MOOI-MGENI TRANSFER SCHEME
PHASE TWO: SPRING GROVE DAM

Summary of Residual Biodiversity Loss in the Dam Basin and Baseline Offset Targets

Author: David Cox

Institute of Natural Resources

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MOOI-MGENI TRANSFER SCHEME PHASE II: SPRING GROVE DAM
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FINAL REPORT

Prepared for

TCTA
A new word for water

Prepared by

Institute of
Natural Resources

External Review
deVilliers Brownlie Associates

September 2013

DECLARATION OF INDEPENDENCE

I, David Cox as duly authorized representative of Institute of Natural Resources NPO, hereby confirm my independence, as well as that of the Institute of Natural Resources NPO (INR) as a specialist and declare that neither I nor the INR have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which the INR was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the development of a wetland and biodiversity offset plan for Spring Grove Dam. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – as is described in this report.

_____

Full Name: David Cox
Title / Position: Principal Scientist
Qualification(s): M Env Dev
Experience (years/ months): 15 years

DECLARATION OF INDEPENDENCE

I, Susie Brownlie, as duly authorized representative of deVilliers Brownlie Associates, hereby confirm my independence (as well as that of deVilliers Brownlie Associates) as a specialist and declare that neither I nor deVilliers Brownlie Associates have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which I was appointed as an Expert Advisor to TCTA, other than fair remuneration for work performed, specifically in connection with the development of a wetland rehabilitation and biodiversity offset plan for Spring Grove Dam. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – as is described in this report.

_____

Full Name: Susan Frances Brownlie
Title / Position: Member of, and Principal Partner in, deVilliers Brownlie Associates
Qualification(s): MSc (Env Studies)
Experience (years/ months): 30 years

EXECUTIVE SUMMARY

BACKGROUND

The environmental authorisation for the development of Spring Grove Dam in the KwaZulu-Natal Midlands included the following two conditions requiring that impacts arising from the inundation of the dam basin be offset:

- *A detailed plan for the rehabilitation of off-site wetlands in the Mooi and Mgeni catchments to mitigate the loss of wetland function and habitat (including base monitoring). Separate plans must be submitted for each individual wetland to ensure site specific issues are included. It is recommended that the Applicant work with The Working for Wetlands programme overseen by the South African National Biodiversity Institute (SANBI) since rehabilitation activities may trigger activities listed in terms of the regulations, 2006; and which will then require an environmental assessment.*
- *A detailed plan of action to establish offset areas to compensate for the loss of biodiversity and habitat, and for their management during the operational phase of the MMTS-2.*

This report documents the Residual[1] Loss of Biodiversity in the dam basin. It ***also presents baseline offsets targets*** based on the application of the relevant policy. It is the first step in the process of developing a Biodiversity Offset Plan and thereby meeting these conditions.

Biodiversity has been documented for each of the main ecosystems to be affected, namely Wetlands, Grasslands and the River Ecosystems. The loss has been documented for each system in terms of:

i. ***The threat status*** *of the* ***ecosystem and*** *the associated* ***species***,
ii. ***The health*** of the affected ecosystems,
iii. The type and value of ***ecosystem services*** to be lost.

The cumulative value of the biodiversity loss has also been discussed, based on the above three aspects and the consideration of ecological processes at a landscape level.

The information is based on a suite of specialist investigations summarised in the following table:

REPORT	AUTHORS
Mooi-Mgeni Transfer Scheme Phase Two: Spring Grove Dam: Baseline Summary of Biodiversity Loss within the Dam Basin *(This document)*	Mr David Cox *(M EnDev) Institute of Natural Resources* Ms Susie Brownlie (*MSc Env Sci. Pr.Sci.Nat. Biodiversity offset specialist advisor and reviewer) deVillers-Brownlie Associates.*
Wetland Assessment for the Spring Grove Dam Basin	Mrs Lulu Pretorius *(M.Sc. Environmental Management, Cand. Sci. Nat Candidate) Ixhaphozi Enviro Services CC.* Mr Ian Bredin (*MSc Pr.Sci.Nat) (Technical Review)Institute of Natural Resources*
Terrestrial Biodiversity Loss within Spring Grove Dam, KwaZulu-Natal: V*egetation Specialist Residual Impact Report)*	*Mr Barry Patrick (MSc Pr.Sci.Nat) ACER-Africa Environmental Consultants*
Spring Grove Dam: Baseline Fauna Report	Mr Barry James *(BSc-Hons, MSc, Pr.Sci.Nat, MSAIE&ES, EAPSA) Brousse-James Associates.*
Mooi-Mgeni Transfer Scheme Phase 2: Spring Grove Dam Aquatic Baseline Survey	Dr Nicholas Rivers-Moore *(Phd, Pr.Sci.Nat) Institute of Natural Resources.*
Ecosystem Services Analysis	*Mrs Catherine Pringle (BSc Agric, LLM-Env Law) Institute of Natural Resources.*

[1] Loss that remains after all available on-site mitigation measures have been considered.

SUMMARY OF RESIDUAL BIODIVERSITY LOSS

A *large proportion of the dam basin is classified as a Critical Conservation Area 1* (CCA 1) i.e. these areas are **irreplaceable** if provincial conservation targets are to be met. Loss of CCA 1 areas are thus considered to be essentially 'non offsetable' as there are no other options in the provincial landscape to meet these targets. Offsets can, however, compensate for residual impacts on specific ecosystems, ecological process areas and habitat for species.

The conservation status of biodiversity that will be residually impacted is significant at a number of levels, as described below.

- *Ecosystems*
  Areas of two wetland and two grassland types will be lost; ***all four ecosystem types are listed as Vulnerable in terms of provincial conservation targets***. A more detailed breakdown of affected wetland types points to at least one Endangered and one Critically Endangered type at a national level.
- *Species*
  There is a ***high concentration of South African and regional endemic species*** as well as a ***number of species with high threat status*** (ranging from Vulnerable to Critically Endangered) ***across all taxa*** (mammals, birds, amphibians, reptiles and plants) within the dam basin.
- *Unique Habitats*
  The ***habitat provided by the Inchbrakie Falls is considered unique*** and supports a community of plants with high conservation value. The loss of this irreplaceable habitat ***cannot be offset.***
- *Ecological Process*
  Spring Grove Dam (SGD) will establish a significant barrier to the use of Mooi River valley as a corridor for the movement of terrestrial species from west to east. Given the extent and 'absolute nature' of the barrier presented by Spring Grove Dam it can be assumed that it will impact the movement of terrestrial species at some level.

OFFSET TARGETS

The following sets of guidelines have informed the determination of the baseline offset areas required in compensation, when applied to the residual loss of biodiversity. Both sets of guidelines are draft and have inherent limitations. They also result in quite significant variations in the baseline offset targets. These limitations have been discussed when applying the principles and/or tools provided with these guidelines.

i. The Draft National Guideline for Wetland Offsets (SANBI 2012) hereinafter referred to as 'the Draft National Guideline'.
ii. Ezemvelo KZN Wildlife (2013) Comprehensive Guideline for Biodiversity Offsets: KwaZulu-Natal Province: Final Draft, February 2013, hereinafter referred to as 'the Draft EKZNW Guideline'.

The following table summarises the main considerations in determining an appropriate offset, namely:

- ***Base Area*** – this is the extent (ha) of the areas to be inundated, or length (kms) in the case of the river.

- ***Functional Equivalence Target*** – for wetlands (and as specified in the Draft National Guideline), a specific target must be set to offset the loss of a range of ecosystem functions. The target is set by multiplying the area lost (ha) by the health of the wetland (a range of values from 0-10) to arrive at a measure of 'ha equivalents'.

- ***Base Biodiversity Protection Targets -*** base biodiversity protection targets[2] were established by applying
  a) The basic offset ratio in the Draft EKZNW Guideline for the affected grasslands and wetland types.
     - In the case of ***wetlands*** the protection target is established by applying the basic offset ratio to the area lost[3]. The basic ratio is 3:1, resulting in a target of 1 386 ha (462 ha x 3).
     - In the case of ***grasslands*** the basic offset ratios were the same for both grasslands types[4] resulting in a target of 630 ha (210 ha x 3).
     - In the case of ***rivers***, no basic offset ratios or protection targets have been set, so the base target is the same as the area of habitat lost i.e. 15.5kms of river.
  b) The protection target ratios in the Draft National Guideline vary significantly between those established for 'wetland type' and 'wetland vegetation'.
     - Using the 'wetland type' classification, protection target ratios for different types of wetland range from 30:1 to 4:1 depending on the threat status of that wetland type.
     - Using the 'wetland vegetation' classification, protection target ratios are 4:1 for all affected wetlands.
     -

- ***Adjusted Biodiversity Targets –*** The Draft EKZNW Guideline provides for adjustment of the basic offset ratio to account for the relative condition of impact and offset areas; impacts on threatened species and special habitats; impacts on ecological process areas and/ or valued ecosystem services; and risk or uncertainty about the offset outcome. For SGD, it is recommended that a multiplier of 1.25:1 be applied to the basic offset ratios set out in the Draft EKZNW Guideline for both wetland and grassland ecosystems. This multiplier is believed to be sufficient to account for the loss of habitat for a concentration of threatened and endemic species across taxa and ecological process impacts. Whilst there is uncertainty about rehabilitation outcomes and timing of offsets, the area-based approach taken here is felt to be sufficient to address these risks, provided that offset areas are secured swiftly, and management of offset sites is rigorous and effective.

Projected targets based on ratios proposed in the Draft National wetland offset policy[5] result in major increases in the base Biodiversity Protection targets for wetlands compared with the provincial values: in the order of 6 480 ha (using wetland type) or 1 848 ha (using wetland vegetation group) compared

[2] i.e. without applying multipliers that take into account e.g. time lags, uncertainty, condition of affected or offset habitat, and/ or the need for buffers.
[3] The Draft EKZNW Guideline uses an area-based ratio only.
[4] Mooi River Highland Grasslands 3:1
Drakensberg Foothill Moist Grassland 3:1
[5] Timing Multiplier: *Target * 1.5* and Risk Multiplier *Target * 1.5* (Risk of failure of wetland rehabilitation).

with 1386 ha. These national targets were considered to be questionable; the Base Biodiversity Protection targets presented in the table below are therefore calculated using the basic offset ratios for the affected wetland types set in the Draft EKZNW Guideline. The Draft National Guideline recommends use of multipliers for risk/ uncertainty and time lags in achieving offsets; multipliers of 1.5:1 would be applicable in this case. However, application of these multipliers produces substantially larger offset targets that are unlikely to be practically or financially feasible. To place the offset targets derived from application of the National Guideline in context, the extent of all wetlands in the upper Mooi and Mgeni River catchments is in the order of 12 000 ha. Of this extent, much will not be appropriate in terms of offset criteria, nor will it be accessible due to lack of landowner willingness. Furthermore, the costs of offsetting areas in the magnitude of several thousand hectares are likely to be prohibitive.

Ecosystem	**Base Area/ Length**	**Base Ratios Source**	**Functional Equivalence Target** (Area * Health)	**Base Biodiversity Protection Target**	**Biodiversity Multiplier** (1.25:1)
Wetlands	462 ha	National (Wet **Type** Ratios)	281 ha equivalents or approximately 940 ha assuming comparable health of offset / impact sites	4 363 ha equivalents or approximately 6480 ha assuming comparable health of offset / impact sites	5 455 ha equivalents or 8 100 ha assuming comparable health of offset / impact sites
	462 ha	National (Wet **Veg** Ratios)		1 125 ha equivalents or approximately 1848 ha assuming comparable health of offset / impact sites	1 406 ha equivalents or 2 310 ha assuming comparable health of offset / impact sites
	462 ha	Provincial	NA	1 386 ha	1 733 ha
Grasslands	210 ha	Provincial	NA	630 ha	786 ha
River	15.5 kms	NA	NA	15.5 kms	NA

Given the unrealistic targets derived using the National Guideline it is proposed that those set in the provincial guideline are applied.

This initial work has highlighted the following regarding biodiversity offsets that need to be borne in mind by all role-players in reviewing this report and in the subsequent steps in the process:

- Biodiversity Offsets are an emerging science and mechanism around which there is draft policy and much theory but limited practice in South Africa.
- The draft policy, and in particular the ratios and calculators used to set targets require further development.
- Spring Grove Dam is one of the largest projects in KwaZulu-Natal to require a biodiversity offset. It will therefore set precedent.

The onus therefore rests on all role-players to arrive at an Offset that gives effect to the principles set by the policy and are yet also practical and implementable. Failure to achieve either will reduce the confidence in offsets as a mechanism to assist in achieving sustainable development.

WAY FORWARD

Documenting the baseline residual loss of biodiversity is the first step in the process of designing and implementing a biodiversity offset. The next step is to obtain stakeholder input into the findings presented and establish explicit objectives for the offset that in turn inform the setting of:

- Final areas to be secured for wetland rehabilitation/ biodiversity offsets, based on offset ratios and multipliers set out in draft guidelines.
- Offset types (protection and/ or rehabilitation).
- The offset planning area (spatial extent of area within which offset will be identified).
- Criteria and the process for the selection, evaluation and prioritisation of offset sites.

The above steps require involvement of stakeholders, including landowners, conservation NGOs and agencies, regulatory authorities and implementing agencies (i.e. the Offsets Working Group that was established at the commencement of the offset planning process for Spring Grove Dam).

Once these steps have been completed, it will be necessary to draw up a comprehensive biodiversity offset programme, with detailed plans for selected offset sites. This detailed planning represents the final step in the offset design phase, and will cover, amongst other aspects:

- Offset type –protection and management, with or without rehabilitation.
- Detailed design of rehabilitation and management requirements (rehabilitation structures, alien clearing methods, stocking and burning rates, etc.)
- Costing – structures, management, monitoring.
- Protection mechanism – stewardship agreement, protected area, servitude, etc.
- Financial provision for securing and managing offset sites, and
- Institutional and management arrangements.

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1. INTRODUCTION

This section introduces the project and provides background on the need for biodiversity offsets and the specific legal requirement to do so. It also summarises the context within which biodiversity offsets are planned and undertaken. This background frames the approach and methods described in the following section.

1.1 Motivation for Offsets

Phase two of the Mooi-Mgeni Transfer Scheme (MMTS-2) involves the construction of a dam, a transfer system (pump-station and pipeline) and associated infrastructure. The construction of Spring Grove Dam (SGD) has been completed with inundation having commenced in March 2013. The dam wall is located on the Mooi River approximately 2kms outside Rosetta. The height of the dam wall is 37m and at full supply the water body will inundate an area of approximately 1 022ha (Fig 1).

