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PHASE 2 - PLANNING REPORT FINAL REHABILITATION PLAN

WAKKERSTROOM
V31A
W42C



February 2013



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South African National Biodiversity Institute

REHABILITATION PLAN FOR WAKKERSTROOM, W42C, MPUMALANGA

MAIN REPORT

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South African National Biodiversity Institute:**Planning, monitoring and evaluation****DISCLAIMER**

- The intervention points and wetland boundary polygons provided in this report are based on the shapefiles that have been provided by SANBI. The datasets included in the Phase 1 Reports have been updated by the Wetland ecologists and verified by the SANBI Provincial Co-ordinators. All reasonable efforts have therefore been made to ensure that the data is accurate. However 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 the responsible Aurecon Engineer, SANBI Provincial Coordinator 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 above mentioned limitation of Aurecon's liability.

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 (Environmental Assessment Practitioner (EAP), Engineer, Wetland Ecologist, and SANBI Provincial Coordinators (PC)) and their subsequent input into the Reporting, which includes intervention design drawings, the wetland 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.

- The level of planning carried out for each project area was dependant on the information contained in the final Phase 1 reports (2011), and in some cases, previously prepared Rehabilitation Plans (2012); along with the Phase 2 site visits that were undertaken during 2012. This document should therefore be read in conjunction with any existing, project-related reports (i.e. FinalPhase 1 or previous rehabilitation plans).
- 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 Provincial Coordinators 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 Report and the associated Basic Assessment Report.
- Rehabilitation activities should not be carried out until the final Wetland Rehabilitation Plan has been approved 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 submitted for Environmental Authorisation 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 and 2012/2013 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 2013/14 PIP.

- Should it be necessary to exclude interventions from the rehabilitation plan, the prioritisation of interventions across the project should strictly be followed.

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&As). 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. Final Phase 1 Report – August 2010; and
2. Other Phase 2 Planning Reports which include the:
 - a. Basic Assessment Report,
 - b. Wakkerstroom Rehabilitation Plan (February 2012), and the
 - c. Wetland Assessment (**Appendix A** of this report).

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National stakeholders				
Refer to Appendix G below			✓(email notification)	
Provincial stakeholders & I&APs				
Refer to Appendix H below.			✓(email notification)	

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Context of the information contained in this Rehabilitation plan in terms of the NEMA information requirements for BARs

The environmental assessment process undertaken to date has culminated in the production of a Final Basic Assessment Report (BAR) and associated Final rehabilitation plans, which provide detailed information relevant to the projects in the Western Cape Province.

In order to guide and focus the reader, the Table below indicates where in the Final Phase 2 reports (the BAR and/ or the Final Rehabilitation Plan) the requisite information as outlined in NEMA can be found:

Table 1: Context of report in terms of NEMA requirements

REGULATION	CONTENT AS REQUIRED BY NEMA	SECTION / ANNEXURE
22(2) (a)	(i) Details of the EAP who prepared the report; and	<i>Introduction of the Final Mpumalanga BAR</i>
	(ii) Details of the expertise of the EAP to carry out basic assessment procedures;	<i>Introduction of the Final Mpumalanga BAR</i>
22(2) (b)	A description of the proposed activity;	<i>Section B Final Mpumalanga BAR; Final Wakkerstroom Rehabilitation Plan</i>
22(2) I	A description and a map of the property on which the activity is to be undertaken and the location of the activity on the property,	<i>Final Wakkerstroom Rehabilitation Plan</i>
22(2) (d)	A description of the environment that may be affected by the proposed activity and the manner in which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity;	<i>Final Wakkerstroom Rehabilitation Plan</i>
22(2) I	An identification of all legislation and guidelines that have been considered in the preparation of the basic assessment report;	<i>Section B of the Final Mpumalanga BAR</i>
22(2) (f)	Details of the public participation process conducted in terms of regulation 21(a) in connection with the application, including –	<i>Section D of the Final Mpumalanga BAR</i>
	(i) The steps that were taken to notify potentially interested and affected parties of the proposed application;	<i>Section D of the Final Mpumalanga BAR</i>

	(ii) Proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the proposed application have been displayed, placed or given;	Appendix E of the Final Mpumalanga BAR
	(iii) A list of all persons, organisations and organs of state that were registered in terms of Regulation 55as interested and affected parties in relation to the application;	Appendix E of the Final Mpumalanga BAR
	(iv) A summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues;	Appendix E of the Final Mpumalanga BAR
22(2) (g)	A description of the need and desirability of the proposed activity	Executive summary Section B of Final Mpumalanga BAR
22 (2) (h)	A description of identified alternatives to the proposed activity that are feasible and reasonable, including advantages and disadvantages that the proposed activity or alternatives will have on the environment and on the community that may be affected by the activity;	Executive summary Section B of Final Mpumalanga BAR
22(2) (i)	A description and assessment of the significance of any environmental impacts, including cumulative impacts, that may occur as a result of the undertaking of the activity or identified alternatives or as a result of any construction, erection or decommissioning associated with the undertaking of the activity;	Section E of the Final Mpumalanga BAR
22(2) (j)	Any environmental management and mitigation measures proposed by the EAP;	Section E of the Final Mpumalanga BAR
22(2) (k)	Any inputs made by specialists to the extent that may be necessary; and	Wetland assessments attached to the Final Wakkerstroom Rehabilitation Plan
22 (2) (l)	a Final environmental management programme containing the aspects contemplated in regulation 33	Appendix G of the Final Mpumalanga BAR
22 (2) (m)	a description of any assumptions, uncertainties and gaps in knowledge	Context of BAR, Final Mpumalanga BAR
22 (2) (n)	a reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation	Section E of the Final Mpumalanga BAR

22 (2) (o)	any representations, and comments received in connection with the application or the basic assessment report	Appendix E, Final Mpumalanga BAR
22 (2) (p)	the minutes of any meetings held by the EAP with interested and affected parties and other role players which record the views of the participants	Appendix E, Final Mpumalanga BAR
22 (2) (q)	any responses by the EAP to those representations, comments and views	Appendix E, Final Mpumalanga BAR
22(2) I	Any specific information required by the competent authority.	-
22 (2) (s)	any other matters required in terms of sections 24(4)(a) and (b) of the Act.	-
22(3) (a)	A BAR must take into account any relevant guidelines; and;	Section B of the Final Mpumalanga BAR
22(3) (b)	A BAR must take into account any practices that have been developed by the competent authority in respect of the kind of activity which is the subject of the application.	-

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

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 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 watertable (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 (m³/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 of 1998).

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).

1. WORKING FOR WETLANDS PROGRAMME OVERVIEW

Working for Wetlands is a government programme (similar to Working for Water, Working on Fire and LandCare) 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). While the programme's primary focus is wetland rehabilitation, the protection, rehabilitation and sustainable use of those wetlands is simultaneously entrenched within the programme's core aims and objectives.

1.1 Vision and Objectives

The vision of Working for Wetlands 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.

Given this approach of linking wetland conservation to sustainable economic development, the 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. Projects are thus focused on rehabilitation, 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.

1.2 Budget and Scope of Work

The programme started off with a R20 million budget that was implemented across 14 projects in 2001. The budget has been increasing steadily and so has the number of projects implemented and beneficiaries employed. The programme is currently implemented across 35 projects countrywide with a budget of R83 million and employs over 1500 workers. The programme makes use of external support to implement its work. Seventeen 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.

Local people are recruited to work in projects. Wage information sourced from the best practice guidelines suggests that workers and contractors would be paid daily rates of R 82 and R 251¹ 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.

Typical activities undertaken within the projects include:

- The construction of structures to control erosion in the wetland, trap sediment and raise water tables;
- The control of invasive alien plants within the immediate catchment, and in the wetland;
- Plugging of artificial drainage channels in the wetland;
- Addressing offsite causes of degradation in the catchment;
- Raising awareness of wetlands among workers, landowners and the general public;
- Providing adult basic education and training, and technical skills, and;
- Developing management plans for the rehabilitated wetlands.

In response to DEA's request to increase the labour component of all government funded projects, the Working for Wetlands project team has had to consider and where practically feasible incorporate softer, more labour intensive ways of rehabilitating wetlands in order to obtain the increased labour component. Accordingly as part of the planning for Phase 2, project team members have factored this requirement into their planning when designing for structures for wetland rehabilitation. This requirement has also had a direct impact on the wetlands that are to be rehabilitated. In some instances where wetlands have already been prioritised for rehabilitation for example, should the particular wetland require hard engineering (concrete structures for example) which require less labour than softer structures, the project team may decide to find other areas within which to work and/ or investigate other rehabilitation options that are more labour intensive for that area.

1.3 Training and Capacity Building

Working for Wetlands has established a working relationship with the Department of Public Works through the Working for Water programme. This

¹without a Supervisor

partnership provides accredited training in accordance with the special public works Code of Good Practice agreements. Capacity building by Working for Wetlands 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 Working for Wetlands as an expanded public works programme, 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.

1.4 Support for Government, Non-Government And Private Agencies

Working for Wetlands 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. Working for Wetlands 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.

The strategic framework of Working for Wetlands 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.

1.5 Legislative Context

Working for Wetlands operates within the context of the Constitution 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. Other national legislation that protects the environment includes the:

Table 2: Summary of applicable legislation

Title of legislation, policy or guideline:	Administering authority:	Date:
The Constitution of South Africa (Act 108)	National Government	1996
National Environmental Management Act (107)	Department of Environmental Affairs	1998
National Environmental Management Act (107) Amendment Act	Department of Environmental Affairs	1998
The National Water Act (36)	Department of Water Affairs	1998
Conservation of Agricultural Resources Act (43)	Department of Agriculture, Forestry & Fisheries	1983
National Heritage Resources Act (25)	National Heritage Resources Agency	1999
World Heritage Conventions Act (49)	Department of Environmental Affairs	1999
The National Environmental Management: Biodiversity Act (10)	Department of Environmental Affairs	2004
National Environmental Management: Protected Areas Act (57)	Department of Environmental Affairs	2003
The Mountain Catchments Areas Act (63)	Department of Water Affairs	1970
EIA Guideline Series, in particular: <ul style="list-style-type: none"> • 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) 	Department of Environmental Affairs	

Title of legislation, policy or guideline:	Administering authority:	Date:
Mpumalanga Biodiversity Conservation Plan	Department of Economic Development & Environmental Affairs/ Mpumalanga Tourism and Parks Agency (MTPA)	
International Conventions, in particular: <ul style="list-style-type: none"> • 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) 		

This legislation informs and guides the Working for Wetlands programme in terms of its vision and objectives, whilst simultaneously regulating the wetland rehabilitation activities which Working for Wetlands carries out. Working for Wetlands has put in place systems to achieve compliance with all legislation. For example, Basic Assessments for Environmental Authorisation are carried out for all listed activities involved in wetland rehabilitation to comply with NEMA.

In terms of Section 39 of the National Water Act (No. 36 of 1998) (NWA), a General authorisation² (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 watercourse³' and 'altering the bed, banks, course or characteristics of a watercourse⁴' where they are specifically undertaken for the purposes of rehabilitating⁵ a wetland for conservation purposes.

A Memorandum of Agreement has been entered into between the DAFF, DEA, DWA and SANBI for the Working for Wetlands programme. Through co-operative governance and partnerships, this Agreement aims to streamline the authorisation processes to facilitate efficient processing of applications for

²Government Notice No. 1198, 18 December 2009

³Section 21(c) of the NWA, No. 36 of 1998

⁴Section 21(i) of the NWA, No. 36 of 1998

⁵Defined 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"

authorisation of wetland rehabilitation activities under CARA, NEMA and NWA respectively.

In terms of the National Heritage Resources Act (No. 25 of 1999) (NHRA), Section 38; “any person who intends to undertake a development categorised as-

- (a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- (b) the construction of a bridge or similar structure exceeding 50 m in length;
- (c) any development or other activity which will change the character of a site-
 - (i) exceeding 5 000 m² in extent; or
 - (ii) involving three or more existing erven or subdivisions thereof; or
 - (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
 - (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
- (d) the re-zoning of a site exceeding 10 000 m² in extent; or
- (e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority,”

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.

Section 38(8) of the NHRA specifically excludes the need for a separate HIA where the evaluation of the impact of a development on heritage resources is required in terms of an EIA process. Accordingly, since the impact on heritage resources would be considered as part of the EIA process outlined here, no separate HIA would be required. SAHRA or the relevant provincial heritage agency would review the EIA reports and provide comments to DEA, who would include these in their final environmental decision. However, should a permit be required for the damaging or removal of specific heritage resources, a separate application would have to 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. It has been proposed that preliminary desktop analysis of the various proposed project areas be conducted to allow SAHRA and, where applicable, the provincial heritage authorities opportunity to provide guidance on whether further, detailed assessments are required.

2. INTRODUCTION

Aurecon South Africa (Pty) Ltd was appointed by SANBI to undertake the various project activities and associated reporting required for the various phases of the rehabilitation planning cycle. These included Phase 1 Reports, the wetland rehabilitation plans as well as the Basic Assessment Reports required for each project area within all nine provinces. Figure 1, below, graphically depicts the entire planning process employed by Working for Wetlands to rehabilitate wetlands.

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 Provincial Coordinators 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.

The Phase 1 prioritisation and identification of wetlands thereof for rehabilitation planning is described in the separate Phase 1 Planning Report for each project.

The 2013/2014 planning approach has been one of consolidation, with limited additional Phase 2 planning. As a result only eight (8) new wetlands, in four (4) provinces have been prioritised for site visits this year (2012). All previously planned and designed interventions will be included in the 2013/2014 implementation period, along with maintenance, alien clearing, and any new interventions which receive authorisation in the current planning phase.

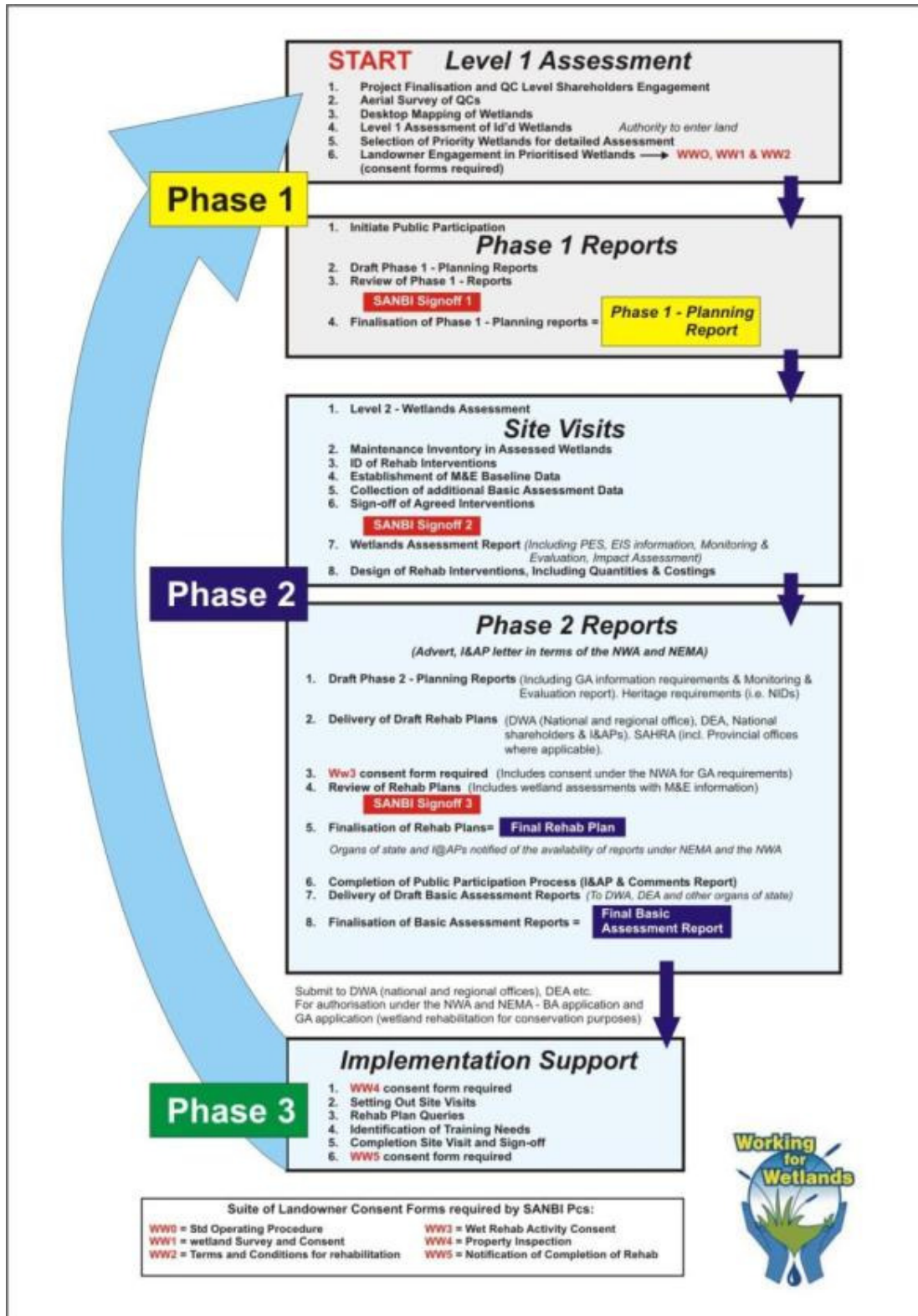


Figure 1: The three phases that must be undertaken for the successful rehabilitation of wetlands

This document comprises the wetland rehabilitation plan for the Wakkerstroom project and will be the primary working document for the implementation of the project via construction/ undertaking of interventions⁶ required for wetland rehabilitation. The document details the general methodology that has been adopted for the planning of rehabilitation interventions for identified wetlands. Details of the rehabilitation plan for each wetland and the individual intervention designs within each wetland are then presented, along with baseline Monitoring and Evaluation (M&E) data. Detailed wetland assessment reports and design drawings are included as appendices in this report.

