Report No: 109664/8818

REHABILITATION PLAN FOR THE WORKING FOR WETLANDS PROGRAMME, MPUMALANGA

PROJECT: HIGHVELD

B20G

APRIL 2014

agriculture, forestry & fisheries
Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

EXPANDED PUBLIC WORKS PROGRAMME
Creating opportunities towards human fulfilment

SANBI
Biodiversity for Life

Working for Wetlands

aurecon

This page was left blank intentionally

REHABILITATION PLAN FOR THE HIGHVELD WETLAND PROJECT (B20G-01), MPUMALANGA: PLANNING YEAR 2014

AS PART OF
THE WORKING FOR WETLANDS PROGRAMME

FOR THE
SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE

MAIN REPORT

April 2014

Prepared by:

Aurecon South Africa (Pty) Ltd
P O Box 494
Cape Town
8000
South Africa
Tel: 021 526 6022
Fax: 021 526 9500
Email: **franci.gresse@aurecongroup.com**

Prepared for:

Working for Wetlands Programme
South African National Biodiversity Institute
Private Bag X101
Pretoria
South Africa
Tel: 012 843 5000
Fax: 012 804 3211
Website: **www.sanbi.org**

This report is to be referred to in bibliographies as:

South African National Biodiversity Institute, South Africa. 2014. Rehabilitation Plan for the Highveld Wetland Project, Mpumalanga: Planning Year 2014. Prepared by Margaret Lowies, Aurecon South Africa (Pty) Ltd as part of the planning phase for the Working for Wetlands Rehabilitation Programme. SANBI Report No. 109664/8819

Page left blank intentionally

PROJECT DETAILS

TITLE	Rehabilitation Plan for the Zaalklapspruit Wetland Project, Mpumalanga: Planning Year 2014
PREPARED BY	Margaret Lowies of Aurecon South Africa (Pty) Ltd (Aurecon)
CONTRIBUTORS	André Beetge of SANBI Cilliers Blaauw of Aurecon Doug MacFarlane of Eco-Pulse Consulting
SUBCONSULTANTS	Eco-Pulse Consulting
CLIENT	South African National Biodiversity Institute (SANBI)
PROJECT NAME	Working for Wetlands Programme
REPORT STATUS	Final
REPORT NUMBER	109664/8819
SUBMISSION DATE	April 2014

Prepared for the South African National Biodiversity Institute by:

_____

M. Lowies
Project Staff
Aurecon SA (Pty) Ltd.

_____

A. van der Merwe
Technical Director
Aurecon SA (Pty) Ltd.

Approved for the South African National Biodiversity Institute by:

_____

A. Beetge
SANBI Provincial Coordinator: Mpumalanga Province
South African National Biodiversity Institute
Planning, Monitoring and Evaluation

Page left blank intentionally

WORKING FOR WETLANDS: CONTEXT DOCUMENT

1. Introduction

Working for Wetlands (WfWetlands) is a government programme managed by the South African National Biodiversity Institute (SANBI), and is a joint initiative of the Departments of Environmental Affairs (DEA), Water Affairs (DWA) and Agriculture, Forestry and Fisheries (DAFF). In this way the programme is an expression of the overlapping wetland-related mandates of the three parent departments, and besides giving effect to a range of policy objectives, also honours South Africa's commitments under several international agreements, especially the Ramsar Convention on Wetlands.

The programme is mandated to rehabilitate damaged wetlands and to protect pristine wetlands throughout South Africa, with an emphasis on complying with the principles of the Expanded Public Works Programme (EPWP) and using only local Small, Medium and Micro Enterprises (SMMEs). The EPWP seeks to draw significant numbers of unemployed into the productive sector of the economy, gaining skills while they work and increasing their capacity to earn an income.

2. Wetlands and their importance

Once considered valueless wastelands that needed to be drained or converted to more useful landuse purposes, wetlands are now seen in an entirely different light. Today wetlands are more commonly perceived as natural assets and natural infrastructure able to provide a range of products, functions and services free of charge.

That which actually constitutes a wetland is often not fully understood. Common misconceptions have been that wetlands must be wet, must have a river running through them, or must always be situated in low-lying areas. The definition of a wetland is much broader and more textured: they are characterised more by soil properties and flora than by an abundance of water.

The National Water Act, No. 36 of 1998 defines a wetland as:

> "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*".

The Ramsar Convention defines wetlands as:

> *"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6m" (*Article 1, Ramsar Convention on Wetlands. 1971*).*

Wetlands can therefore be seasonal and may experience regular dry spells (sometimes even staying dry for up to several years), or they can be frequently or permanently wet. Wetlands can occur in a variety of locations across the landscape (Plate A), and may even occur at the top of a hill, nowhere near a river. A pan, for example, is a wetland which forms in a depression. Wetlands also come in many sizes; they can be as small as a few square metres (e.g. at a low point along the side of a road) or cover a significant portion of a country (e.g. the Okavango Delta).

Plate A: A large, seasonal wetland identifiable by the characteristic flora. This wetland contained no surface water at the time of the photograph.

Wetland ecosystems provide a range of ecological and social services which benefit people, society and the economy at large:

- Wetlands offer services such as water provision, regulation, purification and groundwater replenishment are crucial in addressing objectives of water security and water for food security.
- Wetlands play a critical role in improving the ecological health of an ecosystem by performing many functions that include flood control, water purification, sediment and nutrient retention and export, recharge of groundwater, as well as acting as vital habitats for diverse plant and animal species.
- Wetlands provide ecological infrastructure, replacing the need for municipal infrastructure by providing the same or better benefit at a fraction of the cost.
- Wetlands retard the movement of water in the landscape, which offers the dual benefit of flood control as well as a means of purification. The slow movement of water allows heavier impurities to settle and phreatic vegetation and micro-bacteria the opportunity to remove pollutants and nutrients. For these reasons, artificially created wetlands are often used in newer urban drainage systems to aid both mitigation of flooding and improvement of water quality.
- Wetlands function as valuable open spaces and create recreational opportunities for people that include hiking, fishing, boating, and bird-watching.
- Many wetlands also have cultural and spiritual significance for the communities living nearby. Commercially, products such as reeds and peat are also harvested from wetlands (Plate B).

Wetlands are thus considered to be critically important ecosystems as they provide both direct and indirect benefits to the environment and society.

Plate B: Commercial products made by locals from reeds harvested from wetlands

3. Wetland Degradation

It has been estimated that originally over 10 % of the Republic of South Africa (RSA) was covered by wetlands; however, this figure decreases significantly every year owing to unsustainable land-use practices. It is estimated that more than 50 % of South Africa's wetlands have been destroyed through drainage of wetlands for crops and pastures, poorly managed burning regimes, overgrazing, disturbances to wetland soils, vegetation clearing as well as industrial and urban development (including mining activities).

Although wetlands are high-value ecosystems that make up only a small fraction of the country, they rank among the most threatened ecosystems in South Africa. According to a recent CSIR study[1] South Africa's remaining wetlands were identified as the most threatened of all South Africa's ecosystems, with 48 % of wetland ecosystem types being critically endangered, 12 % endangered and 5 % vulnerable. Only 11 % of wetland ecosystem types are well protected, with 71 % not protected at all.

The remaining wetland systems suffer severe erosion and sedimentation, undesirable plant species and aquatic fauna infestations, unsustainable exploitation, artificial drainage and damming, and pollution. The continued degradation of wetlands will impact on biodiversity, ecological function, and the provision ecosystems services with subsequent impacts on livelihoods and economic activity, as well as health and wellbeing of communities. In the absence of functional wetlands, the carbon cycle, the nutrient cycle and the water cycle would be significantly altered, mostly detrimentally.

Wetland rehabilitation and conservation should be at the heart of water management. It is necessary to prioritise South Africa's remaining wetlands such that those that offer valuable ecosystem services and are least impacted by current pressures or threats are offered immediate attention to avoid further loss, conversion or degradation.

[1] Nel J.L. and Driver A. 2012. South African National Biodiversity Assessment 2011: Technical Report. Volume 2: Freshwater Component. CSIR Report Number CSIR/NRE/ECO/IR/2012/0022/A, Council for Scientific and Industrial Research, Stellenbosch.

4. The Working for Wetlands Programme

South Africa is a dry country, but is endowed with exceptionally rich biodiversity. The nation has a pressing reason to value the water-related services that wetlands provide. It is estimated that by 2025, South Africa will be one of fourteen African countries classified as "*subject to water scarcity*" (SANBI Working for Wetlands Strategy 2006-2010). The conservation of wetlands is fundamental to the sustainable management of water quality and quantity, and wetland rehabilitation is therefore essential to conserving water resources in South Africa.

The guiding principles of the National Water Act, No. 36 of 1998, recognise the need to protect water resources. In responding to the challenge of stemming the loss of wetlands and maintaining and enhancing the benefits they provide, government has recognised that, in order to be truly effective, strategies for wetland conservation need to include a combination of proactive measures for maintaining healthy wetlands, together with interventions for rehabilitating those that have been degraded. These objectives are currently being expressed in a coordinated and innovative way through the WfWetlands Programme.

The two main objectives of the WfWetlands Programme are **wetland conservation** in South Africa and **poverty reduction** through **job creation** and **skills development** amongst **vulnerable** and **marginalised** groups.

Wetland conservation: The strategic framework of the WfWetlands Programme underlines the need for a more refined planning process at catchment scale. Catchment scale planning seeks to promote ecosystem-scale outcomes, long-term custodianship, and the entrenchment of rehabilitation in broader local institutions and frameworks. The recent move to a systematic wetland rehabilitation planning process has provided a fertile and conducive platform for partnerships to be formed and/or strengthened as the process draws in a much wider stakeholder base.

Wetlands are not easy ecosystems to map at a broad scale as they are numerous, often small and difficult to recognise and delineate on remotely sensed imagery such as satellite photos. The WfWetlands Programme houses the National Wetlands Inventory Project (NWI) which aims to provide clarity on the extent, distribution and condition of South Africa's wetlands. The project clarifies how many and which rivers and wetlands have to be maintained in a natural condition to sustain economic and social development, while still conserving South Africa's freshwater biodiversity.

The National Freshwater Ecosystem Priority Areas (NFEPA) has used the NWI data to produce the most comprehensive national wetland map to date, called the NFEPA Atlas. This atlas enables the planning of wetland rehabilitation on a catchment scale.

Skills development: In the 12 years since its inception, the WfWetlands Programme has invested R530 million in wetland rehabilitation and has been involved in over 900 wetlands, thereby improving or securing the health of over 70 000 hectares of wetland environment. The WfWetlands Programme currently has a budget of approximately R94 million per year, of which R32 million is allocated directly to paying wages. Being part of the Expanded Public Works Programme (EPWP), the WfWetland Programme has created more than 12 800 jobs and 2.2 million person-days of paid work. The local teams are made up of a minimum of 60 % women, 20 % youth and 1 % disabled persons.

Training and Capacity Building during the Working for Wetlands Programme

The WfWetlands Programme has established a working relationship with the Department of Public Works through the Working for Water programme. This partnership provides accredited training in accordance with the special public works Code of Good Practice agreements. Capacity building in the WfWetlands Programme operates primarily at two levels:

- The first concerns the need to ensure the development of adequate capacity to rehabilitate, manage and conserve wetlands in South Africa.
- The second relates to the commitment of the WfWetlands Programme as an EPWP to provide appropriate training to its workers in order for them to exit the programme with marketable skills and enhanced personal development.

Workers receive two days of training, either vocational or social development-related, for every 22 days worked. Vocational training includes technical matters related to project activities, occupational health and safety, first aid, fire awareness, and business skills (contractor development). Social development includes literacy, primary health, personal finance, HIV/Aids and diversity awareness.

Wage information sourced from the best practice guidelines suggests that workers and contractors would be paid daily rates of R 82 and R 251[2] respectively and would be employed on limited term contracts, i.e. 24 months in a five-year cycle. Employment of workers complies with the Ministerial Determination on Special Public Works Programmes (Government Notice No. R 63, 25 January 2002) and the Code of Good Practice for Employment and Conditions of Work for Special Public Works Programmes (Government Notice No. R 64, 25 January 2002). Targets for employment specify that the programme's workforce should comprise at least 60 % women, 20 % youth and 2 % disabled people.

The WfWetlands Programme engages with provinces, especially government departments and agencies responsible for biodiversity and environment, and municipalities through individual projects. A stronger working relationship with these spheres of government is being promoted through the programme's emphasis on partnerships. In particular, compatibility with Integrated Development Plans and rehabilitation project objectives will be a key area of future focus. The WfWetlands Programme encourages municipalities to participate in provincial wetland forums as these forums are the platform for the roll out of all the programmes' processes, including planning for future work. Provincial forums also offer support from the government departments and private sectors that are represented. Partnerships with non-governmental organizations and the private sector are also critical, requiring collaboration and cooperation with a wider range of stakeholders and role players in the wetland management field.

Other activities that form part of the WfWetlands Programme include:

- Raising awareness of wetlands among workers, landowners and the general public; and
- Providing adult basic education and training, and technical skills transfer (in line with the emphasis of the EPWP on training, the WfWetlands Programme has provided 168 400 days of training in vocation and life skills).

[2] without a Supervisor

5. Rehabilitation interventions

The successful rehabilitation of a wetland requires that the cause of damage or degradation is addressed, and that the natural flow patterns of the wetland system are re-established (and flow is encouraged to disperse rather than to concentrate). Approximately 500 interventions are implemented every year in the WfWetlands Programme. The key purposes of implementing interventions include:

- Restoration of hydrological integrity (e.g. raising the general water table or redistributing the water across the wetland area);
- Recreation of wetland habitat towards the conservation of biodiversity; and
- Job creation and social upliftment.

- Typical activities undertaken within the projects include:

- Plugging artificial drainage channels created by development or historical agricultural practices to drain wetland areas for other land use purposes;
- Constructing structures (gabions, berms, weirs) to divert or redistribute water to more natural flow paths, or to prevent erosion by unnatural flow rates that have resulted from unsustainable land use practices or development; and
- Removing invasive alien or undesirable plant species from wetlands and their immediate catchments (in conjunction with the Working for Water initiative).

Increased labour requirement for the Working for Wetlands Programme
In response to the government request to increase the labour component of all government funded projects, the WfWetlands Programme project team has had to consider, and where practically feasible incorporate, more labour intensive ways of rehabilitating wetlands in order to obtain the increased labour component. Accordingly the project team members have factored this requirement into their planning when designing structures for wetland rehabilitation.

Methods of wetland rehabilitation may include hard engineering interventions such as:

- Earth berms or gabion systems to block artificial channels that drain water from or divert polluted water to the wetland;
- Concrete and gabion weirs to act as settling ponds, to reduce flow velocity or to re-disperse water across former wetland areas thereby re-establishing natural flow paths;
- Earth or gabion structure plugs to raise channel floors and reduce water velocity;
- Concrete or gabion structures to stabilise head-cut or other erosion and prevent gullies; and
- Gabion structures (mattresses, blankets or baskets) to provide a platform for the growth of desired wetland vegetation.

Soft engineering interventions also offer successful rehabilitation methods, and the following are often used together with the hard engineering interventions:

- The re-vegetation of stabilised areas with appropriate wetland and riparian plant species;
- The fencing off of sensitive areas within the wetland to keep grazers out and to allow for the re-establishment of vegetation;
- The use of biodegradable or natural soil retention systems such as eco-logs, plant plugs, grass or hay bales, and brush-packing techniques;

- In some instances, the use of appropriate fire management and burning regimes. The removal of undesirable plant and animal species; and
- Alien invasive plant clearing, which is an important part of wetland rehabilitation (and this is supported by the Working for Water Programme).

6. Programme, projects and phases

In order to manage the **WfWetlands Programme**, wetlands have been grouped into "projects", and each **Wetland Project** encompasses several smaller wetland systems which are each divided into smaller, more manageable and homogenous wetland units. A Wetland Project may be located within one or more quaternary catchments within a Province. SANBI is currently managing 35 Wetland Projects countrywide, and rehabilitation activities range from stabilising degradation to the more ambitious restoration of wetlands to their original conditions.