Studies on the proposed MMTS-2 started in 2000 culminating in the biophysical impact assessment[6]. The initial specialist studies identified the loss of wetlands as a significant issue warranting mitigation through offsite rehabilitation of wetlands. This recommendation prompted a bridging study in 2004 to identify wetland sites for rehabilitation[7] and associated rehabilitation planning.

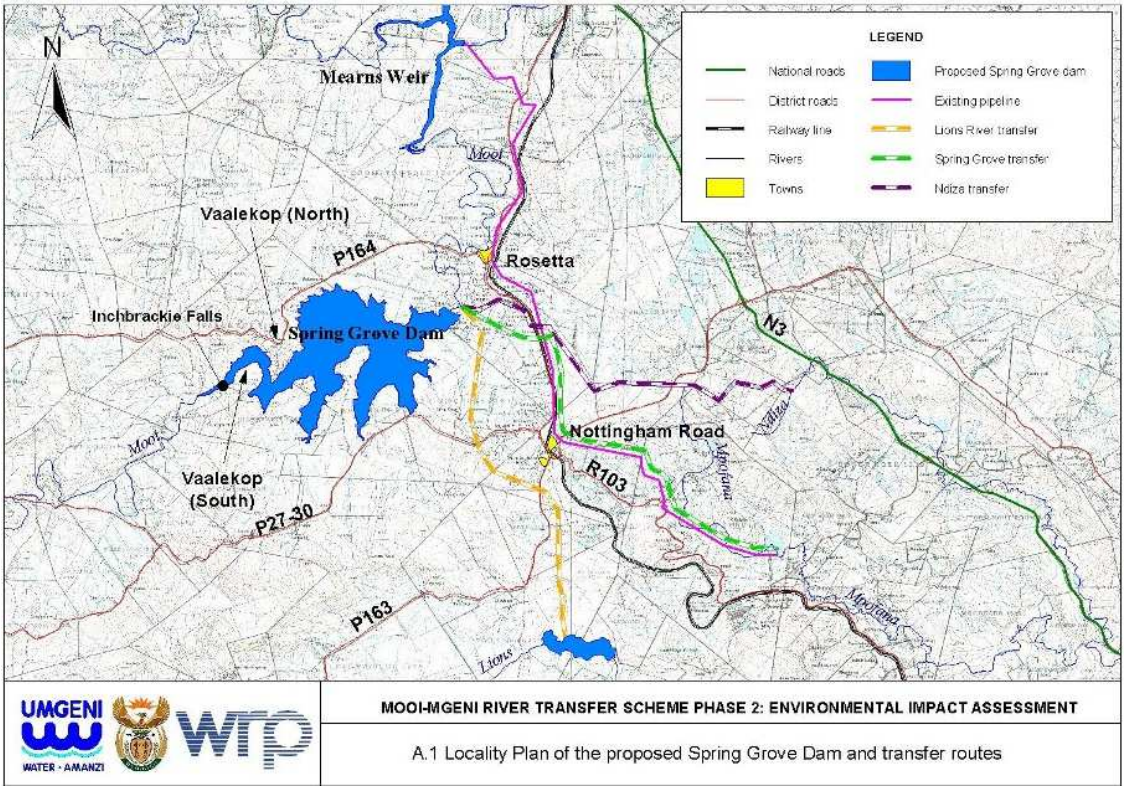

FIGURE 1 Location of extent MMTS-2 elements

[6] Biophysical Impact Assessment by WRP Consulting Engineers, including specialist botanical, wetland, fish, small mammal, amphibian, reptile, invertebrate and bird surveys carried out in 2002.

[7] Cox D, D Kotze and W Russell (2004) report entitled *Identification of Wetland Rehabilitation as a Mitigation Measure for the Wetlands Submerged in the Spring Grove Dam.*

The bridging study identified 14 wetlands (totaling 338ha) on several properties within the Mooi and Mgeni catchments where landowners were willing for rehabilitation work to be carried out. The rehabilitation planning was undertaken, maintenance and monitoring programmes were drawn up and the costs of implementation were determined. Delays in the project and securing the necessary finance meant that these rehabilitation plans were never implemented.

When the project came back on line in the late 2000s, the EIA involved an update of existing information given the time that had elapsed since the original assessment. The final Environmental Impact Report (EIR) dated January 2009 drew on the original assessment and bridging studies. The recommendations for off-site rehabilitation of wetlands were carried through in the EIR and subsequently into the environmental authorisation which was issued on 15 June 2009. The need to compensate for residual negative impacts was expanded from a wetland focus to include the loss of all biodiversity, as defined in the following two conditions of authorisation:

- *A detailed plan for the rehabilitation of off-site wetlands in the Mooi and Mgeni catchments to mitigate the loss of wetland function and habitat (including base monitoring). Separate plans must be submitted for each individual wetland to ensure site specific issues are included. It is recommended that the Applicant work with The Working for Wetlands programme overseen by the South African National Biodiversity Institute (SANBI) since rehabilitation activities may trigger activities listed in terms of the regulations, 2006; and which will then require an environmental assessment.*
- *A detailed plan of action to establish offset areas to compensate for the loss of biodiversity and habitat, and for their management during the operational phase of the MMTS-2.*

The Department of Water Affairs (DWA) is the holder of the environmental authorisation. They have delegated responsibility for compliance of the Environmental Authorization to their implementing agency, the Trans-Caledon Tunnel Authority (TCTA). TCTA submitted separate Environmental Management Plans (EMPs) to the Department of Environmental Affairs (DEA) to address the wetland rehabilitation and offset conditions respectively. Both EMPs have been accepted on condition that programmes incorporating the detailed plans referred to in the conditions are submitted for approval.

1.2 Purpose of this Document

Despite having two EMPs, both conditions will in reality be addressed together to give effect to the holistic approach required to optimize the efficiency and effectiveness of both wetland rehabilitation – a form of biodiversity offset – and the need to establish offsets areas. The EMPs detail three phases in the process of developing the detailed offset plans required by the environmental authorization, namely:

Phase 1: Determination of the residual negative impact and identification of offset options.
Phase 2: Detailed investigation of offset sites.
Phase 3: Finalization of offset plans.

This report documents the residual negative impacts[8] that need to be offset and presents draft baseline offset targets based on the application of relevant policy. The information, targets and recommendations provided here form the basis for the subsequent steps in the offset process which include setting offset objectives that in turn inform the type, location and prioritization of sites.

[8] Residual impacts are impacts that remain after applying all possible on-site mitigation measures.

1.3 Context for Developing Biodiversity Offsets

The residual impact of a project is normally determined in the EIA process. In this case however, studies have been undertaken over more than a decade, with the 2008 EIA drawing heavily on the original assessments[9] undertaken in the early 2000s. The state of our knowledge and experience regarding biodiversity and offsets in particular has changed significantly since the original assessments. These changes are described below.

i. *Wetland Science and Policy* – Guidelines for wetland delineation have been developed[10]. Furthermore, a suite of tools have been developed as part of the WET-Series[11] for assessing the health and functional value of wetlands and in planning, implementing and monitoring wetland rehabilitation. A new wetland classification system has also been finalised in the last year.

ii. *Wetland Rehabilitation Experience* – The SANBI Working for Wetlands programme has been operating in excess of 15 years through which experience has been generated in the planning and implementation of wetland rehabilitation interventions. This experience has also generated understanding regarding the success of rehabilitation interventions and how to optimise resources in terms of ecological returns and economic efficiency.

iii. *Terrestrial Ecosystems Science and Policy* - There have been a number of developments in the way terrestrial ecosystems are being evaluated and assessed e.g. tools and protocols for assessing the health of grasslands.

iv. *Offsets Policy and Practice* – The thinking and science around biodiversity offsets has advanced significantly. These developments have largely been driven through the Business and Biodiversity Offsets Programme (BBOP) and *ad hoc* practice as awareness of the concept has grown. Both regulators and business have identified offsets as a way to address the challenges of achieving sustainable development. Governments across the world have responded in the form of policy, including South Africa where a National Policy Framework for biodiversity offsets is being prepared and Draft Provincial offset guidelines have been developed for the Western Cape, KwaZulu-Natal and Gauteng. Draft national guidelines for wetland offsets were also released in 2012[12]. Financial institutions such as the IFC have also responded by building 'no net loss' and 'net gain' requirements into their Performance Standards. In amongst the formalisation, offsets are being applied in various forms with varying levels of integrity, science and consequently varying levels of success in achieving their intended outcome. The failures have understandably led to scepticism amongst many within the sector who regard offsets as an "excuse to proceed with development". In defining the approach to offsets for SGD, cognisance must be taken of policy and examples of practice, both good and bad, as well as the local context within which SGD is being developed.

[9] Apart from three site visits, there was no fieldwork undertaken.
[10] DWA (2005). A practical field procedure for identification and delineation of wetlands and riparian areas for the Department of Water Affairs and Forestry, Pretoria.
[11] Wetlands Research Programme: Wetland Rehabilitation (WRC Project No. K5/1408)
[12] SANBI 2012. Towards a Best Practice Guideline for Wetland Offsets in South Africa (beta version). D MacFarlane, A von Hase and S Brownlie

v. *Legal and Institutional Framework* – The legislative framework has changed considerably since the initial recommendations for off-site mitigation were made in 2001. Wetland rehabilitation structures now require environmental authorisation due to changes in the EIA regulations. There have also been developments in legal mechanisms to manage biodiversity on private land, provided for in the NEMA: Protected Areas Act 57 of 2003 (PAA) and NEMA: Biodiversity Act 10 of 2004. The KZN stewardship programme has been set up to facilitate the implementation of these instruments. A number of rates and tax relief measures for conservation land use provide some fiscal support and incentives for landowners to 'buy into' this programme.

vi. *Baseline Situation* - The initial impact assessment was undertaken over a decade ago. There was limited update of this work in the 2008 EIA process; although impacts were assessed in broad terms, there was no attempt to arrive at a measure of residual impacts. There have been changes in the landscape within the basin which have altered the area and consequently the extent and state of natural systems. The quantification of the loss is crucial for informing the offset targets and design. It is therefore necessary to document the loss in the basin using the new tools and science referred to above.

vii. *Conservation Targets and Planning* – The size and design of offsets are informed by, among other things, the conservation value of the ecosystems and species that will be lost. Not only has the threat status of the affected biodiversity changed over the last decade, but there have also been changes in the classification of certain ecosystems. Improvements in the resolution and accuracy of conservation planning at both national (NSBA) and provincial (EKZNW Minset) levels mean that there is greater confidence in the understanding of biodiversity value, and the prioritisation of options for offsets to contribute to biodiversity conservation outcomes.

The changes and issues described above have necessitated additional investigations in order to document the residual impact in line with the vastly different context to that under which the original assessment of loss and initial recommendations for offsets were made. The approach and methods for documenting the residual loss have been informed by the context established above.

1.4 Approach

The information provided in this report has been drawn from specialist work summarised in Table 1. The approach to the individual assessments has been informed by the following:

i. *Scope of Specialist Assessments*

A biodiversity offset aims to provide compensation for impacts on ecosystems and species of conservation value, as well as for any affected use and/ or cultural values of natural systems. Specialists were required to gather information to account for the full range of offset objectives and therefore covered the following:

- Type and classification of affected biodiversity.
- Conservation value of that biodiversity at both an ecosystem and species level,

- Health, condition or present ecological state of the affected ecosystems,
- Type and level of ecosystem services provided by the affected ecosystems.

ii. Quantifying Loss

Setting offset targets is dependent on an accurate quantification of the areas to be lost. Current offset policies provide guidance and tools for determining the requirements for biodiversity offset are based on the area and condition of the habitat to be lost. Given the outdated nature of the original biophysical assessments, and need for reliable measures of biodiversity lost as a result of SGD, updates of this information and refinement of mapping was an important aspect of the specialist work.

iii. Landscape Approach

Specialist studies looked at the three main ecosystems impacted by SGD, namely wetlands, grasslands and the river, and the sub categories within each ecosystem. These ecosystems form part of an integrated landscape, combining to provide a mosaic of habitats that support specific species and ecological processes, and provide a range of ecosystem services. An attempt has been made to integrate the combined value of biodiversity loss in the conclusions and consideration of ecosystems, species and ecosystem services.

iv. Accounting for Unique Features and Special Habitats

Unique features and special habitats were identified by specialists; they occur at a finer scale than ecosystems yet may indicate significant biodiversity of conservation value. It is important that these features or habitats are taken into account in designing offsets.

v. Consideration of Mitigation Measures

Offsets are the last step in the mitigation hierarchy. That is, biodiversity offsets should only be considered after all feasible and reasonable measures to avoid, minimize and rehabilitate or restore negative impacts have been exhausted. Offsets account for the residual loss that remains after all alternatives have been considered and on-site mitigation measures implemented. In the case of a dam, options for on-site mitigation are limited given that the biodiversity within the basin is effectively under water; i.e. the residual loss equals everything within the basin. The only opportunity for mitigation at Spring Grove lies within the small corridor of land located between the full supply level and the purchase line which falls under DWA's ownership and is never inundated. The following on-site mitigation activities were implemented by TCTA:

- *Search and Rescue*: A search and rescue operation (S&RO) was undertaken that involved the identification, rescue, propagation and transplantation of high conservation value plant species into a range of receiving areas (protected areas) within the region. While this activity saved a number of individual plants, it did not compensate for the loss of habitat, and does not constitute an offset. It was also an objective of the S&RO that small, higher value animal species would be trapped and relocated. The failure to achieve this intended action led to a proposal to create habitat for these species as they moved out of the basin.

- *On site Habitat Creation*: Efforts have been made to re-create terrestrial habitat within the corridor of land between the full supply level and the purchase line at four sites, as described below[13]. Efforts involved the following:
  - *Site 1*: Rehabilitation of a 1ha area to grassland and mixed bush clumps.
  - *Site 2*: Rehabilitation of an area 1.5 ha in extent by clearing alien invasive plant species and planting grasses and bush clumps.
  - *Site 3*: Rehabilitation to riverine bush habitat of a 1 ha area on the end of the large peninsula going northwards into the centre of the dam.
  - *Site 4*: This site is adjacent to the Coldstream Fish Barrier and no work will commence until the fish barrier is finished.

Photo 1: Habitat rehabilitation efforts at site 1.

Photo 2: Habitat rehabilitation efforts at site 2.