Basic Assessment Reports are compiled as separate documents (one for each province) and are submitted to National DEA for their environmental authorisation decision. This Rehabilitation Plan is attached as an Appendix to the BAR and is therefore also submitted to DEA for their consideration as part of their decision-making process.

Upon approval of this wetland 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.

⁶ This could include soft options such as alien clearing, eco-logs, gabion structures as well as hard structures, for example weirs.

3. GENERAL METHODOLOGY

The wetlands that were prioritised for further detailed assessment in the Phase 1 planning stage were assessed in detail during the fieldwork. This assessment is described in detail below.

Increased labour requirement for the WfWetlands Programme (refer to Section 1.2 above).

As a result of the increased labour requirement for the WfWet programme, the project team were required to investigate more labour intensive intervention options for wetland rehabilitation. These included soft engineering options such as berms, eco-logs as well as alien clearing.

This also resulted in the project team having to investigate other wetland areas in order to meet this requirement. Consequently, some of the wetlands prioritised during Phase 1 would not be rehabilitated during this planning year (due to the large amount of hard engineering required), while new additional wetlands were identified during the Phase 2 site visits as their rehabilitation requirements contributed towards meeting the increased labour component for the programme.

Rehabilitation work within floodplain systems

Based on lessons learnt and project team discussions 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.

3.1 Site Visits

Site visits to prioritised wetlands were conducted by project teams consisting of:

- a Wetland Ecologist,
- an Engineer,
- an Environmental Assessment Practitioner,
- the Working for Wetlands Provincial Coordinator, and where possible and/ or appropriate,
- the Implementing Agent's Project Manager.

One Phase 2 site visit was undertaken for the following project:

1. Goedgevonden: 16 August 2012
2. Paardeplaats: 17 August 2012

3.2 Wetland Assessments

The time and resources required for detailed assessments 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:

Description of the hydro-geomorphic setting of the wetland according to Kotze *et al.* (2005);

Verification and description of the overall health of the wetland at a Level 1 assessment using WET-Health (Macfarlane *et al.*, 2006);

Based on the above findings, identification of specific impacts and/or threats to be addressed by structural rehabilitation and description of these at a Level 2. For example, 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 would be 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 would assist the wetland specialist in choosing 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 will make to improving wetland health and ecosystem delivery through addressing the identified impacts/threats would be 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 would directly link into the *WfWet* Monitoring and Evaluation Framework.

The following steps were followed to assess the contribution of rehabilitation interventions within each wetland system:

- Identify the spatial area likely to be affected by the proposed intervention/s.
- Assess the benefits that are likely to result from achievement of the rehabilitation objective/s 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*) would be compared with the situation with rehabilitation. For health, both situations would be scored on a scale of 0 (critically altered) to 10 (pristine), and this would be undertaken for the hydrology, geomorphology and vegetation components of health. The benefit achieved would be 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 Assessment Reports.

3.2.1 Identification and Location of Intervention Designs

The project teams evaluated the various rehabilitation intervention options available and selected the most appropriate to achieve the rehabilitation objectives for the wetland which included factoring in the increased labour component as required by DEA. Any previously planned interventions that had not been implemented or included into the 2012/13 PIPs 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 interventions had been decided by the planning team, the engineer, in consultation with the wetland specialist, was responsible for choosing the most appropriate designs and locations for the identified rehabilitation interventions in order to achieve the identified rehabilitation objectives. GPS coordinates and digital photographs – sufficiently detailed to clearly identify the locations were taken for record purposes. Appropriate dimensions of the locations were measured in order to be able to design and calculate quantities for the interventions.

3.2.2 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 intervention	to
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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. This is illustrated in the 'new intervention number column' in Table 6 in section 4.5 below.

3.3 Collection of Monitoring and 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 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 would gather the additional data required for M&E baselines which would include 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 would be signed off by the WfWet provincial coordinator and landowner, as indicated by SANBI Signoff 2 in Figure 1.

3.4 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:

1. A hydrological assessment is made to quantify the volume of water expected to be dealt with by the intervention for various recurrence intervals. The results of this assessment allow the engineer to select a design flow to be applied to the intervention.
2. Soil types and their anticipated characteristics are assessed including DCP results or geotechnical investigations where these have been undertaken.
3. Construction materials are selected based on a range of site specific criteria including expected velocities, availability of materials such as rock, labour intensive targets, maintenance requirements etc.
4. Interventions are designed based on the above so that they will meet the objectives for wetland rehabilitation.
5. The designs are 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 is included for gabion structures to improve design clarity for the implementers.
6. Bills of quantities are calculated for the designs and cost estimates made based on unit costs and norms for each project area, as agreed with WfWet.
7. The estimated budget allocation towards labour is indicated.
8. Maintenance requirements for existing interventions in the assessed wetlands are similarly detailed and costs calculated.

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

3.5 Development of Rehabilitation Plans

The standardised rehabilitation plan format has previously been approved by WfWet's Manager: Planning, Monitoring and Evaluation.

Summaries of the wetland prioritisation, problems and rehabilitation objectives were included into the main body of the rehabilitation plans.

Detailed wetland assessment reports, based on, *inter alia*, the information collected during the implementation of WET-Tools, were prepared by the wetland ecologist and/ or the environmental assessment practitioner for each project, and included as an appendix in each project's rehabilitation plans.

The Final rehabilitation plans are submitted to WfWet for a two week review period. Any comment received during this period is taken into account in the finalisation of the rehabilitation plans.

3.6 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.

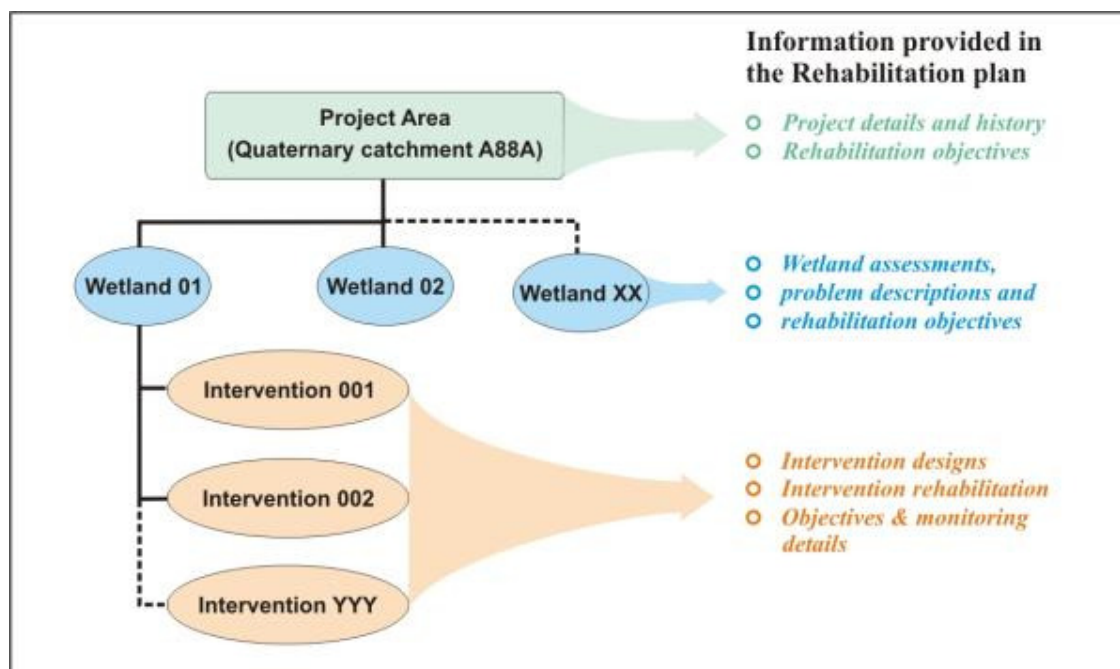


Figure 2: Hierarchy used in the Wetland Rehabilitation Plan

4. PROJECT DESCRIPTION

Goedgevonden wetland:

The Wakkerstroom wetland rehabilitation project was historically located in the V31A and W42C quaternary catchments near the town of Wakkerstroom and Luneburg in the Mpumalanga province. After work in the Wakkerstroom wetlands was completed, the focus shifted to the Goedgevonden wetland (W42C) near Luneburg. The aim of the wetland rehabilitation has been the stabilisation of active erosion and the deactivation of drainage canals and furrows resulting in the desiccation of the identified wetland systems. In 2011 work was also extended on the farm Goedgevonden to include alien clearing, follow up spraying of alien vegetation and the re-seeding of areas previously cleared by the landowner

The 2012/2013 planning cycle addresses the last interventions needed in the Goedgevonden wetland and future planning cycles will identify new wetlands and properties in the catchment area.

Paardeplaats Farm:

Work on the farm Paardeplaats commenced in 2011 and included alien clearing, follow up spraying of alien vegetation and the re-seeding of areas previously cleared by the landowner.

The 2012/2013 planning cycle extended work on the farm to include the rehabilitation and stabilisation of an eroded dirt road, the decommissioning of a highly degraded dirt road, stabilisation of headcut erosion, rehabilitation of gullies and rehabilitation of a hillside seep area.

The project as a whole has further been aligned with the extent of the National Grasslands Biodiversity Programme's (NGBP) demonstration area in the Wakkerstroom/Luneburg area. Both Goedgevonden and Paardeplaats fall within the newly proclaimed Kwa Mandlangampisi Protected Environment. The project area does extend into KwaZulu-Natal, but the focus of the wetland rehabilitation is the wetlands and tributaries within the Mpumalanga province.

The Wakkerstroom project area in the W42C catchment occurs within the upper reaches of the KwaNtombe River, which is considered to be an important water resource within the region. A range of wetland types, characteristic of the region, are represented in the area, including permanent and seasonal marshes, peatlands and seepage areas. The wetlands within the area are considered to be important from a water quantity and quality perspective, especially due to their position in the upper reaches of the river.

A review of the Mpumalanga Biodiversity Conservation Plan (MBCP) highlights that the majority of the Wakkerstroom project area is considered as

'Irreplaceable' in terms of its contribution towards aquatic biodiversity and terrestrial biodiversity. The rehabilitation of the wetlands within the catchment is likely to contribute towards the maintenance of the aquatic and terrestrial biodiversity of the region. The Wakkerstroom wetland is also considered to be regionally important in terms of the maintenance of biological diversity, with the reserve supporting a number of Red Data species, mostly bird species.

4.1 Project Details

Table 3: Project details

Project Name	Wakkerstroom
Region (Province)	Mpumalanga
Project Budget	R 1 633 725
Planning Category	Category 1
Nearest Town/s	Luneburg
Partnership	The Bateleurs



Figure 3: Goedgevonden wetland looking to the south



Figure 4: Paardeplaats wetland/seep looking to the northwest



Figure 5: Typical dryland erosion to be rehabilitated on Paardeplaats

The SANBI Provincial Co-ordinator annually updates the Project's structure reconciliation spreadsheet to accurately reflect historical and current activities within the various projects. Please find the latest updated spreadsheet attached as **Appendix I**.

The scope of the project is listed in the table below:

Table 4: Project scope

Quaternary Catchments	W42C and V31A
Quaternary Catchment area (Ha)	38 470.868 Ha
Number of wetlands identified during the assessment	2
Extension of existing work (previous financial year)	Yes
Work to commence at new wetlands in 2012/ 2013	Yes
Available budget for new interventions	R1 633 725
Available budget for maintenance to existing interventions	
Estimated cost of new interventions	Total: R 4,585,955 (Goedgevonden: R 714 195) (Paardeplaats: R 3 803 661)
Estimated cost of maintenance to existing interventions	R 68,098.35

4.2 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 of low confidence 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:

Wetland No.	Area (ha)	Current hectare equivalents	Projected hectare equivalents gained	Total projected hectare equivalents	% Increase on current hectare equivalents	Projected hectare equivalents secured
W42C-01	66	40.35	14.52	54.87	35.98	N/A
W42C-02	0.61	0.48	0.03	0.51	4.91	N/A

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 only reflects the amount of hectares physically gained as a result of the interventions.

4.3 Prioritisation of Wetlands

Based on the wetland assessments conducted, the current progress of implementation within the project and the prioritisation of the rehabilitation interventions detailed in the following sections, the wetlands must be prioritised for rehabilitation in the following order:

Table 5: Prioritisation of wetlands

Priority	Wetland number	Wetland name	Rationale
1	W42C-01	Goedgevonden	Continuation of previous work. Due to the size and ecological contribution of the Goedgevonden wetland it is considered to be of high priority.
2	W42C-02 (Stabilisation of headcut erosion)	Paardeplaats	Headcut erosion in this seep is likely to undermine the hydrology and geomorphology of the wetland, and therefore needs to be addressed.
3	W42C-02 (Rehabilitation of seep/wetland area)	Paardeplaats	The impacts of the existing road through the seep need to be mitigated to avoid further degradation.
4	W42C-02 (Decommissioning and Rehabilitation of roads)	Paardeplaats	These activities are geared towards assisting with the effective management of the reserve.

