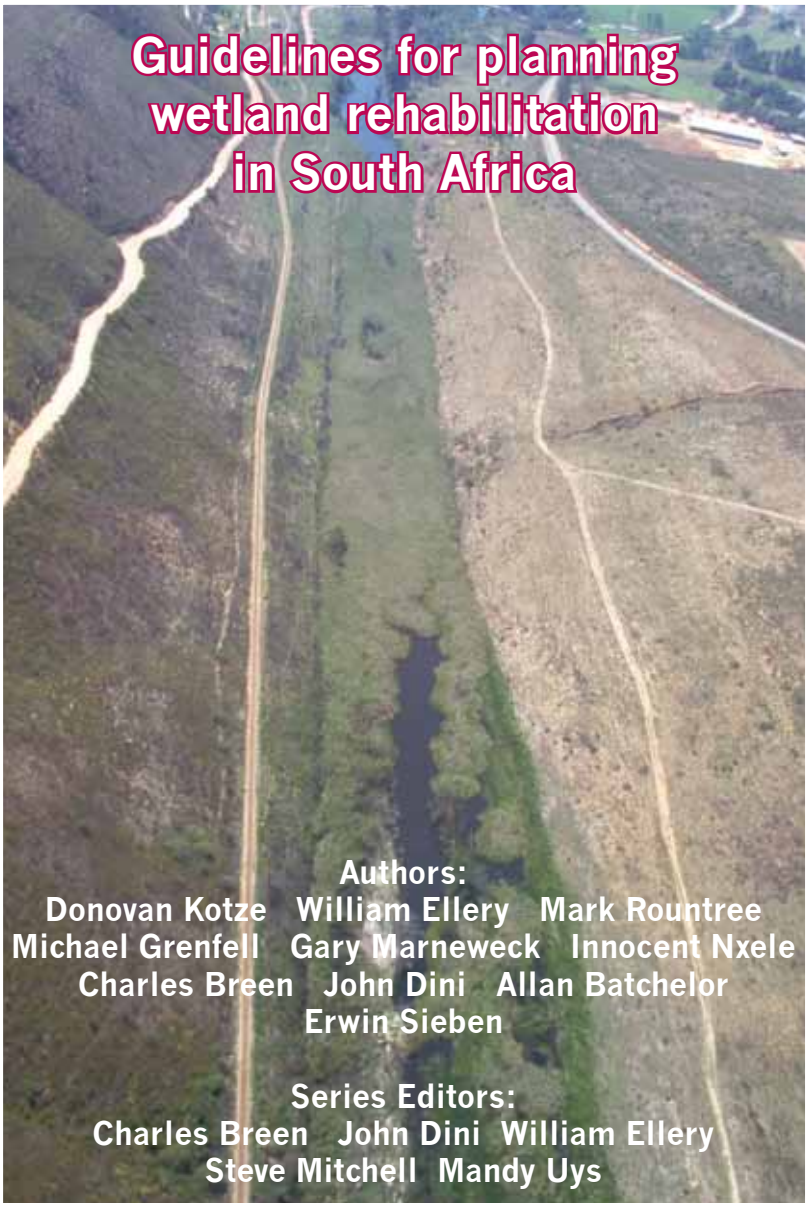
Wetland Management Series

WET-RehabPlan

Guidelines for planning wetland rehabilitation in South Africa



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Environmental Affairs and Tourism
Water Affairs and Forestry
Agriculture

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Water Research Commission

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WRC Report TT 336/09
March 2009

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Front cover: An aerial view of the Kromme River Wetland near Kareedouw, Eastern Cape. The wetland vegetation is dominated by Palmiet (*Prionium serratum*) - the only member of the family Prionaceae, which is endemic to South Africa. Its distribution is restricted to peatlands with quartzitic catchments of the Cape and the Natal Supergroups. *Photograph:* Japie Buckle

Inside front cover: Boneberg's frog (*Natalobatrachus bonebergi*), commonly known as Ngoye frog, is a threatened endemic species along the coastal region of KZN. *Photograph:* Errol Douwes

Preface: Background to the *WET-Management* Series

The need for wetland rehabilitation in South Africa is compelling: loss and degradation of wetlands have been great and national policy and legislation provides clear direction and support for rehabilitation. However, rehabilitating wetlands is often complex because wetlands and their links with people are complex (e.g. through the ways that people use wetlands and the different benefits that people receive from the ecosystem services that wetlands supply). Thus, a series of tools has been developed to assist those wishing to undertake wetland rehabilitation in a well-informed and effective way (Box 1P).