All rehabilitated habitat will support smaller animals (rodents and mammals) moving out of the basin as it floods and, at Site 3, the riverine bush habitat will provide cover/shelter for species such as Reedbuck, Grey Duiker, Cape Clawless Otter, White-tailed Mongoose and Serval, as well as habitat for Bushbuck and Large Spotted Genet. Habitat rehabilitation/creation (a total of approximately 5 ha of terrestrial habitat) is limited, but does reduce the total residual negative impact on biodiversity of the SGD. This area has been accounted for in the offset calculations.

TABLE 1 Summary of specialist work informing the summary report on residual biodiversity loss

REPORT	AUTHORS
Mooi-Mgeni Transfer Scheme Phase Two: Spring Grove Dam: Baseline Summary of Biodiversity Loss within the Dam Basin *(This document)*	Mr David Cox *(M EnDev)* Ms Susie Brownlie (*MSc Env Sci. Pr.Sci.Nat. Biodiversity offset specialist advisor and reviewer)*
Wetland Assessment for the Spring Grove Dam Basin.	Mrs Lulu Pretorius *(M.Sc. Environmental Management, Cand. Sci. Nat Candidate)* Mr Ian Bredin (MSc Pr.Sci.Nat) *(Technical Review)*
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Spring Grove Dam: Baseline Fauna Report.	Mr Barry James (BSc-Hons, MSc, Pr.Sci.Nat, MSAIE&ES, EAPSA)
Mooi-Mgeni Transfer Scheme Phase 2: Spring Grove Dam Aquatic Baseline Survey.	Dr Nicholas Rivers-Moore (Phd, Pr.Sci.Nat)
Ecosystem Services Analysis	Mrs Catherine Pringle (BSc Agric, LLM-Env Law)

[13] PROGRESS REPORT for the FLORA & FAUNA SEARCH AND RESCUE FOR SPRING GROVE DAM MOOI-MGENI TRANSFER SCHEME (PHASE 2), KWAZULU-NATAL. May 2013

1.5 Limitations

The timing for initiating the offset planning process and eventual decision to undertake the baseline has presented the challenges discussed below.

- *Timing for the initiation of the offsets process*
  The offset planning process was initiated once the project was almost complete. A decision as to the likely need for offsets and high level considerations of targets and associated cost should form part of the EIA process, and even sooner if possible. This allows for a balanced decision and for the developer to cost appropriately for the offset if the project is authorised with offsets as a condition. The late initiation of the offset process meant that the offset was not accurately catered for in project budgeting. This has placed pressure on the planning process once initiated and an idea of the likely costs started emerging. It also reduced the options available for financing the offsets, such as through water tariffs, which were set by the time offset planning commenced.

- *Timing of the Baseline Study*
  The timing of the process as a whole was compounded by the late decision to undertake the baseline assessment. This decision was taken in late January with impoundment taking place in early-March. This left a small window within which to mobilise the team and get the field work done. This had the following implications:
    - By this point the state of the basin was highly altered. The impacted condition required that assessment of extent and condition were extrapolated to disturbed areas which in certain cases were for example under stockpiles. It also necessitated a high reliance on historic digital imagery.
    - It was not ideal time of the year to sample certain taxa – notably plants.
    - The rush to get the work done before inundation reduced the options for integrated field work, testing of the proposed methods for field work and analysis by the specialist team.
    - There has been limited time to deal with challenging issues identified in the process, such as detailed modelling of affected species in order to work out habitat requirements in a defensible, scientific way.

2. REGIONAL OVERVIEW OF BIODIVERSITY

This section provides an overview of the biodiversity value of the region within which SGD is located. It establishes the context and motivation for the consideration of the baseline targets that follow.

2.1 Spatial Extent

The spatial extent and location of the three ecosystems occurring in the SGD Basin, namely river, wetlands and grasslands, are shown in Figure 2 and subsequent photos. The assessment considered remaining natural systems in SGD basin. The area shown in white in Figure 2 is transformed by crops, pastures or infrastructure. Of the total SGD basin (1 022ha), approximately 677ha is classified as natural, although the state or condition of these ecosystems varies depending on the level of impact from mainly agricultural activities.

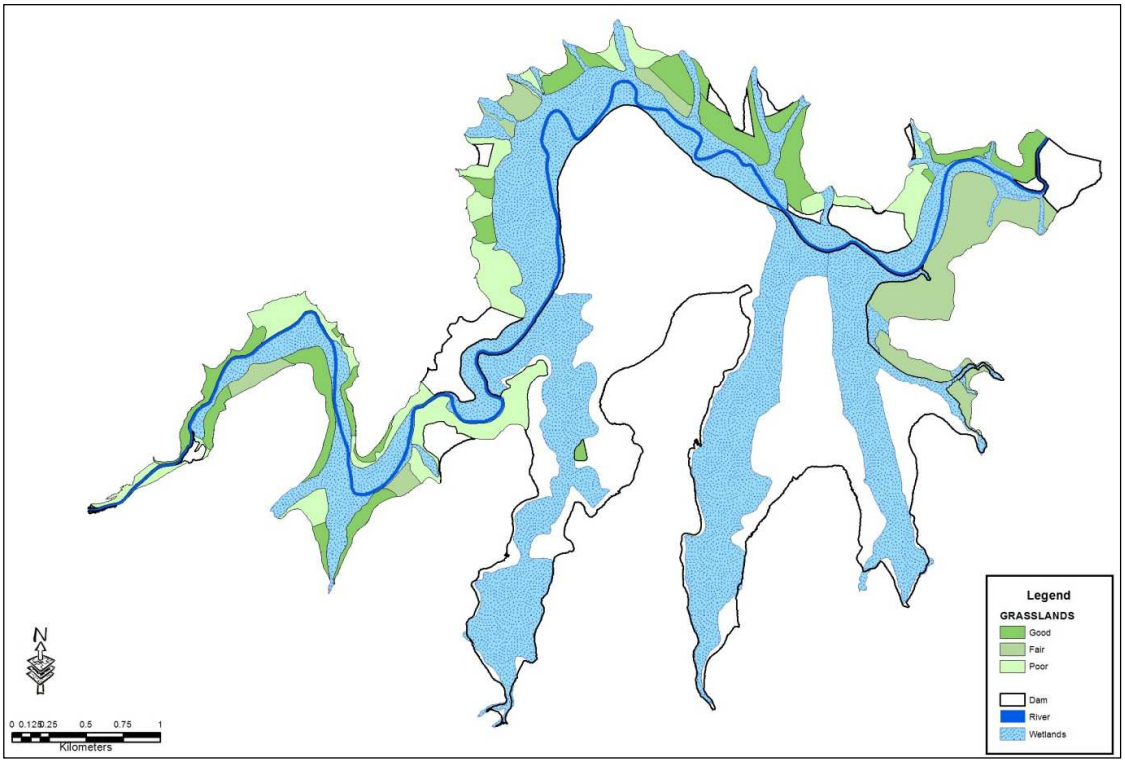

FIGURE 2 Spatial extent and location of natural systems within Spring Grove Dam Basin

Photo 1. Example of grasslands in good condition which cover approximately 73ha of the total SGD basin area.

Photo 2. Natural wetland vegetation within channelled a valley bottom wetland (this area of this system is approximately 70ha).

Photo 3. Inchbrakie falls provides unique habitat for rare fynbos plant species.

Photo 4. Overview of a section of the extensive floodplain system (approximately 166ha).

2.2. Regional Conservation Significance

The conservation value ascribed to the SGD Basin at a regional or provincial scale is based on the irreplaceability and vulnerability of the range of ecosystems and species occurring in the area. It therefore provides an integrated view of the intrinsic value of biodiversity of the basin before unpacking the value of the specific biodiversity elements in the remainder of the report. Taking a broad, ecosystem perspective is important for determining the basic offset ratios that apply in this case as these ratios then need to be adjusted to account for the requirements of particular species of conservation concern, ecological process requirements, and (where applicable) valued ecosystem services.

2.2.1 Terrestrial Conservation Overview

The Ezemvelo KZN Wildlife MINSET coverage is depicted in Figure 3. MINSET is a function or tool within the KZN Wildlife C-Plan (Conservation Planning Software) that is used to identify a "minimum set" of sites (planning units) that would fulfil the role of achieving conservation targets. MINSET identifies the most efficient configuration of sites in the landscape, taking into account constraints such as the need to avoid highly productive agricultural land or land adjacent to major highways.

The MINSET output map shows areas that are already protected; "Mandatory Reserves" and "Negotiable Reserves". Mandatory Reserves are those areas that appear as totally irreplaceable on the irreplaceability map, since there are no other alternatives for achieving the conservation targets. Areas identified as Negotiable Reserves are the areas that the MINSET function returns as the most efficient for achieving targets and constraints (although there are alternative configurations that would achieve conservation targets, they would be less efficient; hence the designation of these areas as 'negotiable'). The following points provide a summary of the MINSET categories.

- *Critical Conservation Areas 1 CCA (Biodiversity Priority Area 1)*[14]*:* designated planning units containing one or more features with an irreplaceability score of 1. This means that there are no other localities identified as alternates to try and meet the conservation target for the designated feature(s). Consequently these are considered mandatory reserves.

[14] Conservation Areas were termed "biodiversity priority areas' in previous versions of the MINSET outputs.

- *Critical Conservation Areas 2 (Biodiversity Priority Area 2):* indicates the presence of one (or more) features with a very high irreplaceability score. In practical terms, this means that there are alternate sites within which the targets could be met, but not many.
- *Critical Conservation Areas 3 (Biodiversity Priority Area 3):* indicates the presence of one (or more) features with a low irreplaceability score.

As illustrated in Figure 3, ***a large proportion of the SGD Basin is classified as a Critical Conservation Area 1 (i.e. irreplaceable)***. According to the Draft EKZNW Guideline, these areas are regarded as 'not offsetable' given their significance and the lack of other spatial options to meet conservation targets. A query of the EKZNW conservation planning database revealed that it is not one feature, but a range of ecosystems and notable species across different ecosystems and taxa (plants, mammals, birds) that generate the high MINSET values. This shows the cumulative value of the landscape and associated habitat that will be lost. The specific biodiversity elements are discussed in more detail in the following sections with regard to their influence on offset targets.

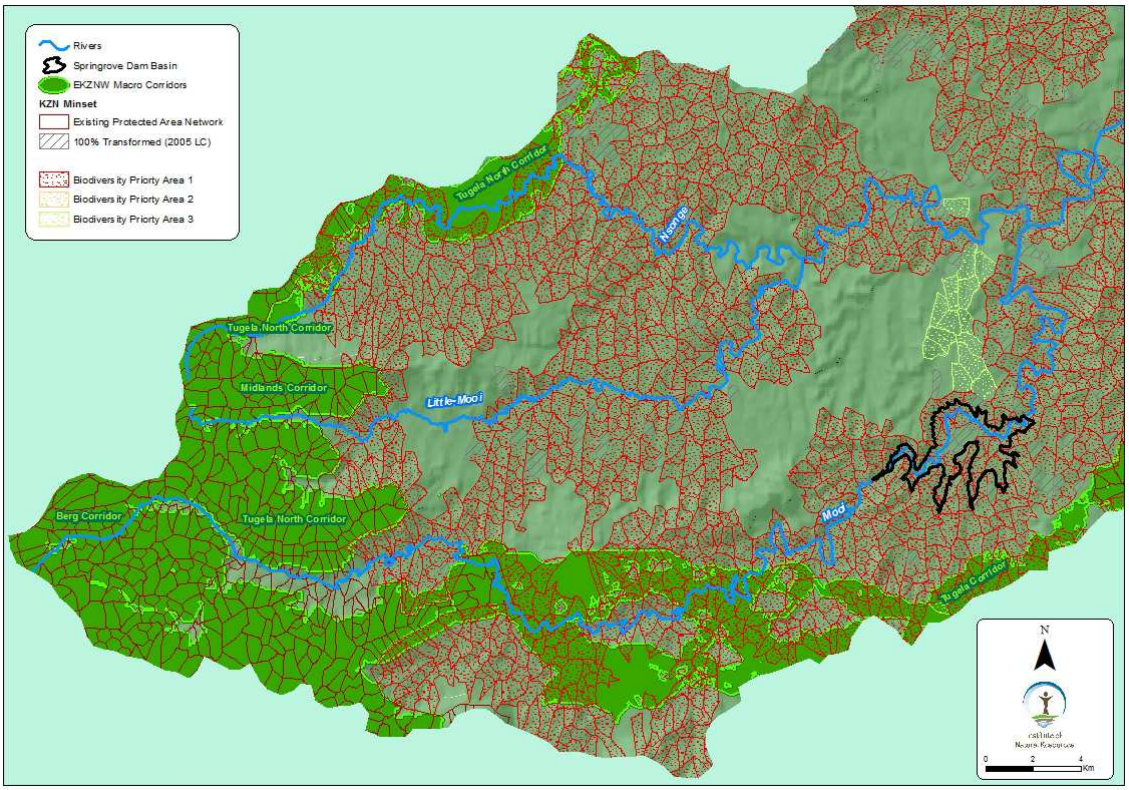

FIGURE 3 Conservation status of the regional terrestrial environment

2.2.2 Aquatic Conservation Overview

The conservation status of the Mooi River and Wetlands as defined by the National Freshwater Ecosystem Priority Areas (NFEPA) assessment is provided in Figure 4. Of note is the fact that the Mooi River has been identified as a River FEPA and a fish sanctuary, the meaning of which is explained below.

- *River FEPA*: Catchments required to achieve biodiversity targets for river ecosystems and threatened/near threatened fish species, identified in rivers that are currently in a good

condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainability of water resources.

- *Fish Sanctuary*: Rivers which are essential for protecting threatened and near-threatened freshwater fish that are indigenous to South Africa. A goal of NFEPA is to stop more freshwater species from becoming threatened and to prevent those fish species that are already threatened or near threatened from going extinct. In order to achieve this goal, there should be no further deterioration in river condition in fish sanctuaries. Fish management plans need to be developed for all fish sanctuaries.