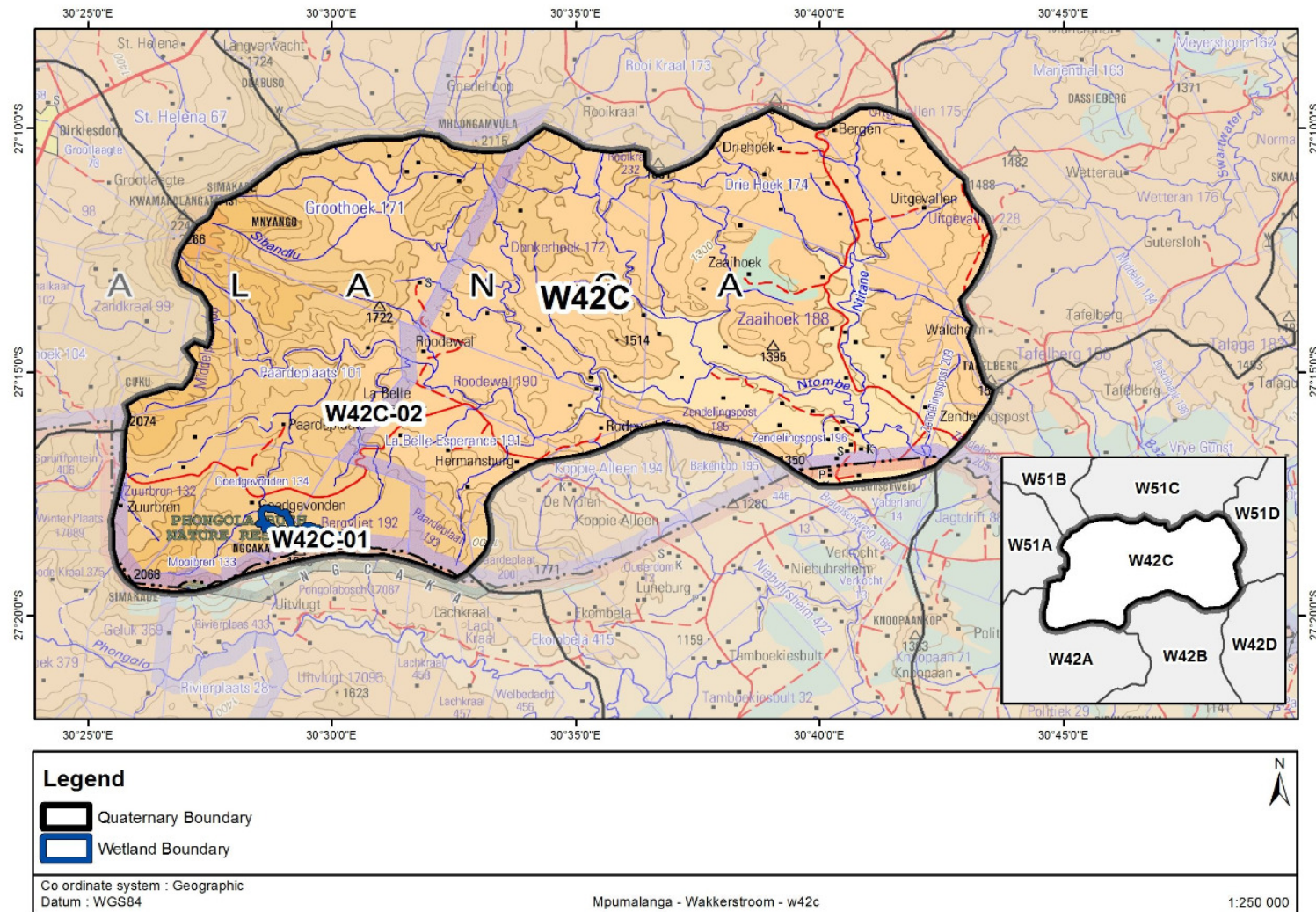


Figure 6: Topographic map showing W42C quaternary catchment’s locality, cadastral boundaries and access routes

4.5 Intervention labelling

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

Table 6: 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				
Goedgevonden				
Earthen Diversion Berm	W42C-01-027	W42C-01-203-00	Construct an earthen diversion berm to divert all flows out of the eastern channel.	Wakkerstroom Final Rehab Plan: Feb 2013
Earthen Diversion Berm	W42C-01-028	W42C-01-204-00	Construct an earthen diversion berm to divert all flows out of the eastern channel	Wakkerstroom Final Rehab Plan: Feb 2013
Reno Matrass	N/A	W42C-01-205-00	Construct a Reno mattress in-channel protection structure to set the base level of the eastern channel.	Wakkerstroom Final Rehab Plan: Feb 2013
Gabion Weir	N/A	W42C-01-206-00	Construct a gabion weir to divert flow out of the western channel onto the western parts of the wetland.	Wakkerstroom Final Rehab Plan: Feb 2013
Gabion Diversion Wall	N/A	W42C-01-207-00	Construct a gabion diversion berm to divert flow out of the eastern channel	Wakkerstroom Final Rehab Plan: Feb 2013

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
Earthen Diversion Berm	N/A	W42C-01-208-00	Construct an earthen diversion berm to divert all flows out of the eastern channel onto the eastern parts of the wetland.	Wakkerstroom Final Rehab Plan: Feb 2013
Concrete Diversion Berm	N/A	W42C-01-209-00	Construct a concrete diversion berm to divert flow out of the eastern channel onto the eastern parts of the wetland.	Wakkerstroom Final Rehab Plan: Feb 2013
Paardeplaats				
Gabions Diversion Wall and Earthen Berms with seeding and biojute	N/A	W42C-02-208-00	Decommission and rehabilitate old road	Wakkerstroom Final Rehab Plan: Feb 2013
Concrete strips and gabion protection	N/A	W42C-02-209-00	Protection of road through construction of concrete strips and gabion cut off wall	Wakkerstroom Final Rehab Plan: Feb 2013
Revegetation of hillslope	N/A	W42C-02-210-00	Contouring, reseeding	Wakkerstroom Final Rehab Plan: Feb 2013
Rockpacks	N/A	W42C-02-211-00	Rock packs to control erosion next to road	Wakkerstroom Final Rehab Plan: Feb 2013
Rockpacks	N/A	W42C-02-212-00	Rock packs to control erosion next to road	Wakkerstroom Final Rehab Plan: Feb 2013
Surface cross drain	N/A	W42C-02-213-00	Construction of surface cross-drains	Wakkerstroom Final Rehab Plan: Feb 2013

Wetland Rehabilitation Plan – Wakkerstroom

February 2013

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
Revegetation	N/A	W42C-02-214-00	Contouring, reseeding	Wakkerstroom Final Rehab Plan: Feb 2013
Rockpacks	N/A	W42C-02-215-00	Rock packs	Wakkerstroom Final Rehab Plan: Feb 2013
Gully stabilisation	N/A	W42C-02-216-00	Rock packs and gabion diversion walls	Wakkerstroom Final Rehab Plan: Feb 2013
Surface cross drains, gabion diversion walls and earthen berms	N/A	W42C-02-217-00	Deactivate old road and protect new road	Wakkerstroom Final Rehab Plan: Feb 2013
Concrete strips and backfill trench	N/A	W42C-02-218-00	Protect sensitive area	Wakkerstroom Final Rehab Plan: Feb 2013
Concrete weir	N/A	W42C-02-219-00		Wakkerstroom Final Rehab Plan: Feb 2013
Surface Cross Drain	N/A	W42C-02-220-00	Construction of surface cross-drains	Wakkerstroom Final Rehab Plan: Feb 2013
Surface Cross Drain	N/A	W42C-02-221-00	Construction of surface cross-drains	Wakkerstroom Final Rehab Plan: Feb 2013
Surface Cross Drain	N/A	W42C-02-222-00	Construction of surface cross-drains	Wakkerstroom Final Rehab Plan: Feb 2013

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
Surface Cross Drain	N/A	W42C-02-223-00	Construction of surface cross-drains	Wakkerstroom Final Rehab Plan: Feb 2013
Surface Cross Drain	N/A	W42C-02-224-00	Construction of surface cross-drains	Wakkerstroom Final Rehab Plan: Feb 2013
Surface Cross Drain	N/A	W42C-02-225-00	Construction of surface cross-drains	Wakkerstroom Final Rehab Plan: Feb 2013
Surface Cross Drain	N/A	W42C-02-226-00	Construction of surface cross-drains	Wakkerstroom Final Rehab Plan: Feb 2013
Surface Cross Drain	N/A		Construction of surface cross-drains	Wakkerstroom Final Rehab Plan: Feb 2013
MAINTENANCE				
Excavation	V31A-01-014	V31A-01-201-01	Excavate existing channel to spread a portion of the flows into the wetland area southwest of main channel	
INTERVENTION REDESIGNS				
N/A				

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 as a cross reference.

5. GOEDGEVONDEN WETLAND –W42C-01

The Goedgevonden wetland is generally an unchannelled valley-bottom wetland that is characterised by soils with high organic matter content.. The Goedgevonden wetland forms part of a large valley-bottom wetland system, with pristine peatlands 700m upstream of the Goedgevonden wetland, The system is considered critical in terms of habitat provision for wetland-dependant species, including Wattled Crane..

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

5.1 Wetland Details

Wetland Name	Goedgevonden
Wetland Number	W42C-01
River System Name	Upper reaches of KwaNtombe River
Land Use in Catchment	Livestock Farming, crop production
Land Use in Wetland	Livestock production
No. of Properties Intersecting Wetland Area	1
Date of Wetland Assessment	31 July 2008 – Rapid Wet Tools Assessment
Wetland Assessor(s)	Craig Cowden
Wetland size	66 Ha

5.2 Biophysical characteristics of the wetland

5.2.1 Gradient of the site (section B1 of the BAR)

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5
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5.2.2 Location in landscape (section B2 of the BAR)

Indicate the landform(s) that best describes the site:

Ridgeline Closed valley Undulating plain / low hills

Plateau	<input type="checkbox"/>	Open valley	<input checked="" type="checkbox"/>	Dune	<input type="checkbox"/>
Side slope of hill/mountain	<input type="checkbox"/>	Plain	<input type="checkbox"/>	Seafront	<input type="checkbox"/>

5.2.3 Groundwater, soil and geological stability of the site (section B3 of the BAR)

Is the site(s) located on any of the following?

	Alternative S1:	
Shallow water table (less than 1.5m deep)	YES	
Dolomite, sinkhole or doline areas		NO
Seasonally wet soils (often close to water bodies)	YES	
Unstable rocky slopes or steep slopes with loose soil		NO
Dispersive soils (soils that dissolve in water)	Yes	
Soils with high clay content (clay fraction more than 40%)		NO
Any other unstable soil or geological feature	YES	
An area sensitive to erosion	YES	

5.2.4 Groundcover (section B4 of the BAR)

Alternative S1:

Natural veld - good condition ^E	Natural veld with scattered aliens ^E	Natural veld with heavy alien infestation ^E	Veld dominated by alien species ^E	Gardens
Sport field	Cultivated land	Paved surface	Building or other structure	Bare soil

If any of the boxes marked with an “E” is ticked, please consult an appropriate specialist to assist in the completion of this section if the environmental assessment practitioner doesn’t have the necessary expertise.

Has a specialist been consulted?		NO
----------------------------------	--	----

Wetland ecologist, Craig Cowden, did the wetland assessment which included present ecological condition.

Species of special concern known to occur in the quaternary catchment:

- Wattle Crane (*Buggeranus carunculatus*) – Critically endangered

5.2.5 Surface water (section B5 of the BAR)

Indicate the surface water present on and or adjacent to the site and alternative sites?

Perennial River	YES	NO	UNSURE
Non-Perennial River	YES	NO	UNSURE
Permanent Wetland	YES	NO	UNSURE
Seasonal Wetland	YES	NO	UNSURE
Artificial Wetland	YES	NO	UNSURE
Estuarine / Lagoonal wetland	YES	NO	UNSURE

If any of the boxes marked YES or UNSURE is ticked, please provide a description of the relevant watercourse.

The purpose of the Working for Wetland's project is wetland conservation and indirectly the protection of biodiversity and South Africa's water resources. Therefore all proposed rehabilitation interventions are located within disturbed wetland areas, seepage zones and rivers with significant problems related to erosion, sedimentation, biodiversity loss, alien infestation, etc.

The KwaNtombe River is an Order 1 tributary to the Pongola River which drains the eastern escarpment towards the Indian Ocean where it finally terminates near Maputo (Mozambique).

5.2.6 Landuse character of surrounding area (section B6 of the BAR)

Indicate land uses and/or prominent features that currently occur within a 500m radius of the site and give description of how this influences the application or may be impacted upon by the application:

Natural area	Dam or reservoir	Polo fields
Low density residential	Hospital/medical centre	Filling station ^H
Medium density residential	School	Landfill or waste treatment site
High density residential	Tertiary education facility	Plantation
Informal residential ^A	Church	Agriculture

Retail commercial & warehousing	Old age home	River, stream or wetland
Light industrial	Sewage treatment plant ^A	Nature conservation area
Medium industrial ^{AN}	Train station or shunting yard ^N	Mountain, koppie or ridge
Heavy industrial ^{AN}	Railway line ^N	Museum
Power station	Major road (4 lanes or more) ^N	Historical building
Office/consulting room	Airport ^N	Protected Area
Military or police base/station/compound	Harbour	Graveyard
Spoil heap or slimes dam ^A	Sport facilities	Archaeological site
Quarry, sand or borrow pit	Golf course	Other land uses (describe)

If any of the boxes marked with an "N" are ticked, how will this impact / be impacted upon by the proposed activity?

N/A

If any of the boxes marked with an "AN" are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain:

N/A

If any of the boxes marked with an "H" are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain:

N/A

Does the proposed site (including any alternative sites) fall within any of the following:

Critical Biodiversity Area (as per provincial conservation plan)	YES	NO
Core area of a protected area?	YES	NO
Buffer area of a protected area?	YES	NO
Planned expansion area of an existing protected area?	YES	NO
Existing offset area associated with a previous Environmental Authorisation?	YES	NO

5.2.7 Cultural or historical features (section B7 of the BAR)

Are there any signs of culturally or historically significant elements, as defined in section 2 of the National Heritage Resources Act, 1999, (Act No. 25 of 1999), including Archaeological or paleontological sites, on or close (within 20m) to the site? If YES, explain:	YES	NO
	Uncertain	
N/A		

If uncertain, conduct a specialist investigation by a recognised specialist in the field (archaeology or palaeontology) to establish whether there is such a feature(s) present on or close to the site. Briefly explain the findings of the specialist:

Not Applicable – A copy of the 2013 Wakkerstroom BAR and Rehabilitation Plan will however be provided to the relevant heritage authorities for consideration.

Will any building or structure older than 60 years be affected in any way?	YES	NO
Is it necessary to apply for a permit in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999)?	YES	NO

If YES, please provide proof that this permit application has been submitted to SAHRA or the relevant provincial authority.

5.2.9 Biodiversity (Section B9 of the BAR)

Indicate the applicable biodiversity planning categories of all areas on site and indicate the reason(s) provided in the biodiversity plan for the selection of the specific area as part of the specific category)

Systematic Biodiversity Planning Category				If CBA or ESA, indicate the reason(s) for its selection in biodiversity plan
Critical Biodiversity Area (CBA)	Ecological Support Area (ESA)	Other Natural Area (ONA)	No Natural Area Remaining (NNR)	The Goedgevonden wetland area is considered as 'Irreplaceable' in terms of its contribution towards aquatic biodiversity and terrestrial biodiversity and it supports a number of Red Data species. The wetland also plays an important role in maintaining the water quality and quantity in the W42C quaternary catchment area.

Indicate and describe the habitat condition on site:

Habitat Condition	Percentage of habitat condition class (adding up to 100%)	Description and additional comments and observations (Incl. additional insight into condition, e.g. poor land management practises, presence of quarries, grazing, harvesting regimes etc.).
Natural	10%	The site is transformed due to historic agricultural activities, straightening of drainage channels and confinement of flow. This has resulted in the incision of the drainage channels and alteration of the surrounding wetland hydrology.
Near Natural (includes areas with low to moderate level of alien invasive plants)	75%	The Goedgevonden wetland has near pristine areas in its upper reaches. Vegetation has been modified to some extent by grazing though. As mentioned above wetland vegetation next to the eastern and western channels has also changed to more ruderal and terrestrial species due to a change in the system's hydrology.

Habitat Condition	Percentage of habitat condition class (adding up to 100%)	Description and additional comments and observations (Incl. additional insight into condition, e.g. poor land management practises, presence of quarries, grazing, harvesting regimes etc.).
Degraded (includes areas heavily invaded by alien plants)	10%	Erosion is occurring in the stream and on surrounding areas of land.
Transformed (includes cultivation, dams, urban, plantation, roads, etc)	5%	Farm homestead and roads along the channels, crossing the main channel at one point.

Complete the table to indicate:

- (i) the type of vegetation, including its ecosystem status, present on the site; and
- (ii) whether an aquatic ecosystem is present on site.

Terrestrial Ecosystems		Aquatic Ecosystems						
Ecosystem threat status as per the NEM:BA (Act No. 10 of 2004)	Critical	Wetland (including rivers, depressions, channelled and unchannelled wetlands, flats, seeps pans, and artificial wetlands)			Estuary		Coastline	
	Endangered							
	Vulnerable							
	Least Threatened							
		YES	NO	UNSURE	YES	NO	YES	NO

Please provide a description of the vegetation type and/or aquatic ecosystem present on site, including any important biodiversity features/information identified on site (e.g. threatened species and special habitats)







Vegetation: The area is dominated by the Wakkerstroom Montane Grassland vegetation unit. It is classified as "Least threatened" by Mucina and Rutherford (2006). According to Mucina and Rutherford (2006) the vegetation unit consists mostly of short Montane grass on plateaus and flatter areas with short forest and *Leurcosidea* thicket occurring on steep, eastern facing slopes. *L. sericea* is mentioned as the predominant woody pioneer species which invades areas subjected to overgrazing.

Aquatic ecosystem: The Goedgevonden wetland forms part of a larger wetland system (which forms the upper catches of the KwaNtombe River) and is considered critical in terms of habitat provision for wetland dependent species, including the Wattled Crane.

