the geomorphological health of the wetland. • Secure intact wetland habitat upstream. • Improve the erosion control eco-service provided by the wetland.	• Stabilisation of headcuts to prevent further migration of the headcut into intact areas of wetland.

IMPACT NAME	IMPACT DESCRIPTION	PROPOSED REHABILITATION OBJECTIVE	PROPOSED REHABILITATION STRATEGY
Channel Erosion	Channel erosion, most often, occurs as a result of flow concentration, such as below dams and linear infrastructure crossings, and is also a consequence of headcut migration. Channel incision and erosion leads to flow concentration and lowering of the water table in the wetland, which, in turn, can cause desiccation of wetland habitat as flows no longer spread across the entire wetland front.	• To deactivate all channels, thereby raising the water table. • To rewet desiccated wetland habitat, creating a mosaic of permanent, seasonal and temporary wetland habitat within the HGM unit	Placement of a series of biological weirs aimed at: • Raising the base-level of the channel, and in so doing raise the water table. • Promoting more frequent overbank topping of the channel. • Reshaping and revegetating eroded channels to improve bank stability.
Road Crossings	Road and other linear infrastructure crossings can have a similar impact on wetland hydrology as dams, causing flow impoundment upstream and flow concentration through culverts, leading to channel incision and changes in the natural saturation patterns across the wetland.	• Improve wetland hydrology by removing impoundments to flow, encouraging diffuse flow through the wetland and limiting the opportunity for further headcutting and channel erosion. • Improve wetland vegetation component by reinstating a saturation regime across the wetland more similar to the natural condition, and by converting infilled road crossings to natural vegetation	• Removal of farm tracks through the wetlands to limit impoundment and reinstate diffuse flow through the wetland and revegetate road crossing footprint., **OR** • Redesign road crossings and road culverts to allow more diffuse flow.
Trenches	Trenches have been dug for a variety of reasons, including to drain wetland areas to allow cultivation, to drain runoff away from roads quickly, or as security trenches to limit access to cultivated fields. They affect wetland hydrology by concentrating and impounding flows and diverting flows away from wetland areas which can lead to desiccation.	Deactivate all trenches and thereby: • Encourage diffuse flows into and through the wetlands, • Improve the distribution of flows across the entire wetland to rewet areas that have dried out; and promote wetland vegetation establishment	• Infill trenches with compacted material; and • Install plugs at regular intervals to prevent flow concentration.

8. EVALUATION OF OFFSET TARGET CLUSTERS

8.1 Evaluation of Possible Gains

The SANBI & DWS (2016) wetland offset calculator was applied to all four target wetland systems to evaluate the possible gains that could be realised through rehabilitation of the wetlands. The results are summarised in Table 10 and Table 11 below.

In terms of the water resources and ecosystem services target requirement of 71 ha-eq., **the 4 wetland systems have the potential to realise 47.3 ha-eq. in gains, resulting in achieving approximately 75 % of the target**. These calculations include an adjustment factor of 0.66 to account for inherent risk of failure in rehabilitation interventions, as per the requirements of the guidelines. The shortfall of 25 % would need to be achieved through alternative offset activities (refer to Section 9).

In terms of the ecosystem conservation target of 78.6 ha-eq, it is clear that the 4 wetlands together would far exceed this target, potentially realising almost 470 ha-eq. if these wetlands can be adequately secured and conserved. These figures are based on the minimum acceptable security of tenure for the shortest acceptable period. If security of the offset was increased and the offset was permanently secured, the indicated gains in the table below would be further increased. The ecosystem conservation target also excludes any buffer zones. If buffer zones were to be implemented around wetlands, the potential gains would again increase even further.

Table 10. Results of the water resources and ecosystem services offset evaluation calculator for the various wetland clusters investigated.

Cluster	Wetland	Area	Functional Value Before	Functional Value After Rehabilitation	Change in Functional Value	Preliminary contribution	Adjustment factor	Final Functional Offset Contribution	TOTAL per Wetland System
Wetland 1	Channelled valley bottom	17.90	45.00%	59.00%	14.00%	2.51	0.66	1.7	16.0
Wetland 1	Seep	32.31	53.40%	58.400%	5.00%	1.62	0.66	1.1	
Wetland 1	Seep	5.65	74.30%	79.30%	5.00%	0.28	0.66	0.2	
Wetland 1	Seep	24.43	40.50%	63.30%	22.80%	5.57	0.66	3.7	
Wetland 1	Seep	28.45	68.50%	73.50%	5.00%	1.42	0.66	0.9	
Wetland 1	Unchannelled valley bottom	95.39	48.50%	53.50%	5.00%	4.77	0.66	3.1	
Wetland 1	Seep	8.18	74.80%	79.80%	5.00%	0.41	0.66	0.3	
Wetland 1	Seep	11.22	59.60%	64.6%	5.00%	0.56	0.66	0.4	
Wetland 1	Seep	4.59	76.80%	81.800%	5.00%	0.23	0.66	0.2	
Wetland 1	Seep	5.28	50.80%	70.10%	19.30%	1.02	0.66	0.7	
Wetland 1	Seep	8.95	77.90%	82.900%	5.00%	0.45	0.66	0.3	
Wetland 1	Seep	8.00	59.10%	68.70%	9.60%	0.77	0.66	0.5	
Wetland 1	Seep	4.64	72.60%	77.600%	5.00%	0.23	0.66	0.2	
Wetland 1	Seep	8.95	62.60%	68.50%	5.90%	0.53	0.66	0.3	
Wetland 1	Seep	30.92	61.10%	71.30%	10.20%	3.15	0.66	2.1	
Wetland 1	Seep	9.98	62.00%	69.80%	7.80%	0.78	0.66	0.5	
Wetland 2	Unchannelled valley bottom	13.89	67.70%	72.70%	5.00%	0.69	0.66	0.5	1.1
Wetland 2	Seep	9.00	66.60%	71.60%	5.00%	0.45	0.66	0.3	
Wetland 2	Seep	10.14	66.00%	71.00%	5.00%	0.51	0.66	0.3	
Wetland 3	Pan	4.77	70.00%	85.00%	15.00%	0.72	0.66	0.5	2.8
Wetland 3	Seep	3.44	69.00%	79.00%	10.00%	0.34	0.66	0.2	
Wetland 3	Unchannelled valley bottom	2.60	72.90%	79.00%	6.10%	0.16	0.66	0.1	