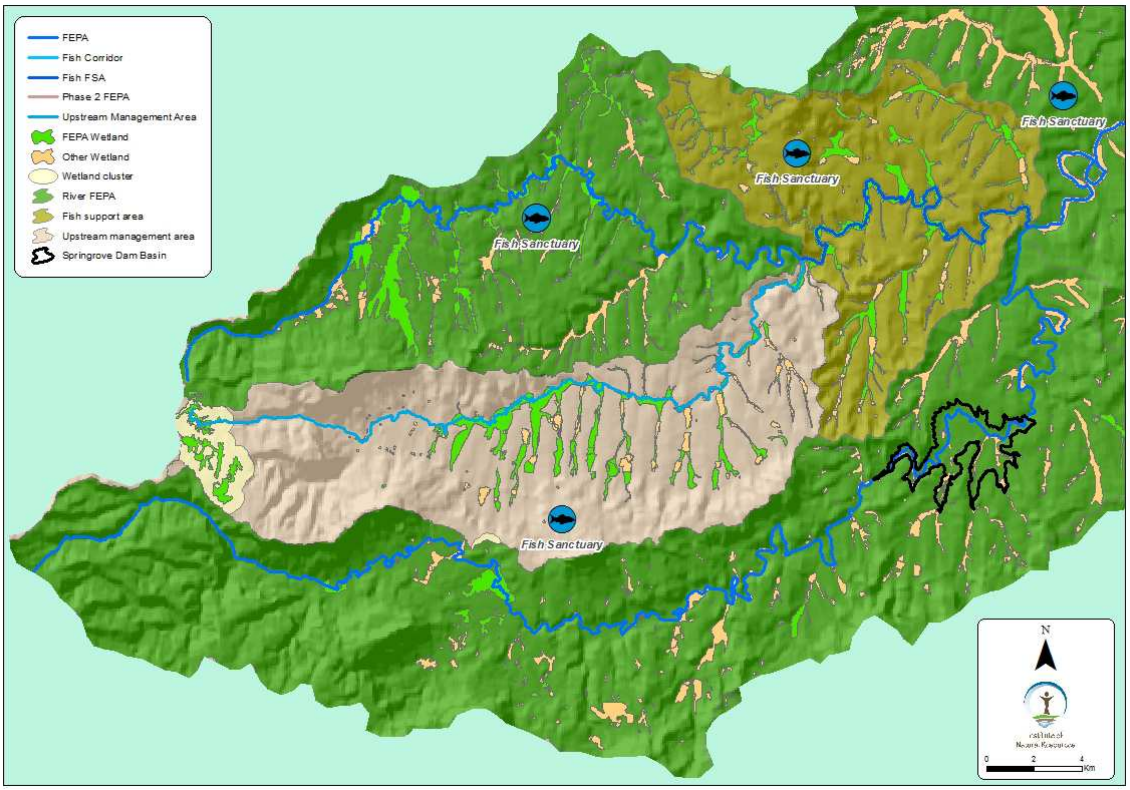

FIGURE 4 NFEPA status of the Mooi River and its primary tributaries.

- *Wetlands:* No wetlands within the SGD Basin were allocated FEPA status; however, there are several FEPA wetlands in the Mooi River and its tributary catchments of the Little Mooi and Nsonge Rivers. Wetland FEPAs were identified using ranks that were based on a combination of special features and modelled wetland condition (e.g. Ramsar wetland status, extensive intact peat wetlands, presence of rare plants and animals, as well as available spatial data on the occurrence of threatened frogs and wetland-dependent birds).

2.2.3 Threatened Ecosystems

The provincial threat status of both grassland vegetation types occurring within the basin, namely Mooi River Highland Grassland (MRHG) and Drakensberg Foothill Moist Grassland (DFMG), is 'Vulnerable'. The area also falls within the "Drakensberg Foothill Wattled Crane Habitat (KZN 47)" which is classified as Vulnerable in the Schedule of Threatened Terrestrial Ecosystems in South Africa (2011).

2.2.4 Species

The range and threat status of species contribute significantly to the classification of the basin as a CCA 1. Impacts on species with 'Least Threatened' (LT) status do not constitute an impact of sufficient significance to warrant offsetting (EKZNW, 2011). The focus is therefore on species listed as 'Vulnerable' (VN), 'Endangered' (EN) and 'Critically Endangered' (CN), and on endemic species – particularly those with restricted range. The desired outcome of offsets is to ensure that the conservation status of these species does not decline. It is therefore important to understand whether the offset targets for particular ecosystems will simultaneously remedy impacts on species of concern, or whether additional offsets might be required to compensate for the loss of habitat for a particular species.

The following summary provides an overview of the range of species of conservation concern across the different ecosystem types. The species with the highest threat value are noted with tables summarising complete inventory of species provided in the specialist report. The specialist team was asked to document the following with regard to the impact of SGD on species:

- Their conservation status, in particular whether or not species are threatened and/ or regional or local endemics.
- Confidence regarding their occurrence within the basin (i.e. whether their occurrence is modelled or based on records).
- The nature and intensity of the impact of SGD on the species by indicating amongst other response; whether local populations will be lost or whether individuals/populations will move out of the basin.
- Whether the species are reliant on one or more of the ecosystems occurring in the basin (i.e. the matrix of habitats is important), and what proportion of the area to be lost constitutes a significant proportion of their habitat.
- Whether there is unique habitat in the basin that will be lost, and/or if species are reliant on that unique habitat.

2.2.4.1 Mammals

All of the twenty-two mammal species[15] known to occur, or that are likely to occur in the SGD basin will be able to escape the rising waters and in most instances they will find new habitat. In view of the conservation status of most mammals (with the exception of the Oribi, all species are of Least Concern or Not Listed), shrinkage of total habitat in the landscape is not seen as a significant concern. Moreover, since the vegetation type is seen as a good surrogate for habitat of affected mammal species, targeting offsets in the same vegetation type is deemed to be 'good enough' for most mammals.

The exception to this statement is ***Oribi*** which is the most threatened antelope species in the country with a Red Data listing of **Endangered**. Oribi are highly territorial and clashes between males often lead to the death of individuals. So, although Oribi will move away from rising water, any loss of grassland habitat that is suitable for Oribi is a concern for the species given their territorial nature, and the fact that their Endangered status is a result of large-scale habitat loss, illegal hunting and inappropriate veld management. They are highly specialised antelope that feed

[15] 5 ungulates, 5 carnivores, 4 rodents and 8 other mammal species recorded in the area.

very selectively on short grass and specific parts of the grass. While they do utilise agricultural lands, they are not as adaptable as other antelope species. Given their specific habitat requirements, they are **flagship species for grasslands**.

Three small family groups comprising approximately between 7 and 10 individuals utilise mainly the southern sections of SGD Basin (Phelan, *pers comm*), with not all the habitat within the basin being suitable for them e.g. the steeper areas on the north western sections. The home range of a male extends from 20 to 60 ha, depending on habitat quality (Oliver *et al.* 1978). Little (*pers comm*) suggested that in the midlands home ranges are in the higher proportion of this range i.e. 40 – 60ha. Given the potential impact on these animals, TCTA consulted the EWT Endangered Grasslands Species Programme and EKZNW. The management options discussed were:

a) Leaving the Oribi to move out and re-establish their home ranges.
b) Capture and relocation.

An assessment of the habitat remaining in the immediate surrounds to the dam basin (between the full supply level and the Lotheni Road which serves as a hard barrier to the movement of Oribi) revealed that it is likely to be adequate to support the affected pairs. Furthermore, densities of Oribi in the immediate area with which the local families could come into conflict are low. Consequently, option (a) was selected (Ian Little, *pers comm*)[16]. It was acknowledged that a risk remains of losing animals and the situation is being monitored with the option still to relocate them. Despite the possible survival of the affected family groups, given:

- The threat status of Oribi,
- Their specific reliance on grasslands, and
- The fact that there are several family groups using SGD basin,

Offsets for SGD should prioritise the protection and restoration of known and potential Oribi habitat.

2.2.4.2 Amphibians

The impact of the dam on the 19 amphibian species known or likely to occur in the SGD Basin will be to change their distribution and population numbers, but not to threaten any particular species; with the exception of the two frog species described below, all amphibians likely to occur in the SGD Basin are of 'Least Concern'. Loss of established vegetation along the banks of the Mooi River, and flooding of wetland vegetation, may affect or influence breeding of various frog species because aquatic vegetation acts as anchor points for egg masses and some egg masses are anchored in trees above the water. There could also be a loss of habitat for shelter and foraging. Conversion of seasonally inundated wetlands to a permanently flooded water body will mean that predatory fish will have access to areas that were previously inaccessible to them; this fact could affect the breeding success of some frog species. Certain species (*Amietia angolensis*) can be affected by the building of dams because the dams serve to isolate populations.

[16]Manager; Threatened Grassland Species Programme of the Endangered Wildlife Trust (EWT)

Of the species occurring in the basin, the following are noteworthy:

- ***The Natal Leaf-folding Frog:*** the ***sub species Afrixalus spinifrons intermedius found in the dam basin is endemic to KwaZulu-Natal and is Near Threatened***. It inhabits marshes, dams, floodplains and riverbeds, and is dependent on wetland habitat. There are numerous threats to the persistence of this species and it is inadequately protected, with only 2.8 % of its predicted range falling within protected areas.
- ***Long-toed Tree Frogs*** are ***endemic to South Africa***, occurring mainly in the southern KwaZulu-Natal highlands, but also marginally in adjacent parts of the Eastern Cape. Their presence in the dam basin is unconfirmed but likely; they are dependent on grassland habitat, occurring mainly in High Altitude Moist Upland Grassland, but also in Short Mistbelt Grassland and North-eastern Mountain Grassland within the grassland biome. They breed in grassy wetlands and marshes. The biology of the species is still poorly known and the eggs and tadpoles have not been recorded. It is classified as ***Endangered*** and is listed as a ***"species of conservation importance"*** by the KZN Conservation Ordinance, Number 15 of 1974, as amended. The main threat to this species is the degradation, fragmentation and loss of habitat caused by afforestation and infestations of alien plants.

The two species of noteworthy frogs are dependent on grassland and wetland habitats. Securing adequate offsets in both these ecosystems should simultaneously address the requirements of these species.

2.2.4.3 Reptiles

For the most part, reptiles will move away from rising water and, if trapped, will swim to safety. There are an estimated 21 species of reptile that are likely to occur in the SGD Basin; most of these species are of little conservation concern. One ***species that is of concern*** is the ***Natal Midlands Dwarf Chameleon***. It is a ***regional endemic*** and is threatened by habitat loss. It requires a mixed habitat of grassland with trees on which young are born. Much destruction of this habitat type took place during construction and preparation for inundation of the dam basin. This was one of the species targeted in the search and rescue efforts, but with almost no success. ***Providing for a mixed habitat of grassland with trees in the selection of offset sites would be an advantage, to cater for the needs of this particular reptile.***

2.2.4.4 Birds

At least 150 bird species are well represented at the Spring Grove Dam site. In terms of the impact of the dam, most water-loving species - 69 in all - will benefit, but all of these species are abundant and widespread. An additional 20 water birds might benefit, on the basis that more water equals more habitat, but much depends upon the nature of the future shoreline and its vegetation. These 20 birds prefer running water, or vlei vegetation, or some other factor typical of smaller waters. Often, big dams mean fewer habitats for niche specialists. In addition, all of the non-aquatic bird species will be eliminated from the flooded area (Barnes, 2000). The most important issue is the number of Red Data, endemic and iconic species that are present, which represent a significant collection: 25 such species, matched by only a few formal protected areas. Almost all of these species will suffer from loss of habitat, some to the point of local extinction, as a result of SGD.

None will definitely benefit, although for a few birds the net effect of the dam on populations and the species is difficult to predict or quantify.

a) Red Data Species

Spring Grove Dam Basin provides habitat for the following Red Data species of bird:

- **Critically Endangered***:* Wattled Crane.
- **Endangered*:*** Bearded Vulture, Black-rumped Buttonquail.
- **Vulnerable*:*** Southern Bald Ibis; Cape Vulture; Tawny Eagle; Martial Eagle; African Marsh Harrier Lesser Kestrel; Blue Crane; Grey Crowned Crane; Corncrake; Denham's Bustard; Barrow's Korhaan African Grass-Owl; Southern Ground-Hornbill.
- **Near-threatened*:*** Black Stork; Secretary bird; Black Harrier; Peregrine Falcon; Lanner Falcon; Black-bellied Bustard; Black-winged Lapwing; Half-collared Kingfisher; Broad-tailed Warbler.

Red Data species of particular concern are addressed below.

Cranes (Wattled Crane, Blue Crane, Grey Crowned Crane)

Cranes are highly dependent on the mixed wetland/grassland ecosystem characteristic of the upper catchments of the major river systems along the escarpment. They therefore serve as indicator species for the climax mix of grassland and wetland. Wattled Cranes (*Bugeranus carunculatus*) are highly dependent on higher altitude, sedge-dominated wetlands for successful breeding while Crowned Cranes (*Balearica regulorum*) prefer the reed-bed dominated marshes of these similar areas. The Blue Crane (*Anthropoides paradiseus*) depends primarily on upland natural grasslands and is therefore less dependent on wetlands for its survival than Wattled or Crowned Cranes. Cranes also utilize agricultural lands for foraging; they often make use of particular lands as traditional feeding sites year after year and such areas have become vital for flocks of non-breeding, immature cranes. KwaZulu-Natal supports most of South Africa's Wattled Crane population. Breeding pairs in KwaZulu-Natal need unspoilt vleis, away from human disturbance.

The importance of the particularly the midlands region for all three species, particularly Wattled Crane is indicated in Figures 5 and 6, which summarize the outputs of the 21012 Aerial census. Spring Grove Dam falls within the 'Midlands West' region.

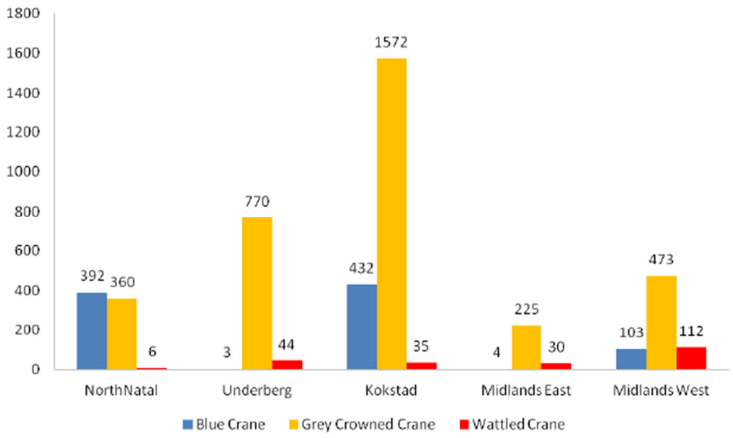

FIGURE 5 The number of Blue, Crowned and Wattled Cranes counted in each of the five different regions of KwaZulu-Natal during the 2012 aerial survey.