The Goedgevonden wetland further falls within a sub-quaternary catchment classified as a Fish Fresh Water Ecosystem Priority Area. The sub-catchment's rivers are classified as generally intact and in a good condition. It also forms part of a Wetland Fresh Water Ecosystem Priority Area.

An area with peat characteristics furthermore exists in the upper reaches of the Goedgevonden wetland area (***although no work within the peat area will occur***).

5.2.10 Site Photos

	
<p>Landscape photo of the Goedgevonden wetland looking in a southerly direction</p>	<p>Western part of the wetland</p>
	
<p>Eastern part of the wetland</p>	<p>Existing berm, eastern channel, looking north</p>
	
<p>Headcut erosion, main channel, looking south</p>	<p>Road through eastern channel, looking north</p>

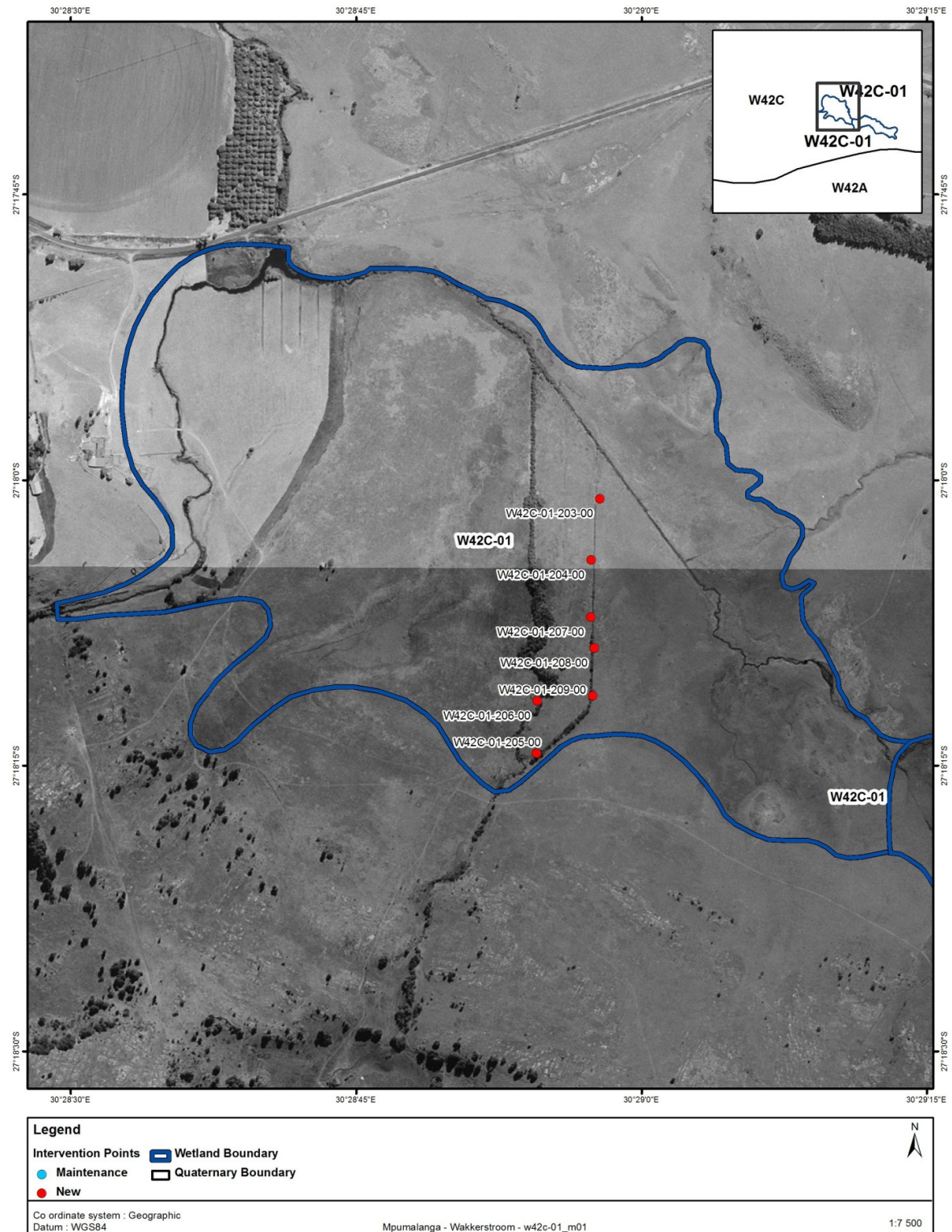


Figure 7: Wetland map, W42C-01 with proposed new wetland interventions indicated.

5.3 Wetland Rehabilitation Problems

The wetland has been subjected to a number of impacts associated with the modification of the system's hydrology, which was likely to have been initiated to allow livestock access for grazing within the valley bottom. The confinement of flow within drainage channels and the straightening of the channel in the lower reaches of the wetland have resulted in the incision of the channels, especially the channel taking flows from the southern tributary. The incision of the channels has resulted in further impact on the system's hydrology, with the desiccation of the adjacent wetland habitat. The alteration of the system's hydrology has resulted in a change in the wetland vegetation, with more terrestrial and ruderal species present within the wetland.

In the upper reaches of the system the incision of the channel has resulted in the formation of headcut erosion where lateral flow enters the channel. The activity of the headcut identified within the system was considered to be relatively limited due to the presence of a hard plinthite layer within the soil profile and the high organic matter content of the soils.

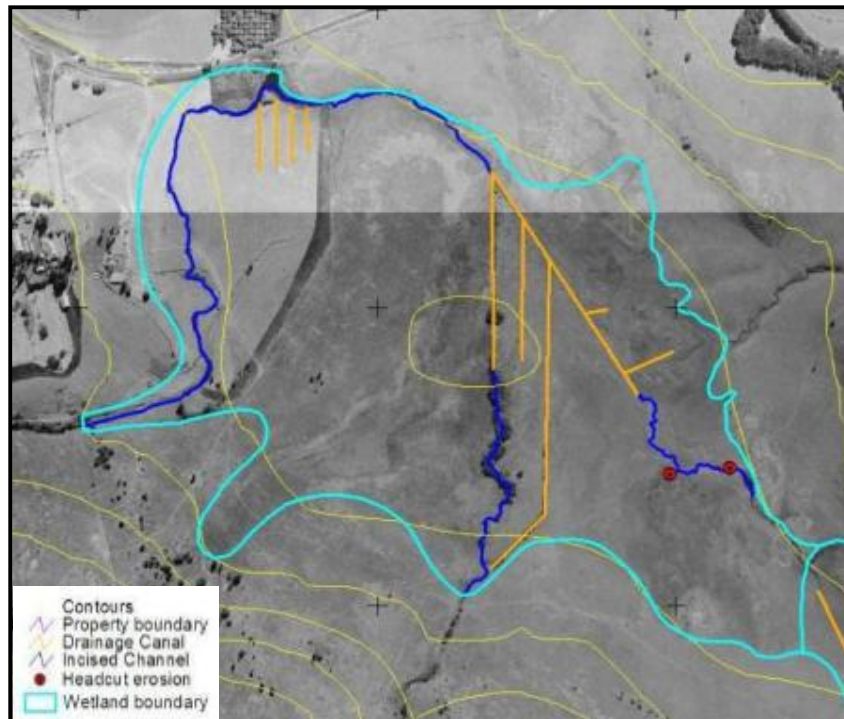


Figure 8: Wetland problems identified.

5.4 Wetland Rehabilitation Objectives

The primary objective of the rehabilitation is to improve the hydrological integrity of the wetland by promoting more diffuse flow through the system, by means of deactivating the incised drainage canals that were historically

excavated throughout the length of the wetland unit. The secondary objective is to prevent further incision of the channel and deactivate the headcut erosion identified within the wetland system.

5.5 Alternatives (section 2(b) in the BAR)

The alternatives have been discussed under each intervention in Section 5.8 below.

5.6 Summary of Existing and Proposed Interventions

The following existing interventions were identified within the wetland:

Table 7: Summary of existing interventions, W42C-01

Intervention Number	Intervention Structure Type	Longitude	Latitude	Estimated maintenance cost
W42C-01-002	Concrete Weir	-27°17'50.35"	30°28'50.56"	R 0
W42C-01-003	Concrete Weir	-27°17'51.78"	30°28'52.32"	R 0
W42C-01-005	Concrete Weir	-27°17'55.71"	30°28'55.71"	R 0
W42C-01-006	Concrete Weir	-27°17'57.96"	30°28'57.21"	R 0
W42C-01-007	Concrete Weir	-27°18'00.20"	30°28'58.80"	R 0
W42C-01-008	Concrete Weir	-27°18'02.01"	30°29'00.16"	R 0
Total				R 0

The following interventions are currently being implemented:

Table 8: Summary of current interventions, W42C-01

Intervention Number	Intervention Structure Type	Longitude	Latitude
W42C-01-014	Gabion weir	-27°18'16.12"	30°29'13.75"
W42C-01-015 (a-e)	Earth berm	-27°18'17.00"	30°29'14.50"
W42C-01-017	Concrete weir	-27°17'54.08"	30°28'54.06"
W42C-01-018	Concrete weir	-27°17'55.80"	30°28'54.05"
W42C-01-019	Concrete weir	-27°17'57.70"	30°28'54.04"

Intervention Number	Intervention Structure Type	Longitude	Latitude
W42C-01-020	Concrete weir	-27°17'59.80"	30°28'54.02"
W42C-01-021	Concrete weir	-27°18'01.80"	30°28'53.90"
W42C-01-022	Concrete weir	-27°18'03.30"	30°28'53.90"
W42C-01-023	Concrete weir	-27°18'00.52"	30°28'53.80"
W42C-01-024	Concrete weir	-27°18'07.70"	30°28'54.10"
W42C-01-025	Gabion weir	-27°17'58.79"	30°28'57.23"

Table 9: Summary of proposed new interventions, W42C-01

Intervention Number	Intervention Structure Type	Implementation Order	Priority	Structure Cost (Excl. Vat)
W42C-01-203-00	Earthen Diversion Berm	5	1	R 22,015.08
W42C-01-204-00	Earthen Diversion Berm	4	1	R 50,454.70
W42C-01-205-00	Reno Matrass	6	2	R 12,196.89
W42C-01-206-00	Gabion Weir	7	2	R 416,400.00
W42C-01-207-00	Gabion Diversion Wall	3	1	R 38,100.85
W42C-01-208-00	Earthen Diversion Berm	2	1	R 67,057.27
W42C-01-209-00	Concrete Diversion Berm	1	1	R 107,970.33
Total				R 714 195. 12

The implementation order indicates the timing order in which interventions should be implemented within the wetland (number 1 first). The priority 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.

New properties will have to be identified in the next planning cycle. No additional interventions on the existing properties have been identified for the next planning cycle. Wetland Rehabilitation Strategy

These proposed interventions address the wetland problems and achieve the rehabilitation objectives as follows:

- Deactivation of the incised channel and drainage channels to restore the hydrological integrity of the wetland system;
- The implementation of rehabilitation interventions to date is limited to the lower reaches of the system, and is generally associated with the wetland channel rather than the adjacent drainage channels. The proposed rehabilitation would attempt to modify the flow patterns within the upper reaches of the system to promote the more diffuse flow across the western and eastern parts of the wetland as opposed to having flow confined to the incised channel and drainage channels.

5.7 Design Selection and Sizing

The objective of the interventions is to deactivate a drain and spread the water that it would have carried into the surrounding wetlands to the east and west. The most appropriate and cost effective method of doing this was considered to involve:

- The construction of a hard structure (concrete or gabion weir) in the main drain with the spillway set at a level that would allow for the backflooding of an adjoining drain to the east of the main drain. This intervention would also increase the occurrence of overbank topping, particularly into the wetland to the west of the main channel.
- Constructing a combination of concrete, gabion and earthen diversion structures that would divert flows out of the eastern drain and into the wetland to the east. Earthen diversions were specified in areas of low energy and will be vegetated to increase their stability. Concrete and gabion diversion structures were specified where higher energy is expected
- Removal of the existing berm alongside the eastern drain (right hand side) to promote the flow of water into the wetland. Material from the berms should be used for the construction of the in-channel earthen diversion berms
- Excavate the entrance to the eastern drain to allow water to flow towards the eastern side of the wetland
- Install a Reno mattress in-channel liner to ensure that the base level of the eastern drain is set to the desired level.

5.8 Intervention Designs

5.8.1 Intervention: W42C-01-203-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Earthen Diversion Berm
Rehabilitation Objective	To divert flow from the channel onto the adjacent land thereby achieving diffuse flow over the eastern part of the wetland.
Latitude (D°M'S")	27°18'0.99"S
Longitude (D°M'S")	30°28'57.81"E
Engineering Drawings	W42C-01-203-00
Alternatives considered	Gabion and concrete diversion walls. Earth was considered a cost effective solution in the low energy environment



Figure 9: Earthen diversion berm, W42C-01-203-00 looking in a south-westerly direction

5.8.1.1 Bill of quantities: W42C-01-203-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Structure Volume	m ³	26.00	R 793.01	R 20,618.19
Earth Works Volume	m ³	2.00	R 698.44	R 1,396.89
Total				R 22,015.08

5.8.1.2 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 a 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).
- b. i.e. replace deeper layers 1st with rhizospheres layer on top.
- c. Based on type of species make sure the sod is orientated in the original direction in terms of aspect.
- d. If sods are not at 90%+ moisture then peg them with wooden stakes.
- e. Mulch the site (or use cloth/geotextile).
- f. Fence livestock out for at least 2 seasons (or brush pack).
- g. If compaction took place then:
 - on flat surfaces, loosen the soil with a fork, and
 - 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

5.8.2 Intervention: W42C-01-204-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Earthen Diversion Berm
Rehabilitation Objective	To divert flow from the channel onto the adjacent land thereby achieving diffuse flow over the eastern part of the wetland.
Latitude (D°M'S")	27°18'4.21"S
Longitude (D°M'S")	30°28'57.37"E
Engineering Drawings	W42C-01-204-00
Alternatives considered	Gabion and concrete diversion walls were considered. Berm was considered a cost effective solution in the low energy environment



Figure 10: Earthen diversion berm, W42C-01-204-00 looking in a south-westerly direction

5.8.2.1 Bill of quantities: W42C-01-204-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Structure Volume	m ³	35.00	R 793.01	R 27,755.25
Earth Works Volume	m ³	32.50	R 698.44	R 22,699.45
Total				R 50,454.70

5.8.2.2 Construction Notes:

The diversion is to be constructed at an angle across the channel to divert flows to the east of the channel. Also see Section 5.8.1.2.

5.8.3 Intervention: W42C-01-205-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Reno mattress
Rehabilitation Objective	Channel protect and to set the base level of the eastern channel
Latitude (D°M'S")	27°18'14.36"S
Longitude (D°M'S")	30°28'54.48"E
Engineering Drawings	W42C-01-205-00
Alternatives considered	No alternatives considered. A Reno mattress was selected as it is adaptable to the profile of the channel.



Figure 11: Reno mattress, WC42-01-205-00, looking in an easterly direction

5.8.3.1 Bill of quantities: W42C-01-205-00

Item	Units	Quantity	Unit Cost	Item Cost
6 x 2 x 0.3 Reno Mattress	m ³	1		
Gabion Rock Volume	m ³	3.6	R 3,000.00	R 10,800.00
Earth Works Volume	m ³	2.00	R 698.44	R 1,396.89
Total				R 12,196.89

5.8.3.2 Construction notes

As under Section 5.8.1.2. The top of the Reno mattress is to be constructed 100mm higher than the water in the upstream channel that is backed up from intervention W42C-01-206-00.