Each Wetland Project is managed in three phases over a two-year cycle as shown in the flow diagram in Plate C. The first two phases straddle the first year of the cycle and involve planning, identification, design and authorisation of interventions. The third phase is implementation, which takes place during the second year.

The first phase is the identification of suitable wetlands which require intervention. The purpose of Phase 1 and the associated reporting is to identify:

- Priority catchments and associated wetlands/ sites within which rehabilitation work needs to be undertaken; and
- Key stakeholders who will provide meaningful input into the planning phases and wetland selection processes, and who will review and comment on the rehabilitation proposals.

The **Project Team** currently comprises the SANBI Programme Manager who oversees the WfWetlands Programme and Provincial Coordinators (PCs) who oversee the identification and implementation of projects in their regions. They are supported by a small team based at the Pretoria Botanical Gardens who fulfil various roles such as planning, monitoring and evaluation, implementation, Geographical Information Systems (GIS) and training. Independent Design Engineers and Environmental Assessment Practitioners (EAPs) are appointed to undertake the planning, design and authorisation components of the project. The project team is assisted by a number of wetland ecologists who provide scientific insight into the operation of wetlands and bring expert and often local knowledge to the project teams.

The programme makes use of external support to implement its work. External implementing agents are currently employed and some are Section 21 companies. Implementers are responsible for employing contractors and their teams (workers), and ensuring that rehabilitation plans are adequately implemented. Funds are transferred from SANBI to the implementing agents, who in turn pay contractors and their teams.

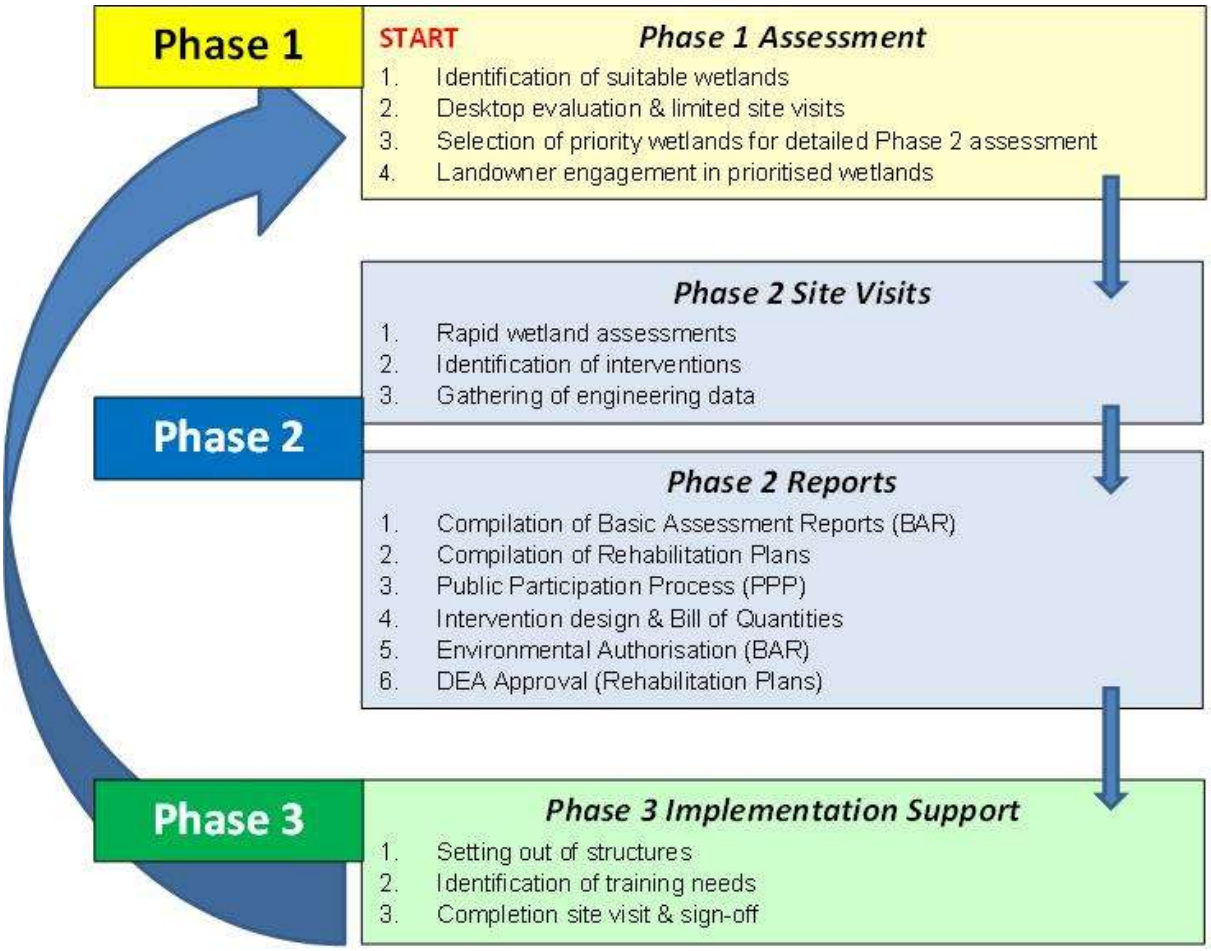

Plate C: The Working for Wetlands planning process (Phase 1 to Phase 3)

Phase 1 commences with a catchment and wetland prioritisation process for every province. The wetland ecologist responsible for a particular province undertakes a desktop study to determine the most suitable wetlands for the WfWetlands rehabilitation efforts. The involvement of Provincial Wetland Forums and other key stakeholders is a critical component of the wetland identification processes since these stakeholders are representative of diverse groups with shared interests (e.g. from government institutions to amateur ecological enthusiasts). This phase also involves initial communication with local land-owners and other Interested and Affected Parties (I&APs) to gauge the social benefits of the work. Aerial surveys of the areas in question may be undertaken, as well as limited fieldwork investigations or site visits to confirm the inclusion of certain wetland projects or units. Once wetlands have been prioritised and agreed on by the various parties, specific rehabilitation objectives are determined for each wetland following a rapid wetland status quo assessment undertaken by the wetland ecologist.

Phase 2 requires site visits attended by the fieldwork team comprising a wetland ecologist, a Design Engineer, an Environmental Assessment practitioner, and a SANBI Provincial Coordinator. Other interested stakeholders or authorities, landowners and in some instances the implementing agents may also attend the site visits on some occasions. This allows for a highly collaborative approach, as options are discussed by experts from different scientific disciplines, as well as local inhabitants with deep anecdotal knowledge. While on site, rehabilitation opportunities are investigated. The details of the proposed interventions are discussed, some survey work is undertaken by the engineers, and GPS coordinates and digital photographs are taken for record purposes. Furthermore, appropriate dimensions of the locations are recorded in order to design and calculate quantities for

the interventions. At the end of the site visit the rehabilitation objectives together with the location layout of the proposed interventions are agreed upon by the project team.

During Phase 2, monitoring systems are put in place to support the continuous evaluation of the interventions. The systems monitor both the environmental and social benefits of the interventions. As part of the Phase 2 site visit, a maintenance inventory of any existing interventions that are damaged and/or failing and thus requiring maintenance is compiled by the PC, in consultation with the Design Engineer.

Based on certain criteria and data measurements (water volumes, flow rates, and soil types); the availability of materials such as rock; labour intensive targets; maintenance requirements etc., the interventions are then designed. Bills of quantity are calculated for the designs and cost estimates made. Maintenance requirements for existing interventions in the assessed wetlands are similarly detailed and the costs calculated. The Design Engineer also reviews and, if necessary, adjusts any previously planned interventions that are included into the historical Rehabilitation Plans.

Phase 2 also comprises a reporting component where Rehabilitation Plans are prepared for each Wetland Project. The Rehabilitation Plans include details of each intervention to be implemented, preliminary construction drawings and all necessary documentation required by applicable legislation. The Rehabilitation Plans are reviewed by various government departments, stakeholders and the general public before a specific subset of interventions are selected for implementation.

Phase 3 requires that certain Environmental Authorisations are obtained before work can commence in the wetlands (please see subsequent sections of this document for detail on Environmental Authorisations). Upon approval of the wetland Rehabilitation Plans by DEA, DWA, and the directly affected landowners is obtained, the work detailed for the project will be implemented within a year with on-going monitoring being undertaken thereafter. The Rehabilitation Plans are considered to be the primary working document for the implementation of the project via the construction/ undertaking of interventions[3] listed in the Plan.

It is typically at this point in the process when the final construction drawings are issued to the Implementing Agents (IAs). Seventeen Implementing Agents are currently employed in the WfWetlands Programme and are responsible for employing contractors and their teams (workers) to construct the interventions detailed in each of the Rehabilitation Plans. For all interventions that are based on engineering designs (typically hard engineered interventions), the Design Engineer is required to visit the site before construction commences to ensure that the original design is still appropriate in the dynamic and ever-changing wetland system. The Design Engineer will assist the IAs in pegging and setting-out interventions. The setting-out activities often coincide with the Phase 1 activities for the next planning cycle. Phase 3 concludes with the construction of the interventions, but there is an on-going monitoring and auditing process that ensures the quality of interventions, the rectification of any problems, and the feedback to the design team regarding lessons learnt.

[3] This could include soft options such as alien clearing, eco-logs, gabion structures as well as hard structures for example weirs.

Rehabilitation work within floodplain systems

Based on lessons learnt and project team discussions held during the National Prioritisation workshop in November 2010 SANBI took an in-principle decision regarding work within floodplain systems.

Recognising the ecosystem services provided by floodplain wetlands and the extent to which they have been transformed, SANBI do not intend to stop undertaking rehabilitation work in floodplains entirely. Instead, SANBI propose to adopt an approach to the rehabilitation of floodplain areas that takes into account the following guiding principles:

1. As a general rule, avoid constructing hard interventions within an active floodplain channel; and rather
2. Explore rehabilitation opportunities on the floodplain surface using smaller (possibly more) softer engineering options outside of the main channel.

When rehabilitation within a floodplain setting is being contemplated, it will be necessary to allocate additional planning resources, including the necessary specialist expertise towards ensuring an adequate understanding of the system and appropriate design of interventions.

7. Environmental legislation

One of the core purposes of the WfWetlands Programme is the preservation of South Africa's valuable wetland systems through rehabilitation and restoration. The WfWetlands Programme operates within the context of the Constitution of South Africa, Act No. 108 of 1996, whereby everyone has the right to have the environment protected and conserved for the benefit of present and future generations. The following legislation (listed in Table A) informs and guides the WfWetlands Programme in terms of its vision and objectives, whilst simultaneously regulating the wetland rehabilitation activities which WfWetlands carries out.

South Africa has rigorous and comprehensive environmental legislation aimed at preventing degradation of the environment, including damage to wetland systems. Development proposals within or near any wetland system are subject to thorough bio-physical and socio-economic assessment as mandatory processes of related legislation. These processes are required to prevent degradation of the environment and to ensure sustainable and environmentally conscientious development.

The WfWetlands Programme requires that both hard and soft interventions are implemented in the wetland system, and it is the activities associated with the construction of these interventions that triggers requirements for various authorisations, licenses or permits. However, it is important to note that the very objective of the WfWetlands Programme is to improve both environmental and social circumstances. The WfWetlands Programme gives effect to a range of policy objectives of environmental legislation, and also honours South Africa's commitments under several international agreements, especially the Ramsar Convention on Wetlands.

Memorandum of Understanding for Working for Wetlands Programme

A Memorandum of Understanding (MOU) has been entered into between the DAFF, DEA, DWA and SANBI for the WfWetlands Programme. Through co-operative governance and partnerships, this MOU aims to streamline the authorisation processes required by the National Environmental Management Act, No. 107 of 1998, the National Water Act. No. 36 of 1998, and the National Heritage Resources Act, No. 25 of 1999 to facilitate efficient processing of applications for authorisation of wetland rehabilitation activities.

Table A: List of applicable legislation

Title of legislation, policy or guideline:	Administering authority:	Date:
The Constitution of South Africa, Act No.108 of 1996	National Government	1996
National Environmental Management Act, No.107 of 1998	Department of Environmental Affairs	1998
The National Water Act, No. 36 of 1998	Department of Water Affairs	1998
Conservation of Agricultural Resources Act, No. 43 of 1983	Department of Agriculture, Forestry & Fisheries	1983
National Heritage Resources Act, No. 25 of 1999	National Heritage Resources Agency	1999
World Heritage Conventions Act, No. 49 of 1999	Department of Environmental Affairs	1999
The National Environmental Management: Biodiversity Act, No. 10 of 2004	Department of Environmental Affairs	2004
National Environmental Management: Protected Areas Act, No. 57 of 2003	Department of Environmental Affairs	2003
The Mountain Catchments Areas Act, No. 63 of 1970	Department of Water Affairs	1970
• EIA Guideline Series, in particular: • Guideline 3 – General Guide to the Environmental Impact Assessment Regulations, 2006 (DEAT 2006) • Guideline 4 – Public Participation in support of the EIA regulations, 2006 (DEAT 2006) • Guideline 5 – Assessment of Alternatives and Impacts, 2006 (DEAT 2006) • Implementation Guidelines: Sector Guidelines for the EIA Regulations (draft) (DEA, 2010). • DEA&DP. 2013. Guideline on Public Participation (DEA&DP, March 2013). • DEA&DP. 2013. Guideline on Alternatives (DEA&DP, March 2013).	Department of Environmental Affairs	2006 - 2013
International Conventions, in particular: • The Ramsar Convention • Convention on Biological Diversity • United Nations Conventions to Combat Desertification • New Partnership for Africa's Development (NEPAD) • The World Summit on Sustainable Development (WSSD)	International Conventions	N/A

Of particular relevance in Table A is the following legislation and the WfWetlands Programme has put systems in place to achieve compliance:

- The National Environmental Management Act, No. 107 of 1998 (NEMA)
  - In terms of Regulations pursuant to the NEMA, certain activities that may have a detrimental impact on the environment (termed Listed Activities) require an Environmental Authorisation from the Department of Environmental Affairs (DEA). The implementation of interventions will trigger NEMA Listing Notices 1 and 3 (G.N. R544 and G.N R546 respectively). In order to meet the requirements of these Regulations, it is necessary to undertake a Basic Assessment Process and apply for an EA. This was previously undertaken on an annual basis per Province as the Wetland Projects became known. However as from 2014, an application is now made per Province for Wetland Projects required in the next few planning cycles (anywhere from one to three planning cycles depending on the information gained through the Catchment Prioritisation Process).
  - **Basic Assessment Reports** (BARs) will be prepared for each Province where work is proposed by the WfWetlands Programme. These BARs will present all Wetland Projects that are proposed in a particular province, together with information regarding the quaternary catchments and the wetlands that have been prioritised for the next few planning cycles (anywhere from one to three planning

cycles depending on the information gained through the Catchment Prioritisation Process). The EA's will be inclusive of all Listed Activities that may be triggered and will essentially authorise any typical wetland rehabilitation activities required during the WfWetlands Programme implementation phase.

- A condition of the EA's is that **Rehabilitation Plans** will be prepared every year after sufficient field work has been undertaken in the wetlands that have an EA. These Rehabilitation Plans will be made available to registered Interested and Affected Parties (I&APs) before being submitted to DEA for approval. The Rehabilitation Plans will describe the combination and number of interventions selected to meet the rehabilitation objectives for each Wetland Project, as well as an indication of the approximate location and approximate dimensions (including footprint) of each intervention.