These tools were developed as part of a comprehensive nine-year research programme on wetland management which was initiated in 2003 by the Water Research Commission (WRC) and a range of partners that examines wetland rehabilitation, wetland health and integrity and the sustainable use of wetlands. The rehabilitation component, which was co-funded by the WRC and the Department of Environmental Affairs and Tourism, through the Working for Wetlands (WfWetlands) programme, was prioritised to take place first because of the need to provide a firm scientific and technical foundation for the extensive rehabilitation work already underway.

The Working for Wetlands Programme is a national initiative that seeks to promote the protection, rehabilitation and wise use of wetlands in South Africa. As part of this initiative, WfWetlands has a national programme for the rehabilitation of wetlands, including a structured process of prioritising rehabilitation sites and supporting their rehabilitation. At the same time, however, it is acknowledged that sustainable use of wetlands in the long term can be achieved only through the dedicated participation of civil society, whose wetland interests may have a strong local focus. Thus, the tools have been developed in such a way that they can be applied outside of the Working for Wetlands Programme, and without having to engage the process of national or provincial prioritisation should the user not desire to do so. Even so, the tools encourage local wetland rehabilitation efforts to strengthen links with the national initiative and the opportunity this provides for fruitful partnerships.

The series consists of a roadmap, two background documents, eight tools and an evaluation of the success of six individual projects (Box 1P). From Table 1P it can be seen that some of the tools (e.g. *WET-RehabMethods*) are designed to be used by those dealing specifically with wetland rehabilitation and its technical requirements. Other tools (e.g. *WET-Health*) have much wider application such as assessing impacts associated with current and future human activities in Environmental Impact Assessments or assessing the Present Ecological State of a wetland in an Ecological Reserve Determination.

One can locate the tools in terms of some basic 'who', 'what', 'where' and 'how' questions that any team undertaking wetland rehabilitation should be asking (Table 2P). Furthermore, each of the tools can be used individually, but there are close links between them (Figure 1P).

Box 1P: Overview of the *WET-Management* Series

The series includes documents that provide background information about wetlands and natural resource management, tools that can be used to guide decisions around wetland management, and an evaluation of rehabilitation outcomes in a number of case studies.

WET-Roadmap

WET-Roadmap provides an introduction to the *WET-Management* tools and includes:

- A brief outline of the documents and tools in the *WET-Management* series and how they inter-relate
- An index of wetland rehabilitation related terms
- Reference to specific sections in the relevant tools.

WET-Origins

WET-Origins describes the remarkable geological and geomorphological processes that give rise to wetlands in South Africa, and provides a background description of:

- The geology, geomorphology, climate and drainage of southern Africa
- An introduction to wetland hydrology and hydraulics
- Geomorphic controls on different wetland types
- Wetland dynamics due to sedimentation and erosion.

It incorporates this understanding into a methodology that can be used to help develop insight into the hydrological and geomorphological factors that govern why a wetland occurs where it does, which is useful when planning rehabilitation.

WET-ManagementReview

WET-ManagementReview has four parts:

1. An assessment of effectiveness at programme level, including:
   - a national overview of land-uses affecting the status of wetlands and the institutional environment that affects wetlands.
   - an overview of 5 natural resource management programmes affecting wetlands and their impact in different land-use sectors; Working for Wetlands, Working for Water, LandCare, the Crane Conservation Programme of the Endangered Wildlife Trust, and the Mondi Wetlands Programme.
2. An assessment, using the *WET-EffectiveManage* tool, of the management effectiveness of 21 wetland sites in a variety of different land-use and land-tenure contexts.
3. An assessment of stakeholder participation in wetland rehabilitation at six wetland sites.
4. A framework for assessing the effectiveness of collaboration between partners, described and applied to a site where a rehabilitation project has been underway for several years.

WET-OutcomeEvaluate

WET-OutcomeEvaluate is an evaluation of the rehabilitation outcomes at six wetland sites in South Africa, including an evaluation of the economic value of rehabilitation. The six sites are:

1. Killarney Wetland
2. Manalana Wetland
3. Kromme River Wetland
4. Dartmoor Vlei
5. Kruisfontein Wetland
6. Wakkerstroom Vlei.