Cluster	Wetland	Area	Functional Value Before	Functional Value After Rehabilitation	Change in Functional Value	Preliminary contribution	Adjustment factor	Final Functional Offset Contribution	TOTAL per Wetland System
Wetland 3	Seep	30.77	69.10%	79.00%	9.90%	3.05	0.66	2.0	
Wetland 4	Unchannelled valley bottom	25.02	76.80%	81.800%	5.00%	1.25	0.66	0.8	**27.4**
Wetland 4	Seep	36.21	73.20%	78.20%	5.00%	1.81	0.66	1.2	
Wetland 4	Seep	21.67	59.00%	64.00%	5.00%	1.08	0.66	0.7	
Wetland 4	Seep	57.16	52.10%	58.10%	6.00%	3.43	0.66	2.3	
Wetland 4	Seep	37.65	58.70%	74.40%	15.70%	5.91	0.66	3.9	
Wetland 4	Channelled valley bottom	110.79	65.10%	75.10%	10.00%	11.08	0.66	7.3	
Wetland 4	Seep	10.02	55.50%	70.20%	14.70%	1.47	0.66	1.0	
Wetland 4	Seep	173.40	62.00%	69.00%	7.00%	12.14	0.66	8.0	
Wetland 4	Seep	14.62	57.50%	71.60%	14.10%	2.06	0.66	1.4	
Wetland 4	Seep	21.83	67.50%	73.20%	5.70%	1.24	0.66	0.8	
TOTAL						**71.69**		**47.3**	

Table 11. Results of the offset evaluation calculator for the ecosystem conservation target.

Cluster	No	Wetland	Area	Habitat intactness	Ha-eq.	Land tenure	Wetland Habitat Contribution	Buffer Zone Contribution	Contribution Towards Ecosystem Conservation Targets	TOTAL per Cluster
Wetland 1	1	Channelled valley bottom	17.90	31.80%	5.69	1	5.69	0	5.69	125.1
Wetland 1	2	Seep	32.31	42.30%	13.67	1	13.67	0	13.67	
Wetland 1	3	Seep	5.65	90.00%	5.09	1	5.09	0	5.09	
Wetland 1	4	Seep	24.43	47.20%	11.53	1	11.53	0	11.53	
Wetland 1	5	Seep	28.45	50.10%	14.25	1	14.25	0	14.25	
Wetland 1	6	Unchannelled valley bottom	95.39	24.70%	23.56	1	23.56	0	23.56	
Wetland 1	7	Seep	8.18	75.70%	6.19	1	6.19	0	6.19	
Wetland 1	8	Seep	11.22	40.00%	4.49	1	4.49	0	4.49	
Wetland 1	9	Seep	4.59	82.20%	3.78	1	3.78	0	3.78	
Wetland 1	10	Seep	5.28	52.40%	2.77	1	2.77	0	2.77	
Wetland 1	11	Seep	8.95	78.20%	7.00	1	7.00	0	7.00	
Wetland 1	12	Seep	8.00	50.50%	4.04	1	4.04	0	4.04	
Wetland 1	13	Seep	4.64	69.00%	3.20	1	3.20	0	3.20	
Wetland 1	14	Seep	8.95	35.30%	3.16	1	3.16	0	3.16	
Wetland 1	15	Seep	30.92	44.00%	13.60	1	13.60	0	13.60	
Wetland 1	16	Seep	9.98	31.00%	3.09	1	3.09	0	3.09	
Wetland 2	1	Unchannelled valley bottom	13.89	59.30%	8.24	1	8.24	0	8.24	18.7
Wetland 2	2	Seep	9.00	55.50%	5.00	1	5.00	0	5.00	
Wetland 2	3	Seep	10.14	53.50%	5.43	1	5.43	0	5.43	
Wetland 3	1	Pan	4.77	80.00%	3.81	1	3.81	0	3.81	27.9
Wetland 3	2	Seep	3.44	64.00%	2.20	1	2.20	0	2.20	
Wetland 3	3	Unchannelled valley bottom	2.60	77.50%	2.01	1	2.01	0	2.01	

Cluster	No	Wetland	Area	Habitat intactness	Ha-eq.	Land tenure	Wetland Habitat Contribution	Buffer Zone Contribution	Contribution Towards Ecosystem Conservation Targets	TOTAL per Cluster
Wetland 3	4	Seep	30.77	64.50%	19.85	1	19.85	0	19.85	
Wetland 4	1	Unchannelled valley bottom	25.02	75.20%	18.81	1	18.81	0	18.81	296.3
Wetland 4	2	Seep	36.21	71.50%	25.89	1	25.89	0	25.89	
Wetland 4	3	Seep	21.67	40.70%	8.82	1	8.82	0	8.82	
Wetland 4	4	Seep	57.16	20.50%	11.72	1	11.72	0	11.72	
Wetland 4	5	Seep	37.65	67.80%	25.53	1	25.53	0	25.53	
Wetland 4	6	Channelled valley bottom	110.79	90.00%	99.71	1	99.71	0	99.71	
Wetland 4	7	Seep	10.02	24.40%	2.44	1	2.44	0	2.44	
Wetland 4	8	Seep	173.40	46.40%	80.46	1	80.46	0	80.46	
Wetland 4	9	Seep	14.62	68.80%	10.06	1	10.06	0	10.06	
Wetland 4	10	Seep	21.83	58.80%	12.83	1	12.83	0	12.83	
TOTAL									**467.9**	

Evaluation of likely functional gains was limited to the immediate footprints of the selected target wetlands, and was undertaken as per the SANBI & DWS (2016) guidelines. These guidelines utilise wetland health/condition (PES scores) as a surrogate for functionality; i.e. an improvement in wetland health/condition is considered to imply an improvement in functionality. This is a fairly broad assumption and in relation to certain provisioning and regulating services the link between condition and functionality can be tenuous (e.g. flood attenuation can be enhanced by increasing water retention in a wetland through installation of berms/dams that retain water, but lead to a drop in wetland health/condition by changing the wetland from its natural state). It is, therefore, important that the functional objectives of the proposed rehabilitation measures are considered, and that evaluation of the success/failure of a wetland rehabilitation initiative is not limited to purely a "hectare equivalents gained" evaluation, but that evaluation against the set objectives also be undertaken.

Predicting changes in wetland health/condition due to rehabilitation interventions is itself also an uncertain exercise, with uncertainty increasing with distance from the rehabilitation interventions. Therefore the decision was made to limit the evaluation of gains to the immediate footprints of the selected target wetlands.

8.2 Estimation of Cost

The cost associated with the rehabilitation of the target wetlands is difficult to estimate without more detail on the required design and also the number of rehabilitation interventions required. Such additional information will only be generated through specialist engineering inputs, work which will likely only be undertaken once this conceptual offset strategy has been approved and access to the wetlands has been negotiated with landowners.