- The National Water Act, No.36 of 1998 (NWA)
  - In terms of Section 39 of the NWA, a General authorisation[4] (GA) has been granted for certain activities that are listed under the NWA that usually require a Water Use License; as long as these activities are undertaken for wetland rehabilitation. These activities include '*impeding or diverting the flow of water in a watercourse*[5]' and '*altering the bed, banks, course or characteristics of a watercourse*[6]' where they are specifically undertaken for the purposes of rehabilitating[7] a wetland for conservation purposes. SANBI are required to register the 'water use' in terms of the GA.
- The National Heritage Resources Act, No. 25 of 1999 (NHRA)
  - In terms of Section 38 of the NHRA; any person who intends to undertake a development as categorised in the NHRA must at the very earliest stages of initiating the development notify the responsible heritage resources authority, namely the South African Heritage Resources Agency (SAHRA) or the relevant provincial heritage agency. These agencies would in turn indicate whether or not a full Heritage Impact Assessment (HIA) would need to be undertaken. Should a permit be required for the damaging or removal of specific heritage resources, a separate application will be submitted to SAHRA or the relevant provincial heritage agency for the approval of such an activity. SANBI has engaged with SAHRA regarding the wetland planning process and has committed to achieving full compliance with the heritage act over the next few years.

[4]Government Notice No. 1198, 18 December 2009

[5]Section 21(c) of the NWA, No. 36 of 1998

[6]Section 21(i) of the NWA, No. 36 of 1998

[7]Defined in the NWA as "*the process of reinstating natural ecological driving forces within part of the whole of a degraded watercourse to recover former or desired ecosystem structure, function, biotic composition and associated ecosystem services*"

Table of Contents

Annexures

Appendix A: Wetland Status Quo Report

Appendix B: General Construction Notes

Appendix C: Design Drawings

Appendix D: Environmental Authorisation

Appendix E: Landowner Agreements

Appendix F: Construction Environmental Management Plan

Appendix G: National Stakeholder Database

Appendix H: Provincial Stakeholder Database

List of Figures

List of Tables

i. CONTEXT OF THE INFORMATION CONTAINED IN THIS REHABILITATION PLAN

Approach to the NEMA Environmental Process

The legislation protecting the environment in South Africa was not written with the intention of preventing wetland rehabilitation efforts, but rather at curtailing development in sensitive environments. It is important to remember that the WfWetlands Programme is not a development proposal, and although this programme technically requires authorisations, licenses and permits, such rehabilitation projects were never meant to be sent through legislative processes aimed at preventing negative environmental impact.

In terms of the environmental management principles of the National Environmental Management Act, No. 107 of 1998 (NEMA), certain activities that may have a detrimental impact on the environment (termed Listed Activities) require Environmental Authorisation (EA) from the Department of Environmental Affairs (DEA). The WfWetlands Programme will require that interventions be implemented and/or constructed in the wetland systems to ultimately restore some of the more natural wetland functions that have been lost to unsustainable land use practices or development. The implementation of certain interventions triggers Listing Notices 1 and 3 (G.N. R544 and G.N R546 respectively).

In order to meet the requirements of the Regulations pursuant to NEMA, it was necessary to undertake a Basic Assessment Process. **Basic Assessment Report (BARs)** were prepared and these reports presented all Wetland Projects for each Province, together with information regarding the quaternary catchments and the wetlands that were prioritised for the next few planning cycles (anywhere from one to three planning cycles depending on the information gained through the Catchment Prioritisation Process).

The EA that has been applied for will be inclusive of all Listed Activities that may be triggered whilst implementing the wetland rehabilitation interventions. Essentially this EA would authorise any typical wetland rehabilitation activities on condition that the specific intervention proposals are submitted in a Rehabilitation plan to DEA for approval.

The **Rehabilitation Plans** for each Wetland Project will be prepared annually after sufficient field work and stakeholder consultation has been undertaken in the wetlands that have an EA. These Rehabilitation Plans will be submitted to DEA for approval as a condition of the EA for the respective Provincial BAR.

ii. CONTACT DETAILS

Details of the applicant: SANBI	
Contact Person:	Mr Umesh Bahadur
Street Address:	Pretoria National Botanical Garden, 2 Cussonia Ave, Brummeria, Pretoria, 0001
Postal Address:	Private Bag X101, Pretoria 0001
Tel:	012-843 5200
Fax:	086-555 9838
Email:	u.bahadur@sanbi.org.za

Details of the EAP: Aurecon	
Contact Person:	Ms Margaret Lowies
Street Address:	Lion Roars Office Park, Cnr. Heugh Rd. and 3rd Avenue, Walmer, Port Elizabeth
Postal Address:	PO Box 5328, Walmer, Port Elizabeth, 6065
Tel:	041 503 3900
Fax:	086 600 4037
Email:	Margaret.Lowies@aurecongroup.com

Details of the Provincial Coordinator: SANBI	
Contact Person:	Mr André Beetge
Postal Address:	PO Box 722, Kranspoort, 1080
Tel:	013 262 8140
Fax:	013 262 8140
Email:	a.beetge@sanbi.org.za

iii. ABBREVIATIONS

BAR	Basic Assessment Report
BID	Background Information Document
BMP	Best Management Practise
CARA	Conservation of Agricultural Resources Act
CEMP	Construction phase Environmental Management Programme
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
EPWP	Expanded Public Works Programme
GA	General authorisation in terms of the NWA
IA	Implementing Agent
I&APs	Interested and Affected Parties
IDP	Integrated Development Plans
NHRA	National Heritage Resources Act
NEMA	National Environmental Management Act
NEM: BA	National Environmental Management Biodiversity Act
NEM: PAA	National Environmental Management Protected Areas Act
NFA	National Forests Act
NWA	National Water Act
OHSA	Occupational Health and Safety Act
PC	Provincial Coordinator
PIP	Project Implementation Plan
RHP	River Health Programme
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SDF	Spatial Development Framework
SPWP	Special Public Works Programme

iv. GLOSSARY OF TERMS

Auger: An instrument used for boring or perforating soils or rocks, in order to determine the quality of soil, or the nature of the rocks or strata upon which they lie, and for obtaining water (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

Avulsion: An abrupt change in the course of a stream from one flow path to another.

Bedload: Sediment that is transported by being rolled or bounced along the bed of the stream (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

Bedrock: The solid rock that underlies unconsolidated material, such as soil, sand, clay, or gravel (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

BAR: A report as described in regulation 23 of the EIA regulation, 2006 that describes the proposed activities and their potential impacts.

BID: A short document describing, and inviting I&APs to comment on, the proposed activities for which authorization is sought.

BMP: Procedures and guidelines to ensure the effective and appropriate implementation of wetland rehabilitation by WfWet implementers.

Biophysical: The biological and physical components of the environment (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

Catchment: All the land area from mountaintop to seashore which is drained by a single river and its tributaries. Each catchment in South Africa has been subdivided into secondary catchments, which in turn have been divided into tertiary catchments. Finally, all tertiary catchments have been divided into interconnected quaternary catchments. A total of 1946 quaternary catchments have been identified for South Africa. These subdivided catchments provide the main basis on which catchments are subdivided for integrated catchment planning and management (consult DWAF [1994]) (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

Collation Report: A report describing the Basic Assessment process followed for a provinces and collating the Basic Assessment reports for the various WfWet Projects within a province.

EAP: The individual responsible for the planning, management and coordination of the environmental impact assessments, strategic environmental assessments, environmental management plans and/or other appropriate environmental instruments introduced through regulations of NEMA.

Eco-log: A cylindrical wire mesh sleeve filled with organic material and/or soil used to prevent and/ or repair minor erosion.

Ecosystem Services Or 'eco services': The services such as sediment trapping or water supply, supplied by an ecosystem (in this case a wetland ecosystem).

EIA: A study of the environmental consequences of a proposed course of action via the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

MP: Details the methods and procedures for achieving environmental targets and objectives.

Gabion: A structure made of wire mesh baskets filled with regularly sized stones, and used to prevent and/ or repair erosion. They are flexible and permeable structures which allow water to filter through them. Vegetation and other biota can also establish in/around the habitat they create.

I&APs: People and organizations that have interest(s) in the proposed activities.

Environmental Impact: An environmental change caused by some human act.

Implementer: The person or organization responsible for the construction of WfWet rehabilitation interventions.

Intervention: An engineered structure such as a concrete or gabion weir, earthworks or re-vegetation that that achieves identified objectives within a wetland e.g. raising of the water table within a drainage canal.

Mitigation: Actions to reduce the impact of a particular activity.

Maintenance: The replacement, repair or the reconstruction of an existing structure within the same footprint, in the same location, having the same capacity and performing the same function as the previous structure ('like for like').

Perched wetland: A wetland where the wetland water table is higher than the local and regional water-table (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

PPP: A process of involving the public in order to identify issues and concerns, and obtain feedback on options and impacts associated with a proposed project, programme or development. Public Participation Process in terms of NEMA refers to: a process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to specific project matters.

Project: An area of WfWet intervention generally defined by a quaternary catchment or similar management unit such as a national park in which a single implementer operates.

Q value: The peak flow (m^3/s) for which a structure is designed, based on a given likely return period rainfall within the catchment

Quaternary Catchment : All land area drained by a fourth order tributary river and its tributaries.

Rehabilitation: Refers to re-instating the driving ecological forces (including hydrological, geomorphological and biological processes) that underlie a wetland, so as to improve the wetland's health and the ecological services that it delivers.

Rehabilitation: Restoring processes and characteristics that are sympathetic to and not conflicting with the natural dynamic of an ecological or physical system (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

Significant impact: An impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment.

Weir: A dam-type structure placed across a watercourse to raise the water table of the surrounding ground and trap sediment on the upstream face without preventing water flow. Weirs are generally used to prevent erosion from progressing up exposed gullies.

Wetland: "Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soils." (SA Water Act of1998).

Wetland: Land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants living there (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

v. ASSUMPTIONS AND LIMITATIONS

In compiling this report, the following has been assumed:

- The information provided in this report is based on site visits that have been undertaken by the project team (EAP, Engineer, Wetland Ecologist, and SANBI PC) and their subsequent input into the Reporting, which includes intervention design drawings, the wetland status quo assessment, in addition to input from SANBI's PC. It is understood that this information is sufficient for the authorisation processes and associated Phase 3 (Implementation phase). This data and relevant information has informed the findings and conclusions of this report.
- Information contained in this Report will be used during Phase 3 to guide and inform the Implementing Agents on design and construction specifications as part of Phase 3. Implementing Agents will thus use this Rehabilitation Plan and the information contained therein when constructing all interventions, the designs of which have been included in this Report.
- SANBI's PCs will be undertaking the landowner engagement and have obtained the requisite landowner consent forms required as part of Phase 1 and 2 of this project. These include:
  - WW(0): Standard operating procedure,
  - WW(1): Wetland survey and Inspection consent,
  - WW(2): Terms and Conditions for carrying out wetland rehabilitation,
  - WW(3): Wetland Rehabilitation Activities Consent, and
  - WW(4): Property Inspection Prior to Wetland Rehabilitation.
- SANBI have provided all relevant information and documentation required to compile this Rehabilitation Plan.
- Rehabilitation activities should not be carried out until the final Wetland Rehabilitation Plan has been approved by DEA and formally signed off by SANBI.
- The implementation of this rehabilitation plan must take into account all relevant provisions of Working for Wetlands Best Management Practices and Construction Environmental Management Plan, the recommendations of the Basic Assessments and the requirements of the Environmental Authorisation (EA) for the project.
- DEA's prerequisite to increase the requirement of percentage of funding to be spent on labour within the Working for Wetlands (WfWet) programme, has been taken into consideration by the project team during the planning process for wetland rehabilitation.

- Due to the dynamic nature of site conditions and associated biophysical changes within wetlands, this wetland rehabilitation plan is only valid for the 2013/14 financial year. Where appropriate interventions that have not been previously implemented or included in the 2009/10, 2010/11, 2011/12, 2012/2013 and 2013/14 Project Implementation Plans (PIPs) were reviewed and where necessary re-designed for inclusion into the 2013/14 wetland rehabilitation plan. This wetland rehabilitation plan therefore supersedes all previous plans for this project and only interventions from this plan should be included in the 2014/15 PIP.
- Should it be necessary to exclude interventions from the rehabilitation plan, the prioritisation of interventions across the project should strictly be followed.

vi. GAPS IN KNOWLEDGE

- The information in this Report is based on existing available information and input from SANBI's PC, the specialist wetland ecologists, the Engineer, EAP as well as comments from Interested and Affected Parties (I&APs). Until this Final Report has been finalised and signed off by SANBI, the content of the Report should be considered as preliminary.
- Designs for the rehabilitation interventions have been developed for site conditions as at the time of the planning site visits. Should site conditions change before the designs are implemented, changes to the design may be necessary. In this case, project implementers may require the assistance of a professional engineer.
- The cost of construction at each project location will vary due to factors such as the local cost and availability of material, transport distances etc. The unit costs have been agreed with SANBI's PCs based on their knowledge of past projects and include an allowance for escalation.
- The labour intensive targets identified in this project are based on assumed productivity rates for various components of the construction process. This will vary in practise and will require regular monitoring to ensure that labour targets are attained.

Aurecon acknowledges the authorship of any information contained in this document from previous planning years, to the previous provider: Land Resources International (LRI).

This Report must be read in conjunction with the following reports for this project:

1. Phase 1 Report – January 2013; and
2. Other Phase 2 Planning Reports which include the:
    a. Basic Assessment Report (2014),
    b. Zaalklapspruit Rehabilitation Plan (February 2013), and the
    c. Wetland Status Quo Report (**Appendix A** of this report).

vii. DISCLAIMER

- This Rehabilitation Plan is for the Zaalklapspruit Wetland Project in the Mpumulanga Province. The plan is to be used to implement the interventions identified as necessary to rehabilitate the Zaalklapspruit wetlands, and is to be approved by the Department of Environmental Affairs (DEA) as part of the conditions of Environmental

Authorisation (EA).

- The intervention points and wetland boundary polygons provided in this report are based on the shapefiles that have been provided by the South African National Biodiversity Institute (SANBI). The datasets included in the Phase 1 Reports have been updated by the Wetland ecologists and verified by the SANBI Provincial Co-ordinators (PCs). All reasonable efforts have therefore been made to ensure that the data is accurate. However Aurecon South Africa (Pty) Ltd (Aurecon) does not accept responsibility for any remaining inaccuracies in the spatial data provided to us, which may be reflected in this report.
- Aurecon accepts responsibility for the engineering design to the extent that this is based on available information. The available information is limited to what could be interpreted during a single site visit of no longer than a few hours. No geotechnical, topographical, geomorphologic and other engineering related surveys have been undertaken to inform the design. This is non-standard engineering practice and therefore Aurecon is indemnified by the Client and does not accept responsibility for the associated risk of failure from the above limitations or any damages that may occur.
- This Rehabilitation Plan must not be amended without prior consultation and approval from DEA, the responsible Aurecon Environmental Assessment Practitioner (EAP), Engineer, SANBI PC and the SANBI Planning, Evaluation and Monitoring Manager.
- All changes must be motivated using the standard change request form supplemented with additional information as necessary.
- Aurecon is indemnified against any associated damages and accepts no liability associated with the construction and implementation of engineering interventions due to Aurecon being instructed to have limited contact with the implementer during the construction phase resulting in our inability to diligently supervise and assess any progress.
- The Client confirms that by accepting these drawings or reports, he acknowledges and accepts the abovementioned limitation of Aurecon's liability.

viii. DISTRIBUTION LIST

NAME	TITLE	FOR ACTION	FOR INFORMATION	RECEIVED PRIOR TO RELEASE
PROPONENT				
Umesh Bahadur	Programme Manager: Working for Wetlands		✓	
Eric Munzhedzi	Implementation Manager		✓	
André Beetge	SANBI Provincial coordinator	✓		✓
NATIONAL STAKEHOLDERS				
Refer to **Appendix G**			✓(E-copy of Rehab Plan)	
PROVINCIAL STAKEHOLDERS & I&APs				
Refer to **Appendix H**			✓(E-mail notification)	
LANDOWNERS				
Refer to **Appendix E**			✓(E-copy of Rehab Plan)	

1 INTRODUCTION

1.1 Working for Wetlands programme overview

The Working for Wetlands (WfWetlands) Programme is a government programme (similar to Working for Water, Working on Fire and Working on Land) managed by the South African National Biodiversity Institute (SANBI) on behalf of the national government departments of Environmental Affairs (DEA), Water Affairs (DWA), and Agriculture, Forestry and Fisheries (DAFF), and forms part of the Expanded Public Works Programme (EPWP).