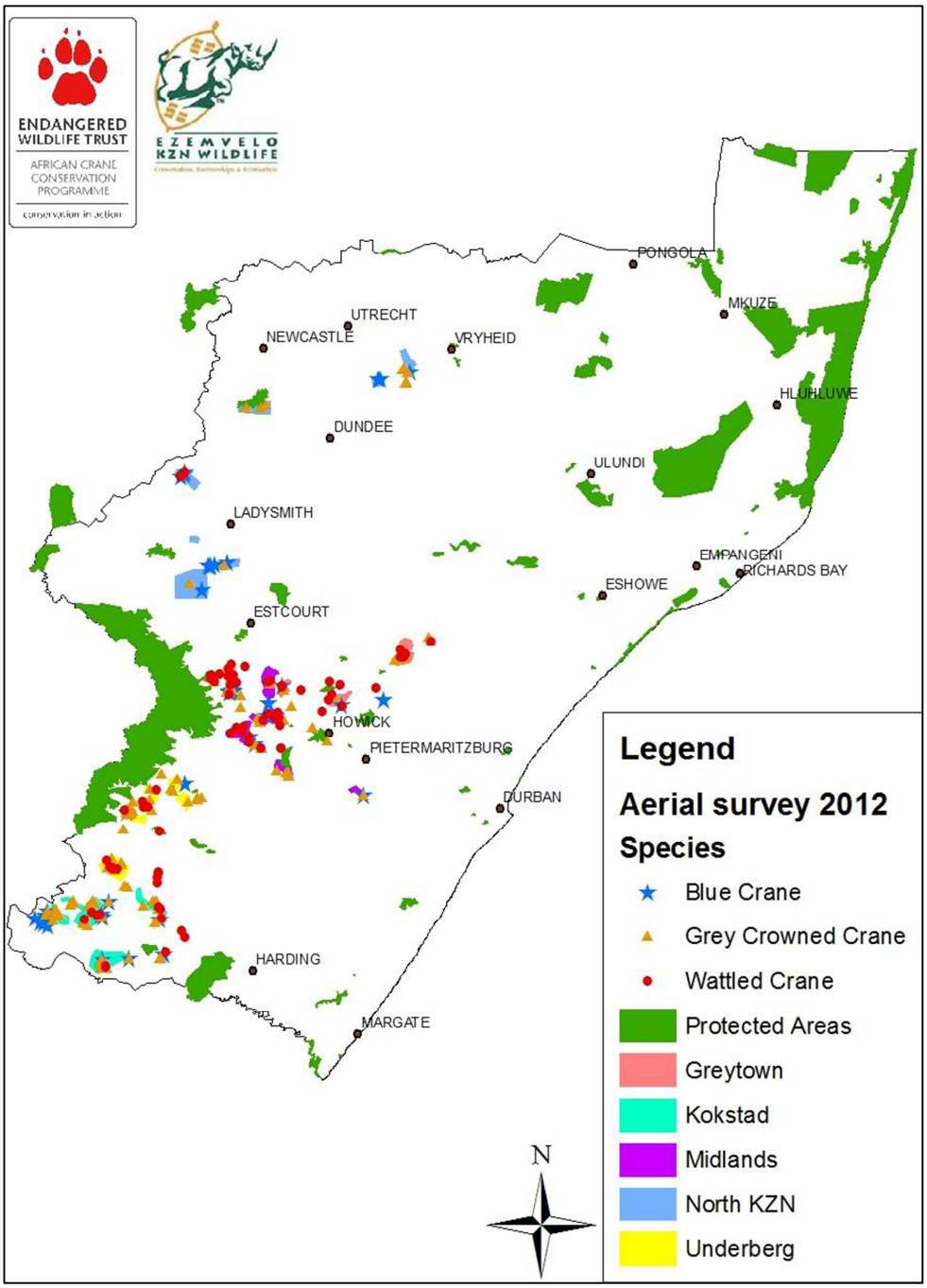

FIGURE 6 2012 KwaZulu-Natal Crane Aerial census Distribution of all three species of crane within KwaZulu-Natal (Source: EWT crane census 2012)

As described above the three species of cranes present in the basin represent indicator species for mixed wetland/grassland. Given their threat status, specific attention was paid to assessing the use of SGD basin in the original assessment (Cox, 2001). At that point there were no nest sites within the basin. The situation has changed since 2001, with Figure 7[17] showing the use of the basin by all three species in terms of nest sites and foraging.

[17] Based on census data provided by Endangered Wildlife Trust (EWT) African Crane Conservation programme.

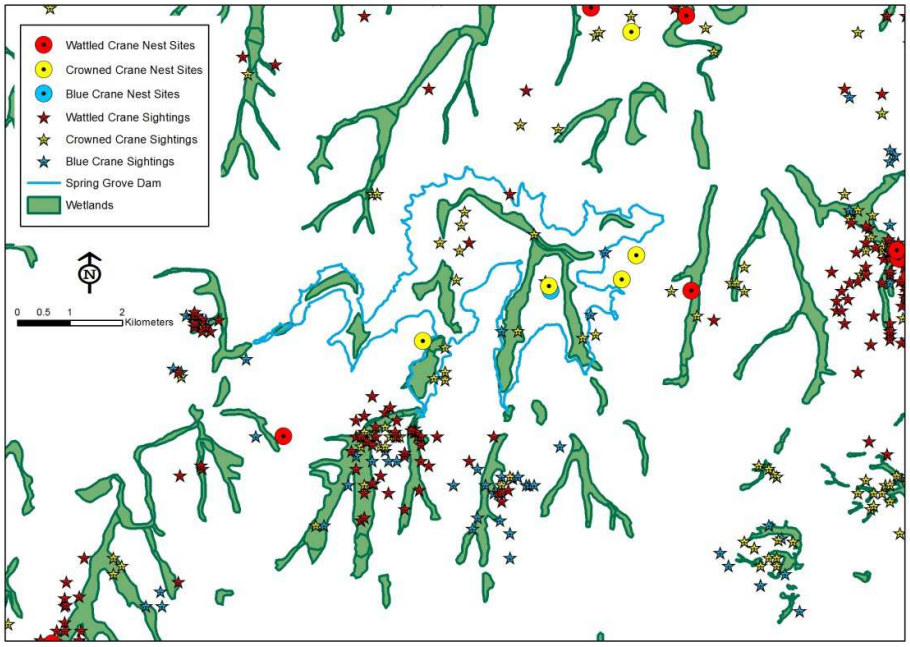

FIGURE 7 Use of the Spring Grove Dam Basin and surrounds by the three crane species

The current use of SGD basin reflects the fact that it provides habitat for all three crane species and can be summarised as follows:

- *Nest sites*:
  There is one nesting pair of both Blue Cranes and Grey Crowned Cranes within the dam basin. There are also nest sites in the wetlands adjacent the dam basin on the farm Strathern, implying that the dam basin also forms a portion of the home range for these birds. The use of these nest sites on an annual basis over the last approximately six years was verified by relevant landowners[18].
- *Foraging Habitat*:
  Census and siting data collated by the ETW has shown that the SGD basin is also used for foraging by flocks of Grey Crowned Crane and the juvenile flock Wattled Crane.

Other Wetland specialists

African Marsh Harrier, African Grass-Owl, Black Stork and Half-collared Kingfisher all make use of specialised wetlands, and would make little or no use of a large dam. The Kingfisher needs flowing water.

Grassland specialists

All of the rest of the Red Data species affected by SGD are grassland specialists. Of particular note is the Endangered resident Black-rumped Buttonquail.

[18] Mr Derek Greene (Owner Spring Grove Farm), and his manager Alistair Smith.

Impact on Red Data Species

The loss of grassland/ wetland habitat for Red Data specialists is important, both in terms of their dependency on that habitat for feeding, but particularly where known breeding sites are inundated. Specific breeding records are lacking, but it is highly probable that African Marsh Harrier, African Grass-Owl, Black-winged Lapwing and Broad-tailed Warbler utilise SGD Basin, as the habitat is as suitable as other places where they are known to breed. This is not a key locality for any one of them, but represents a sizeable fraction of their overall habitable range. The other Red Data species use the site only for foraging.

b) Endemic Species

Thirty-one bird species endemic to southern Africa are present in the SGD Basin, and all are regular inhabitants. This is a high proportion of the whole (31 of 150 species; over 20%) and reflects the fact that the SGD site in the KwaZulu-Natal Midlands lies on the edge of the Drakensberg Centre of Endemism. To place this figure in context, a similar count of e.g. Kruger Park birds would yield about 10 endemics out of 450. Five of the Red Data species are also endemics, giving them 'double importance'; Southern Bald Ibis, Cape Vulture, Blue Crane, Barrow's Korhaan and Black Harrier. The Blue Crane is South Africa's national bird.

Offsets can compensate for residual negative impacts on species either by giving protection to areas at risk of being irreversibly transformed by future land use and / or through improving the condition of degraded habitat suitable for affected species (i.e. increasing the net area available). However, they cannot compensate for the overall shrinkage in area of habitat at landscape scale.

Given the concentration and numbers of Red Data and endemic bird species utilising Spring Grove basin, securing the specific mosaic of habitats for these species should be a principal objective of offsets. Particular attention should be given to the habitat requirements of the Wattled Crane in view of its Critically Endangered status, and as an indicator species for the climax wetland/grassland habitat upon which the two other species of Crane and many of the other bird species depend.

2.2.4.5 Plants

Summary lists of plants found within the different habitats to be inundated are provided in the specialist reports. The lists indicate that several national and in some cases regional (*Geranium natalense*- KZN Midlands) endemics and species with high threat status (*Nerine pancratioides*– Vulnerable) are found in each of the broad wetland and grassland ecosystem types.

The list of plant species does not highlight the importance of the habitat and associated plant communities occurring at Inchbrakie Falls, a unique feature consisting of several cascades with islands and wet and dry cliffs. The falls and its immediate surroundings contain a large number of microhabitats, including many ephemeral habitats. These microhabitats accommodate many species not found elsewhere in the SGD Basin, including rare or threatened species. One of these unique microhabitats is the "fynbos" type with *Passerina drakensbergensis, P. montana, Euclea coriacea, Erica woodii, Anthospermum monticola* and *Cliffortia repens*. When compared with other waterfalls

in the area, the vegetation on the edge, islands and seasonal pools of the Inchbrakie Falls is unique (Landscape Dynamics 2004).

The loss of this waterfall will result in permanent loss of microhabitats and refugia for the rare species present; it is likely that some of these plant communities will become locally extinct. While the search and rescue effort resulted in the individuals of these important species being saved, **the inundation of the Inchbrakie Falls will result in irreplaceable loss of unique habitat that cannot be offset** – i.e. cannot be restored or recreated.

Wetland and grassland offset targets will account for the important species occurring in these systems. The unique physical attributes and habitats of the waterfall cannot be offset. At best, compensation for its loss should be achieved by protecting and managing sites with similar habitat and this should be an objective of the offset.

2.2.5 Aquatic Species

The conservation value of the fish, macro-invertebrates and plants linked to the river and riparian habitats is described below.

- ***Fish***

None of the four indigenous species[19] occurring in this section of river is threatened. However, taken in context, the fish community within the Mooi River is important in contributing to the ***Mooi River's being defined as a FEPA fish sanctuary*** area (Nel *et al*. 2011).

- ***Macro-invertebrates***

Most notable from the investigation is that five of the six species of burrowing mayfly known from South Africa have been recorded from the Mooi River (de Moor 2002), although recent studies have only located one of the species – *Ephoron savignyi: Polymitarcyidae* (Swanepoel *et al.* 2006). The burrowing mayfly guild is noteworthy because of their requirement for adequate flow to deliver sediment for habitat, which would typically occur within meandering river reaches; the meandering section of river impacted by SGD meets this habitat requirement with its high sinuosity index score. This characteristic of the stretch of river is a distinguishing one

- ***Plants***

Riparian plants of high conservation value found, or likely to be found, at Spring Grove Dam along the banks of the Mooi River and particularly at Inchbrakie Falls are addressed in 2.2.3.5 above.

It is recommended that the offset incorporates stretches of river that are of the same river type, have similar characteristics (pool riffle sequence), and are meandering so that they account for the specific habitat requirements of the mayfly and fish species.

[19] The migratory longfin eel (*Anguilla mossambicus*) as a long-distance anadromous migratory species; the widespread chubbyhead barb (*Barbus anoplus*) and the less common bowstripe barb (*B. viviparous*); and the Natal yellowfish (*Labeobarbus natalensis*) which occurs downstream of Inchbrakie Falls and which also exhibits a degree of migratory behaviour.

2.2.6 Ecological Processes

The maintenance of connectivity is essential to a number of ecological processes, including species migrations, seasonal and altitudinal dispersal, and range displacement in response to climate change. Ezemvelo KZN Wildlife has mapped macro-biodiversity corridors which are important for maintaining ecological connectivity at the provincial level. As illustrated in Figure 3, Spring Grove Dam lies to the north and west of the Thukela Macro-Biodiversity Corridor[20]. River Valleys constitute one type of ecological corridor. It is apparent in Figure 4 that SGD will establish a significant barrier to the use of Mooi River valley as a corridor for the movement of terrestrial species from west to east. While the river would have presented a west-east barrier to some species, the dam will also preclude any movement in a north- south direction along a distance of approximately 10km. It is argued by Gallé *et al* (1995), that for a river valley to represent a corridor, it should link core habitat areas, species should use the valley and that it should be important to their survival. Given the extent and 'absolute nature' of the barrier presented by Spring Grove Dam it can be assumed that it will impact the associated terrestrial species at some level.

Ecological corridors should be considered in the selection and establishment of offset areas. In particular, offset sites should preferably help to protect and provide buffers to river valley habitat, and should establish connectivity between isolated patches of remaining habitat suitable for key species such as Oribi.

2.3 Summary Statement

The cumulative value of the biodiversity located within Spring Grove Dam Basin is illustrated by the concentration of ecosystems having a relatively high threat status and the high diversity of species across all taxa – including a concentration of threatened and endemic species - occurring within the basin. This value is also reflected in the fact that SGD Basin lies in a Critical Conservation Area (CCA1) containing irreplaceable biodiversity, meaning that it will no longer be possible to meet the conservation targets for several of these ecosystems, their ecological processes and habitats for species. So, while the risk of individuals or populations of species being lost is limited, the inundation of SGD Basin represents a considerable loss (over 600 ha of natural habitat) which cumulatively is notable. While offsets can provide some level of compensation for residual negative impacts on ecosystems and habitat for species, it is unlikely that they will be able fully to 'offset' impacts on CCA 1 areas.