WET-RehabPlan

WET-RehabPlan offers a process that can be followed to develop comprehensive wetland rehabilitation plans. It has three main elements:

- Introduction to rehabilitation, planning and stakeholder involvement.
- General principles to follow in planning wetland rehabilitation.
- Step-by-step guidelines for undertaking the planning and implementation of wetland rehabilitation at a range of scales from national/provincial to catchment to local. It directs the user to the right tools and sections at appropriate points in the rehabilitation process.

Good planning ensures a rational and structured approach towards rehabilitation as well as a clear understanding of the reasons for rehabilitation, the actions and interventions required, and the benefits and beneficiaries.

WET-Prioritise

WET-Prioritise helps to identify where rehabilitation should take place once the objectives of rehabilitation are identified. It works at three spatial levels. At national and provincial level, an interactive GIS modelling tool assists in identifying priority catchments by evaluating a range of scenarios, based on different combinations of 13 socio-economic and bio-physical criteria (e.g. Biodiversity Priority Areas, High Poverty Areas). Once a catchment is selected, the tool helps to identify areas for rehabilitation within that catchment. Finally, individual wetlands are selected based on the predicted cost-effectiveness and sustainability of rehabilitation.

WET-Prioritise provides step-by-step guidelines applicable at all three spatial scales, including:

- Identifying objectives and an appropriate scale.
- Developing prioritisation criteria.
- Applying the criteria, usually in a two step process of rapidly screening all candidate sites to arrive at a preliminary set of sites, from which individual priority sites are selected.

Three case examples of prioritisation are described.

WET-Legal

WET-Legal presents South African legislation that is relevant to wetland rehabilitation, including the Conservation of Agricultural Resources Act (CARA), National Environmental Management Act (NEMA), and National Water Act (NWA), as well as relevant international agreements such as the Ramsar Convention on Wetlands. *WET-Legal* lists the environmental impacts potentially associated with typical wetland interventions and the legislative provisions that apply to each of these impacts. It also covers laws compelling rehabilitation and the legal responsibilities of different parties involved in rehabilitation.

WET-EcoServices

WET-EcoServices is used to assess the goods and services that individual wetlands provide, thereby aiding informed planning and decision-making. It is designed for a class of wetlands known as palustrine wetlands (i.e. marshes, floodplains, vleis or seeps). The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing). The first step is to characterise wetlands according to their hydro-geomorphic setting (e.g. floodplain). Ecosystem service delivery is then assessed either at Level 1, based on existing knowledge or at Level 2, based on a field assessment of key descriptors (e.g. flow pattern through the wetland).

WET-Health

WET-Health assists in assessing the health of wetlands using indicators based on geomorphology, hydrology and vegetation. For the purposes of rehabilitation planning and assessment, *WET-Health* helps users understand the condition of the wetland in order to determine whether it is beyond repair, whether it requires rehabilitation intervention, or whether, despite damage, it is perhaps healthy enough not to require intervention. It also helps diagnose the cause of wetland degradation so that rehabilitation workers can design appropriate interventions that treat both the symptoms and causes of degradation. *WET-Health* is tailored specifically for South African conditions and has wide application, including assessing the Present Ecological State of a wetland for purposes of Ecological Reserve determination in terms of the National Water Act, and for environmental impact assessments. There are two levels of complexity: Level 1 is used for assessment at a broad catchment level and Level 2 provides detail and confidence for individual wetlands based on field assessment of indicators of degradation (e.g. presence of alien plants). A basic tertiary education in agriculture and/or environmental sciences is required to use it effectively.

WET-EffectiveManage

WET-EffectiveManage provides a framework that can be used to assess management effectiveness at individual wetlands based on 15 key criteria (e.g. the extent to which a regularly reviewed management plan is in place for the wetland). A scoring system is provided for rapidly assessing the criteria. This tool is Chapter 2 in the *WET-ManagementReview* manual.

WET-RehabMethods

WET-RehabMethods is used to guide the selection and implementation of rehabilitation methods that are appropriate for the particular problem being addressed and for the wetland and its catchment context. It provides detailed practical rehabilitation guidelines for inland palustrine wetlands and their catchments, and focuses particularly on wetlands associated with natural drainage networks. It can be adapted to meet specific needs. Some aspects of the tool require high levels of civil engineering expertise, but it is designed primarily for rehabilitation workers who have completed training in soil conservation, life sciences or engineering at a diploma level or higher, and who have practical field experience.

WET-RehabMethods includes the following:

- Key concepts relating to wetland degradation, particularly those

resulting from erosion.