5.8.4 Intervention: W42C-01-206-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Gabion Weir and earthen berm
Rehabilitation Objective	To divert flow from the channel onto the adjacent land thereby achieving diffuse flow over the western part of the wetland. The weir is to encourage high flows to enter the eastern drain.
Latitude (D°M'S")	27°18'11.61"S
Longitude (D°M'S")	30°28'54.52"E
Engineering Drawings	W42C-01-206-00
Alternatives considered	A robust impermeable structure was required to withstand the force of the water from the catchment. Earthen material was therefore not considered



Figure 12: Gabion weir wall, W42C-01-206-00 looking in a south-easterly direction



Figure 13: Berm, W42C-01-206-00 looking in a north-westerly direction

5.8.4.1 Bill of quantities: W42C-01-206-00

Item	Units	Quantity	Unit Cost	Item Cost
1.5 x 1 x 1 Gabion Basket	Baskets	18		
2 x 1 x 1 Gabion Basket	Baskets	2		
3 x 1 x 1 Gabion Basket	Baskets	16		
4 x 1 x 1 Gabion Basket	Baskets	4		
3 x 1 x 0.5 Gabion Basket	Baskets	2		
4 x 1 x 0.5 Gabion Basket	Baskets	3		
2 x 1 x 0.3 Gabion Basket	Baskets	7		
3 x 1 x 0.3 Gabion Basket	Baskets	10		
6 x 2 x 0.3 Gabion Basket	Baskets	6		
Earth Works Volume	m ³	150		
Gabion Rock Volume	m ³	138.8	R 3,000.00	R 416,400.00
Geotextile	m ²	110		
Plastic Sheet	m ²	44		
			Total	R 416,400

5.8.4.2 Construction notes

Refer to Section 5.8.1.2

5.8.5 Intervention W42C-01-207-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Gabion Diversion Berm
Rehabilitation Objective	To divert flow from the channel onto the adjacent land thereby achieving diffuse flow over the eastern part of the wetland.
Latitude (D°M'S")	27°18'7.21"S
Longitude (D°M'S")	30°28'57.34"E
Engineering Drawings	W42C-01-207-00
Alternatives considered	Gabions were specified as a robust structure is required to handle higher energy in the system in the event of the upstream earthen diversion berm failing.



Figure 14: Gabion diversion wall, W42C-01-207-00, looking in a south-easterly direction

5.8.5.2 Bill of quantities: W42C-01-207-00

Item	Units	Quantity	Unit Cost	Item Cost	Estimated Labour Budget %	Labour budget
Earth Structure Volume	m ³	41.00	R 793.01	R 32,513.30		
Earth Works Volume	m ³	8.00	R 698.44	R 5,587.56		
Total				R 38,100.85		

5.8.5.3 Construction notes

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

5.8.7 Intervention W42C-01-208-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Earthen Diversion Berm
Rehabilitation Objective	To divert flow from the channel onto the adjacent land thereby achieving diffuse flow over the eastern part of the wetland.
Latitude (D°M'S")	27°18'8.84"S
Longitude (D°M'S")	30°28'57.52"E
Engineering Drawings	W42C-01-208-00
Alternatives considered	Earth was specified as the bulk of the flows will be diverted by the upstream concrete diversion wall. An earthen diversion was considered a cost effective option



Figure 15: Earthen diversion berm, W42C-01-208-00 looking in a north-westerly direction

5.8.7.1 Bill of quantities: W42C-01-208-00

Item	Units	Quantity	Unit Cost	Item Cost	Estimated Labour Budget %	Labour budget
Earth Structure Volume	m ³	37.00	R 793.01	R 29,341.27		
Earth Works Volume	m ³	54.00	R 698.44	R 37,716.01		
Total				R 67,057.27		

5.8.7.2 Construction notes:

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

Refer to Section 5.8.1.2

5.8.8 Intervention W42C-01-209-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Concrete Diversion Berm
Rehabilitation Objective	To divert flow from the channel onto the adjacent land thereby achieving diffuse flow over the eastern part of the wetland.
Latitude (D°M'S")	27°18'11.34"S
Longitude (D°M'S")	30°28'57.44"E
Engineering Drawings	W42C-01-209-00
Alternatives considered	The intervention will be receiving the full force of water in the drain and an earthen berm was therefore not considered.



Figure 16: Concrete diversion wall, W42C-01-209-00 looking in a north-westerly direction

5.8.8.1 Bill of quantities: W42C-01-209-00

Item	Units	Quantity	Unit Cost	Item Cost	Estimated Labour Budget %	Labour budget
Concrete: 20 MPa	m ³	10	R 6,606.37	R 66,063.65		

Item	Units	Quantity	Unit Cost	Item Cost	Estimated Labour Budget %	Labour budget
Cement	Pockets	68				
Sand	m ³	6.5				
Stone	m ³	7				
Earth Works Volume	m ³	60	R 698.44	R 41,906.68		
Weldmesh Ref 617	m ²	63				
Mass of Steel	kg	95				
Concrete: 20 MPa	m ³	10	R 6,606.37	R 66,063.65		
Total				R 107,970.33		

5.8.8.2 Construction notes:

The concrete wall is to have a 500mm freeboard and is to be constructed at an angle across the channel to divert flows to the right hand side

5.9 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 WfWet best management practices and specific requirements of the land owner. The implementation of these interventions must also take into account all relevant provisions of Working for Wetlands Best Management Practices and the Construction Environmental Management Plan, the recommendations of the Basic Assessments submitted for Environmental Authorisation and the requirements of the Environmental Authorisation Record of Decision for the project.

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

The following project-specific management issues apply:

- The wetland is located directly downstream from a relatively pristine peatland system that provides breeding habitat for a pair of endangered Wattled Crane. The Working for Wetlands team's movements and activities are planned to be limited to the Goedgevonden Farm, limiting the potential for disturbance of the nesting pair of cranes, especially as construction is likely to coincide with the breeding period.
- The portion of the incised channel that is dominated by woody species is characterised by the presence of various sizes of tree ferns that would need to be safely removed and relocated into sections of the riparian habitat upstream of the wetland. This would need to be undertaken in consultation with Mpumalanga Parks and Tourism Agency to ensure survival of these plants.
- The area generally provides habitat for a number of Red Data species and the construction activities should be planned and managed to reduce impacts on the fauna and flora in the area in accordance with WfWet best management practices and with input from the land owner and local conservation organisations.

5.10 Wetland Management Recommendations

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

5.11 Baseline M&E Data

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

5.11.1.1 Erosion Problems

The erosional features within the wetland are generally limited to channel incision and are relatively stable, and will therefore not be monitored specifically. If these features were to become unstable at any point, monitoring should be undertaken.

5.11.1.2 Fixed Point Photography

In order to provide the ability to visually determine the degree of change within the wetland system photography of the wetland system has been taken prior to the implementation of wetland rehabilitation activities.

Locations

FPP Number	01	
GPS Location (DMS)	Latitude	27°17'48.45"S
	Longitude	30°29'04.66"E
Description of Photography Point		
Fixed point photograph taken from a ridge opposite the wetland, adjacent to a small tree.		

Photographs**Description of the features within the photographs**

View of the Goedgevonden wetland looking in a southerly direction.

5.11.1.3 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):

HGM Unit	Area (ha)	Hydro Health	Geo Health	Vegetation Health
2008 assessment	66.00	4.0	8.4	7.0

6. PAARDEPLAATS WETLAND –W42C-02

The landowner of Goedgevonden also owns land on adjacent properties within the same catchment and it was therefore decided to extend the work onto this property, especially considering the recent proclamation of the KwaMandlangampisi Protected Environment.

The 2011/2012 Rehabilitation Plan included alien clearing, follow up spraying of alien vegetation and the re-seeding of areas previously cleared by the landowner. The project had been aligned with the extent of the National Grasslands Biodiversity Programme's (NGBP) demonstration area in the Wakkerstroom/Luneburg area and falls within the newly proclaimed KwaMandlangampisi Protected Environment.

Work for the 2012/2013 planning cycle primarily includes the rehabilitation of two badly eroded dirt roads (hereafter referred to as Road A and Road B) on the farm. In addition the following interventions were identified on site during the site visit in August 2012:

- a section of an access road will be stabilised by protecting it from headcut erosion and constructing concrete strips over the affected area
- rehabilitation of an area affected by hillslope failure
- rehabilitation of two erosion ditches next to one of the roads
- rehabilitation of a seep/wetland area which is drained by a ditch and also used by cattle as a watering point.

The following new interventions are therefore proposed for the selected areas.

Table 10: Summary of new interventions, W42C-02

Intervention Number	Intervention Structure Type	Implementation Order	Priority	Cost (Excl. Vat)
W42C-02-208-00	Gabions Diversion Wall and Earthen Berms with seeding and biojute	20	4	R 1,290,084.32
W42C-02-209-00	Concrete strips and gabion protection	18	3	R 44,425.46
W42C-02-210-00	Revegetation of hillslope	19	4	R 71,241.35
W42C-02-211-00	Rockpacks	16	4	R 400,650.74
W42C-02-212-00	Rockpacks	17	4	R 254,037.44
W42C-02-213-00	Surface cross drain	11	4	R 27,379.03
W42C-02-214-00	Revegetation	15	4	R 13,968.89

Intervention Number	Intervention Structure Type	Implementation Order	Priority	Cost (Excl. Vat)
W42C-02-215-00	Rockpacks	12	4	R 723,730.79
W42C-02-216-00	Gully stabilisation	7	4	R 325,202.71
W42C-02-217-00	Surface cross drains, gabion diversion walls and earthen berms	8	4	R 124,911.22
W42C-02-218-00	Concrete strips and backfill trench	2	3	R 66,441.73
W42C-02-219-00	Concrete weir	1	2	R 269,934.21
W42C-02-220-00	Surface Cross Drain	9	4	R 35,934.97
W42C-02-221-00	Surface Cross Drain	10	4	R 15,400.70
W42C-02-222-00	Surface Cross Drain	3	4	R 8,555.95
W42C-02-223-00	Surface Cross Drain	4	4	R 6,844.76
W42C-02-224-00	Surface Cross Drain	5	4	R 5,133.57
W42C-02-225-00	Surface Cross Drain	6	4	R 23,956.65
W42C-02-226-00	Surface Cross Drain	14	4	R 54,758.06
W42C-02-227-00	Surface Cross Drain	13	4	R 41,068.54
Total				R 3 871 759.44

The implementation order indicates the timing order in which interventions should be implemented within the wetland (number 1 first). The priority 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.

6.1 Wetland Details

Wetland Name	Paardeplaats
Wetland Number	W42C-02
River System Name	Upper reaches of KwaNtombe River
Land Use in Catchment	Livestock Farming, crop production
Land Use in Wetland	Protected area (KwaMandlangampisi Protected Environment). Farmer renting property from Mpumalanga Tourism and Parks Agency for livestock farming
No. of Properties Intersecting Wetland Area	1
Date of Wetland Assessment	15 August 2012– Rapid Wet Tools Assessment
Wetland Assessor(s)	Brad Graves
Wetland size	0.61ha

Biophysical characteristics of the wetland

6.1.1 Gradient of the site (section B1 of the BAR)

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5
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6.1.2 Location in landscape (section B2 of the BAR)

Indicate the landform(s) that best describes the site:

Ridgeline	<input type="checkbox"/>	Closed valley	<input type="checkbox"/>	Undulating plain / low hills	<input type="checkbox"/>
Plateau	<input type="checkbox"/>	Open valley	<input type="checkbox"/>	Dune	<input type="checkbox"/>
Side slope of hill/mountain	<input checked="" type="checkbox"/>	Plain	<input type="checkbox"/>	Seafront	<input type="checkbox"/>

6.1.4 Groundwater, soil and geological stability of the site (section B3 of the BAR)

Is the site(s) located on any of the following?

	Alternative S1:	
Shallow water table (less than 1.5m deep)	YES	
Dolomite, sinkhole or doline areas		NO
Seasonally wet soils (often close to water bodies)	YES	
Unstable rocky slopes or steep slopes with loose soil		NO
Dispersive soils (soils that dissolve in water)		NO
Soils with high clay content (clay fraction more than 40%)	YES	
Any other unstable soil or geological feature	YES	
An area sensitive to erosion	YES	

6.1.5 Groundcover (section B4 of the BAR)

Alternative S1:

Natural veld - good condition ^E	Natural veld with scattered aliens ^E	Natural veld with heavy alien infestation ^E	Veld dominated by alien species ^E	Gardens
Sport field	Cultivated land	Paved surface	Building or other structure	Bare soil

If any of the boxes marked with an “E” is ticked, please consult an appropriate specialist to assist in the completion of this section if the environmental assessment practitioner doesn’t have the necessary expertise.

Has a specialist been consulted?		NO
----------------------------------	--	----

Wetland ecologist, Craig Cowden/Bradley Graves, did the wetland assessment which included present ecological condition.

Species of special concern known to occur in the quaternary catchment:

- Wattle Crane (*Bugeranus carunculatus*) – Critically endangered

6.1.6 Surface water (section B5 of the BAR)

Indicate the surface water present on and or adjacent to the site and alternative sites?

Perennial River	YES	NO	UNSURE
Non-Perennial River	YES	NO	UNSURE
Permanent Wetland	YES	NO	UNSURE
Seasonal Wetland	YES	NO	UNSURE
Artificial Wetland	YES	NO	UNSURE
Estuarine / Lagoonal wetland	YES	NO	UNSURE

If any of the boxes marked YES or UNSURE is ticked, please provide a description of the relevant watercourse.

The purpose of the Working for Wetland's project is wetland conservation and indirectly the protection of biodiversity and South Africa's water resources. The proposed wetland rehabilitation interventions are located in and around a seep area on an east facing hillside slope. The seep/wetland area is dissected by a dirt road and the seep is drained by an artificial drainage ditch in order to keep the road dry. Water from the ditch is conveyed via a pipe underneath the road where it is released into the surrounding grassland, leading to a wetland area downhill of the road.

6.1.7 Land use character of surrounding area (section B6 of the BAR)

Indicate land uses and/or prominent features that currently occur within a 500m radius of the site and give description of how this influences the application or may be impacted upon by the application:

Natural area	Dam or reservoir	Polo fields
Low density residential	Hospital/medical centre	Filling station ^H
Medium density residential	School	Landfill or waste treatment site
High density residential	Tertiary education facility	Plantation
Informal residential ^A	Church	Agriculture
Retail commercial & warehousing	Old age home	River, stream or wetland

Light industrial	Sewage treatment plant ^A	Nature conservation area
Medium industrial ^{AN}	Train station or shunting yard ^N	Mountain, koppie or ridge
Heavy industrial ^{AN}	Railway line ^N	Museum
Power station	Major road (4 lanes or more) ^N	Historical building
Office/consulting room	Airport ^N	Protected Area
Military or police base/station/compound	Harbour	Graveyard
Spoil heap or slimes dam ^A	Sport facilities	Archaeological site
Quarry, sand or borrow pit	Golf course	Other land uses (describe)

If any of the boxes marked with an "N" are ticked, how will this impact / be impacted upon by the proposed activity?

N/A

If any of the boxes marked with an "AN" are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain:

N/A

If any of the boxes marked with an "H" are ticked, how will this impact / be impacted upon by the proposed activity? Specify and explain:

N/A

Does the proposed site (including any alternative sites) fall within any of the following:

Critical Biodiversity Area (as per provincial conservation plan)	YES	NO
Core area of a protected area?	YES	NO
Buffer area of a protected area?	YES	NO
Planned expansion area of an existing protected area?	YES	NO
Existing offset area associated with a previous Environmental Authorisation?	YES	NO

6.1.8 Cultural or historical features (section B7 of the BAR)

Are there any signs of culturally or historically significant elements, as defined in section 2 of the National Heritage Resources Act, 1999, (Act No. 25 of 1999), including Archaeological or paleontological sites, on or close (within 20m) to the site? If YES, explain:

YES	NO
Uncertain	

N/A

If uncertain, conduct a specialist investigation by a recognised specialist in the field (archaeology or palaeontology) to establish whether there is such a feature(s) present on or close to the site. Briefly explain the findings of the specialist:

Not Applicable – A copy of the 2013 Wakkerstroom BAR and Rehabilitation Plan will however be provided to the relevant heritage authorities for consideration.

Will any building or structure older than 60 years be affected in any way?	YES	NO
Is it necessary to apply for a permit in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999)?	YES	NO

If YES, please provide proof that this permit application has been submitted to SAHRA or the relevant provincial authority.

6.1.9 Biodiversity (Section B9 of the BAR)

Indicate the applicable biodiversity planning categories of all areas on site and indicate the reason(s) provided in the biodiversity plan for the selection of the specific area as part of the specific category)

Systematic Biodiversity Planning Category				If CBA or ESA, indicate the reason(s) for its selection in biodiversity plan
Critical Biodiversity Area (CBA)	Ecological Support Area (ESA)⁷	Other Natural Area (ONA)	No Natural Area Remaining (NNR)	<p>The Paardeplaats farm forms part of the KwaMandlangampisi Protected Environment area, which was the first protected area of its sort in South Africa. According to the World Wildlife Fund (2010) the KwaMandlangampisi Protected Environment it is a critical water catchment area for South Africa that includes the headwaters of the Pongola River and the Assegai River, which feeds the Heyshope Dam and provides clean water for national power generation.</p> <p>it spans threatened high altitude grasslands, wetlands and indigenous Mistbelt forest, and is home to threatened and endemic plant, bird and animal species, including the Oribi and South Africa’s three Crane species (Wattled, Grey Crowned and Blue).</p>

Indicate and describe the habitat condition on site

Habitat Condition	Percentage of habitat condition class (adding up to 100%)	Description and additional comments and observations (Incl. additional insight into condition, e.g. poor land management practises, presence of quarries, grazing, harvesting regimes etc.).
Natural	10%	The surrounding area is mostly in a near natural state, parts of the surrounding environment is however not impacted by grazing or historic land uses and can therefore be classified as completely “natural”.