The following sections of this report provide more detailed understanding of the extent and conservation value of the three ecosystems that will be impacted as a result of SGD, namely: wetlands, grasslands and river.

[20] Ezemvelo KZN Wildlife (2010) KwaZulu-Natal Provincial Macro-Ecological Corridors version 3. Unpublished GIS Coverage [kzncor05v310_wll], Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife, P. O. Box 13053, Cascades, Pietermaritzburg, 3202.

3. WETLANDS

3.1 Wetland Type and Extent

Wetlands constitute a significant area (462 ha, or approximately 45%) of the Spring Grove Dam Basin. The considerable wetland cover reflects the generally flat topography within the basin that gives rise to an extensive floodplain. In addition to the floodplain wetlands, there are three extensive valley bottom wetlands draining into the basin from the south (CVB1-3), and numerous hillslope seeps that drain down the steeper slopes of the north and western sections of the basin, feeding the floodplain. These wetlands were not all previously mapped in the original 2000 delineation, meaning that the extent of wetland habitat was underestimated. The location and extent of the various wetlands is depicted in Figure 8 (note that drainage lines are not included as wetlands). The classification, area and condition of these wetland ecosystems is summarised in Table 4.

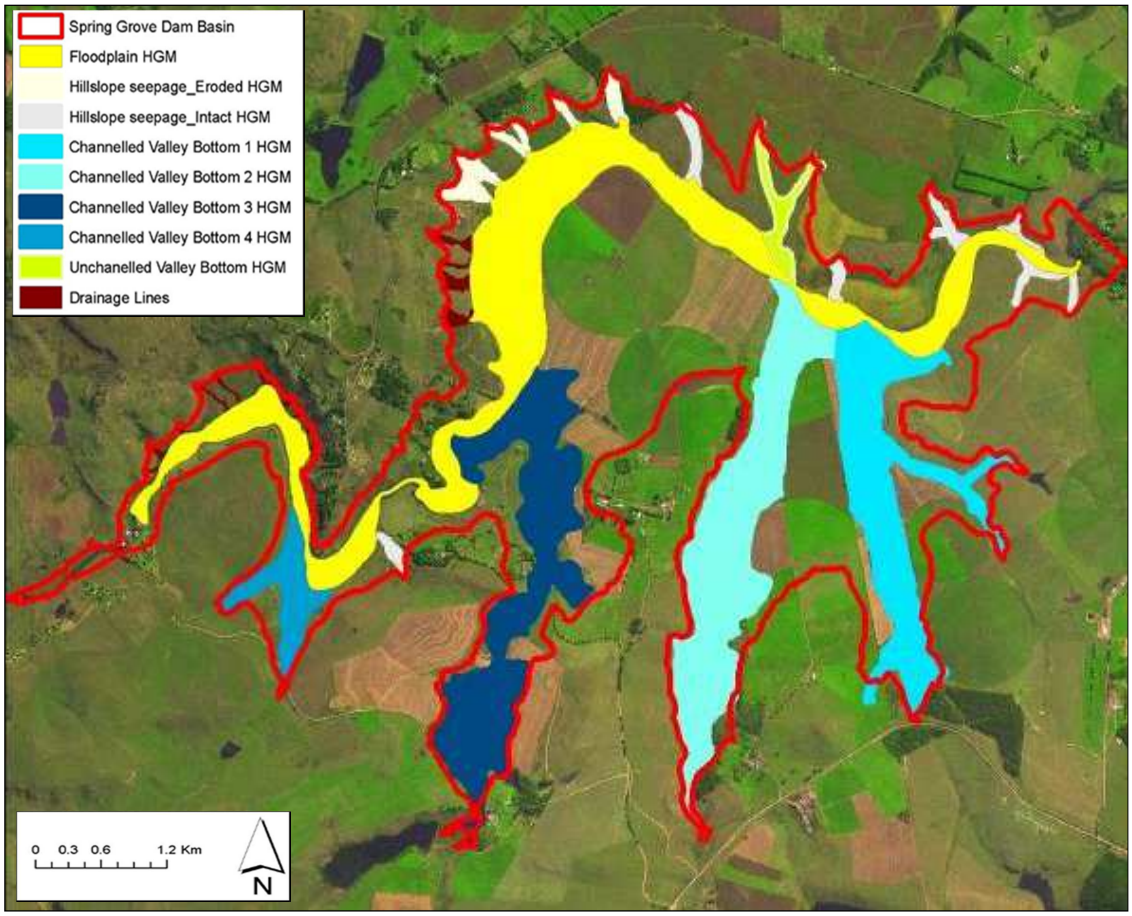

FIGURE 8 Location and distribution of wetlands within Spring Grove Dam Basin

The WET-health tool was used to establish the condition of the wetlands in the basin. The tool considers the three components for which specific conditions define a wetland i.e. hydrology, geomorphology (soils) and vegetation. The outputs of the tool are health categories ranging from A-F as described in Table 3.

TABLE 2 WET-health categories and associated scores.

Health Category	*Description*	*Score*
A	Unmodified, natural.	0 – 0.9
B	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
C	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
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9
E	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
F	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

Overall health rating = [(Hydrology*3) + (Geomorphology*2) + (Vegetation*2)] / 7

The WET-health scores are provided in Table 5 and reflect the relatively degraded state of a large proportion of the wetlands in the dam basin, particularly the large valley bottom ecosystems and the floodplain which provide flat areas suitable for cultivation; the valley bottom (VB) wetlands in particular have been drained to facilitate planting of pastures and crops. There are also large dams in VBC1 and VBC 3 which affect the hydrology by altering the flow regime and volume of water available to the downstream system, as there is abstraction for irrigation purposes. The floodplain has been less affected by cultivation given the difficulties associated with drainage and the presence of very wet sections such as the oxbows, hence its higher wetland health rating.

TABLE 3 Summary of wetland health categories per wetland unit

National Wetland Classification *(Sub-Escarpment Grassland Group 5)*	***WET-Health Category***	***Wetland Area (ha)***
Floodplain	*C*	166
Channelled Valley Bottom (VBC 1)	*D*	70
Channelled Valley Bottom (VBC 2)	*D*	92
Channelled Valley Bottom (VBC 3)	*D*	88
Channelled Valley Bottom 4 (VBC 4)	*C*	18
Unchannelled Valley Bottom (VBU 1)	*C*	8
Hillslope Seepage linked to a stream channel, Intact (HSI)	*B*	11
Hillslope Seepage linked to a stream channel, Eroded (HSE)	*C*	9
	Total Area	***462 ha***

3.2 Offset Targets

The offset targets for wetlands are established to account for both loss of functional value and biodiversity conservation/ protection requirements based on threat status as defined by the relevant conservation agency and application of ratios provided in the applicable guideline. In many cases the offset area required to compensate for loss of functional area may simultaneously meet protection requirements, or *vice versa*. However, it is necessary to consider both aspects.

There are two guidelines of relevance to determining an appropriate wetland offset:

i. The Draft National Guideline for Wetland Offsets (SANBI 2012) [21] hereinafter referred to as 'the Draft National Guideline'.
ii. Ezemvelo KZN Wildlife (2013) Comprehensive Guideline for Biodiversity Offsets: KwaZulu-Natal Province: Final Draft, February 2013, hereinafter referred to as 'the Draft EKZNW Guideline'.

These guidelines propose different approaches, resulting in contrasting offset requirements. The offset implications of each guideline are addressed in separate sections below.

3.2.1 National Guideline for Wetland Offsets

3.2.1.1 Functional Area

For the purposes of offsetting loss of wetland function, the overall wetland health rating is multiplied by the area of impacted wetland to arrive at a measure of functional area or "hectare equivalents", as described in the Draft National Guideline. Application of the calculation tools provided in this guideline yields a functional target of **281 hectare equivalents** (Table 5). Offsetting this loss is achieved through rehabilitation actions in offset wetland sites that improve the functional value of these systems by this target value. That is, the total area required to be offset will depend in part on the gains in wetland health that can be achieved at offset sites; with greater gains in condition/ health, the required area decreases; where negligible gains are likely, a proportionately larger offset area will be needed to compensate for functional losses.

TABLE 4 Hectare equivalents per wetland unit.

Wetland Classification	*WET-Health*	*Wetland Area (ha)*	*Hectare Equivalents*
Floodplain	*C*	166	118
Channelled Valley Bottom (VBC 1)	*D*	70	32
Channelled Valley Bottom (VBC 2)	*D*	92	49
Channelled Valley Bottom (VBC 3)	*D*	88	49
Channelled Valley Bottom 4 (VBC 4)	*C*	18	13
Unchannelled Valley Bottom (VBU 1)	*C*	8	5
Hillslope Seepage linked to a stream channel, Intact (HSI)	*B*	11	9
Hillslope Seepage linked to a stream channel, Eroded (HSE)	*C*	9	6
	Total	***462 ha***	***281 ha equivalents***

From a biodiversity conservation perspective, there is an increasing risk of failure to offset biodiversity losses when rehabilitating wetlands that are in a significantly more degraded state than the impacted systems. The Draft National Guideline therefore proposes exchange rules as follows:

[21] SANBI 2012. Towards a Best Practice Guideline for Wetland Offsets in South Africa (beta version). D MacFarlane, A von Hase and S Brownlie.

- In the case of rehabilitation, the offset site must be *at most* one category lower than the impact site before rehabilitation.
- The end condition of the rehabilitated wetland must be at least the same as the category of the impacted wetland.
- If the exchange rules cannot be met then the site is considered unsuitable.

With regard to the actual areas of wetland that are likely to be required to attain these functional equivalence targets, and assuming that the exchange rules are applied as proposed (i.e. offsets target wetlands one category lower than impacted wetlands), an area of approximately 940 ha would be required to be rehabilitated. Should the exchange rules not be applied (i.e. relatively severely degraded wetlands are targeted), then this area would decrease.

The text box below provides an example to show how improvement in the condition of the offset site affects the area required to meet the functional equivalence requirements.

EFFECT OF REHABILITATION SUCCESS ON OFFSET AREA REQUIREMENTS

If one needs to provide 50 ha equivalents in the offset area through wetland rehabilitation and protection, the following scenarios could be possible:

- With major rehabilitation success, an improvement in wetland condition from a Wet-health score of 8 before rehabilitation to 3 after rehabilitation would result in only 100 ha of wetland having to be set aside and rehabilitated.
- With little rehabilitation success, a change in wetland condition from a Wet-health score of 4 before to 3 after rehabilitation would result in an area of 500 ha having to be set aside to compensate for functional equivalence losses.
- If negligible rehabilitation is probable and/ or the same Wet-health category of wetland is selected, then up to 5000ha of wetland could be required.

3.2.1.2 Biodiversity Protection Target

Many wetland types are highly threatened and/ or have low levels of formal protection. Without conservation action it will not be possible to meet the 20% conservation targets for wetland ecosystems and their associated biodiversity. In keeping with the national approach to offsets adopted by SANBI, 'outcomes based' wetland protection multipliers (ratios) are used to adjust the offset target for impacted wetlands. These ratios are linked to the particular wetland threat status, taking into account existing protection levels; i.e. the higher the threat status, the higher the offset ratio applied as per the categories detailed in Table 6. Due to levels of uncertainty regarding the condition of many wetland types, the national guideline proposes using a precautionary approach to determining the offset ratio for the impacted wetland; it advises use of the higher of two offset ratios (one for the wetland vegetation group within which the wetland type occurs, and one for the wetland type).

TABLE 5 Threat status categories and associated offset ratios for wetland protection.

Ecosystem Threat Status	*Percentage Of Largely Intact Wetlands Remaining*	*Starting Multipliers*
Least Threatened (LT)	>60% 35-60%	1:1 2:1
Vulnerable (VU)	35-60%	3:1
Endangered (EN)	35-60% 25-30% 22.5-25% 20-22.5%	4:1 5:1 10:1 15:1
Critically Endangered (CR)	<20%	30:1 Projects should ideally have been turned down earlier in the mitigation hierarchy. Offsets are not recommended.

Notes:

- The following definitions were applied for protection status (Nel et al 2011):
  - Zero protection 0% biodiversity target in the protected areas in good condition
  - Hardly protected ≥ 0% biodiversity target in the protected areas in good condition.
  - Poorly protected ≥ 5% biodiversity target in the protected areas in good condition.
  - Poorly protected ≥ 5% biodiversity target in the protected areas in good condition.
  - Moderately protected ≥ 50% biodiversity target in the protected areas in good condition.
  - Well protected ≥ 100% biodiversity target in the protected areas in good condition.
- In the case of VU and LT wetlands, the availability of wetlands in moderate as well as good condition was included.

The protection ratios and associated targets according to the Draft National Guideline are provided in Table 7. When protection alone (i.e. no rehabilitation of wetlands) is proposed as an offset, then the condition of the offset wetland must be at least as good as the condition of the impacted wetland.

TABLE 6 Wetland offset protection targets based on ratios in the Draft National Guideline

Description	**Wetland Area (ha)**	**Wet Health Score**	**Wet Health Category**	***Functional Equivalence Offset Target*** *(area*change inhealth)*	***Protection Target*** *(Functional area* Wet Type ratios)*	***Protection Target*** *(Functional area* Wet Veg ratios)*
Floodplain	166	2.9	C	118	3536	471
Channelled Valley Bottom (VBC 1)	70	5.39	D	32	161	129
Channelled Valley Bottom (VBC 2)	92	4.7	D	49	244	195
Channelled Valley Bottom (VBC 3)	88	4.47	D	49	243	195
Channelled Valley Bottom 4 (VBC 4)	18	2.64	C	13	66	53
Unchannelled Valley Bottom (VBU 1)	8	3.51	C	5	52	21
Hillslope Seepage linked to a stream channel, Intact (HSI)	11	1.6	B	9	35	35
Hillslope Seepage linked to a stream channel, Eroded (HSE)	9	3.23	C	6	24	24
	462 ha			**281 Ha equivalents**	**4 363 ha equivalents**	**1 125 ha equivalents**

The application of these ratios, without taking into account multipliers to address risk and time lags, results in a basic protection target for the offset of 4 363 ha equivalents using wetland type. This extensive target is driven primarily by the large ratio assigned to floodplain ecosystems which at a national level are Critically Endangered and therefore assigned an offset ratio of 30:1. The Draft National Guideline proposes that projects impacting floodplain ecosystems represent a fatal flaw and should be dismissed at an early point in the decision-making process. This was not an option in the case of Spring Grove Dam. The final column in Table 8 presents the protection target based on the wetland vegetation group linked to the wetland type, which equates to a considerably lower protection target of 1 125ha. It should be noted that the Draft National Guideline applies a conservative approach which requires that the 'wetland vegetation' ratios only be used where they are higher than the 'wetland type' ratios. In the case of the SGD, the wetland type ratios are higher and would apply. It is also noted that the wetland type categorisation was essentially a desk-top exercise at coarse scale; its reliability is thus questionable.