- Guidelines for the selection of an appropriate type of rehabilitation intervention (including both 'soft' and 'hard' engineering options).
- Detailed guidance, provided for designing a wide variety of intervention types (e.g. determining an adequate spillway to account for runoff intensity).
- Detailed guidance provided for the implementation of the different intervention types.

WET-RehabEvaluate

WET-RehabEvaluate is used to evaluate the success of rehabilitation projects, and is designed with the understanding that monitoring and evaluation are closely tied to planning, which, in turn, should accommodate monitoring and evaluation elements. *WET-RehabEvaluate* provides the following :

- Background to the importance of evaluation of wetland rehabilitation projects.
- Step-by-step guidelines for monitoring and evaluation of rehabilitation projects, both in terms of project outputs and outcomes. The outcomes are based on system integrity and the delivery of ecosystem services, and results from *WET-Health* and *WET-EcoServices* are therefore included. The guidelines include: review project objectives, identify performance indicators and standards, develop and implement a monitoring and evaluation plan, evaluate and report on performance.

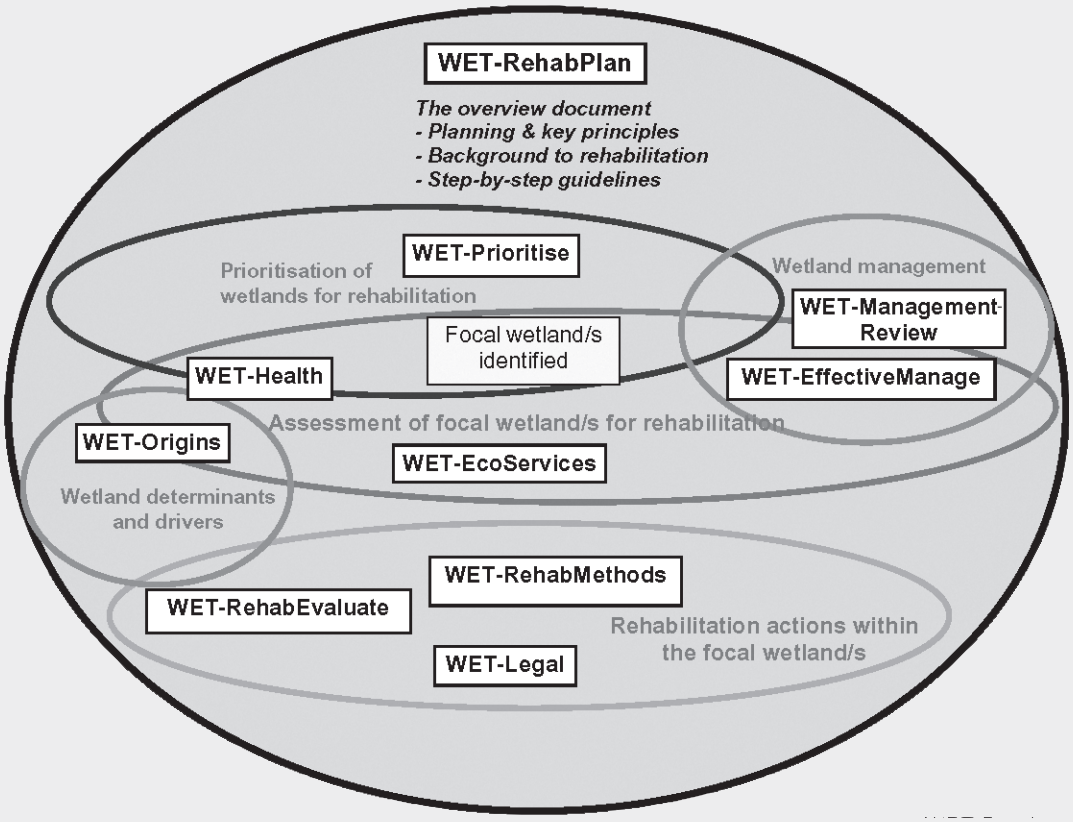

Figure 1P: How do the *WET-Management* tools relate to each other in a rehabilitation context?