To provide a rapid and very rough estimate of expected rehabilitation costs, a graph was compiled showing the ***high-level costings determined as part of preliminary designs*** for previous wetland rehabilitation projects on the Mpumalanga Highveld in relation to the hectare equivalents expected to be gained through the rehabilitation. It must however be borne in mind that every wetland requires site-specific rehabilitation measures and provides unique challenges that need to be addressed and that affect the costs of rehabilitation interventions, making it difficult to make generalisations regarding cost between different sites. A very rough estimation can however be made.

Based on the 4 previous wetland rehabilitation projects considered, it can be estimated that the rehabilitation costs for meeting the full target of 63.5 hectare equivalents could cost in the region of R 55 million to R75 million.

Based on the projected gains realised in this study (47 hectare equivalents), the estimated rehabilitation costs would be in the range of R 45 million to R 62 million. The wetland offset guidelines (SANBI & DWS, 2016) require that a wetland offset be secured for at least 30 years or the period for which residual impacts of the specific project would endure.

These costs **do not include any land purchases or costs associated with land tenure agreements**.

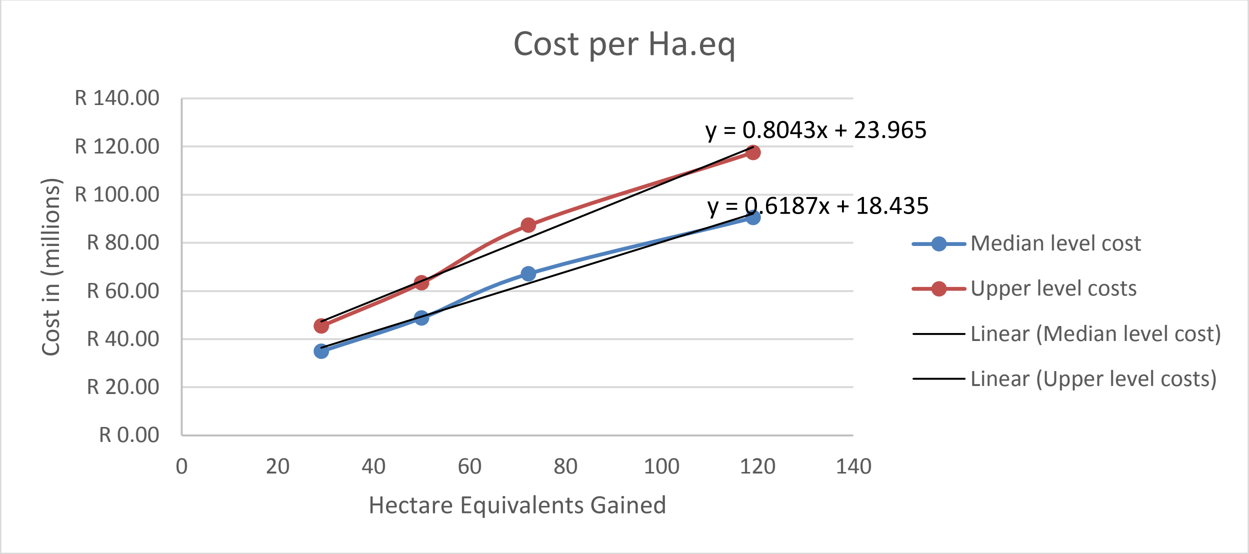


Figure 15. Graph showing estimated high-level costs in relation to hectare equivalent gains derived for previous wetland rehabilitation projects on the Mpumalanga Highveld.

9. DEVELOPMENT OF A WETLAND OFFSET IMPLEMENTATION PLAN

The wetland offset implementation strategy proposed in this section adopts a phased approach and sets out the parameters for the wetland offset implementation plan to be developed following approval of this wetland offset strategy. The phased implementation is based on the consideration of a number of factors, including control of land (ownership), ease of implementation, requirements for additional work and expected gains amongst others. There is also opportunity to link such a phased approach to the phased development of the Kendal 30-year ADF, i.e. as the development footprint of the ADF extends and impacts on wetlands, so the roll-out of the wetland offset strategy and the realisation of gains is extended to compensate for the expected impacts. The proposed phases should ideally be seen as overlapping, with some components of the different phases running concurrently.

9.1 Phase 1 – Wetland System 3

The rehabilitation and protection of wetland system 3 (refer to Section 6.1.3 above) will form the focus of the first phase of the implementation of the wetland rehabilitation strategy. Wetland system 3 was selected as this wetland is located on Eskom owned land and is therefore under the full control of Eskom and rehabilitation and management measures can be implemented without need of entering into negotiations for external landowner consent etc.

Full implementation of the rehabilitation measures proposed for Wetland System 3 will result in the realisation of 2.8 hectare equivalents in gains for the water resources target, and 27.9 hectare equivalents for the ecosystem conservation target. This translates to achieving 4.4 % of the water resources target and ***35.5 % of the ecosystem conservation target***. However, as the wetlands in question are under the full control of Eskom, it can be argued that the risk of failure for rehabilitation interventions is significantly reduced and the 0.66 risk multiplier used in the offset evaluation calculations can be excluded in this case. This would increase ***the gains for the water resources target to 4.3 hectare equivalents or 6.8 % of the target***.

There is also opportunity to further increase the hectare equivalent gains realised through the protection and rehabilitation of the wetland system 3 by exploring opportunities of increasing the protection of the wetland system through for example declaring the wetland system or the affected farm portions as protected areas, or through pursuing another form of formalised protection. The inclusion of wetland buffer zones, especially in the case of the pan wetland associated with wetland system 3 could further increase the gains towards the ecosystem conservation target, possibly by as much as a further 9 hectare equivalents (contributing a further 11% towards the target).

The following key tasks will therefore form part of Phase 1 of the offset project:

- Full implementation of the proposed wetland rehabilitation and management interventions detailed in this report for wetland system 3;
- Determination and implementation of suitable buffer zones for inclusion in the wetland systems targeted for protection;
- Investigation of formalised protection measures for wetland system 3 and, if found viable, the implementation of such measures; and
- Engage with DWS and other relevant authorities to update stakeholders on the progress of implementing the offset strategy.

9.2 Phase 2 – Wetland Systems 1 and 2

As part of Phase 2 of the wetland offset strategy, the rehabilitation of wetland systems 1 and 2 will be targeted. These wetland systems present a challenge as they are not located on Eskom owned land and belong to third parties. Access to the wetlands and the implementation of rehabilitation and management measures will therefore need to be negotiated and agreed between Eskom and the third parties. This runs the risk that third parties might only agree to the implementation of some of the recommended rehabilitation measures, or even completely deny access, impacting on the projected gains that could be realised from full rehabilitation of the wetlands. The measures most likely to meet with resistance during negotiation with third parties include the exclusion of wetlands currently under cultivation and the limitation of livestock numbers. Hectare equivalent gains derived from these activities are therefore likely to reduce from ideal predictions, unless an appropriate compensation can be negotiated.