The vision of the WfWetlands Programme is to facilitate the protection, conservation, rehabilitation and sustainable use of wetlands in South Africa, in accordance with national policies and commitment to international conventions and regional relationships. The two main objectives of the programme are **wetland conservation** in South Africa and **poverty reduction** through job creation and skills development amongst vulnerable and marginalised groups.

The WfWetlands Programme forms part of the EPWP which seeks to draw significant numbers of unemployed into the productive sector of the economy. These individuals gain skills while they work thus increasing their capacity to earn an income. Rehabilitation efforts are thus focused on wetland conservation and the appropriate use of wetlands in a way that attempts to maximize employment creation, support for small business and the transfer of skills to the unemployed and poor.

In the 12 years since its inception, the WfWetlands Programme has invested R530 million in wetland rehabilitation and has been involved in over 900 wetlands thereby improving or securing the health of over 70 000 hectares of wetland environment. The WfWetlands Programme has created more than 12 800 jobs and 2.2 million person-days of paid work. Local people are recruited to work and targets for employment specify that the programme's workforce should comprise at least 60% women, 20% youth and 2% disabled people.

1.1.1 Programme, projects and phases

In order to manage the WfWetlands Programme, prioritised wetlands that have been identified for rehabilitation have been grouped into "Wetland Projects" within each Province, and each Wetland Project encompasses several wetland systems which are each divided into smaller, more manageable and homogenous wetland units. A Wetland Project may be located within one or more quaternary catchments within a Province.

Each Project is managed in three phases over a two-year cycle. The first two phases (Phase 1 and Phase 2) straddle the first year of the cycle and involve planning, identification, design and authorisation of interventions. The third phase (Phase 3) is implementation of specific interventions to achieve rehabilitation, and this takes place during the second year. SANBI is currently managing 35 Wetland Projects countrywide, and approximately 500 interventions within these Wetland Projects will be implemented to meet the objectives of the Programme.

1.1.2 Methods of rehabilitation

The successful rehabilitation of a wetland requires that the cause of damage or degradation is addressed, and that the natural flow patterns of the wetland system are re-established (and flow is encouraged to disperse rather than to concentrate). The main aims of the WfWetlands Programme are:

- Restoration of hydrological integrity (e.g. raising the general water table or redistributing the water across the wetland area);
- Recreation of wetland habitat towards the conservation of biodiversity;
- Job creation and social upliftment.

Rehabilitation activities range from stabilising degradation to the more ambitious restoration of wetlands to their original conditions. Typical activities within the Wetland Projects include:

- Plugging artificial drainage channels created by development or historical agricultural practices to drain wetland areas for other land use purposes;
- Constructing structures (gabions and weirs) to divert or redistribute water to more natural flow paths, or to prevent erosion by unnatural flow rates that have resulted from unsustainable land use practices or development.
- Removing invasive alien or undesirable plant species from wetlands and their immediate catchments as part of the Working for Water Programme.

1.1.3 Intervention options

Methods of wetland rehabilitation may include hard engineering interventions such as:

- Earth berms in conjunction with gabion systems to block artificial channels that drain water from or divert polluted water to the wetland;
- Concrete weirs to act as settling ponds, to reduce flow velocity or to re-disperse water across former wetland areas thereby re-establishing natural flow paths;
- Concrete, earth or gabion structures plugs to raise channel floors and reduce water velocity;
- Concrete or gabion structures to stabilise head-cut or other erosion and prevent gullies; and
- Gabion structures (mattresses, blankets or baskets) to provide a platform for the growth of desired wetland vegetation.

Soft engineering interventions also offer successful rehabilitation methods, and the following are often used together with the hard engineering interventions:

- The re-vegetation of stabilised areas with appropriate wetland and riparian species;
- The fencing off of sensitive areas within the wetland to keep grazers out and to allow for vegetation to become re-established;
- The use of biodegradable or natural soil retention systems such as eco-logs, plant plugs, grass or hay bales, and brush-packing techniques.
- The removal of undesirable plant and animal species as part of the Working for Water initiative. Alien invasive plant clearing is an important part of wetland rehabilitation;

- In some instances, the use of appropriate fire management and burning regimes.

For more information on the WfWetlands Programme, please refer to the WfWetlands Context Document included in the front of this report.

1.2 Project team

The project team currently comprises the SANBI Programme Manager who oversees the WfWetlands Programme and provincial coordinators (PCs) who oversee the identification and implementation of projects in their regions. They are supported by a small team based at the Pretoria Botanical Gardens who fulfil various roles such as finance, Geographical Information Systems (GIS) and training.

Aurecon South Africa (Pty) Ltd (Aurecon) has been appointed to undertake the project activities and associated reporting required by the WfWetlands Programme. The Aurecon team comprises design engineers and environmental assessment practitioners (EAPs) who undertake the planning, design and authorisation components of the project. The Aurecon Team is assisted by an external team of Wetland Ecologists who provide scientific insight into the operation of wetlands and bring expert and often local knowledge of the wetlands. The project team is also complimented by the SANBI Provincial Coordinators (PCs) who are each responsible for provincial planning and implementation.

1.3 Mpumalanga Wetland Projects

Wetland Projects for the 2014/2015 planning cycle were identified during the Phase 1 activities associated with the WfWetlands Programme. Catchment and wetland prioritisation assessments were undertaken by the wetland ecologist/s to identify priority catchments and associated wetlands within which rehabilitation work needed to be undertaken. A review was undertaken to determine local knowledge and identify existing studies of the quaternary catchments in the province. SANBI's current five year strategic plans were further used as a guide to identify wetlands, as well as data from the National Freshwater Ecosystem Priority Areas (NFEPA) project. Decisions on priority areas were informed by input from wetland forums, biodiversity/ conservation plans, municipalities, state departments and various other stakeholders.

Based on this process, the following quaternary catchments (and associated wetland systems) were identified for the 2014/2015 planning cycle in the Mpumulanga Province (**Table 1**):

Table 1: Mpumalanga Wetland Projects

Project Name	*Wetland Number*	*Wetland System*
Highveld Project	B20G-01	Zaalklapspruit
Lowveld Project	B42B-02	Gustav Klingbiel Nature Reserve
	B42B-03	Gustav Klingbiel Nature Reserve

Project Name	*Wetland Number*	*Wetland System*
	X31L-01	Bushbuckridge
	X31L-02	Bushbuckridge
	X31L-04	Bushbuckridge
Nkomati Project	X21F-01	Hartebeesspruit
Steelpoort Project	B32A-01	Hondekraal
	B32A-02	Parys

A basic EIA application has been lodged with the National DEA on the 4 March 2014 for the undertaking of listed activities in terms of NEMA. The DEA will issue an EA that will permit the WfWetlands Programme to undertake wetland rehabilitation in the abovementioned wetland systems within the Mpumalanga Province. This Rehabilitation Plan focusses on the Zaalklapspruit Wetland Project (Ai) and is to be submitted to DEA for their approval as a condition of the EA.

1.3.1 The Zaalklapspruit Wetland Project

This document comprises the Rehabilitation Plan for the Zaalklapspruit Wetland Project and includes the Zaalklapspruit wetland system. The Rehabilitation Plan will be the primary working document for the project via the implementation (construction/ undertaking of) of interventions[8] required to meet the wetland rehabilitation objectives. The document details the general methodology that has been adopted for the planning of rehabilitation interventions for identified wetlands. Details of the rehabilitation planning for each wetland and the selected intervention options (including designs, dimensions and locations) within each wetland are presented, along with baseline Monitoring and Evaluation (M&E) data.

Reports on the current status of the wetland and design drawings are included as **Appendix A** and **B** of this report. Upon approval of this Rehabilitation Plan by both DEA and the directly affected landowners, the work detail for the project will be implemented within a year with on-going monitoring being undertaken from thereon.

1.4 Project scope

The scope of this Wetland Project is detailed in the **Table 2** below:

[8] This could include soft options such as alien clearing, eco-logs, gabion structures as well as hard structures, for example weirs.

Table 2: Project Scope

Quaternary Catchments	**B20G**
Quaternary Catchment area (Ha)	52 200 Ha
Number of wetlands identified during the assessment	1
Extension of existing work (previous financial year)	No
Work to commence at new wetlands in 2014/2015	Yes
Available budget for new interventions	R2 086 079
Available budget for maintenance to existing interventions	N/A
Estimated cost of new interventions	Total: R 2,381,257
Estimated cost of maintenance to existing interventions	N/A

2 GENERAL METHODOLOGY

Each Wetland Project is managed in three phases over a two-year cycle as shown in the flow diagram in **Figure 1** below. The first two phases straddle the first year of the cycle and involve planning, identification, design and authorisation of interventions. The third phase is implementation, which takes place during the second year.

2.1 Landowner consent

The flow diagram (**Figure 1**) also clearly demonstrates the point at which various consent forms must be approved via signature from the directly affected landowner. SANBI's PCs are responsible for undertaking the necessary landowner engagement and for ensuring that the requisite landowner consent forms required as part of Phase 1 and 2 of this project are signed. These include:

- WW(0): Standard operating procedure
- WW(1): Wetland survey and Inspection consent,
- WW(2): Terms and Conditions for carrying out wetland rehabilitation,
- WW(3): Wetland Rehabilitation Activities Consent,
- WW(4): Property Inspection Prior to Wetland Rehabilitation, and
- WW(5): Notification of Completion of Rehabilitation.

Refer to **Appendix E** for a copy of the landowner agreements.

2.2 Phase 1

The wetland ecologist responsible for the Mpumalanga Province undertook a desktop study to determine the most suitable wetlands for the WfWetlands rehabilitation efforts. The involvement of Provincial Wetland Forums and other key stakeholders was a critical component of the wetland identification processes since these stakeholders are representative of diverse groups with shared interests (e.g. from government institutions to amateur ecological enthusiasts). This phase also involved initial communication with local land-owners and other interested and affected parties to gauge the social benefits of the work. The following wetland was prioritised and agreed to by the various parties for the Highveld Wetland Project:

1. Zaalklapspruit (B20G-01)

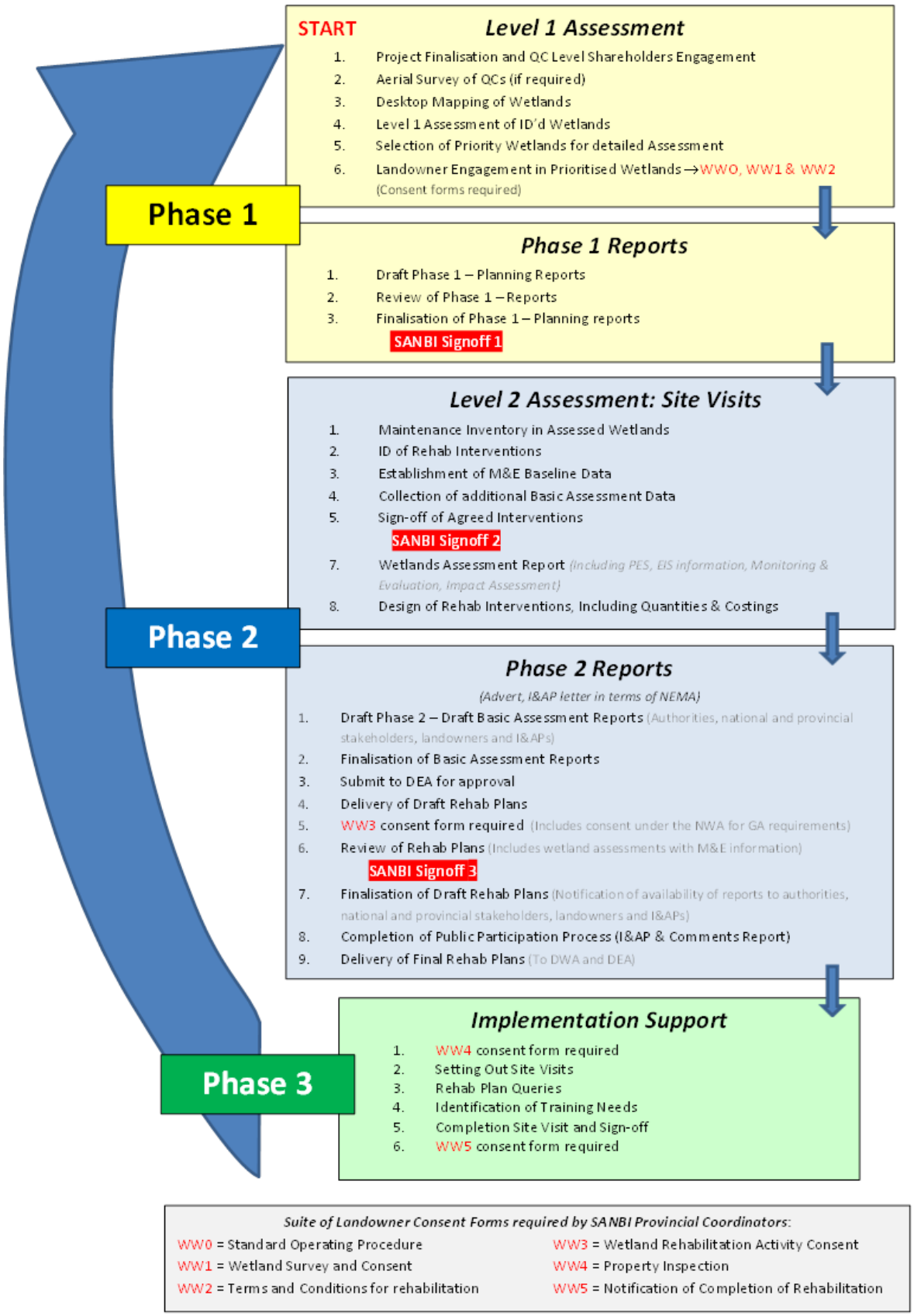

Figure 1: The three phases that must be undertaken for the successful rehabilitation of wetlands

2.3 Phase 2

2.3.1 Site visits

Phase 2 required site visits attended by the fieldwork team comprising a wetland ecologist, a design engineer, an EAP, and a SANBI provincial coordinator. This allowed for a highly collaborative approach to be used, as options were discussed by experts from different scientific disciplines, as well as local inhabitants with deep anecdotal knowledge. One site visit was undertaken for the Zaalklapspruit Wetland Project on the 28th of August 2013.

The following team members attended the site visits:

- Doug Macfarlane (wetland ecologists)
- Cilliers Blaauw (engineer)
- André Beetge (SANBI PC)
- A. Bothma (Implementer)

At the end of the site visit the rehabilitation objectives together with the location layout of the proposed interventions were agreed upon by the project team.

During Phase 2, monitoring systems were put in place to support the continuous evaluation of interventions. The systems monitor both the environmental and social benefits of the interventions. As part of Phase 2 site visit, a maintenance inventory of any existing interventions that were damaged and / or failing and thus requiring maintenance was compiled by the PC, in consultation with the Design Engineer.