Table 1P: Likely relevance of the background reading and tools in the *WET-Management* series to a variety of different potential uses

Potential users	*WET-Origins*	*WET-Management - Review*	*WET-RehabPlan*	*WET-Prioritise*	*WET-Effective-Manage*	*WET-Legal*	*WET-Rehab-Methods*	*WET-Eco-Services*[1]	*WET-Health*[2]	*WET-Rehab-Evaluate*
Rehabilitation planning - wetland specialist										
Rehabilitation planning - engineer		Part 1	Step 5							
Rehabilitation programme coordination - *national*										
Rehabilitation programme coordination - *provincial*										
Rehabilitation implementation			Step 5							
Impact assessment		Part 1						Level 1	Level 2	
Wetland management										
Ecological Reserve Determination - DWAF officials & consultants		Part 1						Level 1	Level 2	
Catchment planners - CMAs and others		Part 1								
Broad-scale biodiversity conservation planning		Part 1								

The tool is likely to have some relevance

The tool is likely to have a very high level of relevance

[1] *WET-EcoServices* is of particular relevance in determining the Ecological Importance and Sensitivity (EIS) of a wetland.

[2] *WET-Health* is of particular relevance ino determining the Present Ecological State (PES) of a wetland.

CMA = Catchment Management Agency
DWAF= Department of Water Affairs and Forestry

Table 2P: Rehabilitation-related questions typically posed at different spatial levels, and the tools most relevant to assisting the user in answering each question

Common questions	Tool/s likely to be relevant in addressing the question
Questions that might typically be asked at the national or regional level	
What is causing the degradation of wetlands?	*WET-Health* (Level 1) & *WET-ManagementReview*
Which are the most important wetlands?	*WET-Prioritise* & *WET-EcoServices* (Level 1)
Which wetlands should we rehabilitate?	*WET-Prioritise*
How should wetland rehabilitation be integrated within broad-scale catchment management?	*WET-Prioritise* & Dickens *et al*. (2003)
Questions that might typically be asked at the local level	
How effectively is the wetland being managed?	*WET-EffectiveManage*
What is causing the degradation of the wetland?	*WET-Health* (Level 2)
Is the wetland in need of rehabilitation?	*WET-Health* (Level 2) & *WET-Origins*
How do I decide what rehabilitation interventions will be appropriate for meeting my rehabilitation objectives?	*WET-RehabPlan* (Step 5F) & *WET-RehabMethods*
What are specific technical considerations I must make when designing a rehabilitation intervention?	*WET-RehabMethods*
Will the planned project be legally compliant?	*WET-Legal*
How do I evaluate my rehabilitation project?	*WET-RehabEvaluate*
Who should be involved in the rehabilitation project?	*WET-RehabPlan*
How do I align my rehabilitation project with catchment-, regional- or national-level programme/s?	*WET-RehabPlan* & WfWetlands Strategy (Working for Wetlands, 2005)

The National Water Act defines wetlands as:

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

This is the definition used by the *WET-Management* Series.

Summary of *WETRehabPlan*

The overall purpose of *WET-RehabPlan* is to assist in undertaking well-planned and well-informed wetland rehabilitation that is integrated into the broader management of the wetland and catchment, and which produces sustainable outcomes. *WET-RehabPlan* provides three main elements: background information on wetland rehabilitation, guiding principles for rehabilitation, and a framework with step-by-step guidelines for undertaking the planning and implementation of wetland rehabilitation. The background information deals with: What is wetland rehabilitation? Why is there need for wetland rehabilitation? Why does rehabilitation require effective collaboration? It also deals with the relationships between wetland rehabilitation and planning, governance and stakeholder involvement, recognising that an integral part of wetland rehabilitation is working with people within a particular legal and institutional context.

The rehabilitation of a wetland requires both technical and social processes, and the principles provided by *WET-RehabPlan* reflect both of these. Open local and regional processes are required that incorporate the contribution of landowners or users and other key stakeholders.

A large proportion of this document is focussed on a step-by-step procedure for the planning and implementation of wetland rehabilitation. This procedure covers planning at a range of scales from a national/provincial scale, to catchment scale and through to individual sites at a local scale. The first step of the procedure at all scales, is stakeholder-engagement, and the development of a shared vision for the wetland rehabilitation at the particular scale being considered. Guidance is provided with reference to *WET-RehabPrioritise*, for the broad-scale selection of priority catchments within which to rehabilitate wetlands.

Wetland rehabilitation planners are often faced with a number of technical questions needing to be addressed at individual sites. These include the following:

- Is the wetland degraded, and if so, what has diminished its health?
- Which aspects of the decline in health can be addressed through rehabilitation?
- Will rehabilitation affect the health of the wetland and its delivery of ecosystem services, and if so, how?
- What rehabilitation measures would be most appropriate for this wetland?
- What needs to be monitored in the wetland to be able to evaluate the success of the project?