Under a scenario where the full rehabilitation and management measures detailed in this report are implemented, wetland systems 1 and 2 could potentially realise 17 hectare equivalents of gains towards the water resources target (equal to 27 % of the target) and 144 hectare equivalents towards the ecosystem conservation target (equal to 180 % of the target). However, a more realistic scenario is likely to include only partial implementation of recommended rehabilitation measures (based on outcomes of negotiations). A more reasonable estimate of gains towards the water resources target might be in the region of 9-10 hectare equivalents (14 – 16 % of the target).

Opportunities to tie into other offset initiatives being undertaken in the region will also be investigated. Other known offset strategies in the general area, all of which are still at some level of planning, include the Kusile Power Station Offset, New Largo Offset, Klipspruit Offset and Vlakfontein Offset. Where opportunities exist to link up with or add benefit to these other offset initiatives, these will be further explored.

The following key tasks will therefore form part of Phase 2 of the offset project:

- Initiate negotiations with the affected third parties to allow for implementation of proposed wetland rehabilitation measures in wetland systems 1 and 2;
- Based on the outcomes of the negotiations, implement the wetland rehabilitation measures proposed;
- Appoint an agricultural extension officer/agricultural consultant or other suitable professional to engage with affected landowners around the implementation of improved landuse management practices to assist with protection and maintenance of wetland drivers and habitat; and
- Engage with DWS and other relevant authorities to update stakeholders on the progress of implementing the offset strategy.

9.3 Phase 3 – Wetland System 4

As part of Phase 3 of the wetland offset strategy, the rehabilitation of wetland system 4 will be targeted. This wetland system again presents a challenge as it is not located on Eskom owned land and belongs to third parties. Access to the wetlands and the implementation of rehabilitation and management measures will therefore need to be negotiated and agreed between Eskom and the third parties. This runs the risk that third parties might only agree to the implementation of some of the recommended rehabilitation measures, or even completely deny access, impacting on the projected gains that could be realised from full rehabilitation of the wetlands. The measures most likely to meet with resistance during negotiation with third parties include the exclusion of wetlands currently under cultivation and the limitation of livestock numbers. Hectare equivalent gains derived from these activities are therefore likely to be reduced from the prediction.

Under a scenario where the full rehabilitation and management measures detailed in this report are implemented, wetland system 4 could potentially realise 27 hectare equivalents of gains towards the water resources target (equal to 42.5 % of the target) and 296 hectare equivalents towards the ecosystem conservation target (equal to 370 % of the target). However, a more realistic scenario is likely to include only partial implementation of recommended rehabilitation measures (based on outcomes of negotiations). A more reasonable estimate of gains towards the water resources target might be in the region of 13-16 hectare equivalents (20 – 25 % of the target).

The following key tasks will therefore form part of Phase 3 of the offset project:

- Initiate negotiations with the affected third parties to allow for implementation of proposed wetland rehabilitation measures in wetland system 3;
- Based on the outcomes of the negotiations, implement the wetland rehabilitation measures proposed;
- Appoint an agricultural extension officer/agricultural consultant or other suitable professional to engage with affected landowners around the implementation of improved landuse management practices to assist with protection and maintenance of wetland drivers and habitat; and
- Engage with DWS and other relevant authorities to update stakeholders on the progress of implementing the offset strategy.

9.4 Phase 4 – Rehabilitation on Eskom-owned Land at other Power Stations

In addition to targeting wetland systems 1, 2, 3 and 4 for rehabilitation, Eskom will undertake a further review of available wetland systems on land associated with other Eskom power stations located on the Mpumalanga Highveld in an aim to identify further wetland systems for inclusion within the offset strategy. Although such a study has already been undertaken at a desktop level (WCS, 2018), changes in future development plans could result in wetlands areas currently considered unsuitable for rehabilitation interventions, due to possible future developments, to become suitable. A special focus should be placed on identifying pan wetlands, and attention here is drawn to alternatives 2 and 3 identified as part of the WCS (2015) study. These pan clusters are located on land owned by Eskom at the Kriel and Matla power stations, respectively, and could potentially realise between 6 and 10 hectare equivalents towards the Water Resources target (contributing a further 9 – 15 %). Should it be found through future revisions of the IWWMP's for these power stations that these pans are available for rehabilitation and protection, these should be incorporated into the offset strategy.

- Engage with other Eskom power stations on the Mpumalanga Highveld to identify potentially suitable wetlands for rehabilitation and protection, with a special emphasis on pan wetlands (e.g. Alternatives 2 and 3 as detailed in the WCS 2015 study);
- Explore opportunities to tie into other offset strategies in the region being implemented by third parties; and

9.5 Phase 5 –Direct compensation options

Phase 5 of the implementation of the wetland offset strategy is considered a review of the process and progress undertaken to date (i.e. over phases 1 to 4) in consultation with the relevant authorities. A study should be undertaken and presented to the general wetland community (e.g. via the wetland indaba and provincial wetland forums) detailing the success and failures of the offset strategy, as well as learnings and guidance that could help future wetland offset strategies.

Under a scenario where the determined offset targets have not been achieved after implementation of Phases 1 to 4 above, alternative means of compensating for the wetland losses associated with the Kendal 30-year ADF should be investigated for feasibility. Such alternative measures could include various forms of direct compensation and / or contributions towards other provincial spatial development plan initiatives or offset receiving areas, and would be dependent on impacts and needs of surrounding water users and communities at the time and would be determined in consultation with the relevant authorities.

A number of alternative options are provided below, though additional alternatives not mentioned might be identified through consultation processes with stakeholders and authorities. Not all of the alternatives mentioned here are likely to proceed to implementation, though it is proposed to investigate and evaluate a variety of options to determine the most suitable and implementable alternatives that could then be taken further.

1. Monitoring of Priority Wetlands in Wilge River Catchment

The recently gazette Reserve for the Olifants Letaba Catchments has identified a number of priority wetlands across the catchment, including 8 priority wetlands in the Wilge River catchment. As part of the Reserve, the DWS is obligated to monitor these wetlands and ensure that the Recommended Ecological Category of the wetlands is met. A shortage of funding and capacity within the DWS however often results in such work not being undertaken, and the Reserve not being implemented.