2.3.2 Wetland assessments

The time and resources required to determine the current status of the wetlands was generally limited, and thus a rapid procedure was adopted to assist the project team in systematically carrying out the assessments under constraints. The procedure was based on the following steps:

a. Assess impacts and threats

The following steps were used by the wetland ecologist to assess the impacts and threats within each wetland system:

- The hydro-geomorphic setting of the wetland was described according to Kotze *et al.* (2005);
- The overall health of the wetland at a Level 1 assessment using WET-Health (Macfarlane *et al.*, 2006) was described and verified;
- Based on the above findings, the specific impacts and/or threats to be addressed by structural rehabilitation were identified, and described at a Level 2 assessment (e.g. for headcut erosion, the specific dimensions and level of activity of headcuts would be described).

b. Set rehabilitation objectives and choose appropriate measures for achieving the objectives

Rehabilitation objectives were informed by the above assessments (*e.g*., if the primary threat to the wetland was identified as headcut erosion threatening to propagate through the wetland then an appropriate rehabilitation objective would be to halt propagation of the erosion headcut). The engineer was assisted by the wetland ecologist in selecting appropriate interventions to achieve the identified rehabilitation objectives.

c. Assess the likely contribution of rehabilitation interventions to wetland health and ecosystem delivery

An assessment of the predicted contribution that the identified rehabilitation interventions would make to improving wetland health and ecosystem delivery through addressing the identified impacts/threats was required. Without these assessments, a wetland rehabilitation programme is unlikely to have a well-informed basis on which to improve the rehabilitation's "return on investment" (with return being measured in terms of wetland health and ecosystem services delivery). This is directly linked into the *WfWet* Monitoring and Evaluation Framework. The following steps were followed to assess the contribution of rehabilitation interventions within each wetland system:

- The spatial area likely to be affected by the proposed intervention/s was identified.
- The benefits that were likely to result from achievement of the rehabilitation objective/s were determined in terms of the integrity of the affected area of the wetland (using WET-Health) and the ecosystem services that the area delivers (using WET-Ecoservices: Kotze *et al.*, 2005).

The same approach was used for the assessment of the different threats/impacts that would be addressed through rehabilitation. In this instance, the situation without rehabilitation (i.e. no intervention or *status quo*) was compared to the situation with rehabilitation. For health, both situations were scored on a scale of 0 (critically altered) to 10 (pristine), and this was undertaken for the hydrology, geomorphology and vegetation components of health.

The benefit achieved is the improvement in relation to the maximum score. For example, in areas threatened by headcut erosion which are to be rehabilitated by halting the spreading of the headcut, the benefits in terms of health would be determined based on the difference between the current health and the projected health if the headcut proceeded to erode through the threatened area. In such a case, stopping the expansion of the headcut would presumably secure the current situation.

Refer to **Appendix A** which contains the Wetland Status Quo Report.

2.3.3 Identification and location of intervention designs

The project teams evaluated the various rehabilitation intervention options available and selected the most appropriate intervention options to achieve the rehabilitation objectives for the wetland. Choices of intervention options were also informed by the increased labour component as required by DEA. Any previously planned interventions that had not been implemented or included into the previous planning cycle reports were assessed and

included into the current year's selection, if appropriate to the re-assessed rehabilitation objectives for the wetland. Agreed cost/benefit ratios in terms of 'Rands per hectare of rehabilitated wetland' were taken into account, along with operational considerations and larger scale project objectives.

After the appropriate intervention options were selected by the planning team, the engineer, in consultation with the wetland ecologist determined the most appropriate designs and locations for the identified interventions in order to achieve the rehabilitation objectives for the wetland in question. GPS coordinates and digital photographs – sufficiently detailed to clearly identify the selected locations were then taken for record purposes. Appropriate dimensions of the locations were measured in order to be able to design and calculate quantities for the interventions.

a. Intervention naming convention

A new naming convention was introduced in the 2011/2012 planning phase and this has been continued in this years' Rehabilitation Plans.

The **historical naming convention** for interventions is explained below:
A00A-00-000, where

Number	Explanation
A00A	quaternary number
00	wetland number
000	intervention number

The accepted **naming convention** which has been applied to all interventions (old and new) is explained below with examples being provided as well.

A00A-00-000-00 (new),

A00A-00-000-01 (maintenance), where

Number	Explanation		
A00A	quaternary number		
00	wetland number		
200	intervention number with the '**200**' included for differentiation from previous interventions		
00	**New** intervention	**01**	**Maintenance** to intervention

An additional two digits will therefore be added to the end of each of the intervention numbers to indicate maintenance on this specific intervention and/ or whether the structure is new (00) for tracking purposes. All new interventions will have a default of 00. Should built structures require maintenance, they would be numbered numerically beginning with '01' e.g. 01, 02, 03, etc. for each year that maintenance is undertaken on the intervention.

In addition, the new naming convention also added a '200' digit in the front of the intervention number to avoid confusion from previously named interventions.

2.3.4 Collection of Monitoring & Evaluation Baseline and Basic Assessments Data

In accordance with WET-Rehab-Evaluate (Cowden & Kotze, 2007) the collection of baseline monitoring information is important to allow for the evaluation of the performance of wetland rehabilitation activities. Monitoring and evaluation facilitate the dissemination of lessons learnt and provide a means of reporting on the success of specific wetland rehabilitation initiatives. The monitoring and evaluation (M&E) of an identified wetland rehabilitation project's performance is therefore considered vital to inform the evaluation of wetland rehabilitation success. Baseline monitoring needs to be carried out prior to the implementation of rehabilitation activities to provide comparable data for monitoring at a later stage, following the wetland rehabilitation.

While the engineer was working on measurement of the intervention locations, the wetland ecologist gathered the additional data required for M&E baselines which included the following:

- Photographs and GPS co-ordinates of the identified problems;
- Fixed-point photography (in accordance with the guidelines outlined in WET-Rehab-Evaluate: Cowden & Kotze, 2007);
- WET-Health information (allowing the comparison of wetland ecological integrity before and after rehabilitation activities); and
- Details relating to the estimated hectare equivalents.

Any additional data/information required for the assessment of the potential impacts of the proposed interventions and construction activities was also collected by the wetland ecologist and the EAP to inform the Basic Assessments.

At the end of the site visit a location layout of the agreed interventions and rehabilitation objectives was signed off by the SANBI PC and landowner, as indicated by SANBI Signoff 2 in **Figure 1.**

2.3.5 Engineering design

The detailed procedure followed by the engineers is described in the Engineering Design Brief, which documents the procedure agreed upon by Aurecon and SANBI. The document also addresses important issues such as risk and liability. A summary of the process followed for the engineering design is described below:

- A hydrological assessment was undertaken to quantify the volume of water expected to be dealt with by the intervention for various recurrence intervals. The results of this assessment allowed the engineer to select a design flow to be applied to the intervention.

- Construction materials were selected based on a range of site specific criteria including expected velocities, availability of materials such as rock, labour intensive targets, maintenance requirements etc.
- Interventions were designed based on the above to meet the objectives for wetland rehabilitation.
- The intervention designs were drafted to show, at a minimum, a plan view, a longitudinal section and front elevation at appropriate scales, and appropriate dimensions. A legend indicating basket sizes was included for gabion structures to improve design clarity for the implementers.
- Bills of quantities were calculated for the designs and cost estimates were made based on unit costs and norms for each project area, as agreed with the SANBI PC.
- Maintenance requirements for existing interventions in the assessed wetlands were similarly detailed and the anticipated costs calculated.

The engineer also reviewed and, if necessary, adjusted any previously planned interventions that are included into the current rehabilitation plan.

2.3.6 Development of the Rehabilitation Plan

The standardised Rehabilitation Plan format has been approved by SANBI Programme Manager: Planning, Monitoring and Evaluation.

Summaries of the wetland prioritisation, problems and rehabilitation objectives were documented in the Highveld Rehabilitation Plan. Reports on the current status of the wetland, based on, *inter alia*, the information collected during the implementation of WET-Tools, were prepared by the wetland ecologist, and included as **Appendix A** to this report.

The Final Highveld Rehabilitation Plan was submitted to the SANBI PC and wetland ecologist for review before it was made available to stakeholders for comment. Any comments received during the comments period were taken into account in the finalisation of the Rehabilitation Plans.

a. Reporting Format

All relevant information acquired during the assessments and field visits has been included in this document and its appendices in a hierarchy as shown in **Figure 2** below.

- All intervention locations are given in geographical coordinates, (degrees, minutes and seconds), based on the WGS84 datum.
- Mapping was done in Albers Equal Area Conic projection, WGS84 datum. The grids displayed on all maps are geographic and measured in Degrees Minutes and Seconds. The scale bar on each map is based on Albers Equal Area Conic projection and measured in metres.

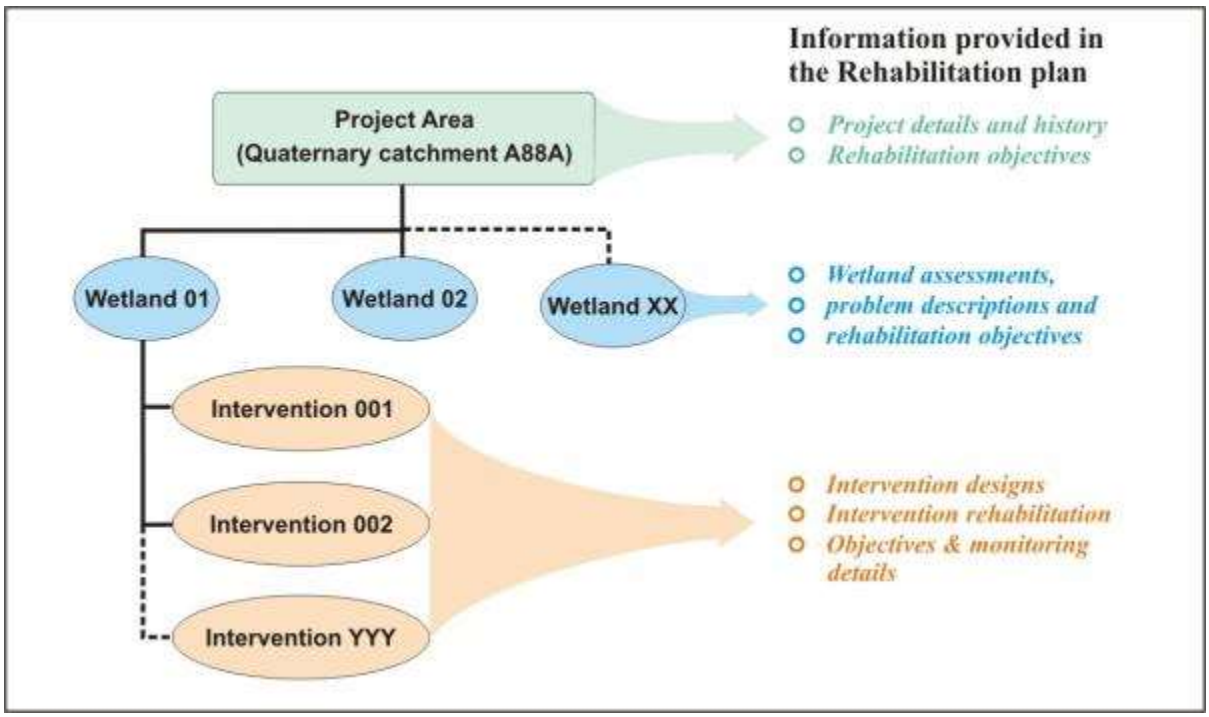

Figure 2: Hierarchy used in the Wetland Rehabilitation Plan

3 PROJECT DESCRIPTION

3.1 Project details

Background: This wetland system is located in quaternary catchment B20G in the Upper Olifant's catchment, Mpumalanga and has been identified as a suitable site for rehabilitation in consultation with Coaltech and the CSIR.

The Zaalklapspruit wetland (B20G-01) forms part of a larger wetland system along the Grootspruit, a tributary of the Zaalklapspruit (Saalklapspruit) River which then flows into the Wilge River approximately 35 km northwest of Witbank Town. The wetland is situated directly below areas subject to coal mining and as such, is likely to be subject to significant water quality impacts (refer **Figure 3** and **Table 3** below).

The local climate is characterized by a low mean annual precipitation of 668.4 mm and a high mean annual potential evapotranspiration of 2104.6 mm. This gives a MAP to PET ratio of 0.3 (vulnerability index of 1.05), which means that the wetland has a relatively high sensitivity to hydrological impacts (changes in water input volumes and patterns).

The control on the formation and dynamics of the system is linked to the base level of the Zaalklapspruit stream into which this wetland system flows. This prevents down-cutting of the valley and encourages alluvial deposition in the valley upstream of this junction. Water inputs into the wetland are primarily from the upstream catchment although the presence of significant areas of seasonal and temporary seepage areas leading into the wetland suggests that lateral sub-surface seepage is also an important input.

As with other wetlands in the region, the lower, more permanently saturated sections of the wetland appear to be naturally characterized by extensive beds of *Phragmites australis* (common reed) and *Typha capensis* (bulrush). Seasonal and temporary zones along the edge of the wetland are naturally much more diverse and characterized by a mix of hygrophilous grasses, sedges and forbs. Typical sedges species include *Bulboschoenus glaucus, Bulbostylis hispidula, Choenoplectus corymbosus, Cyperus congestus, Cyperus fastigiatus* and species of *Juncus* and *Schoenoplectus*. Typical grass species include *Imperata cylindria, Agrostis lachnantha, Harpochloa Falx and Pennisetum Sphacelatum*.

Herbs such as *Kniphoffia spp*. are also common along the edges of the wetland. Some transformation of wetland areas has taken place in response to historic agricultural activities which have included ridge and furrow cultivation, drainage and construction of small impoundments for livestock watering. Poplars (*Populus spp*.) have also impacted part of the wetland.

Table 3: Project details

Project Name	Zaalklapspruit
Region (Province)	Mpumalanga
Project Budget	R 2 086 079
Planning Category	Category 2
Nearest Town/s	Clewer
Partnership	CoalTech and CSIR

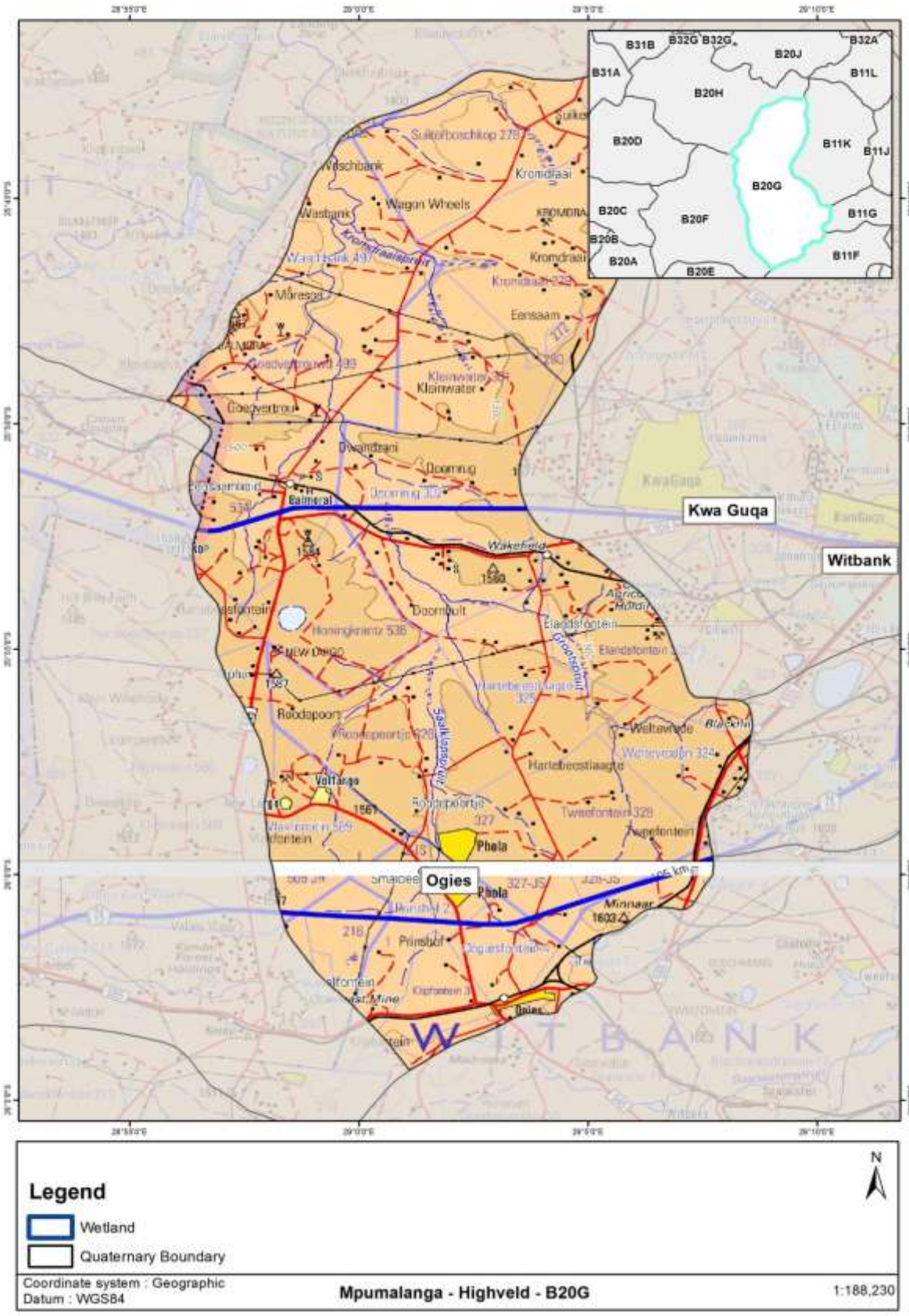

Figure 3: Topographic map showing B20G quaternary catchment's locality, cadastral boundaries and access routes

Wetlands selected: The wetland that have been identified for rehabilitation efforts for this planning cycle is only one wetland i.e. the Zaalklapspruit wetland (B20H-01) (**Table 4**).