⁷ Ecological Support Areas are supporting zones required to prevent the degradation of Critical Biodiversity Areas and Protected Areas. These may include areas that are degraded or even transformed if these areas still play an important role in supporting CBAs (e.g. heavily invaded riparian strips or farmland within a coastal corridor).

Habitat Condition	Percentage of habitat condition class (adding up to 100%)	Description and additional comments and observations (Incl. additional insight into condition, e.g. poor land management practises, presence of quarries, grazing, harvesting regimes etc.).
Near Natural (includes areas with low to moderate level of alien invasive plants)	80%	Most of the surrounding area is impacted to some extent by cattle grazing in the area as well as erosion. Large areas can however be classified as very close to "natural".
Degraded (includes areas heavily invaded by alien plants)	5%	Headcut erosion is occurring at the seep area. The seep area is further impacted by cattle using it as a watering point and a drainage ditch draining water from the seep.
Transformed (includes cultivation, dams, urban, plantation, roads, etc.)	5%	Various eroded dirt roads are present on the farm. The seep/wetland area is also dissected by a dirt road (Road B).

Complete the table to indicate:

- (iii) the type of vegetation, including its ecosystem status, present on the site; and
- (iv) whether an aquatic ecosystem is present on site.

Terrestrial Ecosystems		Aquatic Ecosystems						
Ecosystem threat status as per the NEM:BA (Act No. 10 of 2004)	Critical	Wetland (including rivers, depressions, channelled and unchannelled wetlands, flats, seeps pans, and artificial wetlands)			Estuary		Coastline	
	Endangered							
	Vulnerable							
	Least Threatened							
		YES	NO	UNSURE	YES	NO	YES	NO

Please provide a description of the vegetation type and/or aquatic ecosystem present on site, including any important biodiversity features/information identified on site (e.g. threatened species and special habitats)

Vegetation: The area is dominated by the Wakkerstroom Montane Grassland vegetation unit. It is classified as “Least threatened” by Mucina and Rutherford (2006). According to Mucina and Rutherford (2006) the vegetation unit consists mostly of short Montane grass on plateaus and flatter areas with short forest and *Leurcosidea* thicket occurring on steep, eastern facing slopes. *L. sericea* is mentioned as the predominant woody pioneer species which invades areas subjected to overgrazing.




A small patch of Paulpietersburg Moist Grassland occurs on the eastern parts of the farm. The seep/wetland area falls in this vegetation unit. It is classified as “Vulnerable” by Mucina and Rutherford (2006) with only a small portion being statutorily conserved.

Small patches of Northern KwaZulu-Natal Mistbelt Forest also occur on the Paardeplaats farm. This vegetation unit is described as “least threatened” in Mucina and Rutherford (2006). None of the proposed intervention will occur in or close to these forest patches.

Aquatic ecosystem: The Paardeplaats farm forms part of the upper reaches of the KwaNtombe River and greater Pongola River catchment area with various smaller streams draining the farm. These streams flow in a north-easterly direction towards the KwaNtombe River, which is about 4KM downstream of the north-eastern boundary of the farm.

The farm further falls within a sub-aternary catchment classified as a Fish Fresh Water Ecosystem Priority Area. The sub-catchment's rivers are classified as generally intact and in a good condition. It's also forms part of a Wetland Fresh Water Ecosystem Priority Area.

6.1.10 Site Photos

	
<p>Headcut erosion to be stabilised by gabion baskets looking in a north-westerly direction (Intervention W42-02-209-00)</p>	<p>Road to be stabilised by means of concrete strips. Looking in a northern direction(Intervention W42-02-209-00)</p>
	
<p>Hillslope failure identified for contouring and rehabilitation looking in a south-westerly direction (Intervention W42C-02-2010-00)</p>	<p>Erosion next to road looking in a south-easterly direction to be stabilised by rockpacks (Intervention W42C-02-210-00)</p>
	
<p>Road to be protected by surface cross drains looking in a south-easterly direction (Intervention W42C-02-213-00, W42C-02-226-00 and W42C-02-227-00)</p>	<p>Seep area looking in a north-westerly direction (Intervention W42C-02-219-00)</p>

	
<p>Pipe used to drain water onto the surrounding field (Interventions W42C-02-218-00 and W42C-02-219-00)</p>	<p>Wetland area looking in an easterly direction (Interventions W42C-02-218-00 and W42C-02-219-00)</p>
	
<p>Section of road next to the seep area to be protected by concrete strips thereby also protecting further degradation of the seep/wetland area (Interventions W42C-02-218-00 and W42C-02-219-00)</p>	<p>Road to be decommissioned and rehabilitated looking in a north-easterly direction (W42C-02-208-00)</p>
	
<p>Road to be decommissioned and rehabilitated looking in an easterly direction (W42C-02-208-00)</p>	

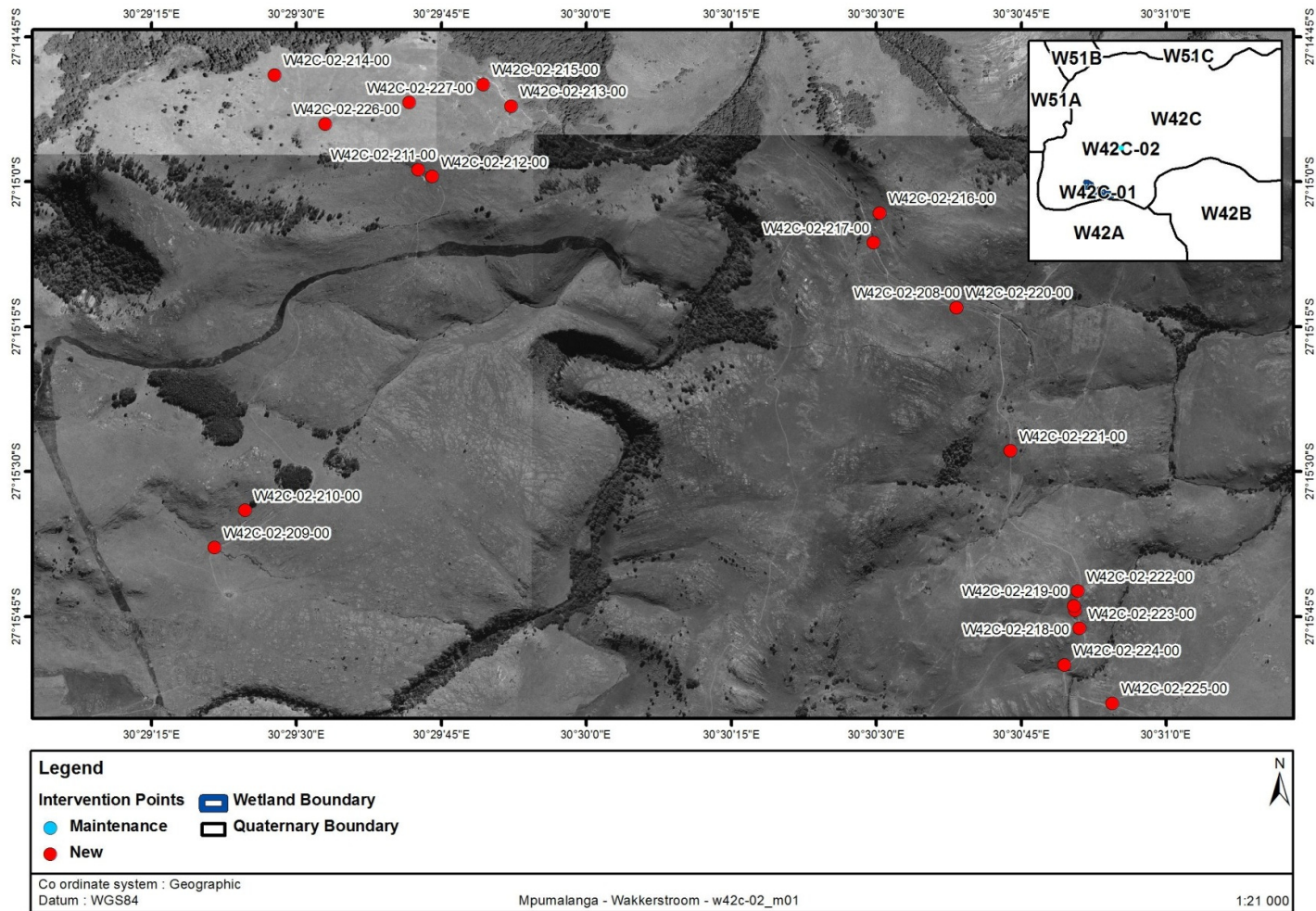


Figure 17: Wetland map, W42C-01 with proposed new wetland interventions indicated.

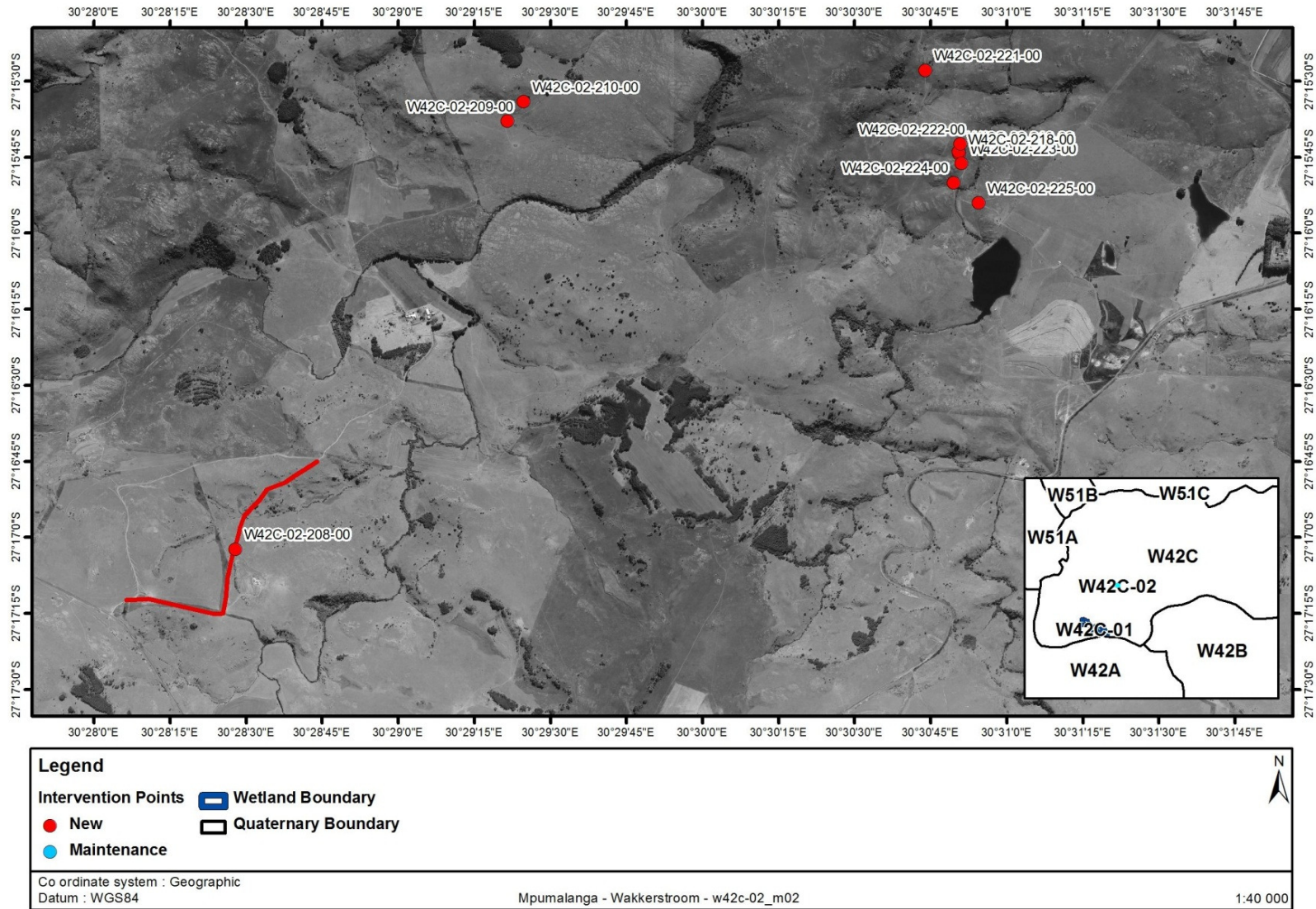


Figure 18: Wetland map, W42C-01 with proposed new wetland interventions indicated.

6.1.11 Wetland Rehabilitation Problems

The biophysical drivers of the wetland have been impacted upon by various activities, including inter alia:

- construction of an access road through the wetland;
- the diversion of flow by a trench adjacent to the road; and
- the use of the seep area as a watering point by cattle.

The upper portion of the wetland has been subjected to a number of impacts associated with the modification of the system's hydrology, which was likely to have been initiated to allow for the access across the wetland (see Figure 19 below). The problems identified within the wetland system can be addressed with the implementation of rehabilitation activities, which would include the deactivation of the headcut and trench, and the construction of concrete strips to stabilise the existing road/tracks.

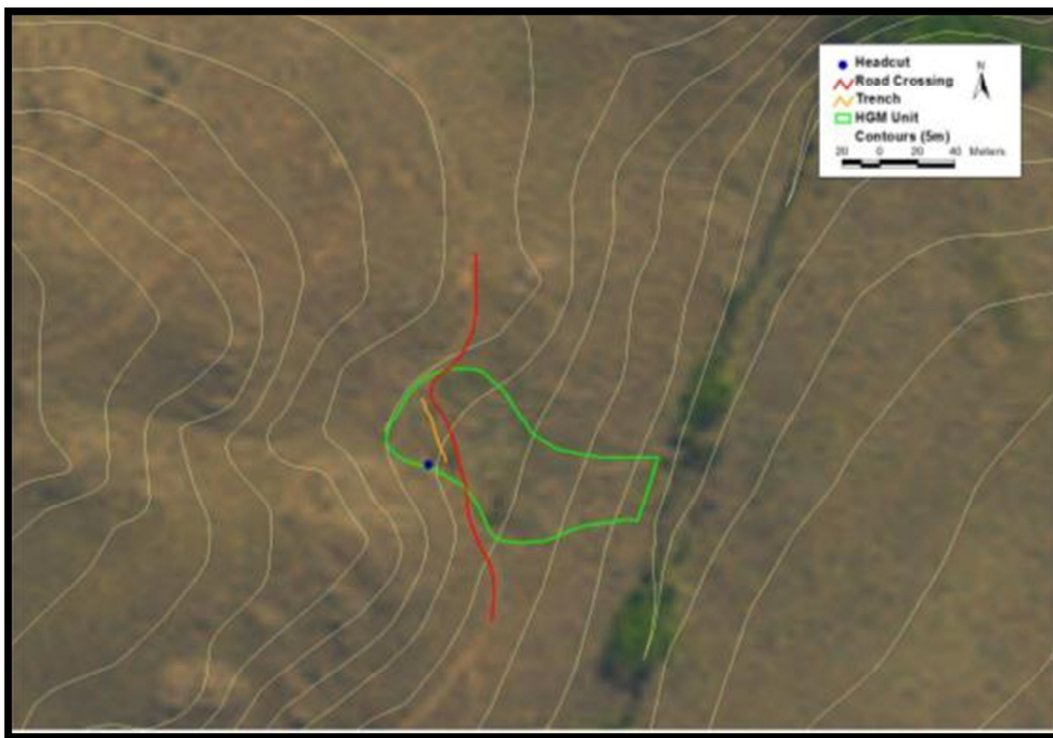


Figure 19: Wetland problems identified within wetland W42C-02

6.1.12 Wetland Rehabilitation Objectives

The primary objectives of the rehabilitation are as follows:

- reduce the threat to the seep/wetland area by headcut erosion;
- promoting diffuse flow;
- reduce further impacts from thoroughfare travelling along the road; and
- protecting the wetland from cattle using it as a watering point.