It is therefore suggested that Eskom engage with the DWS regarding the possibility of funding the required baseline monitoring of all priority wetlands (a total of 8 wetland systems) within the Wilge River subcatchment (Integrated Unit of Assessment 2), as illustrated in Figure 16 below. It is envisaged that Eskom could appoint a suitably qualified wetland specialist to undertake the monitoring and submit the results to the DWS, so that the DWS takes ownership of any data generated. Such an approach would also provide opportunity for DWS staff and interns to accompany experts into the field and receive training in the monitoring of wetlands and the application of wetland assessment tools. Such skills development should be a key component of the initiative. The scope of work for the monitoring would be informed by the requirements of the gazetted Reserve, and would include an initial baseline monitoring event to generate all the required data, as well as then a follow-up monitoring surveys every 5 years until complete rehabilitation of the Kendal 30-year ADF has been achieved. A further requirement should be the presentation of findings after every monitoring event at a suitable public forum such as the Wetland Indaba and the provincial wetland forum.

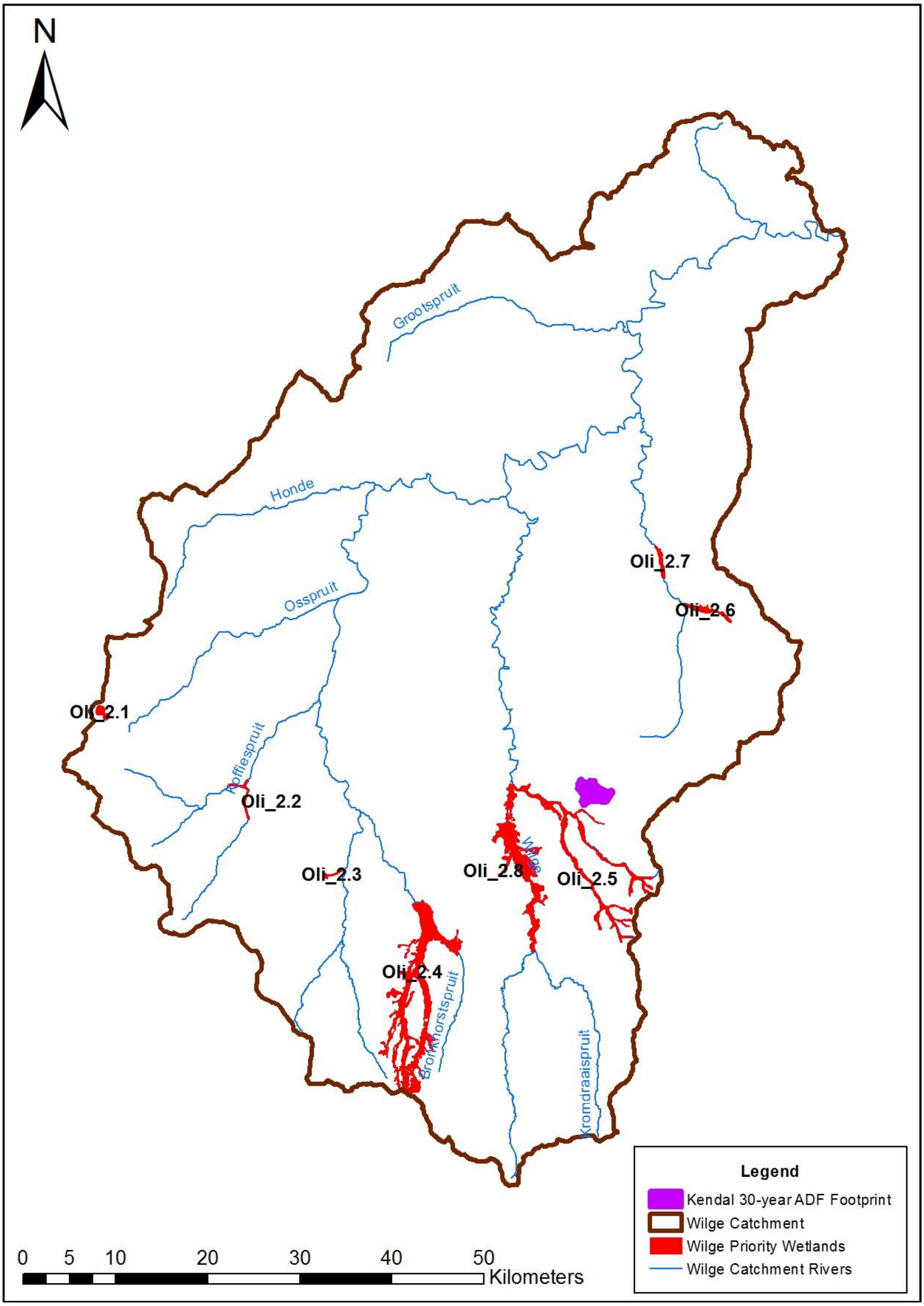


Figure 16. Map of the Wilge River sub-catchment showing priority wetlands as identified in the Olifants Letaba Reserve.

2. **Greater Flamingo Research**

Eskom commits to investigate the option of undertaking / funding research on the movement ecology of the Greater Flamingo, which utilises pans on the Highveld, to further understand conservation efforts required in relation to habitat. Such a research project is considered a worthwhile contribution to the proposed offset strategy as one of the key impacts identified during the Kendal 30-year ADF EIA was the loss of the pan wetland and the habitat it provides for Red Data listed Greater Flamingo.

3. **Support for Working for Water or similar organisations**

In addition, Eskom commits to evaluating the opportunity to provide financial support to government initiatives such as Working for Water for the clearing of alien vegetation along the Wilge River within the affected quaternary catchments, i.e. catchments B20E and B20F. This initiative should be informed by consultations with the relevant role players and might be dependent on the requirements of the Working for Water initiative at the time.

4. **Alternative Direct Compensation Alternatives**

A number of further alternative direct compensation mechanisms could be investigated for implementation by Eskom to determine feasibility and suitability (in consultation with relevant stakeholders and authorities), and dependent on the success or not of the phases detailed above. The list of alternatives provided here is not an exhaustive list, as other available and feasible offset interventions would be considered as part of this phased implementation of the offsets if identified during the course of further work undertaken. Alternatives that could be considered include the following:

- Contributions toward water treatment (e.g. Phola waste water treatment works).
- Financial contributions and assistance to government initiatives such as Working for Water or Working for Wetlands, with a focus on the affected quaternary catchments of the Wilge River.
- Financial contributions to organisations such as the Water Research Commission to drive relevant research needs.
- Engagement with provincial conservation authorities to identify funding needs. Numerous project proponents have already considered targeting the Greater Lakenvlei Protected Environment. An alternative would be the Chrissiesmeer Protected Environment, though this would be in a different catchment. Maybe also the proposed Devon Grasslands Protected Environment could be an initiative to support.