WET-RehabPlan does not contain a lot of technical detail. It provides concise guidelines designed to help address each of the questions above, and directs the user to other tools in the *WET-Management* Series (e.g. *WET-Health* for assessing the health of a wetland and the impacts on wetland health, *WET-RehabMethods* for selecting and designing appropriate rehabilitation interventions and *WET-RehabEvaluate* for monitoring and evaluating the outputs and outcomes of rehabilitation). Thus, *WET-RehabPlan* provides an overall structure and process for the planning of wetland rehabilitation, and a framework for integrating the various assessments made during wetland rehabilitation planning. A fundamental assumption of *WET-RehabPlan* is that rehabilitation takes place within the context of an institutionalised management system, with clearly defined roles, and that responsibilities for carrying out these roles have been assumed.

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Feedback

In South Africa the rehabilitation of wetland ecosystems is still in its infancy. In order to promote the growth of this activity, this manual may need to be revised by including the experiences of those individuals involved in wetland rehabilitation. Any comments or advice can be sent to:

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1. INTRODUCTION

1.1 The imperative for wetland rehabilitation

The problem

South Africa's landscapes have changed dramatically over the past few centuries, largely through human settlement and associated activities. Agricultural and urban development and inappropriate land use practices have significantly impacted on South Africa's ecosystems, including wetlands. Yet we rely on these very ecosystems to provide the life-support services that sustain us and maintain our rich biodiversity. Some of the ecosystem services provided by wetlands include flood attenuation, water quality improvement, sediment trapping, biodiversity maintenance, and the provision of water and natural resources (see Kotze *et al.*, 2009).

Wetlands are prime examples of ecosystems that, despite their considerable provision of beneficial services, have not escaped the impacts of human activities. In some catchments more than 60% of the wetland area has been lost or severely degraded. The impact of this on ecosystem services has not been quantified, although various attempts to assess this loss suggest that it is substantial (Millennium Ecosystem Assessment, 2005). It is important to add, however, that this loss does not have to be permanent: international and South African experience has shown that it is possible, through rehabilitation interventions, to recover some of the health and services of lost and degraded wetlands.

A new way of seeing wetlands

Fortunately, in the last few decades, wetlands have become increasingly acknowledged for the range of services that they provide. Many of these services are not always immediately apparent or easily quantifiable, which has led in the past to them being given inadequate attention in many decision-making processes. Today, wetlands are more commonly perceived as natural assets able to provide a range of services, free of charge. The Millennium Ecosystem Assessment (2005), the most comprehensive analysis of the state of the planet's ecosystems undertaken, confirms the role of healthy wetlands in underpinning human well-being. Focusing on the links between ecosystems and human well-being, the assessment also confirms that wetland ecosystems seem to be deteriorating at a faster rate than most other ecosystems, with severe consequences for human well-being.

Policy context for wetland rehabilitation in South Africa

Current approaches to the conservation and sustainable use of wetlands need to take into account the considerable historical loss of wetland area and health as well as the current pressures and threats facing wetlands. Thus, there is a general recognition that in order to be effective, strategies for wetland conservation need to include a combination of proactive preventative measures (i.e. wetland protection and wise use), together with remedial interventions focused on reversing past degradation (i.e. wetland rehabilitation). In South Africa, both of these measures are being increasingly expressed through a range of policy and legislative frameworks, particularly within the environment and water sectors. Legislation of the Departments of Environmental Affairs and Tourism, Water Affairs and Forestry, and Agriculture, protect wetlands as well as encouraging their rehabilitation. Furthermore, several national policies and programmes and multilateral agreements to which South Africa is party have incorporated the twin-pronged approach of maintaining healthy wetlands while rehabilitating degraded wetlands.

There is global interest in the rehabilitation of ecosystems. The emphasis of this interest is promoting the benefits to society of ecosystem goods and services provided by healthy ecosystems (www.ma.org). South Africa has actively supported the sponsoring of programmes for ecosystem rehabilitation. Two examples of such programmes are Working for Water (WfWater), involved in clearing alien plants, including those in both terrestrial and wetland systems, and Working for Wetlands (WfWetlands), involved in the rehabilitation of degraded wetland ecosystems. In keeping with South Africa's national policy on environmental protection, and its commitment to international conventions and regional partnerships, the purpose of WfWetlands is to: '*champion the protection, rehabilitation and sustainable use of South Africa's wetlands through co-operative governance and partnerships*' (Working for Wetlands, 2005). Despite this purpose, South Africa lacks a comprehensive overview of the extent, the diversity and the distribution of its wetlands, as well as their status and relative importance. Consequently, this makes the prioritisation and planning of wetland rehabilitation and conservation more difficult.