6.1.13 Alternatives (section 2(b) in the BAR)

Alternatives for each of the interventions are detailed in the various sections of Section 6.4.

6.1.14 Summary of Existing and Proposed Interventions

No existing interventions are present on the Paardeplaats farm. The following interventions are currently being implemented/were implemented during the 2011/2012 planning cycle:

Table 11: Summary of current interventions, W42C-02

Intervention Number	Intervention Type	Structure	Longitude	Latitude
W42C-02-201-00	Re-seeding		30°31'01.43"E	27°14'18.69"S
W42C-02-202-00	Re-seeding		30°30'52.24"E	27°14'47.37"S
W42C-02-203-00	Follow up spraying - wattle		30°29'55.75"E	27°14'53.93"S
W42C-02-204-00	Follow up spraying - wattle & bugweed		30°29'11.55"E	27°14'44.02"S
W42C-02-205-00	Follow up spraying - wattle		30°28'56.90"E	27°14'56.90"E
W42C-02-206-00	Follow up spraying - wattle		30°28'49.14"E	27°15'2.24"S
W42C-02-207-00	Cut and frill - wattle and follow up spraying.		30°30'02.63"E	27°15'27.09"S

The following new interventions are proposed for the Paardeplaats farm.

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Table 12: Summary of proposed new interventions, W42C-02

Intervention Number	Intervention Structure Type	Implementation Order	Priority	Structure Cost (Excl. Vat)
W42C-02-208-00	Deactivation of old road using gabions, diversion berms and grass seeding	20	4	R 1,290,084.32
W42C-02-209-00	Concrete strips and gabion cut off wall	18	3	R 44,425.46
W42C-02-210-00	Rehabilitation of hillslope erosion with grass seeds, erosion control blankets, water deflection berms and alien plant clearing	19	4	R 71,241.35
W42C-02-211-00	Contouring and rehabilitation of erosion ditches next to road with rock packs	16	4	R 400,650.74
W42C-02-212-00	Contouring and rehabilitation of erosion ditches next to road with rock packs	17	4	R 254,037.44
W42C-02-213-00	Surface cross drains to protect steep section of road	11	4	R 27,379.03
W42C-02-214-00	Rehabilitation of hillslope erosion with grass seeds, erosion control blankets and water deflection berms	15	4	R 13,968.89
W42C-02-215-00	Rehabilitation of erosion ditches next to road with rock packs	12	4	R 723,730.79
W42C-02-216-00	Gully stabilisation with rockpacks and gabion diversion walls	7	4	R 325,202.71
W42C-02-217-00	Deactivate old road (gabion walls and earthen diversion berms) and protect new road (surface cross drains)	8	4	R 124,911.22

Wetland Rehabilitation Plan – Wakkerstroom

February 2013

Intervention Number	Intervention Structure Type	Implementation Order	Priority	Structure Cost (Excl. Vat)
W42C-02-218-00	Concrete strips, backfilling of trench and fencing to protect the sensitive area	2	3	R 66,441.73
W42C-02-219-00	Deactivate headcut erosion through construction of concrete weir	1	2	R 269,934.21
W42C-02-220-00	Surface cross drain	9	4	R 35,934.97
W42C-02-221-00	Surface cross drain	10	4	R 15,400.70
W42C-02-222-00	Surface cross drain	3	4	R 8,555.95
W42C-02-223-00	Surface cross drain	4	4	R 6,844.76
W42C-02-224-00	Surface cross drain	5	4	R 5,133.57
W42C-02-225-00	Surface cross drain	6	4	R 23,956.65
W42C-02-226-00	Surface cross drain	14	4	R 54,758.06
W42C-02-227-00	Surface cross drain	13	4	R 41,068.54
Total				R 3 871 759.44

The implementation order indicates the timing order in which interventions should be implemented within the wetland (number 1 first). The priority 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.

New properties will be identified in the next planning cycle. No future interventions are planned on Paardeplaats.

6.2 Wetland Rehabilitation Strategy

These proposed interventions address the wetland problems and achieve the rehabilitation objectives as follows:

- reduce the threat to the seep/wetland area by stabilising the headcut erosion;
- promoting diffuse flow by deactivating a drainage ditch next to the road;
- installing concrete strips to reduce further impacts from thoroughfare travelling along the road; and
- protecting the wetland by fencing off the area from cattle using it as a watering point.

6.3 Design Selection and Sizing

The objectives of the interventions are to deactivate headcut erosion, stabilise hillslope erosion and erosion gullies, alien plant clearing, protect sensitive wet areas from degradation by traffic and livestock, close and deactivate old roads and protect the steep sections of the existing roads with surface cross drains.

The most appropriate and cost effective method of achieving the objectives was considered in each case. Where possible, the available materials on site (e.g. rocks for rockpacks and earth material for earthen berms) were utilised in the designs. Concrete was considered to be the most appropriate material for the headcut stabilisation structure as it will be impermeable and long lasting. Gabions were specified in the erosion gullies where it was anticipated that flows would damage rock packs.

All the interventions were sized according to dimensions of the problems that were measures on site.

6.4 Interventions Designs

6.4.1 Intervention: W42C-02-208-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Rehabilitate old road with a series of gabion and earthen deflection structures, sloping of vertical banks and grass seeding
Rehabilitation Objective	Decommission old road
Latitude (D°M'S")	Linear feature
Longitude (D°M'S")	Linear feature
Engineering Drawings	W42C-02-208-00
Alternatives Considered	No alternatives were considered. Gabions were specified on the steeper areas in order to break the energy of the surface runoff. Earthen diversion berms were specified in the low energy environments. Gabions were better suited to the site conditions than concrete



Figure 20: Old road requiring closure and rehabilitation (Intervention W42C-02-208-00)

6.4.1.1 Bill of quantities: W42C-02-208-00

Item	Units	Quantity	Unit Cost	Item Cost
3 x 1 x 1 Gabion Basket	m ³	9		
4 x 1 x 1 Gabion Basket	m ³	18		
Earth Structure Volume	m ³	900	R 793.01	R 713,706

Item	Units	Quantity	Unit Cost	Item Cost
Gabion Rock Volume	m ³	99	R 3,000.00	R 297,000.00
Earth Works Volume	m ³	400	R 698.44	R 279,377.84
Seeding and Biojute	m ²	1420		
Total				R 1,290,084.32

6.4.1.2 Construction Notes:

The steep approaches to the stream are to be rehabilitated by alternating gabion deflection walls and earthen berms. The remaining sections are to be rehabilitated with earthen berms to deflect water off the road. The berms are to be at least 500mm higher than the natural ground level on the lower side where the water is discharging and have crest widths of 0.5m (side slopes of 1 in 2). Vertical banks are to be sloped to 1 in 2 slopes to promote the establishment of vegetation. The flatter bare areas are to be loosened to 100mm, apply kraal manure, seed and biojute. Quantities are as follows: 9 Gabions walls (each wall is 11x1x1): 270 square meters of geofabric; 28 earthen berms (901 cubic meters); slope banks (400 cubic meters); seeding and biojute (1420 square meters)

Standards revegetation specifications:

The bare areas (3 of) are to be rehabilitated by constructing diversion berms (to divert surface runoff off the eroding area: berms approximately 500mm high, 500mm crest width and 1 in 2 side slopes) diagonally across the bare areas at approximately 7m intervals, loosen the surface material to a depth of 100mm, apply kraal manure, grass seed and apply biojute as per suppliers specification. The emerging wattle saplings in the area are to be hand pulled.

SOIL PREPARATION

It is generally recommended that soil samples be collected and analysed by an agricultural laboratory to determine the need for site specific supplementary fertilizing. This is especially necessary for areas cleared from Wattles.

In instances where soils sampling could not be done, soil should be prepared by applying 50kg 2:3:2 per ha or alternatively provide a good spread of "kraalmanure". Care should be taken that manure used is not contaminated with other alien invasive species.

The fertilizer must be applied by hand on the identified area. The soil is then loosened to a depth of 100 to 150mm. This is to prevent the fertilizer to be washed away by runoff water as well as to ensure an even spread through the treatment area. Topsoil should be mixed with the fertilizing agent (2;3;2; or manure) if needed.

RESEEDING

An appropriate seed mixture should be sown in by hand at a rate of 20kg's of seed per ha. The seeds should be lightly covered with soil by dragging a branch over the sowed area or raked with a garden rake.

An appropriate mixture of seed will depend on what is available in stock at the time. Currently the following mixture is proposed based on available stock.

Seed mixture

40% Cynodon dactylon	20% Heteropogon contortus
10% Eragrostis curvula	10% Setaria sphacelata
10% Eragrostis tef	10% Themeda triandra

AFTERCARE

When seedlings has established and reached a height of 2 to 3 cm an additional fertilizer, 50kg super phosphate per ha, can be added.

It is recommended to exclude livestock grazing and/or fire from the rehabilitated areas until the roots of the new grass plants are well established. This is to avoid the pulling out of young plants by the herbivores or physical damage due to trampling.

Of utmost importance is follow-up work on cleared areas to prevent it from re-infesting. Hand pulling of invasive species seedlings is recommended at height below 1 meter. Should follow-up herbicide spraying be needed, only broad leave herbicides should be used as not to kill the grass.

Fire should not be applied within two years from establishment. All fires applied thereafter should only take place under moist soil conditions.

Subsequent livestock trampling (and trough this, grazing pressure) can influence the longevity and so the effectiveness of the reseeded area.

6.4.2 Intervention: W42C-02-209-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Gabions and concrete road strips
Rehabilitation Objective	Protect wet area from damage by vehicles
Latitude (D°M'S")	27°15'37.90"S
Longitude (D°M'S")	30°29'21.50"E
Engineering Drawings	W42C-02-209-00
Alternatives Considered	No alternatives considered. Gabions were specified for the cut off wall as they are permeable and would allow for the movement of subsurface flows. Gabions would not be suitable for protecting the vehicle tracks as they would require on-going maintenance and concrete was therefore the preferred option for the road strips



Figure 21: Road to be stabilised/protected by means of concrete strips and a gabion cut off wall (W42C-02-209-00) looking in south-westerly direction

6.4.2.1 Bill of quantities: W42C-02-209-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete: 20 MPa	m ³	4	R 6,606.37	R 26,425.46
Cement	Pockets	27.2		
Sand	m ³	2.6		
Stone	m ³	2.8		
3 x 1 x 1 Gabion Basket	m ³	2		

Item	Units	Quantity	Unit Cost	Item Cost
Gabion Rock Volume	m ³	6	R 3,000.00	R 18,000.00
Concrete: 20 MPa	m ³	4	R 6,606.37	R 26,425.46
Total				R 44,425.46

6.4.2.2 Construction Notes:

The gabions and road strips are to be constructed level with the natural ground. Geofabric is to be installed on all contact surfaces between the gabions and the soil.

6.4.3 Intervention W42C-02-210-00

Designer	Trevor Pike
Design Date	September 2012
Intervention Description	Erosion rehabilitation
Rehabilitation Objective	Prevent further erosion, stabilise and revegetate slope
Latitude (D°M'S")	27°15'37.90"S
Longitude (D°M'S")	30°29'21.50"E
Engineering Drawings	N/A
Alternatives Considered	N/A



Figure 22: Hillslope failure/erosion to be contoured and revegetated (W42C-02-211-00) looking in a south-westerly direction

6.4.3.1 Bill of quantities: W42C-02-210-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Works Volume	m ³	102	R 698.44	R 71,241.35
Total				R 71,241.35

6.4.3.2 Construction Notes:

The bare areas (3 of) are to be rehabilitated by constructing diversion berms (to divert surface runoff off the eroding area: berms approximately 500mm high, 500mm crest width and 1 in 2 side slopes) diagonally across the bare areas at approximately 7m intervals, loosen the surface material to a depth of 100mm, apply kraal manure, grass seed and apply biojute as per suppliers specification. The emerging wattle saplings in the area are to be hand pulled.

Standard revegetation specifications:

SOIL PREPARATION

It is generally recommended that soil samples be collected and analyzed by an agricultural laboratory to determine the need for site specific supplementary fertilizing. This is especially necessary for areas cleared from Wattles.

In instances where soils sampling could not be done, soil should be prepared by applying 50kg 2:3:2 per ha or alternatively provide a good spread of "kraalmanure". Care should be taken that manure used is not contaminated with other alien invasive species.

The fertilizer must be applied by hand on the identified area. The soil is then loosened to a depth of 100 to 150mm. This is to prevent the fertilizer to be washed away by runoff water as well as to ensure an even spread through the treatment area. Topsoil should be mixed with the fertilizing agent (2;3;2; or manure) if needed.

RESEEDING

An appropriate seed mixture should be sown in by hand at a rate of 20kg's of seed per ha. The seeds should be lightly covered with soil by dragging a branch over the sowed area or raked with a garden rake.

An appropriate mixture of seed will depend on what is available in stock at the time. Currently the following mixture is proposed based on available stock.

Seed mixture

40% *Cynodon dactylon*

10% *Eragrostis curvula*

10% *Eragrostis tef*

20% *Heteropogon contortus*

10% *Setaria sphacelata*

10% *Themeda triandra*

AFTERCARE

When seedlings has established and reached a height of 2 to 3 cm an additional fertilizer, 50kg super phosphate per ha, can be added.

It is recommended to exclude livestock grazing and/or fire from the rehabilitated areas until the roots of the new grass plants are well established. This is to avoid the pulling out of young plants by the herbivores or physical damage due to trampling.

Of utmost importance is follow-up work on cleared areas to prevent it from re-infesting. Hand pulling of invasive species seedlings is recommended at height below 1 meter. Should follow-up herbicide spraying be needed, only broad leave herbicides should be used as not to kill the grass.

Fire should not be applied within two years from establishment. All fires applied thereafter should only take place under moist soil conditions.

Subsequent livestock trampling (and trough this, grazing pressure) can influence the longevity and so the effectiveness of the reseeded area.

6.4.4 Intervention W42C-02-211-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Rockpacks
Rehabilitation Objective	Stabilise the erosion gully
Latitude (D°M'S")	27°14'58.74"S
Longitude (D°M'S")	30°29'42.61"E
Engineering Drawings	W42C-02-211-00
Alternatives Considered	No alternatives considered. Gabions were preferred due to the availability of rocks on site



Figure 23: Erosion rehabilitation (intervention W42C-02-211-00) looking in a south-easterly direction

6.4.4.1 Bill of quantities: W42C-02-211-00

Item	Units	Quantity	Unit Cost	Item Cost
Rockpacks	m ³	157	R 2,000.00	R 314,000.00
Sack Gabion	m ³	22	R 3,938.67	R 86,650.74
Geotextile	m ²	460		
Total				R 400,650.74

6.4.4.3 Construction Notes:

The toe of the rockpacks are to be secured with a sack gabion. Rocks are to be packed on the upstream side to the level of the top of the gully. The sack gabions, as well as the rock packs are to be keyed into the sides of the gully. A total of 6 packs are proposed for the gully (22m³ of sack gabions, 157 cubic meters of rock and 460 square meters of geofabric). Volumes based on rock packs with 1m crest width, 1m height and 1 in 2 side slopes. Width of gully is 7m and depth 1m

6.4.6 Intervention W42C-02-212-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Rockpacks
Rehabilitation Objective	Stabilise the erosion gully
Latitude (D°M'S")	27°14'58.74"S
Longitude (D°M'S")	30°29'42.61"E
Engineering Drawings	W42C-02-212-00
Alternatives Considered	No alternatives considered. Rockpacks were preferred due to the availability of rocks on site making them cost effective structures. Earthen berms were not considered due to the steep gradient of the site and high energy of the runoff



Figure 24: Erosion rehabilitation (intervention W42C-02-212-00) looking in a north-westerly direction

6.4.6.1 Bill of quantities: W42C-02-212-00

Item	Units	Quantity	Unit Cost	Item Cost
Rockpacks	m ³	64	R 2,000.00	R 128,000.00
Sack Gabion	m ³	32	R 3,938.67	R 126,037.44
Geotextile	m ²	441		
Total				R 254,037.44

6.4.6.3 Construction Notes:

The toe of the rockpacks is to be secured with a sack gabion. Rocks are to be packed on the upstream side to the level of the top of the gully. The sack gabions, as well as the rock packs are to be keyed into the sides of the gully. A total of 7 packs are proposed for the gully (98m of sack gabions, 64 cubic meters of rock and 441 square meters of geofabric). Volumes based on rock packs with 1m crest width, 1m height and 1 in 2 side slopes. Gully width is 10m and depth 0.5m.