Application of the protection target rules elevates the ***area of wetland that will be required to meet the base functional equivalence target (approximately 940 ha).*** Assuming equivalent Wet Health scores of the impact and offset wetland areas, the area of wetland needed to be secured through an offset would be likely to be in the region of:

- ***6 480 ha*** (if one applies the wet type protection ratio), and
- ***1 848 ha*** (if one applies the wet veg protection ratio).

3.2.2 Draft EKZNW Guideline

The EKZNW classification for wetland types within the SGD Basin differs from that found in the national guideline. In the provincial classification, affected wetland types are described as Eastern Temperate Wetlands (Near Threatened), and Temperate Alluvial Vegetation: Midlands Floodplain Grassland (Vulnerable). The basis upon which the wetland offsets are calculated in the Draft EKZNW Guideline differs from the approach applied in the Draft National Guideline. The thinking applied in the provincial guideline is that the offset ratio should not be discounted based on poor habitat integrity. A straight area-based approach is therefore adopted which prescribes a ratio of 3:1 for all wetlands. EKZNW further require that offset sites be rehabilitated to a level which is fair, irrespective of the original condition.

The basic offset ratio for both wetland types (i.e. excluding their value as habitat for species and/ or their ecosystem services value) is 3:1[22]. ***Application of the provincial ratio*** to the extent of wetlands to be lost results in a ***wetland offset target of 1 386 ha*** (462 ha x 3), with a requirement to protect and rehabilitate (where applicable) the offset sites. The Draft EKZNW Guideline recommends a minimum buffer of 100m around wetlands; this requirement would need to be addressed in offset selection.

[22] Ezemvelo KZN Wildlife (2013) Comprehensive Guideline for Biodiversity Offsets: KwaZulu-Natal Province, South Africa. (V4 FINAL February 2013)

4. GRASSLANDS

Being in the grassland biome, the original cover of natural vegetation in the terrestrial areas of the basin would have been grassland, also incorporating limited areas of *Leucosidea sericea* thicket. The majority of the original cover has been transformed over time through cultivation, commercial afforestation and planting of pastures. Invasive alien plants, overgrazing, soil erosion, infrastructure associated with agriculture and mowing for hay production have also impacted the condition of original cover of natural vegetation in many places. **Approximately 20% of the dam basin still contains natural grasslands**. Although the remaining grasslands are not pristine, good quality sections do remain, and relatively biodiversity-rich areas are present, typically associated with rocky outcrops (photo 1).

4.1 Vegetation Types

Within the dam basin, the Provincial and National classification and extent of terrestrial vegetation types correspond. Given its higher resolution, the provincial delineation of the boundaries of these vegetation types has been applied, with the majority of the basin falling within the Mooi River Highland Grassland (MRHG) vegetation type while a small eastern portion of the SGD Basin comprises Drakensberg Foothill Moist Grassland (DFMG).

4.2 Conservation Status

Mooi River Highland Grassland (MRHG) **-** Mucina and Rutherford (2006) regard this as a dry version of Drakensberg Foothill Moist Grassland, generally occurring in an adjacent rain shadow area. Only a very small portion is conserved in the Swamp Nature Reserve. Almost a quarter of the area has been transformed for agriculture or plantation forestry. The provincial conservation status is ***Vulnerable*****.**

Drakensberg Foothill Moist Grassland (DFMG) – Approximately 6% of this vegetation type is protected; 2-3% is conserved in the uKhahlamba Drakensberg Park and Ntsikeni Wildlife Reserve. It is also conserved in the following nature reserves: Karkloof, Mount Currie, Coleford, Fort Nottingham, Impendle, Ngeli and Umgeni Vlei. Almost 20% is transformed by cultivation, plantations and urbanisation. The provincial conservation status is ***Vulnerable***.

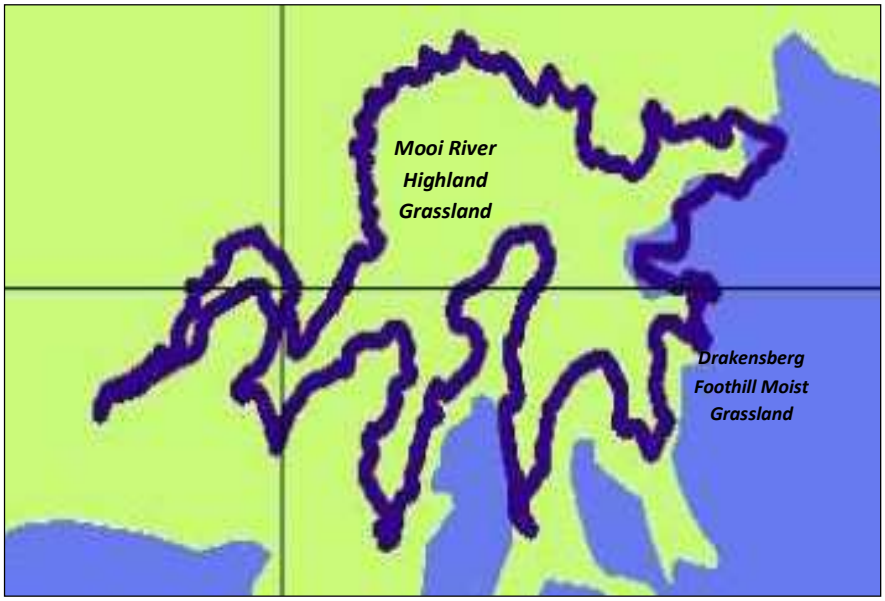

FIGURE 9 The distribution of vegetation types at Spring Grove Dam

4.3 Ecosystem Health

Ecosystem health was established by applying the habitat condition module in EKZNW's Stewardship Programmes Ecosystem Service Assessment spread sheet. The outcomes are summarised in the following table. The distribution of the specific areas that make up these combined areas is provided in Figure 1.

TABLE 7 Area and condition status of grassland types within Spring Grove Basin

Vegetation Type	Condition			Total Area
	Good	*Medium*	*Poor*	
Mooi River Highland Grassland (MRHG)	73 ha	44 ha	75 ha	192 ha
Drakensberg Foothill Moist Grassland (DFMG)	0 ha	23 ha	0 ha	23 ha
			Total Area	***215 ha***

4.4 Offset Targets

Offset targets are defined by the basic ratios set in the Draft EKZNW Guideline, designed to ensure that conservation targets for biodiversity in the province can be met. The size of offset area required is established by multiplying the impact area for each ecosystem type in a good or medium condition by the basic ratio for that ecosystem. These ratios are linked to the threat status of the affected ecosystem (vegetation) types as calculated in Table 9.

TABLE 8 Basic offset ratios and targets per grassland type

Vegetation Type Condition	Total Area (ha)	Mitigation (ha)	Residual Impact (ha)	Offset Ratio	Total Base Target (ha)
Mooi River Highland Grassland (MRHG)	192	5	187	3	**561 ha**
Drakensberg Foothill Moist Grassland (DFMG	23	-	23	3	**68 ha**

The emphasis, as stated in the Draft EKZNW Guideline, is to secure habitat in good condition; it is important, therefore, that the offset site comprises good quality grassland. In addition all efforts should be made to improve the condition of the grassland by addressing threats or current factors affecting health e.g. halting/rehabilitating erosion, clearing alien invasive species, and improved management through appropriate fire and grazing practices. ***In summary the base offset target for grasslands is the protection and restoration, where applicable, of 561ha of MRHG and 68ha of (DFMG) in moderate to good condition.***

5. MOOI RIVER

The river reach affected by the Spring Grove Dam falls within a largely homogeneous lower foothill longitudinal zone, characterised by a gentle gradient. Its most marked characteristic is the meander pattern through the valley, with associated oxbow lakes. River systems likely to be most analogous with this reach are the Little Mooi and Nsgone Rivers (also known as the Hlatikulu River), which are both meandering tributaries of the Mooi River and of the same river type as that impacted.

5.1 Conservation Status

The following table summarises relevant information relating to the baseline aquatic conservation assessment of the reach of Mooi River to be inundated by Spring Grove Dam. Notable points are that the ***section of river within the dam basin represents 6.25% of this river type***; a not insubstantial proportion. The entire Mooi River is ***classified as a Freshwater Ecosystem Priority Area*** in terms of being considered a fish sanctuary and in good condition. It is also worth noting that only ***a very small proportion of this river type is currently protected;*** approximately 1-2% of the overall length falls within the Kamberg, Giants Castle and Ntambamhlope protected areas.

Unlike for terrestrial ecosystems, conservation targets for river systems have not been defined at a provincial scale. Taking into account the fact that the NSBA (Nel *et al*. 2011) use 20% as a general conservation target at a national scale, a 1:1 offset ratio would be appropriate in this case, namely incorporating a river stretch of approximately 15,5 km into the offset areas.

TABLE 9 Summary information for the stretch of Mooi River within the Spring Grove Dam Basin

METRIC	VALUE
Primary catchment	V (Thukela)
Quaternary catchment	V20D
Gauging weirs	V2H005 @ top of V20D
River length affected (km)	15.5
Gradient of inundated zone	0.25m/100m (ca. 1450m – 1412m amsl)
River type[1]	5901
Lost contribution to provincial river type[2]	6.25%
Longitudinal zone	Lower foothill
NFEPA	Yes, plus fish sanctuary
Sinuosity Index[3]	1.78

[1] *According to the hierarchical classification of Rivers-Moore and Goodman, the inundated area falls within the Thukela aquatic biogeographic region (5000), upland topographic type (900) and has a Hydrological Index class of 1 (low flow variability)*
[2] *Based on a total length of c. 251km of river type 5901, which is the total 1:500 000 river length contained within this river type zone.*
[3] *Based on a river actual path length of 15.7km and a shortest path length of 8.8km*

5.2 Ecosystem Health

5.2.1 Ecological Indices

Based on SASS5 scores from two sample sites, the overall health of the river system would approximate to a **Present Ecological State (PES) category of B[23]**, which is in agreement with the MIRAI (macroinvertebrate index) assessment score. This category is described as: "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".

[23] This rating is higher than the 'C' category allocated to this river reach in the recent DWA PES assessment (DWA, 2013). The findings of this assessment is considered more appropriate given the higher resolution of the data and information used compared with the national level/desktop approach of the DWA study.

5.2.2 Water Quality

Water quality data undertaken pre and during construction (pH, conductivity - μS/cm; turbidity – NTUs) were available for two sites. Samples taken at each site over a range of daily/weekly and monthly intervals showed that values for each site were comparable to values provided in earlier reports (BKS 2009), ***and in accordance with good (class B) water quality standards (DWAF 2008***). There appears to be an on-going trend of increasing alkalinity in the water, as report in the EIA document (BKS 2009). The high standard deviations of the turbidity data are most likely to be a function of periodic disturbances in sediments linked to the construction process, and not considered a cause for concern.

An additional water quality report included data from six sampling events at five sites between the fish barrier and the town of Rosetta, between June 2011 and April 2013. These data consisted of values for a total of 15 water quality determinants, including heavy metals, hydro-carbons and E. coli, with **levels all found to be within ranges of acceptability (DWAF 1996)** for domestic, ecosystems, irrigation and livestock use**.**

In summary, the **Present Ecological State (health)** of this section of the Mooi-River can be **classified as a B Category**.

5.3 Offset Targets

In the absence of specific policy and offset ratios related to protection targets for rivers the following is recommended in terms of offsets – that:

- At least the same length of the same river type be incorporated into an offset area – either 15.7km in a B condition (to be improved if possible) or 12.5 in excellent condition.
- The offset stretch possesses the same characteristics and particular habitat as the stretch of river inundated by the SGD; i.e. the sinuosity and meandering nature of the river.

The ecosystem services aspects of the river system are addressed in the following section.

6. ECOSYSTEM SERVICES

6.1 Introduction

Ecosystem services are defined as the benefits that people obtain from the environment. The Economics of Ecosystems and Biodiversity (TEEB) study identified a number of ecosystem service categories. These categories have been applied in the current assessment and include:

- ***Provisioning services*** - are the materials that ecosystems provide such as food, water and raw materials
- ***Cultural services*** - are the non-material benefits of ecosystems – from recreation to spiritual inspiration to mental health
- ***Regulating services*** - are the services that ecosystems provide by acting as regulators. This includes regulation of air and soil quality, as well as flood and disease control

The fourth category of services is: **Habitat or supporting services** (ecosystems provide living spaces for plants and animals – and maintain their diversity). The rest of this report is concerned with biodiversity services and they are therefore not considered further here.

Need for Consideration of Ecosystem Services

The provincial offset guideline explains that where an impact site contains ecosystems that underpin services of high use or non-use value to affected communities or society, the significance of the residual impact would increase depending on the level of dependence (demand for the service) and whether or not acceptable, accessible and affordable substitutes for those degraded or lost services exists. It is therefore necessary to establish:

- What services are supplied by the systems and the level of supply,
- The demand for these services,
- Whether additional offset activities or actions are required to address the loss in ES.

The following approach and methods were applied in the assessment.

6.2 Approach to Ecosystem Services Assessment

- ***Establishing Supply***

Each of the ecosystems within the basin supplies different types and levels of ecosystem services. For example, grasslands and wetlands are able to provide valuable grazing for livestock whereas rivers are not. The WET-Ecoservices tool was applied in the case of wetlands and the EKZNW Stewardship Ecosystem Services Assessment tool was applied to grasslands and the river to establish levels of supply from each system for the different systems in all three main categories. These supply scores were extracted from these tools and combined into an ecosystem service supply matrix per ecosystem type. The list and definition of services differed across the tools, which required that they were aligned with the TEEB categories for consistency and to allow for comparison.

- ***Establishing Demand***

The demand for ecosystem services varies between services. Provisioning services are often used by local communities living close to the ecosystem delivering the service, while regulating services often benefit large numbers of people at a regional or global scale. In addition, some users may visit the ecosystem to use the service as is the case for recreational activities. The demand for services therefore needs to be assessed in terms of the scale at which the benefit is derived. Furthermore, alternatives may exist for some services and not for others. For example, visitors who utilise a stretch of river for recreational fishing may be able to utilise a different stretch of river to obtain the same benefit. However, a community who live along the banks of a river and benefit from its flood attenuation function do not have an alternative and are entirely dependent on the continuation of the supply of this service for their well-being. Thus, the level of dependence is an important criterion which should be considered in identifying critical services.