This document, *WET-RehabPlan*, provides a scientific basis for the planning of wetland rehabilitation in South Africa, to be used by WfWetlands and any other national, regional or local initiative that seeks to rehabilitate wetlands. *WET-RehabPlan* is one of a series of ten different *WET-Tools* produced through the Wetland Rehabilitation Research Programme for addressing a range of needs of the organisations involved in wetland rehabilitation and management in South Africa. It provides an overall description of the process of rehabilitating wetlands, and makes frequent reference, at appropriate times in the process, to all of the other *WET-Tools* in the series.

1.2 What is wetland rehabilitation?

Wetland rehabilitation refers to the process of assisting in:

1. the recovery of a degraded wetland's health and ecosystem service delivery by reinstating the natural ecological driving forces or
2. halting the decline in health of a wetland that is in the process of degrading, so as to maintain its health and ecosystem service-delivery.

To summarise, *wetland rehabilitation is the process of assisting in the recovery of a wetland that has been degraded or in maintaining the health of a wetland that is in the process of degrading*.

Certain key concepts are encompassed within this definition. These are:

1. Rehabilitation is not the static endpoint of a recipe-like process (Kusler and Kentula, 1990). Rather, it is a process in its own right, whereby the wetland system is given an opportunity for a new beginning (Grenfell *et al.*, 2007).
2. Rehabilitation requires that we attempt to imitate natural processes and reinstate the natural ecological driving forces in such a way that we aid the recovery (or maintenance) of dynamic systems so that, although they are unlikely to be identical to their natural counterparts, they will be comparable in critical ways so as to function similarly (Jordan *et al.*, 1987).
3. We recognise that rehabilitation interventions may have different ecological starting points (ranging from totally degraded to slightly degraded) and different goal endpoints (ranging from a state that is close to the pristine to one that is still far from pristine, but nonetheless an improvement on the state of the system without any rehabilitation intervention). The chosen goal endpoint depends on what is achievable given the site conditions and those ecosystem attributes and

services that are considered most important. Any rehabilitation project should therefore be based on an understanding of both the ecological starting point and on a defined goal endpoint, and should accept that it is not possible to predict exactly how the wetland is likely to respond to the rehabilitation interventions.

The most typical rehabilitation interventions designed to assist in the recovery of degraded wetland ecosystems are 'plugs' constructed within artificial drainage channels. The 'plugs' are placed with the intention of re-instating a more natural hydrology. Typical interventions for maintaining the health of wetland ecosystems that are in the process of degrading are the placement of erosion control structures which assist in halting the advance through a wetland of an erosion headcut. However, rehabilitation is not confined to physical structures as it may include interventions such as reducing livestock grazing-pressure or reducing the frequency of burning.

From the discussion above it can be seen that 'wetland rehabilitation' is defined very broadly in this document, and in all of the documents in the *WET-Management* series. A number of other authors (e.g. Grenfell *et al*. 2007) have chosen to define rehabilitation more narrowly, through drawing a distinction between rehabilitation and other terms such as 'restoration'. Those readers interested in a detailed description of terminology relevant to wetland rehabilitation should refer to Grenfell *et al*., (2007).

1.3 Wetland rehabilitation in South Africa

As highlighted in Section 1.1, a clear need exists in South Africa for wetland rehabilitation. Rehabilitation of eroding wetlands was undertaken to some extent through the Department of Agriculture's soil conservation programme, particularly from the 1970s through to the early 1990s. Since 2000 the bulk of wetland rehabilitation in South Africa has been undertaken by Working for Wetlands (WfWetlands), a national government-funded programme that uses a poverty-relief focused implementation model to achieve its core business, the rehabilitation of wetlands. Through WfWetlands, which has undertaken rehabilitation work in over 100 wetlands across the country, large amounts of funding have been made available for wetland rehabilitation (Dini, 2004).

> "*Working for Wetlands came into being when the policy imperative to rehabilitate wetlands was matched with government's priority to create employment and alleviate poverty through the use of public works programmes. In its four years of existence, first as a sub-programme within Working for Water and then as a stand-alone programme under DEAT, Working for Wetlands' track record in delivery of outputs relating to poverty alleviation and employment creation has been established. Public assets are being rehabilitated while contributing to the objectives of the Expanded Public Works Programme.*" (Working for Wetlands, 2005).