6.4.8 Intervention W42C-02-213-00

Designer	Trevor Pike
Design Date	September 2012
Intervention Description	Surface cross drains
Rehabilitation Objective	Divert flows off the road to prevent erosion of the steep areas
Latitude (D°M'S")	Linear activity. Refer to layout plans
Longitude (D°M'S")	
Engineering Drawings	W42C-02-213-00
Alternatives Considered	<i>In situ</i> cross drains are a cost effective option of managing surface runoff. Hard structures (e.g. concrete berms) were therefore not considered



Figure 25: Road to be stabilised by surface cross drain (intervention W42C-02-213-00) looking in a south-easterly direction

6.4.8.1 Bill of quantities: W42C-02-213-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Works Volume	m ³	39.2	R 698.44	R 27,379.03
Total				R 27,379.03

6.4.8.2 Construction Notes:

Earthen cross drains are to be constructed at 20m intervals on the steep sections to divert surface flows off the road. The cross drains must not restrict the access of vehicles.

6.4.9 Intervention W42C-02-214-00

Designer	Trevor Pike
Design Date	September 2012
Intervention Description	Hillside erosion rehabilitation
Rehabilitation Objective	Rehabilitation of hillside erosion by means of grass seeding and water diversion berms
Latitude (D°M'S")	27°14'49.46"S
Longitude (D°M'S")	30°29'27.59"E
Engineering Drawings	N/A
Alternatives Considered	Seeding was considered the most appropriate method to rehabilitate the area. Hard options were not considered as vegetative cover was required



Figure 26: Hillside erosion rehabilitation (intervention W42C-02-215-00) looking in a north-westerly direction

6.4.9.1 Bill of quantities: W42C-02-214-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Works Volume	m ³	20	R 698.44	R 13,968.89
Total				R 13,968.89

6.4.9.3 Construction Notes:

The bare area is to be rehabilitated by loosening the surface material to a depth of 100mm, apply kraal manure, grass seed and apply biojute as per supplier's specification. The area to be rehabilitated is 120 square meters. Approximately 3 diversion berms, to divert surface runoff off the eroding area, (berms approximately 500mm high, 500mm crest width and 1 in 2 side slopes) to be constructed diagonally across the bare areas. Volume of earth for 3 berms is 20 cubic meters.

6.4.11 Intervention W42C-02-215-00

Designer	Trevor Pike
Design Date	September 2012
Intervention Description	Rock packs
Rehabilitation Objective	Stabilise erosion gully next to road
Latitude (D°M'S")	27°14'49.32"S
Longitude (D°M'S")	30°29'49.31"E
Engineering Drawings	W42C-02-215-00
Alternatives Considered	Rock packs were considered cost effective interventions as they would utilise available rock on site. Earthen berms were not considered due to the steep gradient of the gully



Figure 27: Gully to be rehabilitated (W42C-02-215-00) looking in a south-easterly direction

6.4.11.1 Bill of quantities: W42C-02-215-00

Item	Units	Quantity	Unit Cost	Item Cost
Rockpacks	m ³	289	R 2,000.00	R 578,000.00
Sack Gabion	m ³	37	R 3,938.67	R 145,730.79
Geotextile	m ²	730		
Total				R 723,730.79

6.4.11.3 Construction Notes:

The toe of the rockpacks is to be secured with a sack gabion. Rocks are to be packed on the upstream side to the level of the top of the gully. The sack gabions, as well as the rock packs are to be keyed into the sides of the gully. A total of 10 packs are proposed for the gully, 112m of sack gabions, 289 cubic meters of rock and 730 square meters of geofabric). Volumes based on rock packs with 1m crest width, 1m height and 1 in 2 side slopes. Gully width varies from 10m to 6m and depth is 1m.

6.4.13 Intervention W42C-02-216-00

Designer	Trevor Pike
Design Date	September 2012
Intervention Description	Gabions and earthen berms and rockfill of the flow path
Rehabilitation Objective	Deactivate erosion gully
Latitude (D°M'S")	27°15'2.92"S
Longitude (D°M'S")	30°30'29.85"E
Engineering Drawings	W42C-02-216-00
Alternatives Considered	Gabions were considered cost effective interventions on the steep areas as they would utilise available rock on site. Earthen berms were specified on the flatter areas. Concrete was not considered due to the associated costs



Figure 28: Deactivation of erosion gully next to road (W42C-02-216-00) looking south-southeast

6.4.13.1 Bill of quantities: W42C-02-216-00

Item	Units	Quantity	Unit Cost	Item Cost
2 x 1 x 1 Gabion Basket	Baskets	1		
3 x 1 x 1 Gabion Basket	Baskets	6		
4 x 1 x 1 Gabion Basket	Baskets	3		
Earth Works Volume	m ³	70		
Gabion Rock Volume	m ³	32	R 3,000.00	R 96,000.00
Sack Gabion	m ³	13	R 3,938.67	R 51,202.71
Rockpacks	m ³	89	R 2,000.00	R 178,000.00

Item	Units	Quantity	Unit Cost	Item Cost
Geotextile	m ²	286		
Total				R 325,202.71

6.4.13.2 Construction Notes:

The toes of the rockpacks are to be secured with a sack gabion. Rocks are to be packed on the upstream side to the level of the top of the gully. The sack gabions, as well as the rock packs are to be keyed into the sides of the gully. The gabion walls are to be constructed across the gully to stabilise the gully and trap sediment. Volume of gabions is 32 cubic meters, rock packs are 66 cubic meters, sack gabions are 40m and geotextile is 286 square meters. The flow channel between the gabions is to be filled with rocks (23 cubic meters).

6.4.15 Intervention W42C-02-217-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Gabions and earthen berms
Rehabilitation Objective	Deactivate old road and protect new road with surface cross drains
Latitude (D°M'S")	Linear feature
Longitude (D°M'S")	Linear feature
Engineering Drawings	W42C-02-217-00
Alternatives Considered	<p>Deactivation of old road: Gabions were considered cost effective interventions on the steep areas as they would utilise available rock on site. Earthen berms were specified on the flatter areas.</p> <p>Protection of new road: <i>In situ</i> cross drains are a cost effective option of managing surface runoff. Hard structures (e.g. concrete berms) were therefore not considered</p>



Figure 29: Deactivation of old road (left hand side photo) and protection of new road (right hand side photo) by means of gabion walls and earthen diversion berms (W42C-02-217-00)

6.4.15.1 Bill of quantities: W42C-02-217-00

Item	Units	Quantity	Unit Cost	Item Cost
2 x 0.5 x 0.5 Gabion Basket	Baskets	3		
Gabion Rock Volume	m ³	1.5	R 3,000.00	R 4,500.00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Structure Volume	m ³	113	R 793.01	R 89,609.81
Earth Works Volume	m ³	44.1	R 698.44	R 30,801.41
2 x 0.5 x 0.5 Gabion Basket	Baskets	3		
Total				R 124,911.22

6.4.15.2 Construction Notes:

The length of the old road to be closed is 280m. A total of 5 gabion diversion walls (5x0.5x0.5) and 10 earthen berms (total of 130 cubic meters) are to be constructed on the old road. Approximately 18 surface cross drains are required on the new road

6.4.16 Intervention W42C-02-218-00

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Concrete road strips, backfilling of trench and fencing
Rehabilitation Objective	Protect seep and wetland area from damage by vehicles, promote diffuse flows cattle trampling
Latitude (D°M'S")	27°15'43.92"S
Longitude (D°M'S")	30°30'50.46"E
Engineering Drawings	W42C-02-218-00
Alternatives Considered	Concrete was considered a permanent and suitable material for the road strips. Gabions were not considered due to the associated maintenance requirements



Figure 30: Section of road requiring concrete strips and adjacent trench (right side of road) to be backfilled (W42C-02-218-00), looking in a south-south-eastern direction

6.4.16.2 Bill of quantities: W42C-02-218-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete: 20 MPa	m ³	9	R 6,606.37	R 59,457.29
Cement	Pockets	61.2		
Sand	m ³	5.85		
Stone	m ³	6.3		
Earth Works Volume	m ³	10	R 698.44	R 6,984.45
Total				R 66,441.73

6.4.16.3 Construction Notes:

Concrete road strips, backfilling of the trench adjacent to the road and fencing: The concrete strips will reduce the disturbance to the road in the wet area, whilst backfilling the trench will reduce the diversion of water away from the wetland. The seepage area is to be fenced off to prevent damage by livestock. The length of the concrete strips is 60m, length of fencing is 310m and backfill in trench is 10 cubic meters (40m long)

6.4.17 Intervention W42C-02-219-00

Designer	Trevor Pike
Design Date	September 2012
Intervention Description	Concrete Weir and stock watering trough
Rehabilitation Objective	Deactivate headcut erosion and protect seep area from damage by cattle
Latitude (D°M'S")	27°15'43.92"S
Longitude (D°M'S")	30°30'50.46"E
Engineering Drawings	W42C-02-219-00
Alternatives Considered	An impermeable structure was required and gabions were therefore not considered for stabilising the headcut



Figure 31: Headcut erosion stabilisation with concrete (intervention W42C-02-219-00) looking in a north-westerly direction

6.4.17.1 Bill of quantities: W42C-02-219-00

Item	Units	Quantity	Unit Cost	Item Cost	Estimated Labour Budget %	Labour budget
Gabion Rock Volume	m ³	4.8	R 3,000.00	R 14,400.00		
Concrete: 20 MPa	m ³	38.68	R 6,606.37	R 255,534.21		
Cement	Pockets	263.024				
Sand	m ³	25.142				
Stone	m ³	27.076				
Weldmesh Ref 617	m ²	60.93				

Item	Units	Quantity	Unit Cost	Item Cost	Estimated Labour Budget %	Labour budget
Weldmesh Ref 888	m ²	113.74				
Mass of Steel	kg	529				
Total				R 269,934.21		

6.4.17.2 Construction Notes:

The spillway of the weir is to be built to the level of the top of the headcut. Weepholes are to be installed through the spillway (350mm above the level of the slab), and a subsoil drain is to be installed at the base on the back/behind the spillway. A counter weir (300mm high) is to be constructed to allow for the collection of water. A pipe is to be installed into the counter weir (and then buried) to carry water to a suitable area where it is to be connected to a stock watering trough with a ball valve to control flows. The area around the trough is to be protected with a concrete capped Reno mattress.

6.4.19 Intervention W42C-02-220-00 to W42C-02-225-00

Designer	Trevor Pike
Design Date	September 2012
Intervention Description	Surface cross drains
Rehabilitation Objective	Divert flows off the road to prevent erosion of the steep areas
Latitude (D°M'S")	Linear activity. Refer to layout plans
Longitude (D°M'S")	
Engineering Drawings	W42C-02-221-00- W42C-02-226-00
Alternatives Considered	<i>In situ</i> cross drains are a cost effective option of managing surface runoff. Hard structures (e.g. concrete berms) were therefore not considered



Figure 32: Surface cross drain (interventions W42C-02-221-00 to W42C-02-226-00) looking in a south and south-easterly direction

6.4.19.2 Bill of quantities: W42C-02-220-00 to W42C-02-225-00

Intervention No.	Item	Units	Quantity	Unit Cost	Item Cost
W42C-02-220-00	Earth Works Volume	m ³	51.45	R 698.44	R 35,934.97
W42C-02-221-00	Earth Works Volume	m ³	22.05	R 698.44	R 15,400.70
W42C-02-222-00	Earth Works Volume	m ³	12.25	R 698.44	R 8,555.95
W42C-02-223-00	Earth Works Volume	m ³	9.8	R 698.44	R 6,844.76
W42C-02-224-00	Earth Works Volume	m ³	7.35	R 698.44	R 5,133.57
W42C-02-225-00	Earth Works Volume	m ³	34.3	R 698.44	R 23,956.65
Total					R 95 826.60

6.4.19.3 Construction Notes:

Earthen cross drains are to be constructed at 20m intervals on the steep sections to divert surface flows off the road. The cross drains must not restrict the access of vehicles.

6.4.21 Intervention W42C-02-226-00 and W42C-02-227-00

Designer	Trevor Pike
Design Date	September 2012
Intervention Description	Surface cross drains
Rehabilitation Objective	Divert flows off the road to prevent erosion of the steep areas
Latitude (D°M'S")	Linear activity. Refer to layout plans
Longitude (D°M'S")	
Engineering Drawings	W42C-02-226-00 & W42C-02-227-00
Alternatives Considered	<i>In situ</i> cross drains are a cost effective option of managing surface runoff. Hard structures (e.g. concrete berms) were therefore not considered



Figure 33: Surface cross drain (interventions W42C-02-227-00 and W42C-02-228-00) looking in a south and south-easterly direction

6.4.21.1 Bill of quantities: W42C-02-226-00 & W42C-02-227-00

Intervention No.	Item	Units	Quantity	Unit Cost	Item Cost
W42C-02-226-00	Earth Works Volume	m ³	78.4	R 698.44	R 54,758.06
W42C-02-227-00	Earth Works Volume	m ³	58.8	R 698.44	R 41,068.54
Total					R 95 826.60

6.4.21.2 Construction Notes:

Earthen cross drains are to be constructed at 20m intervals on the steep sections to divert surface flows off the road. The cross drains must not restrict the access of vehicles.

6.5 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 WfWet best management practices and specific requirements of the land owner. The implementation of these interventions must also take into account all relevant provisions of Working for Wetlands Best Management Practices and the Construction Environmental Management Plan, the recommendations of the Basic Assessments submitted for Environmental Authorisation and the requirements of the Environmental Authorisation Record of Decision for the project.

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

The following project-specific management issues apply:

- The area generally provides habitat for a number of Red Data species and the construction activities should be planned and managed to reduce impacts on the fauna and flora in the area in accordance with WfWet best management practices and with input from the land owner and local conservation organisations.

6.6 Wetland Management Recommendations

The system is currently utilised for livestock grazing, but following the implementation of the rehabilitation activities certain areas of the system will become inaccessible for livestock due to fencing (seepage areas). The landowner should consider managing livestock access to limit grazing in these sensitive areas.

6.7 Baseline M&E Data

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

6.7.1.1 *Erosion Problems*

The erosional features within the wetland are generally planned to be stabilised at the head of the erosional feature, and will therefore not be monitored. If these features were to be stabilised by back-flooding from a downstream intervention, monitoring would have been necessary.

6.7.1.2 *Fixed Point Photography*

In order to provide the ability to visually determine the degree of change within the wetland system photography of the wetland system has been taken prior to the implementation of wetland rehabilitation activities.

Locations

FPP Number	01	
GPS Location (DMS)	Latitude	27 15' 43.39" S
	Longitude	30 30' 49.56" E
Description of Photography Point		
The photograph was taken from an elevated area looking downhill in a south-easterly direction.		

Photographs



6.7.1.3 *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):

HGM Unit	Area (ha)	Hydro Health	Geo Health	Vegetation Health
W42C-02	0.61	7	9.1	8.1

7. Wakkerstroom Wetland: Maintenance: WC-42-03-201-01

During a site visit to the Wakkerstroom Wetland, it was discovered that one of the interventions did not function properly, and could be improved. A ditch was dug in the wetland in order to achieve diffuse flow onto an area southwest of a straightened drainage channel. The ditch is however too shallow to ensure flow throughout the year.

It is therefore proposed that the material is excavated from the ditch in order to ensure a deeper channel and thus flow in the channel throughout the year and not only during the peak rainfall months.

7.1 Intervention V31A-01-201-01

Designer	Trevor Pike
Design Date	July 2012
Intervention Description	Earthworks/Excavation
Rehabilitation Objective	Deepen channel to achieve diffuse flow throughout the year
Latitude (D°M'S")	27°20'50.10"S
Longitude (D°M'S")	30° 8'57.59"E
Engineering Drawings	V31A-01-201-01
Alternatives Considered	N/A



Figure 35: Channel to be excavated (V31A-01-201-01), looking in a north-easterly direction

7.1.1.2 Bill of quantities: V31A-01-201-01

Item	Units	Quantity	Unit Cost	Item Cost
Earth Works Volume	m ³	97.5	R 698.44	R 68,098.35
Total				R 68,098.35

7.1.1.3 Construction Notes:

The channel is to be lowered by 300mm over a distance of 65m and is to be shaped to a trapezoidal shape.