Demand for each service was assessed for four different types of users relative to the ecosystem which provides the service, namely:

i. ***In situ users*** - refer to users who are located immediately adjacent or in close proximity to the ecosystem providing the service,

ii. ***Local neighbours*** - refer to users who are located outside the dam basin and bordering on in situ users. In the case of river related services local neighbours extend to Mearns Wier.
iii. ***Distant users*** - may be located in a different catchment or region all together.
iv. ***Visiting users*** - make use of the service by travelling to the ecosystem providing the service.

The demand for each service by each of these user group types was scored from 0 to 5 (where 0 is no demand and 5 is high demand) using expert judgement and data relating to users. The dependence of each of these user groups on the supply of each ecosystem service was also rated using the same scoring system. These two scores were then multiplied together to obtain an overall demand score per user group type for each ecosystem service category.

- ***Identifying critical ecosystem services***

A variety of ecosystem services are likely to be lost or altered as a result of the construction of the dam. However, not all of these services require mitigation or consideration for offsets. Important services which require further consideration were identified by comparing the level of supply of a particular service against the level of demand for that service. It was assumed that if a particular service has both a high level of supply and a high level of demand that these services should be prioritised for conservation and/or mitigation initiatives. However, those with a low level of supply and a low level of demand were not deemed to be important. The following matrix was used to identify critical services.

	Demand					
Supply	Very high Score = 21 - 25	High Score = 16 – 20	Moderate Score = 11- 15	Low Score = 6 - 10	Very Low Score = 1- 5	No demand Score = 0
Very high Score = 5						
High Score = 4						
Moderate Score = 3						
Low Score = 2						
Very low Score = 1						
No supply Score = 0						

6.3 Ecosystem Services Assessment Findings

The assessment concluded that:

i. There is no loss of critical services that will result in specific users being disadvantaged and that warrant additional activities in terms of offsets activities or compensation.
ii. The critical services are across users and scale at a societal level and relate to water services, these being: water supply, water regulation, flood attenuation and waste water treatment.
iii. The delivery of these services was also considered with the dam in place. In the case of several services, the dam provides either a different or better level of service. For example, in the case of water regulation, the ability of the dam to regulate water supply to meet the significant demand downstream by distant users i.e. Durban and Pietermaritzburg is increased (assuming releases to downstream uses in the Mooi River are maintained).

Similarly, the dam provides a significant capacity to attenuate floods - greater than that of the 460ha of wetlands within the basin.

iv. Maintaining the capacity of the dam to regulate (by reducing silt loads into the dam) and having good quality water, increases the importance of maintaining these services in the catchment in future.

v. The proposed offset measures i.e. wetland and grassland rehabilitation and protection will result in the improvement of these services in the catchment.

vi. The value of the services can however be enhanced in the selection of sites e.g. rehabilitating a wetland below a piggery will provide greater capacity for enhancing water quality, than another wetland not situated below a point source of pollution. The selection of sites to enhance these services requires that relevant criteria are built into offset selection and design process. This however depends on what stakeholders decide are the objectives of the offset i.e. to address biodiversity loss (target wetlands with key species) or maintain the lifespan of the dam and water quality (target wetlands below point sources of pollution).

These findings are discussed in the next section and will inform the next step in the offset process, that of setting offset objectives.

7. ADJUSTMENT OF OFFSET TARGETS

7.1 Considerations for Adjusting Targets

The Draft EKZNW Guideline makes provision for the adjustment of basic offset ratios according to the following additional considerations, which are discussed in turn:

i. The relative **condition of** the affected **habitat** and the **offset areas**;
ii. The presence of any **threatened species**;
iii. The presence of any **special habitats**;
iv. The role of the affected area in the bigger landscape with regard to **ecological processes**;
v. The role of the affected area in delivering **ecosystem goods and/or services** of socioeconomic value to local human communities and/or society as a whole;
vi. The **level of risk or uncertainty** associated with the offset.

i. Condition of Habitat

EKZNW requires that the basic offset ratio is applied when the affected habitat is in moderate to good condition. When the impacted habitat is degraded but not completely transformed then the ratio could be reduced, on condition that the habitat serves no other significant function, such as supporting threatened species, important ecological processes and/ or delivering valued ecosystem services. In this case both the grassland and wetland habitat, despite certain areas being in a less than 'moderate' condition, do support threatened species, ecological processes and a range of ecosystem services. The recommendation is therefore that the ***base ratio is applied to all wetland and grasslands ecosystems regardless of condition.***

ii. Threatened species

Where the affected habitat contains threatened species, the significance of the residual impact on these species would depend on:

- The size and viability of the affected population (i.e. is it sufficiently large to be viable in the long term?);
- Its threatened status (i.e the significance would increase from vulnerable to endangered and to critically endangered); and
- The contribution of the affected population to the persistence of the species (e.g. relatively high if it constitutes a high percentage of national population at the affected site, relatively low if it were one of numerous populations of the same species in the region).

In the case of Spring Grove Basin, a range of threatened and endemic species across all taxa are impacted in the form of habitat loss, and it is therefore recommended that a multiplier is applied to the basic offset ratios as illustrated in Table 12. In determining this 'biodiversity multiplier', the habitat requirements of the most vulnerable (i.e. highly threatened) species, with habitat requirements that would best represent the habitat needs of other impacted species in the SGD Basin, was seen as a priority. Since Oribi is seen as a specialist grassland species and is a threatened endemic, the Wattled Crane is Critically Endangered, and there are two other threatened Crane species known to utilize the SGD Basin, these animals provided a focus for considering an appropriate multiplier.

TABLE 10 The implications of applying a 'biodiversity multiplier' to base offset targets.

Base Area (ha)	**Base Protection Ratios for offsets**	**Functional Equivalents Target** (Area x Health) (ha equivalents)	**Base Biodiversity Protection Target**	**Biodiversity Multiplier** (1.25:1)	**Estimated area required** (ha)
Wetlands					
462	National Wetland Type	281	4 363 (ha equivalents)	5 455 ha equivalents	8 100
462	National Wetland Veg	281	1 125 (ha equivalents)	1406 ha equivalents	2 310
462	Provincial	n/a	1 386 ha	1 733 ha	1 733
Grasslands					
210	Provincial	n/a	630 ha	786 ha	786

iii. Special habitats

This requires consideration of whether a particular type of special habitat will be lost and the irreplaceability of that habitat. In some instances, it would be impossible to compensate for these impacts. The habitat provided for plant communities at Inchbrakie Falls represents an example of such a habitat. Recommendations have been made earlier in this report for conserving the most similar type habitat.

iv. Ecological Processes

While the environmental flows are designed to account for migration of aquatic species along the system, the dam represents a barrier to movement of mammals and other species along the Mooi River Valley or across it. While difficult to quantify, the impact would appear considerable at a local level given the size of the dam and the absolute nature of the barrier it creates.

v. Ecosystem goods and/or services

As documented in section six, no local communities or users will be significantly impacted by the loss of ecosystem services currently provided by the natural systems within the basin (noting that biodiversity is dealt with in the rest of the report and that water-related impacts are addressed through functional equivalence metrics in sections on wetlands). Furthermore, the dam will provide a different, but in some cases increased level of services. Given that the majority of the services that are important from a broader societal point of view are water related, much of the impact will be accounted for by rehabilitation of wetlands, and protection/improvement in grasslands which play a lesser, but also important role in water regulation. No additional offset requirement is therefore considered necessary with regard to ecosystem services, provided that the offsets are located in such a way that their benefits flow to those parties who were impacted by the SGD.

***vi.* Level of risk or uncertainty**

EKZNW (2011) describe risks or uncertainties as factors affecting the outcome of a biodiversity offset. They are primarily situations where:

- Rehabilitation or restoration is proposed, but the success of these offset activities is not known, as there is little prior experience on which to draw and/ or insufficient assurance that the necessary resources would be made available; and
- Background patterns of land and/ or natural resource use may pose a threat to the future viability of a potential offset area.

The requirement in the Draft EKZNW Guideline in such situation is either to increase the size of the proposed offset to provide an appropriate safety margin for the offset, and/or provide appropriate supporting activities to remove or substantially reduce threats to the offset site(s).

The Draft National Guideline proposes set 'multipliers' to deal with issues of risk and time lags. The multipliers proposed in the Draft National Guideline are provided in the Tables 13 and 14.

TABLE 11 Adjustment factors to account for temporary losses of wetland ecosystem services associated with paned rehabilitation/restoration activities (Macfarlane, Von Hase and Brownlie, 2012)

Timing of mitigation	Multiplier
Advance: Offset activities completed[28] prior to development impacts taking place	1
Concurrent: Offset activities are completed within two years of impacts taking place	1.25
Delayed (<5 years): Offset activities are completed within five years of impacts taking place	1.5
Delayed (<10 years): Offset activities are completed and signed off within ten years of impacts taking place	3

TABLE 12 Multipliers to account for the risk associated with different types of wetland offset activities (Macfarlane, Von Hase and Brownlie, 2012)

Type of offset	Multiplier
Protection	1.0
Rehabilitation / restoration	1.5
Averted loss	1.5
Establishment[30]	3.0

In the case of SGD, it is likely that some protection offset activities could be completed within 2 years of construction, but rehabilitation and protection activities would take up to 5 years at least. That is, a multiplier of *1.5:1 would be appropriate for temporal loss,* applied to much of the offset.

Similarly, it is likely that while all offset activities for SGD would involve protection (i.e. obviating the need for a multiplier), some would prioritise rehabilitation as the predominant activity, with uncertain outcomes – suggesting that a *risk multiplier of 1.5:1 should be applied* to relevant areas (the Condition of Authorization explicitly requires wetland rehabilitation). In total, a multiplier of 2.25 would satisfy the Draft National Guideline[24]. The implications of applying these two ratios, assuming comparable condition of impact and offset areas, are illustrated in Table 15.

TABLE 13 The implications of applying Draft National Guideline multipliers to base offset targets.

Base Area (ha)	**Base Protection Ratios for offsets**	**Functional Equivalents Target** (Area x Health) (ha equivalents)	**Base Biodiversity Protection Target**	**Timing Multiplier** (1.5:1)	**Risk Multiplier** (1.5:1)	**Estimated area required** (ha)
462	National Wetland Type	281	4 363 (ha equivalents)	6 545 ha equivalents	9 818 ha equivalents	15 341
462	National Wetland Veg	281	1 125 (ha equivalents)	1 688 ha equivalents	2 531 ha equivalents	3 956
462	Provincial	n/a	1 386 ha	2 079 ha	3 119 ha	3 119

Increasing the area of the offset alone would not necessarily rectify the problem created either by the time lag or the risks associated with rehabilitation; a focus on swift securing of offsets in the landscape, a firm and enforceable commitment to rehabilitation and effective management (with sufficient provision for necessary resources) would, in our view, suffice in this instance.

It must be noted that these multipliers are at best based on experience elsewhere in the world, but that they have little solid foundation in science. In part, these multipliers act as incentives/ disincentives to drive 'best practice' in achieving good biodiversity outcomes.

7.2 Recommendations for Adjustment and Implications

For the reasons discussed in the previous section, it is not considered necessary to apply multipliers for habitat condition, ecosystem services or unique habitats that will be lost. However, it is recommended that a ***Biodiversity*** Multiplier of 1.25:1 is applied to base offset targets to account for the combined impact on the ecosystems, habitat of a high concentration of numerous species (including threatened and endemic species) and ecological process considerations which cumulatively represent an irreplaceable Critical Conservation Area (CCA 1).

As illustrated in Sections 3 and 4, as well as Tables 12 and 15, the application of several multipliers either to offset targets determined using the Draft National Guideline and the Draft EKZNW Guideline has significant implications for the final offset target. In our view, application of the multipliers in the Draft National Guideline produces offset targets that are both unrealistic from a practical perspective and unreasonable when compared with the residual negative impacts; in part, these high values are linked to the relatively high Protection Ratios applied to the wetland types and/ or wetland vegetation. To place this comment in context, there is approximately 12 000 ha of wetland in the Upper Mooi and Mgeni Catchments of which a vast proportion of this will either not

[24] Note that the timing and risk multiplier advocated by the Draft National Guideline is separate from the proposed Biodiversity Multiplier of 1.25:1 recommended in this report.

be appropriate, or accessible. Clearly, targets upwards of several thousand hectares 2 000 ha are unlikely to be achievable, financially feasible, nor appropriate when compared with the loss.

One resolution with regard to the use of multipliers would be firstly to decide on the most appropriate base offset target for the affected ecosystems (i.e. to use either the Draft National Guideline Protection Ratios or the Draft EKZNW Guideline ratios), and then to define a reasonable combined multiplier through engagement with key stakeholders that would incorporate multiple considerations of uncertainty/ risk and time lags in delivering offsets, as well as biodiversity concerns. Whatever the agreed outcome, it needs to be justified. Both the recommended 'biodiversity multiplier' and the potential addition of multipliers to account for risk and time delays need to be considered and agreed by stakeholders as part of the next step in the process i.e. setting offset objectives and final targets, and deciding on the most effective ways to implement these offsets.

8. WAY FORWARD

This report documents the extent and significance of the biodiversity to be lost within Spring Grove Dam. It is the first step in the process of designing and implementing a biodiversity offset. The next step is to establish objectives for the offset that in turn inform the setting of:

- Final areas based on agreed offset ratios and multipliers.
- Offset types (rehabilitation, protection etc)
- Offset planning area (spatial extent of area within which offset will be identified)
- Criteria and process for the selection, evaluation and prioritisation of offset sites.

The above steps require involvement of stakeholders, including landowners, conservation NGOS and agencies, regulatory authorities and implementing agencies i.e. the Offsets Working Group that was established at the commencement of the offset planning process for Spring Grove. Having set the direction and parameters for the offsets, the nest phase of the process is to identify appropriate sites to achieve the offset targets.

The final output is a biodiversity offset programme with detailed plans for selected offset sites covering, the following. This detailed planning represents the final step in the design phase:

- Offset type – rehabilitation or protection.
- Detailed design of rehabilitation and management requirements (rehabilitation structures, alien clearing methods, stocking and burning rates, etc.) -.
- Costing – structures, management, monitoring.
- Protection mechanism – stewardship, formal protection etc.
- Financial provision for securing and managing offset sites, and
- Institutional and management arrangements.

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