9.6 Implementation Timeline

Offset activities have been divided into five phases as described above. These phases will commence upon receipt of authorisation and will be completed systematically in order to correspond achieving offset targets with the completion of the ash dump. A number of the phases will run concurrently but will be concluded at various stages during the construction of the ash dump. Phase 1 will be completed before the first ash is deposited on the 30-year ADF, as will some components of Phase 5. Phases 2, 3 and 4 are subject to third party negotiations and will be targeted for completion during the construction phases of the 30-year ADF. A start date for the implementation strategy is difficult to define at this stage as the commencement of the strategy will be dependent on the end of life of the existing ash dump. However, ***the commencement of the wetland offset strategy will occur within 5 years from the date of environmental authorisation***. An approximate implementation timeline is proposed in Table 12.

Table 12. Approximate implementation timeline proposed for the wetland offset strategy. The commencement date of the strategy is dependent on the end of life of the existing ash facility and therefore not known. Commencement is assumed to be within 5 years of environmental approval and at least 3 years before first ash deposition is planned.

Tasks	Commencement	Duration (months)
Phase 1: Rehabilitation of Wetland System 3 (Eskom-owned)	**Minimum 3 years before ash deposition & within 5 years of environmental approval**	**2 years**
Planning phase (Financial, detailed design, engagement with stakeholders, environmental authorisations etc.)		1 year
Implementation phase (rehabilitation, management, monitoring, protection)		1 year
Phase 2: Rehabilitation of Wetland Systems 1 & 2	**Minimum 3 years before ash deposition & within 5 years of environmental approval**	**5 years**
Negotiation with third party landowners and planning phase (Financial, detailed design, engagement with stakeholders, environmental authorisations etc.)		3 years
Implementation phase (rehabilitation, management, monitoring, protection)		2 years
Phase 3: Rehabilitation of Wetland System 4	**Minimum 2 years before ash deposition**	**5 years**
Negotiation with third party landowners and planning phase (Financial, detailed design, engagement with stakeholders, environmental authorisations etc.)		3 years
Implementation phase (rehabilitation, management, monitoring, protection)		2 years
Phase 4: Rehabilitation of wetlands at other Power Stations	**Year of first ash deposition**	**3.5 years**
Discussions with other Power Stations, review of IWWMP's, review of future development plans		0.5 years
Planning phase (Financial, detailed design, engagement with stakeholders, environmental authorisations etc.)		1 year
Implementation phase (rehabilitation, management, monitoring, protection)		2 years
Phase 5:		
Greater Flamingo Research	Within 12 months of Environmental Approval	36 months
Investigate and evaluate other direct compensation mechanisms	Follows completion of planning for Phases 1, 2 & 3	Unknown
Implementation of selected direct compensation	Year of first ash deposition	Unknown

alternatives		

10. WETLAND MANAGEMENT PLAN FOR TARGET WETLANDS

All of the wetlands within the target clusters have been moderately or largely modified, implying that considerable opportunity exists for improving the remaining wetlands' condition and functioning through rehabilitation activities. Conceptual solutions and projected improvements and costing have been discussed briefly in the above sections. Further management measures applicable to all of the wetlands are detailed in this section.

10.1 Construction Environmental Management Plan (CEMP)

The implementation of the proposed rehabilitation interventions must take into account all relevant provisions of Best Management Practices and wetland related Construction Environmental Management Plans. The appointed EAP (Environmental Assessment Practitioner) of the project must, in conjunction with the design engineer, compile the general construction notes and the Construction Phase EMP (CEMP) for the project.

10.2 Wetland Management Recommendations

While construction-related impacts will be addressed through best management practices and the CEMP, there are a range of longer-term aspects that need to be addressed to ensure that anticipated improvements in wetland functionality are achieved and maintained over the long-term. A range of management recommendations are therefore detailed here, which will need to be taken into account when managing the wetland systems. The proponent must appoint an independent consultant to undertake monitoring of wetlands on site. The consultant and/or specialist must be a suitable specialist registered with South African Council for Natural Scientific Profession (SACNASP) in an appropriate field of practice and have relevant wetland rehabilitation and monitoring experience. The measures included in this report plus additional measures required for managing and protecting the wetlands should be incorporated into a Wetland Management Plan for the area.

10.3 Management of rehabilitation interventions on the remaining rehabilitated wetland areas

Regular monitoring of interventions is critical to ensure that any problems with rehabilitation interventions are picked up in a timeous manner. In this regard, the following potential concerns should be taken into consideration when inspecting interventions:

- Signs of erosion around the sides of structures (particularly constructed weirs);
- Signs of scouring below the concrete weirs and other structures which could undermine the structures;

- Signs of water not being retained behind weirs which would suggest that water may be finding its way around or under the structures;
- Cracks in concrete structures or damage caused by debris washed down during storms;
- Head-cuts that may develop downstream of structures where water re-enters the main drain;
- Wash / disturbance that has caused failure of earth berms / distribution berms;
- Poor vegetation cover of areas where earthworks have been undertaken; and
- Lack of recovery of wetland vegetation in sections of the wetland.

Where such concerns are noted, input from the wetland specialist should be sought to assess the need for maintenance or additional interventions to address issues of concern.

10.4 Upstream and surrounding mining activities

A number of active and defunct mines are located in close proximity to and within the catchment of the selected target wetlands. These mines pose a risk to water quality within the target wetlands, while future mining expansions could also impact further on water inputs to the wetlands. Future mine expansions must therefore be considered in planning the management of affected wetlands.

Emphasis must also be placed on monitoring for upstream impacts entering the wetlands from adjacent mines or land uses, to ensure pollution sources can be accurately identified.

10.5 Stormwater infrastructure maintenance

All stormwater management infrastructure on site should be inspected at least twice per year, ideally just before the start of the wet season and then again during the middle of the wet season, for any damage or obstructions. Obstructions should be cleared and damage repaired immediately to ensure optimal operation of the infrastructure. All discharge points should also be inspected for signs of erosion and any erosion damage repaired immediately and corrective measures implemented as required.

10.6 Management of agricultural lands

It is expected that cultivated fields around the selected target wetlands will continue to be used for agricultural activities. Ideally, agricultural use of herbicides, pesticides and fertilizers in the vicinity of the wetlands should be carefully controlled to avoid toxic effects on the flora and fauna occurring within the wetlands. Cultivation techniques should also employ measures to limit erosion and sediment loss from the cultivated fields, i.e. contour ploughing etc. However, it is unlikely that such measures could be practically implemented on third party land.

Furthermore, it would be preferable if all cultivation should be withdrawn from delineated wetland areas. In addition, a vegetated buffer of, at least, 20m is recommended between any agricultural lands and wetland areas so as to limit impacts associated with sedimentation and pollutant runoff. Once again however, it is unlikely that such measures could be practically implemented on third party land.