Table 4: Identified wetlands within the Zaalklapspruit Wetland Project

Wetland Number	Wetland Name	Longitude	Latitude
B20G-01	Zaalklapspruit	29° 3'6.62"E	25°54'26.07"S

3.2 Landowner details

The landowners were identified for this Wetland Project (**Table 5**) and consent for any proposed wetland rehabilitation (subject to the approval of the Final Rehabilitation Plans) has been sought. Copies of the consent obtained are provided in **Appendix E**.

Table 5: List of Landowners and SG Key

Wetland Number	Property SG Key	Owner	Consent Obtained
B20G-01	T0JS00000000030200029	A.H. Hertzog	Yes

3.3 Projected rehabilitation indicators

The rehabilitation planning process relies on the measurement of wetland ecological integrity based on the assessment of the hydrology, geomorphology and vegetation components of the specified systems. In theory this information could be converted into a hectare equivalent which could serve as a baseline indicator to then provide a projection of the area of wetland habitat gained or secured. In practice the level of confidence associated with interpretations of this nature are usually low and difficult to defend and hence should be interpreted with great caution. For example, this approach should not be followed for hectare equivalents secured where a large wetland complex with many contiguous tributary arms of unknown size are present upstream. Similarly, the area of wetland gained should not be determined if there isn't good knowledge of inter alia the hydrogeological characteristics of both the bedrock and unconsolidated sedimentary cover. In well-known systems rehabilitation plans can outline the following projected values for the proposed wetland rehabilitation, which can be used as an indicator of wetland rehabilitation success within each wetland system (**Table 6**):

Table 6: Projected Values

Wetland No.	Area (ha)	Current hectare equivalents	Projected hectare equivalents gained	Total projected hectare equivalents	% Increase on current hectare equivalents	Projected hectare equivalents secured
B20G-01	138.7	94.4	9.4	103.8	9.1%	9.4

Please note that important factors such as biodiversity, species habitat, sense of place cultural significance etc. are not incorporated into hectare equivalents and therefore the full value of the

system is not quantified. For the purpose of this report and due to the reasons above, the above table (**Table 6**) only reflects the amount of hectares physically gained as a result of the interventions.

3.4 Prioritisation of wetlands

This wetland was prioritized for a rehabilitation perspective from a broad suite of potential sites in the catchment. The primary reason for selecting this site was due to the degraded nature of the system (providing an opportunity for enhancement) and the sites location below coal mining activities with notable water quality problems.

3.5 Interventions required

The following table (**Table 7**) provides a list of interventions requiring redesign, maintenance and or new structures for this project and their associated new intervention number.

Table 7: Summary of the interventions including a cross reference of intervention numbers

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
NEW				
Zaalklapspruit				
Concrete Weir	N/A	B20G-01-214-00	Construct a side inlet concrete weir to prevent head cut progressing and to increase the water level in the channel to the maximum height. High flows to flood over onto the northern side of the wetland.	Zaalklapspruit Final Rehab Plan: Feb 2013
Stone masonry drop-inlet weir	N/A	B20G-01-215-00	Construct a stone masonry drop-inlet weir to de-activate secondary drain and potential for head-cut formation. Increase saturation and facilitate re-activation of adjacent wetland by elevating water levels in main drain.	Zaalklapspruit Final Rehab Plan: Feb 2013
Stone masonry drop-inlet weir	N/A	B20G-01-216-00	Construct a stone masonry drop-inlet weir to increase saturation and facilitate re-activation of adjacent wetland by elevating water levels in main drain. Flood secondary erosion channel and upstream drain.	Zaalklapspruit Final Rehab Plan: Feb 2013
Stone masonry drop-inlet weir	N/A	B20G-01-217-00	Construct a stone masonry drop-inlet weir to increase saturation and facilitate re-activation of adjacent wetland by elevating water levels in main drain.	Zaalklapspruit Final Rehab Plan: Feb 2013
Stone masonry drop-inlet weir & gabion road crossing	N/A	B20G-01-218-00	Construct a stone masonry drop-inlet weir to increase saturation and facilitate re-activation of adjacent wetland by elevating water levels in	Zaalklapspruit Final Rehab Plan: Feb 2013

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
			main drain. Formalize crossing point for livestock and vehicle access.	
Stone masonry drop-inlet weir	N/A	B20G-01-219-00	Construct a stone masonry drop-inlet weir to increase saturation and facilitate re-activation of adjacent wetland by elevating water levels in main drain.	Zaalklapspruit Final Rehab Plan: Feb 2013
Stone masonry drop-inlet weir	N/A	B20G-01-220-00	Construct a stone masonry drop-inlet weir to increase saturation and facilitate re-activation of adjacent wetland by elevating water levels in main drain. Reduce risk of head-cut creation as a result of water entering from upstream wetland area.	Zaalklapspruit Final Rehab Plan: Feb 2013
Stone masonry drop-inlet weir	N/A	B20G-01-221-00	Construct a stone masonry drop-inlet weir to increase saturation levels upstream of eroded channel. Reduce risk of erosion upstream of dolerite dyke.	Zaalklapspruit Final Rehab Plan: Feb 2013
Earth works (Cut & Fill) and Re-vegetate	N/A	B20G-01-222-00	Earth Works (Cut & fill to NGL) to improve natural water distribution and retention patterns by de-activating areas affected by historic ridge & furrow cultivation.	Zaalklapspruit Final Rehab Plan: Feb 2013
Earth works (Cut & Fill) and Re-vegetate	N/A	B20G-01-223-00	Construct alternating earth plugs and revegetate plugs to de-activate lateral side drain in order to reinstate natural flows.	Zaalklapspruit Final Rehab Plan: Feb 2013
Earth works (Cut & Fill) and Re-vegetate	N/A	B20G-01-224-00	Cut & fill to NGL to improve natural water distribution and retention patterns by de-	Zaalklapspruit Final Rehab Plan: Feb 2013

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
			activating areas affected by historic furrow drainage during cultivation.	
Earth Structure (Earthen berm) and Re-vegetate	N/A	B20G-01-225-00	Construct Earthen berm with Stone masonry drop inlet & outlet pipe (into main channel) to stabilize head-cuts created by cattle paths.	Zaalklapspruit Final Rehab Plan: Feb 2013
Earth works(Cut & Fill) and Re-vegetate	N/A	B20G-01-226-00	Cut & fill to NGL to improve natural water distribution and retention patterns by de-activating areas affected by historic drain in order to promote diffuse flows across the wetland.	Zaalklapspruit Final Rehab Plan: Feb 2013
Earth works (Fill) and Re-vegetate	N/A	B20G-01-227-00	Construct alternating earth plugs and revegetate plugs to de-activate secondary drain and allow flows to move diffusely over wetland.	Zaalklapspruit Final Rehab Plan: Feb 2013

The intervention designs/ drawings included in this Rehabilitation Plan have been labelled according to the **new naming convention** only. For historical labelling of interventions, please use the table above (**Table 7**) as a cross reference.

4 ZAALKLAPSPRUIT WETLAND (B20G-01)

4.1 Wetland details

The Zaalklapspruit Wetland is a moderate sized (~135 ha) naturally unchannelled valley bottom wetland system located along the Grootspruit River. This wetland system is located in quaternary catchment B20G in the Upper Olifant's catchment, Mpumalanga. The Zaalklapspruit wetland (B20G-01) forms part of a larger wetland system along the Grootspruit, a tributary of the Zaalklapspruit (Saalklapspruit) River which then flows into the Wilge River approximately 35km northwest of Witbank Town. Also refer to **Figure 3** for the locality map.

The assessment of the Zaalklapspruit wetland, its problems, and the development of the rehabilitation objectives are described in detail in **Appendix A**: Wetland Status Quo Reports. The following sections provide a brief summary for this wetland.

4.1.1 Motivation for selection

The wetland catchment is heavily impacted by various activities such as coal mining, agriculture and dams. The wetland provides an array of wetland services such as toxicant removal, stream flow regulation and sediment trapping. Through rehabilitation of the wetland the extent and magnitude of these wetland services will be increased.

Based on an understanding of the goods and services provided by the wetland, the EIS assessment indicates that this wetland has a "Moderate to "High" importance and sensitivity (also refer to Wetland Status Quo Report, **Appendix A**). This is attributed primarily to the ecological importance and sensitivity value which is regarded as high due to aspects such as the high threat status of the wetland and sensitivity to hydrological changes, particularly low flows. The hydrological importance is moderate while direct benefits are limited as discussed previously.

4.1.2 Description

The Zaalklapspruit Wetland is a moderate sized (~135 ha) naturally unchannelled valley bottom wetland system located along the Grootspruit River. It occurs in a landscape of quite low topographic relief and is located in a shallow valley bottom location. The local climate is characterized by a low mean annual precipitation of 668.4 mm and a high mean annual potential evapotranspiration of 2104.6 mm. This gives a MAP to PET ratio of 0.3 (vulnerability index of 1.05), which means that the wetland has a relatively high sensitivity to hydrological impacts (changes in water input volumes and patterns).

The control on the formation and dynamics of the system is linked to the base level of the Zaalklapspruit stream into which this wetland system flows. This prevents down-cutting of the valley and encourages alluvial deposition in the valley upstream of this junction. Water inputs into the wetland are primarily from the upstream catchment although the presence of significant areas of seasonal and temporary seepage areas leading into the wetland suggests that lateral sub-surface seepage is also an important input.

4.1.3 Rehabilitation

The main aim of the rehabilitation work in the Zaalklapspruit wetland is to enhance the water quality improvement functions of the wetland. While a number of problems and threats have been identified, drainage and associated channel incision, resulting in concentration of flows and a reduction in plant growth is regarded as having the most significant impact on the ability of the wetland to improve water quality. Rehabilitation is therefore focused largely on addressing the impacts associated with artificial drainage and ridge and furrow cultivation within targeted areas.

During the initial rehabilitation planning was undertaken during 2012/13 and focused on the central section of the wetland while subsequent planning (2013/2014) focused on the lower section of the wetland.

The 2013/2014 rehabilitation planning focused specifically on the following:

- Preventing further channel incision by preventing potential head-cut advancement.
- De-activating the central drain to promote water retention and diffuse flows across the wetland.
- De-activating secondary drains and areas of historic ridge and furrow cultivation

Table 8: Summary of the wetland details

Wetland Name	Zaalklapspruit
Wetland Number	B20G-01
River System Name	Grootspruit
Land Use in Catchment	Livestock Farming, crop production, coal mining
Land Use in Wetland	Livestock grazing, dams, historic cultivation. Mining extends into the wetland upstream of this assessment unit.
No. of Properties Intersecting Wetland Area	4
Date of Planning Site Visit	20 – 21 November 2012
Wetland Assessor(s)	Doug Macfarlane
Wetland size	135 Ha

4.1.4 Site photos

View south towards the body of the wetland.

Wetland looking in a western direction

Wetland looking in an eastern direction

View west over mid-section of impact unit 28. Area is dominated by terrestrial grass species.

View east over mid-section of impact unit 28. Area is dominated by terrestrial grass species.

Figure 4: Site Photos of the Zaalklapspruit wetland

4.2 Wetland problems

Apart from changes in catchment hydrology and sediment dynamics, the ecological integrity of Zaalklapspruit wetland has been impacted by several site-based factors including:

- Drainage and associated channel incision;
- Ridge and furrow cultivation;
- Introduction of pasture grass species;
- Construction of a gravel roads across the wetland;
- Alien invasive plants (particularly Poplars);
- Construction of small “dams” in the central reaches of the wetland.

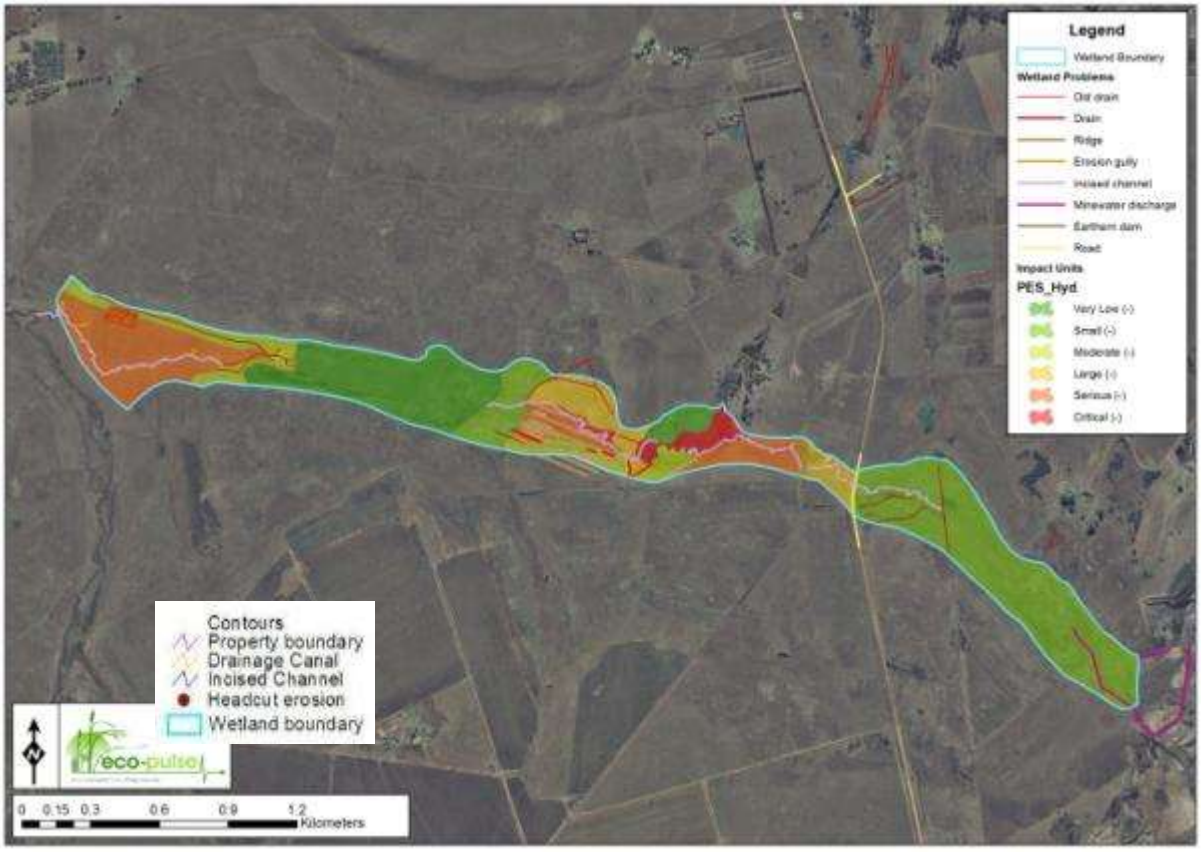

Figure 5: A map of Zaalklapspruit wetland showing impacts to water distribution and retention patterns within each assessment unit prior to rehabilitation.

4.3 Rehabilitation objectives

The focus of rehabilitation of this particular wetland is to assess the ability of wetlands to address water quality impacts associated with upstream coal mining activities. As such, the primary objective is to enhance the water quality improvement functions of the wetland.

While a number of problems and threats have been identified, drainage and associated channel incision, resulting in concentration of flows and a reduction in plant growth is regarded as having the most significant impact on the ability of the wetland to improve water quality. Rehabilitation is therefore focused largely on addressing the impacts associated with artificial drainage and ridge and furrow cultivation within targeted areas.

Initial rehabilitation planning was undertaken during 2012/13 and focused on the central section of the wetland while subsequent planning focused on the lower section of the wetland. Details of the rehabilitation objectives, together with the planned strategy for achieving this objective in each of the targeted areas are summarized in **Table 9** below:

Table 9: Summary of rehabilitation objective and proposed rehabilitation strategies to achieve these

Rehabilitation objective	Rehabilitation strategy
Central section of the wetland (2012/13 planning)	
To improve the water quality enhancement functions of the wetland in addressing impacts associated with upstream coal mining activities.	• Prevent further channel incision by de-activating head-cut upstream of main channel; • De-activate central incised channel, encouraging water to flow diffusely across the wetland. • Re-activate areas affected by ridge and furrow cultivation.
Lower section of the wetland (2013/14 planning)	
To improve the water quality enhancement functions of the wetland in addressing impacts associated with upstream coal mining activities.	• Prevent further channel incision by preventing potential head-cut advancement. • De-activate central drain to promote water retention and diffuse flows across the wetland. • De-activate secondary drains and areas of historic ridge and furrow cultivation.

4.4 Summary proposed interventions

The effects of implementation of the rehabilitation strategy and proposed interventions on the Zaalklapspruit wetland have been assessed by predicting the anticipated future state of the wetland with and without rehabilitation (**Table 10** and

Table 11). This was used to estimate hectare equivalents likely to be achieved through wetland rehabilitation activities following rehabilitation of each focal area.

Based on the Wet-Health assessments undertaken, it was predicted that **4.2** hectare equivalents would be rehabilitated or secured through initial planning. Further improvements amounting to 5.2 hectare equivalents are estimated through rehabilitation of the lower wetland area bringing estimated total gains to 9.4 hectare equivalents.

Table 10: Summary of anticipated outcomes from implementation of the initial rehabilitation strategy associated with 2012/13 planning[9].

		Status Quo	With Rehabilitation	Without Rehabilitation
Size of wetland (Ha)		135.3		
Impact Scores	**Hydrology**	3.9	3.7	4.0
	Geomorphology	1.1	0.8	1.2
	Vegetation	3.3	3.0	3.3
	Overall	2.9	2.7	3.0
Ecological Category		**C**	**C**	**C**
Hectare equivalents		95.8	99.1	94.9
Anticipated gains		4.2		

Table 11: Summary of anticipated outcomes from implementation of the full rehabilitation strategy (2012-2014 planning)

		Status Quo	With Rehabilitation	Without Rehabilitation
Size of wetland (Ha)		135.3		
Impact Scores	**Hydrology**	3.9	3.4	4.0
	Geomorphology	1.1	0.6	1.2
	Vegetation	3.3	2.3	3.3
	Overall	2.9	2.3	3.0
Ecological Category		**C**	**C**	**C**
Hectare equivalents		95.3	103.8	94.4
Anticipated gains		9.4		

Rehabilitation is currently underway in the mid-reaches of the wetland.

[9] Note that the actual area and associated PES scores differ slightly from the subsequent assessment due to refinements made following more detailed field investigations of the lower wetland area.

Table 12: Interventions currently under construction in the wetland

Intervention Number	Structure Type	Implementation order	Structure Cost (Excl. Vat)
B20G-01-201-00	Concrete weir	1	R158 400,00
B20G-01-202-00	Concrete weir	2	R195 700,00
B20G-01-203-00	Low concrete wall and removal of berms	4	R126 000,00
B20G-01-204-00	Earthworks - leveling	5	R51 750,00
B20G-01-205-00	Low concrete wall	6	R65 250,00
B20G-01-206-00	Concrete weir	12	R208 525,00
B20G-01-207-00	Concrete weir	13	R237 925,00
B20G-01-208-00	Earthworks - distribution berm	10	R153 750.00
B20G-01-209-00	Earthworks - berm	9	R162 785,00
B20G-01-210-00	Earthworks - berm	8	R63 275,00
B20G-01-211-00	Earthworks - berm	7	R40 875,00
B20G-01-212-00	Earthworks - distribution berm	11	R 108 375.00
B20G-01-213-00	Concrete weir	3	R154 000,00
		Total	**R 1 172 6610.00**

The new interventions that are proposed (

Figure 6) are discussed in detail in the subsequent sections of this report. The table below (**Table 13**) provides a summary of the new interventions. The "implementation order" as depicted in the table indicates the timing order in which interventions should be implemented within the wetland (number 1 first). The "priority" as depicted in the table indicates the relative importance of each intervention across the project as a whole – if interventions have to be omitted for any reason, those with the lowest priority (highest number) across the whole project should be omitted first.

Table 13: Summary of proposed new interventions, B20G-01

Intervention Number	Structure Type	Implementation order	Priority	Cost Estimate
B20G-01-214-00	Concrete	1	1	R 182 795.00
B20G-01-215-00	Rock Masonry	2	2	R 215 565.00
B20G-01-216-00	Rock Masonry	3	3	R 297 770.00
B20G-01-217-00	Rock Masonry	4	4	R 297 770.00
B20G-01-218-00	Rock Masonry	4	4	R 251 370.00
B20G-01-219-00	Rock Masonry	4	4	R 210 185.00
B20G-01-220-00	Rock Masonry	4	4	R 149 455.00

Intervention Number	Structure Type	Implementation order	Priority	Cost Estimate
B20G-01-221-00	Rock Masonry	5	5	R 91 460.00
B20G-01-222-00	Earth Works	7	7	R 324 650.00
B20G-01-223-00	Earth Works	6	6	R 22 482.00
B20G-01-224-00	Earth Works	7	7	R 49 265.00
B20G-01-225-00	Earth Berm	3	3	R 78 420.00
B20G-01-226-00	Earth Works	4	4	R 154 215.00
B20G-01-227-00	Earth Works	4	4	R 55 855.00
			Total	**R 2 381 257.00**

Please note that the location of the interventions described in section 4.5 may change as a result of changes in the landscape (due to continued erosion, for example) during the time period that has lapsed between the initial planning site visit and the actual implementation thereof.

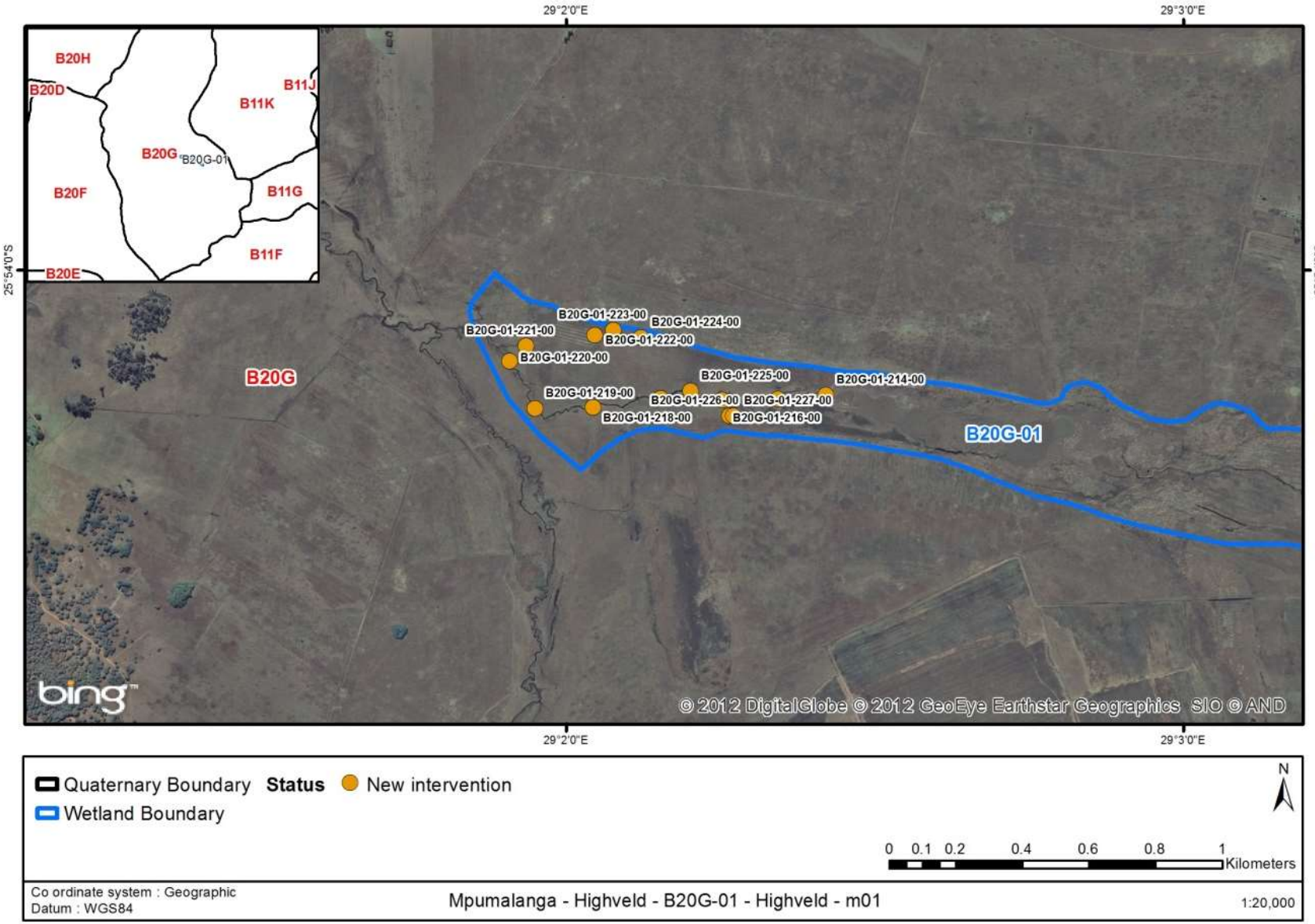

Figure 6: Wetland map, B20G-01 with proposed new wetland interventions indicated.

4.4.1 Design selection and sizing

The main aim of the interventions is to increase the water quality improvement functions of the wetland. This will mostly be achieved by increasing saturation and facilitate re-activation of adjacent wetland by elevating water levels in main drain and deactivating erosion and side drains/furrows.

The selection of design type was done to allow as low as possible freeboard to result in a maximum increase of water level in the channel during low flows and spill over into adjacent wetland during higher flows. The materials were selected considering availability and the combination of practical constructability and optimum person days required for construction thereof.

4.5 Intervention designs

4.5.1 Intervention: B20G-01-214-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Concrete Weir
Rehabilitation Objective	Construct a side inlet concrete weir to prevent head cut progressing and to increase the water level in the channel to the maximum height. High flows to flood over onto the northern side of the wetland.
Latitude (DºM'S")	25° 54’ 12.10"S
Longitude (DºM'S")	29° 02’ 25.30"E
Engineering Drawings	B20G-01-214-00
Alternatives considered	Gabions, but the footprint area would have been larger and the design parameters could not be achieved with gabions.

Figure 7: New concrete weir B20G-01-214-00

4.5.1.1 Bill of quantities: B20G-01-214-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete	m^3	34.3	R 5 250	R 5 250
Earth Works Volume	m^2	160	R 17	R 2 720
Total				**R 7 970**

4.5.1.2 Construction Notes

The diversion is to be constructed at an angle across the channel to divert flows to the right hand side.

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile). i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.2 Intervention: B20G-01-215-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Stone masonry drop-inlet weir
Rehabilitation Objective	Construct a stone masonry drop-inlet weir to de-activate secondary drain and potential for head-cut formation. Increase saturation and facilitate re-activation of adjacent wetland by elevating water levels in main drain.
Latitude (DºM'S")	25° 54’ 12.50"S
Longitude (DºM'S")	29° 02’ 20.60"E
Engineering Drawings	B20G-01-215-00
Alternatives considered	Gabions, but the footprint area would have been larger and the design parameters could not be achieved with gabion spillway.

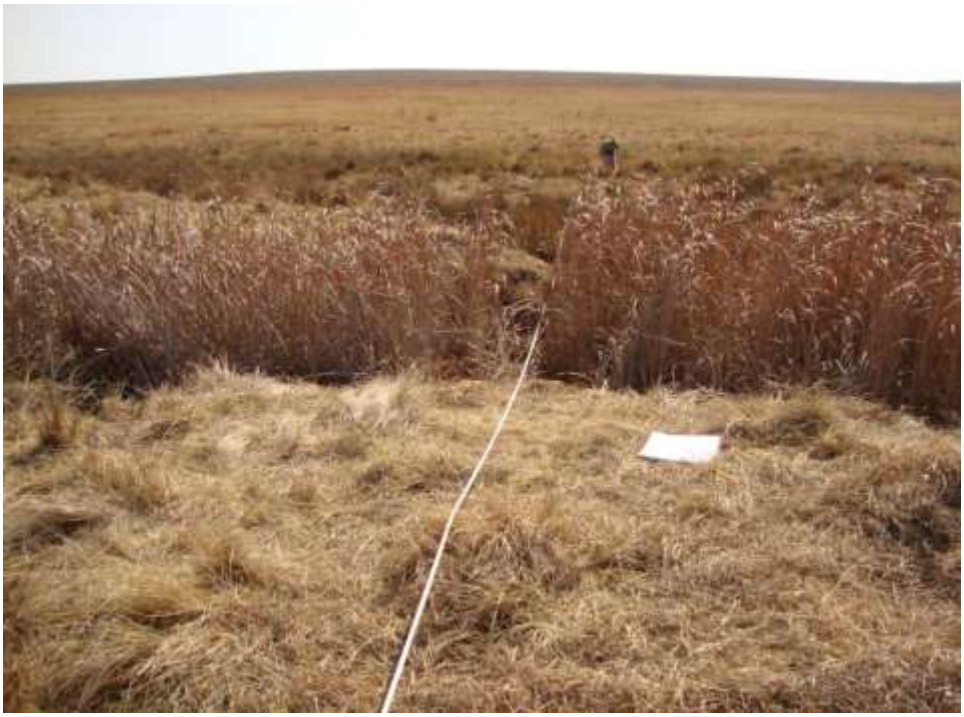

Figure 8: Stone masonry drop-inlet weir B20G-01-215-00

4.5.2.1 Bill of quantities: B20G-01-215-00

Item	Units	Quantity	Unit Cost	Item Cost
Stone masonry	m^3	38.6	R 5 000	R 193 000
Gabions	m^3	4.3	R 3 350	R 14 405
Earth Structure (Berm)	m^3	6.8	R 900	R 6,120
Revegetate	m^2	120	R 17	R 2,040
			Total	**R 215 565**

4.5.2.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)

d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.
e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:

i. on flat surfaces, loosen the soil with a fork, and
ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.3 Intervention: B20G-01-216-00

Designer	C. Blaauw
Design Date	August 2013
Intervention Description	Stone masonry drop-inlet weir
Rehabilitation Objective	Stone masonry drop-inlet weir. Increase the water level in the channel during low flows and spilling high flows out of the channel (re-wet the area currently drained by the channel). Flood secondary erosion channel and upstream drain.
Latitude (DºM'S")	25° 54’ 12.60"S
Longitude (DºM'S")	29° 02’ 15.20"E
Engineering Drawings	B20G-01-216-00
Alternatives considered	Gabions, but the footprint area would have been larger and the design parameters could not be achieved with gabion spillway.