As the measures detailed under this sub-section are likely to be challenging to implement on land not owned by Eskom, the best case scenario may be for Eskom to appointment an agricultural extension officer/agricultural consultant to meet with affected landowners to assist these with improved land management practices within the catchments of the targeted wetlands.

10.7 Fire management

With the exception of special treatment areas, as a general rule, for low rainfall regions (<900 mm per annum), an area of wetland should be burnt every 4 to 5 years. Where possible, burning should be undertaken on a rotational basis. Cool and patchy burns should be promoted, where possible, by burning when relative humidity is high and air temperatures are low, preferably after rain. Preference should be given to burning of areas with abundant dead (moribund) stem and leaf material that limits new growth. Autumn/early winter breeding species such as the grass owl and marsh harrier may be negatively impacted by early winter burning. Where these species occur, burning should be done rotationally through block burning and checked before burning by having 'beaters' 10 m apart walking through the area and then closely examining all localities where these birds are flushed. Areas should be left un-burnt where chicks have still not fledged, or, if possible, delay burning for that year. Further reference to this must be according to the recent published SANBI Grazing & Burning Guidelines (SANBI, 2014). A burning management strategy should be included in the Wetland Management Plan for this purpose.

As the measures detailed under this sub-section are likely to be challenging to implement on land not owned by Eskom, the best case scenario may be for Eskom to appointment an agricultural extension officer/agricultural consultant to meet with affected landowners to assist these with improved land management practices within the catchments of the targeted wetlands.

10.8 Control of alien invasive plants

Alien invasive plants (particularly Poplars, Black wattle, and Eucalyptus) occurring within the wetlands and sub-catchments pose a threat to wetland functioning and should ideally be removed and controlled through an ongoing alien vegetation management plan compiled and implemented for the entire offset target areas. Such a plan will need to be developed by a suitably qualified professional.

10.9 Livestock management

Livestock numbers should be maintained within acceptable carrying capacities to ensure that plant species composition is not compromised and trampling does not lead to further erosion of wetland areas. Ideally a rangeland management plan should be compiled for areas targeted for livestock grazing or, at a minimum, the Department of Agriculture should be called upon to determine the grazing capacity for the bioclimatic region in which the wetland is located. As a general rule, grazing capacity in temporary wetland areas can be estimated as 1.5 times that of dryland areas, while grazing within seasonal and permanently wet areas should be restricted to 0.5LU/ha during the spring months. Where cattle trampling is causing significant disturbance near drinking points, alternative water sources should be provided or the area hardened to reduce the potential for erosion.

As the measures detailed under this sub-section are likely to be challenging to implement on land not owned by Eskom, the best case scenario may be for Eskom to appoint an agricultural extension officer/agricultural consultant to meet with affected landowners to work with these on establishing improved land management practices within the catchments of the targeted wetlands.

10.10 Management and monitoring of important biota

- No threatened flora should be collected or harvested;
- No threatened fauna should be hunted;
- Where endangered animal species occur in the wetland, records should ideally be kept of sightings in order to help establish whether or not wetland management practices and rehabilitation efforts are having a positive impact on these species; and
- The local district conservation officer should be contacted to obtain further information on monitoring of important species.

10.11 Road crossings

Further roads through the wetland should be avoided as far as possible. Should these be necessary, then design and mitigation of road crossings should be informed by suitable specialists to ensure impacts to flow connectivity and changes to flow distribution and retention in the wetland are minimised.

10.12 Monitoring and evaluation measures

For the purpose of monitoring the offset project rehabilitation outcomes, a Level 2[1] assessment is proposed. The following outcomes are included in a Level 2 assessment:

1. Ecological outcomes – wetland assessments (Present Ecological State (PES) pre and post rehabilitation)
2. Survival outputs - Structural Integrity assessment and erosion. Erosion measured pre and post implementation of rehabilitation interventions.
3. Aesthetic outcomes - Visual and morphological change assessment of the system, photographic record taken and kept pre and post implementation of rehabilitation interventions
4. Hydro-geochemical outcomes - Water levels, water distribution and water retention

The summary of monitoring is provided below with the details shown in Table 13 and Table 14**.**

[1] Rapid assessment of rehabilitation outcomes as well as an assessment of the execution and social outputs which would encompass compliance with Working for Wetlands Best Management Practices.

Table 13. Summary of monitoring timing and sequence for the Khwezela Rehabilitation Strategy.

LEVEL 2 – MONITORING			
MONITORING ACTIVITES	**TIMING**	**FREQUENCY**	**RESPONSIBLE PERSON**
WET-Health data (PES scores)	Not Applicable	Before and 3 years after completion	Eskom to appoint Wetland Specialist
Structural Integrity	-	Immediate after construction and seasonal inspections and specifically after flood events	Eskom to appoint Environmental Engineer
Erosion stabilisation	Winter	Annually[2]	Eskom to appoint Environmental Engineer
Water level	Winter	Annually	Eskom to appoint Environmental Engineer
Vegetation inventory	Late spring/Summer	Annually	Eskom to appoint Wetland Specialist
Aesthetic outcomes	Late Spring/ Summer	Annually	Eskom to appoint Wetland Specialist

[2] Annually - for all annually monitoring frequency within the monitoring Tables 12 and 13, this should take place for the period of 5 years after implementation of rehabilitation interventions on site.

Table 14. Kendal Wetland Offset Strategy timing and frequency of monitoring - Level 2 monitoring (with details on activities)

LEVEL 2 – MONITORING			
MONITORING ACTIVITIES	**TIMING**	**FREQUENCY**	**RESPONSIBLE PERSON**
WET-Health data (PES scores) should be collected prior to rehabilitation on site to be used as baseline monitoring data. The integrity scores will be used and the goal for monitoring to meet the projected integrity scores post rehabilitation onsite. The objective of rehabilitation is to retain and/or improve these baseline categories where possible and the projected improvements are already included in the projections undertaken for the project and therefore monitoring will be to ensure that rehabilitation activities are planned accordingly to meet these predefine projected health categories.	Not Applicable	Before and 3 years after completion	Wetland Specialist
Structural Integrity - this will focus on the presence of the following forms of structural vulnerability: 1. Sign off to see if interventions is constructed according to specifications 2. Post rehabilitation, the following inspection and reporting will be required: a. Undermining b. Sliding, tilting or overturning c. Side bank collapse d. Scouring/erosion upstream and downstream e. Side cutting around the structure f. Exposed soils, and g. Premature decay of the structural material (e.g. gabion wire, earthwork settlements and etc. Detail design phase of the project will provide specific details of the interventions (construction notes and actual dimensions) that will be required for monitoring. An inventory of the issues to be monitored will be compiled by the engineer upon completion of the detailed designs and these will be	-	Immediate after construction and subsequently seasonal inspections and specifically after flood events	Environmental Engineer

LEVEL 2 – MONITORING			
MONITORING ACTIVITIES	**TIMING**	**FREQUENCY**	**RESPONSIBLE PERSON**
incorporated in the monitoring programme of the rehabilitation project.			
Erosion stabilisation - dimensions of problems (headcuts and gully erosion) collected during detail design phase of the project will be used for monitoring any improvements post rehabilitation onsite. Any changes in dimensions (improvements and/or otherwise) will be recorded post rehabilitation for further attention that may be recommended by the assessor of the system. These areas include the areas that are proposed to be backfilled. The dimensions of those areas will be recorded by the engineer for the purpose of designing appropriate rehabilitation interventions during detail design phase of the project. The recorded figures will be used as baseline and post rehab dimensions will be measured in relation to these. An inventory of the issues to be monitored will be compiled by the engineer upon completion of the concept designs and these will be incorporated in the monitoring programme of the rehabilitation project.	Winter	Annually	Environmental Engineer
Water level - the depth of water level used for detailed engineering intervention design, particular for the specific problem areas where the objective is to raised water level, rewet and redistribute water across the wetland areas, will be used as baseline prior to rehabilitation. Post rehabilitation in the same area, water levels will be measured to determine adequacy of intervention designs in meeting the objectives. An inventory of the interventions aimed at raising the water table and rewetting the wetland will be compiled by the engineer during the detail design phase of the project. The levels of water which include degradations pre rehabilitation and used for designs will be used as baseline data.	Winter	Annually	Environmental Engineer
Vegetation inventory - the inventory will be limited to the identified areas infested by alien vegetation. The extent of these as they stand pre rehabilitation will be used as current baseline information and compared with the post rehabilitation scenario i.e. removal and eradication of these. Regrowth monitoring will be undertaken and this will included recording any improvement	Late spring/Summer	Annually	Wetland Specialist

LEVEL 2 – MONITORING			
MONITORING ACTIVITIES	**TIMING**	**FREQUENCY**	**RESPONSIBLE PERSON**
including replacement of these species by either secondary grasslands and/or wetland species post rehabilitation and successive monitoring plan to further monitor this for the future will be put in place.			
Aesthetic outcomes – this includes visual and morphological changes in the system. Fixed point photographs as per specified conditions in the WetRehab Evaluate document at specific points will be taken prior to implementation of rehabilitation plan and these will be used as baseline information and on completion of the rehabilitation activities photographic records will be kept and be taken at the same point as baseline information to visually assess any changes in the system. The specifications as outlined in the WetRehab Evaluate document will be applied for the monitoring of the project.	Late Spring/ Summer	Annually	Wetland Specialist

11. CHALLENGES & RISK

11.1 Challenges Associated with Land Ownership and Conflicting Future Land Uses

The majority of the target wetlands are located on privately owned land and are thus not under the control of Eskom. This poses a significant risk to the successful rehabilitation of the wetlands if access and management of the land and wetlands cannot be ensured.

A number of the proposed management measures required to improve wetland habitat in the selected target wetlands (e.g. withdrawing cultivation, fire management, livestock management etc.) impose landuse limitations that might not be acceptable to land owners. Failure to implement such measures will result in reduced rehabilitation gains.

Uncertainty with regard to future landuse and/or mineral rights could also compromise the proposed wetland rehabilitation measures in certain areas. The purpose of the offset strategy is to ensure that land set aside for offset is protected, rehabilitated and managed to meet targets, over a long period of time or permanently. The risks are self-evident if a suitable land tenure and management option for the candidate wetland areas cannot be achieved/guaranteed.

The proponent will need to secure, in some form, the areas earmarked for wetland rehabilitation and offsetting in order to implement a meaningful offset strategy. The following land tenure options/arrangements could be considered:

1. Outright purchasing of the all identified properties;
2. Subdivision and purchasing of portions of the farms; and only purchasing/keeping the wetland areas (with a suitable buffer zone around them- a biodiversity servitude);
3. Easement agreements, whereby wetland areas are essentially “rented” from existing landowners, and their protection is guaranteed. Such an approach is generally much cheaper than to purchase the land outright on which the wetlands that are to be rehabilitated are located. However wetland protection is uncertain under this type of arrangement. It would then require from Eskom a commitment to support and fund a long term inspection programme to ensure that the wetlands are protected and managed. As part of the agreement the farmers would have to agree to allow the inspections. or
4. Declaration of the area/s as nature reserves or Protected Environments.

Whichever arrangement is selected it may require the sterilisation of the remaining mineral resource within the earmarked areas. In any application for authorisation there is no guarantee that authorisation will be granted given South Africa’s economic status, dependence on fossil fuels for the majority of its power generation and the value of coal as an export commodity. Therefore, there is a risk of not acquiring authorisation to sterilise the resource, promoting conflicting future landuse which may compromise the effectiveness of the offsets.

12. REFERENCES

Brinson, M. M. 1993. A hydrogeomorphic classification for wetlands. Wetlands Research Program Technical Report WRP-DE-4. U. S. Army Corps of Engineers, Waterway Experiment Station. Vicksburg, MS: Bridgham and Richardson.

Department of Water Affairs and Forestry. 1999a. Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems Version 1.0, Pretoria.

Department of Water Affairs and Forestry, 2005. A practical field procedure for identification and delineation of wetland and riparian areas. DWAF, Pretoria.

Kotze, D.C. and Marneweck, G.C. 1999. Guidelines for delineating the boundaries of a wetland and the zones within a wetland in terms of the South African Water Act. Pretoria: Department of Water Affairs.

Mbona, N., Job, N., Smith, J., Nel, J., Holness, S., Memani, S. and Dini, J. 2015. Supporting better decision-making around coal mining in the Mpumalanga Highveld through the development of mapping tools and refinement of spatial data on wetlands. WRC Report No TT 614/14. Water Research Commission, Pretoria.

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

Rountree, M.W., H. Malan and B. Weston (editors). 2012. Manual for the Rapid Ecological Reserve Determination for Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study. WRC Report No. 1788/1/12. Water Research Commission, Pretoria.

SANBI & DWS. 2016. Wetland Offsets: a best-practice guideline for South Africa. South African National Biodiversity Institute and the Department of Water Affairs. Pretoria. 69 pages.

South Africa. 1998. National Water Act 38 of 1998. Pretoria: Government Printer

Wetland Consulting Services. 2016. Baseline Wetland Delineation and Assessment for the Kendal 30-Year ADF Project. Wetland Consulting Services (Pty.) Ltd. 2013. Report reference: 1032-2013