Figure 9: Stone masonry drop-inlet weir

4.5.3.1 Bill of quantities: B20G-01-216-00

Item	Units	Quantity	Unit Cost	Item Cost
Stone masonry	m^3	56.3	R 5 000	R 281 500
Gabions	m^3	4.4	R 3 350	R 14 740
Revegetate	m^2	90	R 17	R 1 530
Total				**R 215 565**

4.5.3.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.4 Intervention: B20G-01-217-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Stone masonry drop-inlet weir
Rehabilitation Objective	Construct a Stone masonry drop-inlet weir to increase the water level in the channel during low flows and spilling high flows out of the channel (re-wet the area currently drained by the channel).
Latitude (DºM'S")	25° 54’ 12.40"S
Longitude (DºM'S")	29° 02’ 09.20"E
Engineering Drawings	B20G-01-217-00
Alternatives considered	Gabions, but the footprint area would have been larger and the design parameters could not be achieved with gabion spillway.

Figure 10: Stone masonry drop-inlet weir B20G-01-217-00

4.5.4.1 Bill of quantities: B20G-01-217-00

Item	Units	Quantity	Unit Cost	Item Cost
Stone masonry	m^3	56.3	R 5 000	R 281 500
Gabions	m^3	4.4	R 3 350	R 14 740
Revegetate	m^2	90	R 17	R 1 530
Total				**R 215 565**

4.5.4.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.5 Intervention: B20G-01-218-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Stone masonry drop-inlet weir & road crossing
Rehabilitation Objective	Construct a stone masonry drop-inlet weir to increase the water level in the channel during low flows and spilling high flows out of the channel (re-wet the area currently drained by the channel).
Latitude (DºM'S")	25° 54’ 13.30"S
Longitude (DºM'S")	29° 02’ 02.60"E
Engineering Drawings	B20G-01-218-00
Alternatives considered	Gabions, but the footprint area would have been larger and the design parameters could not be achieved with gabion spillway.

Figure 11: Stone masonry drop-inlet weir and road crossing, B20G-01-218-00

4.5.5.1 Bill of quantities: B20G-01-218-00

Item	Units	Quantity	Unit Cost	Item Cost
Stone masonry	m^3	46.4	R 5 000	R 232 000
Gabions	m^3	5.3	R 3 350	R 17 755
Revegetate	m^2	95	R 17	R 1 615
Total				**R 251 370**

4.5.5.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.6 Intervention: B20G-01-219-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Stone masonry drop-inlet weir
Rehabilitation Objective	Construct a stone masonry drop-inlet weir to increase the water level in the channel during low flows and spilling high flows out of the channel (re-wet the area currently drained by the channel).
Latitude (DºM'S")	25°54’13.40” S
Longitude (DºM'S")	29°01’57.00” E
Engineering Drawings	B20G-01-219-00
Alternatives considered	Gabions, but the footprint area would have been larger and the design parameters could not be achieved with gabion spillway.

Figure 12: Stone masonry drop-inlet weir, B20G-01-219-00

4.5.6.1 Bill of quantities: B20G-01-219-00

Item	Units	Quantity	Unit Cost	Item Cost
Stone masonry	m^3	38.8	R 5 000	R 194 000
Gabions	m^3	4.4	R 3 350	R 14 740
Revegetate	m^2	85	R 17	R 1 445
Total				**R 210 185**

4.5.6.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.7 Intervention: B20G-01-220-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Stone masonry drop-inlet weir.
Rehabilitation Objective	Construct a Stone masonry drop-inlet weir to increase the water level in the channel during low flows and spilling high flows out of the channel (re-wet the area currently drained by the channel).
Latitude (DºM'S")	25° 54’ 08.80"S
Longitude (DºM'S")	29° 01’ 54.50"E
Engineering Drawings	B20G-01-220-00
Alternatives considered	Gabions, but the footprint area would have been larger and the design parameters could not be achieved with gabion spillway.

Figure 13: Stone masonry drop-inlet weir, B20G-01-220-00

4.5.7.1 Bill of quantities: B20G-01-220-00

Item	Units	Quantity	Unit Cost	Item Cost
Stone masonry	m^3	25.8	R 5 000	R 129 000
Gabions	m^3	5.7	R 3 350	R 19 095
Revegetate	m^2	80	R 17	R 1 360
Total				**R 149 455**

4.5.7.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.8 Intervention: B20G-01-221-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Stone masonry drop-inlet weir
Rehabilitation Objective	Construct a Stone masonry drop-inlet weir to increase the water level in the channel during low flows and spilling high flows out of the channel (re-wet the area currently drained by the channel).
Latitude (DºM'S")	25°54'07.30" S
Longitude (DºM'S")	29°01'56.10" E
Engineering Drawings	B20G-01-221-00
Alternatives considered	Gabions, but the footprint area would have been larger and the design parameters could not be achieved with gabion spillway.

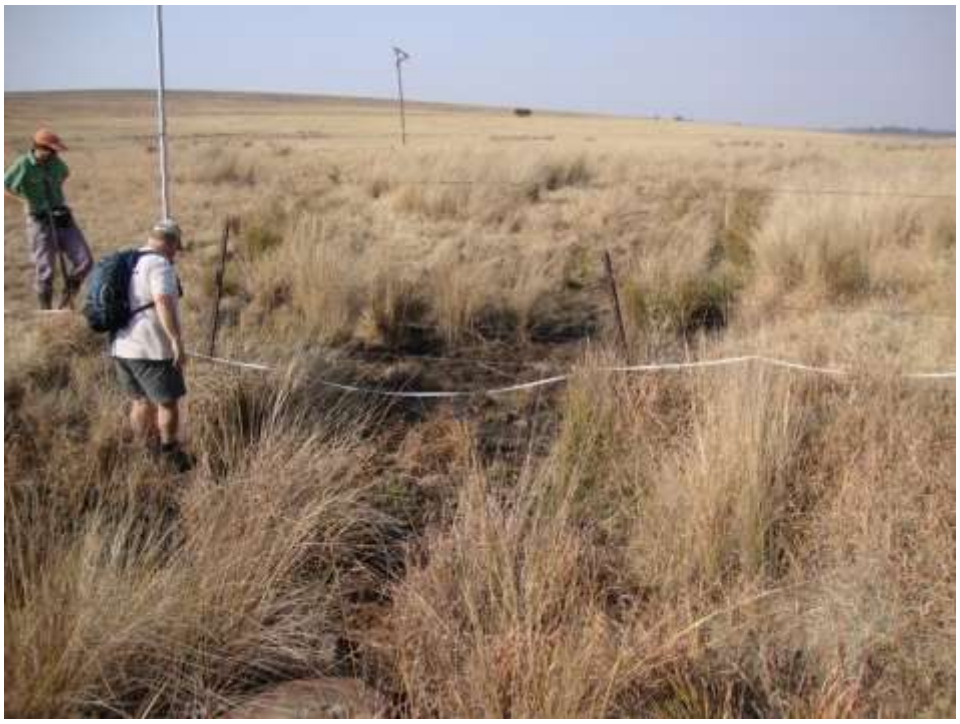

Figure 14: Stone masonry drop-inlet weir, B20G-01-221-00

4.5.8.1 Bill of quantities: B20G-01-221-00

Item	Units	Quantity	Unit Cost	Item Cost
Stone masonry	m^3	13.9	R 5 000	R 69 500
Gabions	m^3	6.2	R 3 350	R 20 770
Revegetate	m^2	70	R 17	R 1 190
Total				**R 215 565**

4.5.8.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.9 Intervention: B20G-01-222-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Earth works (cut & fill) and re-vegetate
Rehabilitation Objective	Earth Works (Cut & fill to NGL to improve natural water distribution and retention patterns by de-activating areas affected by historic ridge & furrow cultivation..
Latitude (DºM'S")	25°54'06.30" S
Longitude (DºM'S")	29°02'02.80" E
Engineering Drawings	B20G-01-222-00
Alternatives considered	N/A

Figure 15: Earth works (cut & fill) and re-vegetate B20G-01-222-00

4.5.9.1 Bill of quantities: B20G-01-222-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Works (Cut and fill)	m^3	550	R 309	R 169 950
Revegetate	m^2	9100	R 17	R 154 700
Total				**R324 650**

4.5.9.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.10 Intervention: B20G-01-223-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Earth works (fill) and re-vegetate
Rehabilitation Objective	Construct alternating earth plugs and revegetate plugs to de-activate lateral side drain in order to reinstate natural flows.
Latitude (DºM'S")	25º 54’ 05.8” S
Longitude (DºM'S")	29 º 02 ‘04.6 “E
Engineering Drawings	B20G-01-223-00
Alternatives considered	N/A

Figure 16: Earth works (fill) and re-vegetate, B20G-01-223-00

4.5.10.1 Bill of quantities: B20G-01-223-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Works (Fill)	m^3	48	R 309	R 14 832
Revegetate	m^2	450	R 17	R 7 650
Total				**R22 482**

4.5.10.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.11 Intervention: B20G-01-224-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Earth Works (cut & fill) and re-vegetate
Rehabilitation Objective	Cut & fill to NGL to improve natural water distribution and retention patterns by de-activating areas affected by historic furrow drainage during cultivation.
Latitude (DºM'S")	25º 54' 06.5" S
Longitude (DºM'S")	29º 02' 07.3" E
Engineering Drawings	B20G-01-224-00
Alternatives considered	N/A

Figure 17: Earth Works (cut & fill) and re-vegetate, B20G-01-224-00

4.5.11.1 Bill of quantities: B20G-01-224-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Works (Cut and fill)	45	550	R 309	R 13 905
Revegetate	m^2	2080	R 17	R 35 360
			Total	**R49 265**

4.5.11.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1^{st} sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.12 Intervention: B20G-01-225-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Earth structure (earthen berm) and re-vegetate
Rehabilitation Objective	Construct Earthen berm with Stone masonry drop inlet & outlet pipe (into main channel) to stabilize head-cuts created by cattle paths.
Latitude (DºM'S")	25º 54'11.7" S
Longitude (DºM'S")	29º 02'12.1" E
Engineering Drawings	B20G-01-225-00
Alternatives considered	Gabions that may have resulted in higher construction cost.

Figure 18: Earth structure (earthen berm) and re-vegetate, B20G-01-225-00

4.5.12.1 Bill of quantities: B20G-01-225-00

Item	Units	Quantity	Unit Cost	Item Cost
Stone masonry	m^3	4	R 5 000	R 20 000
Earth Structure (Berm)	m^3	60	R 900	R 54 000
Revegetate	m^2	260	R 17	R 4 420
Total				**R 215 565**

4.5.12.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.13 Intervention: B20G-01-226-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Earth works (cut & fill) and re-vegetate
Rehabilitation Objective	Cut & fill to NGL to improve natural water distribution and retention patterns by de-activating areas affected by historic drain in order to promote diffuse flows across the wetland.
Latitude (DºM'S")	25º 54' 14.1 "S
Longitude (DºM'S")	29º 02' 15.9" E
Engineering Drawings	B20G-01-226-00
Alternatives considered	Hard interventions at much higher cost

Figure 19: Earth works (cut & fill) and re-vegetate, B20G-01-226-00

4.5.13.1 Bill of quantities: B20G-01-226-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Works (Cut and fill)	m^3	235	R 309	R 72 615
Revegetate	m^2	4 800	R 17	R 81 600
Total				**R154 215**

4.5.13.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.5.14 Intervention: B20G-01-227-00

Designer	C. Blaauw
Design Date	November 2013
Intervention Description	Earth works (fill) and re-vegetate
Rehabilitation Objective	Construct alternating earth plugs and revegetate plugs to de-activate secondary drain and allow flows to move diffusely over wetland.
Latitude (DºM'S")	25 º 54’ 14.1” S
Longitude (DºM'S")	29 º 02’ 16.3” E
Engineering Drawings	B20G-01-227-00
Alternatives considered	Hard interventions at much higher cost

Figure 20: Earth works (fill) and re-vegetate, B20G-01-227-00

4.5.14.1 Bill of quantities: B20G-01-227-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Works (Fill)	m^3	145	R 309	R 44 805
Revegetate	m^2	650	R 17	R 11 050
Total				**R55 855**

4.5.14.2 Construction Notes:

Stilling basin DS may not be required due to backwater pool from DS intervention. General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

The following is guidance for working within an area with soils with high organic matter content.

General:

a. Work only in low rainfall periods,
b. Prevent compaction of the soil,
c. Prevent draining, drying and desiccation of soil,
d. Use the general BMP of the WfWet manual for working within wetlands, and
e. Do not bring in any foreign vegetable matter (e.g. mulch) into the wetland area (especially from alien species).

Entering the wetland:

a. Prevent compaction (and thus potential channelling and erosion) of by not driving into the wetland.
b. However if required to drive into the wetland, then spread the weight of traffic (using walkways, boardwalks, geotextiles etc.). Construction workers and wheelbarrows should use these enforced paths as well.

Excavations (pre-construction):

a. Remove soil in the form of sods (20- 40 x20x20cm)
b. 1st sod layer must include the Rhizome layer (20cm intervals might be a bit too thin for *Phragmites*, but then it might be too difficult to work on thicker sods so keep it at 20cm increments).
c. Cut vegetation short if it will make handling easier. Use cut vegetation as mulch (see next point)
d. Store soil of different layers in different spots (stockpile soils according to the different soil layers as per the soil profile), in order not to mix layers of profile.

e. Cover with mulch or cloth (geotextile) and keep at least 40% moisture If possible, stockpile soils in piles as high as possible (to retain moisture).

Construction – maintain moisture (if work continues into wet season make sure stockpiled soil will not be flooded – removes top rhizome layer at least).

Post-construction

a. Replace sods back into the system in the same order/ layers as to what is naturally occurring (according to the profile) i.e. replace deeper layers 1st with rhizospheres layer on top.
b. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
c. If sods are not at 90%+ moisture then peg them with wooden stakes.
d. Mulch the site (or use cloth/geotextile).
e. Fence livestock out for at least 2 seasons (or brush pack).
f. If compaction took place then:
    i. on flat surfaces, loosen the soil with a fork, and
    ii. on paths with slopes, put/ create small contour berms.

Draining/pumping

a. If any draining was done during construction, ensure that no preferential flow takes place in the drain after infilling.
b. All decanting points should have energy dissipaters

4.6 Construction Environmental Management Plan issues

The proposed rehabilitation is to be undertaken on privately owned land and the project team should access the site and manage the site in accordance with the WfWetlands Best Management Practices and specific requirements of the landowner. The implementation of these interventions must also take into account all relevant provisions of WfWetlands Best Management Practices and the Construction Environmental Management Plan, the recommendations of the approved Basic Assessments and EA for the project.

The general construction notes, the Construction phase EMP (CEMP) are included as Appendix B and F.

4.7 Wetland management recommendations

The system is currently utilised for livestock grazing, but following the implementation of the rehabilitation activities parts of the system may become inaccessible for livestock, particularly during the wet season. The landowner should consider fencing the wetland and managing livestock access to limit grazing to the winter months.

4.8 Baseline Monitoring and Evaluation (M&E) data

The collection of baseline information was carried out to show changes in the system associated with the wetland rehabilitation activities.

4.8.1 Baseline WET-Health data

The assessment of the current level of ecological integrity of the wetland system provides a baseline assessment for comparative assessments that would be carried out for monitoring purposes 3 years after completion of the wetland rehabilitation activities. The following WET-Health information was collected for the wetland (Refer to **Appendix A**):

Wetland No	Ha	Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
B20G-01	139	3.9	0	1.1	0	3.3	0
PES Categories		C	→	B	→	C	→
Wetland Impact Score		2.92					
Wetland PES		C					