There is a growing recognition that the activities of Working for Wetlands should extend beyond physical rehabilitation measures, as captured by Working for Wetlands (2005):

> "*The (WfWetlands) programme is now seen as an appropriate vehicle to do more than mechanical rehabilitation work. Coupled with this is the recognition that rehabilitation can only be truly effective if aligned with a range of supplementary activities, including education, extension and enforcement. This requires the coordinated attention of several government departments.*
>
> *In reflecting upon its current activities, in collaboration with key stakeholders,*

Working for Wetlands recognizes that whilst its activities have historically been restricted to the erection of structures to assist the rehabilitation of wetlands, its activities should expand to encompass:

- *a more comprehensive approach to rehabilitation, which is not restricted to the erection of structures; and,*
- *proactive projects to protect targeted wetlands and promote the sustainable use of others.*

By doing this it will act as a catalyst for similar projects in South Africa that do not fall under the Working for Wetlands ambit."

WfWetlands is a partnership between the three national government departments most directly mandated with regulating the use and management of wetlands: the Department of Environmental Affairs and Tourism (DEAT), the National Department of Agriculture (NDA) and the Department of Water Affairs and Forestry (DWAF). These three departments sit on the steering committee of WfWetlands, together with the Mondi Wetlands Project (MWP). The MWP, initiated in 1991, aims to catalyze the rehabilitation, wise use and sustainable management of South Africa's wetlands.

1.4 Rehabilitation and planning

Rehabilitation is often a costly and invasive activity, and as a result has legal, social and environmental implications. For this reason, a transparent and structured planning procedure is generally required, thus promoting public accountability with respect to the costs, implementation and outcome of the project (Box 1). The advantages of having a national planning process include:

- identification and establishment of objectives and priorities;
- the clear communication of these objectives and priorities;
- the integration of needs and priorities of various partners and stakeholders;
- the ability to evaluate rehabilitation activities against the objectives and priorities;
- the coordination of programmes to set and meet public expectations; and
- the development and application of uniform standards to meet common goals.

The cost for planning may sometimes be as high as 20% of the overall project budget, but is generally money well spent because sound planning is likely to save considerable costs in both the implementation and the long-term sustainability of the rehabilitation (Rutherfurd *et al*., 2000a and b).

Box 1: The power of planning (adapted from Rutherfurd *et al*., 2000a)

Planning enables one to:

- Clearly define the purpose of rehabilitation
- Focus on the most important issues relating to the project
- Identify and focus on the causes of problems rather than the symptoms
- Identify and understand the domains of scale of the problem
- Prioritise problems and thus optimise the cost-effectiveness of addressing them
- Set clear and measurable objectives that will enable the evaluation of the success of the completed project, and
- Promote efficiency in the implementation of the project.

1.5 Rehabilitation and governance

The National Policy on the Conservation and Sustainable Use of South Africa's Biodiversity, produced by DEAT calls for the identification of key sites for rehabilitation based upon biological and socio-economic criteria, and the development and implementation of rehabilitation plans for identified sites. It also makes provision for linking rehabilitation actions to the creation of jobs, transferral of skills and opportunities for the poor and disadvantaged wherever possible and appropriate.

Contracting parties[1] to the Ramsar Convention are also urged to establish national programmes to restore degraded systems. Resolutions adopted by the Conferences of the Parties on this subject emphasise that wetland rehabilitation that is ecologically, economically and socially feasible, and coordinated within the broader governance framework, may provide substantial benefits to both people and the environment.

Similarly, the Convention on Biological Diversity lists rehabilitation as an important tool for promoting the conservation of biodiversity. Article 8 (f) states that each contracting party shall, as far as possible and appropriate, "*rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies*."

In addition, as one of the eight themes under the Environment Initiative of the New Partnership for Africa's Development (NEPAD), the vision for the wetland conservation and sustainable use theme is that "*African countries and their people have healthy and productive wetlands and watersheds that can support fundamental human needs (clean water, appropriate sanitation, food security and economic development) in a healthy and productive environment.*" Rehabilitation is likely to be a core component of the actions taken in trying to accomplish this proposed vision (Working for Wetlands, 2005).

In addition to the above, a number of other legal issues also need to be considered during rehabilitation planning in general. This is because certain activities associated with rehabilitation may also have common law legal controls or consequences. There are several areas of common law that are likely to have a bearing on activities associated with wetland rehabilitation. They are the law of delict, the law of nuisance and the law of trespass (Winstanley, 2000; Armstrong, 2009). These issues are dealt with in more detail in *WET-Legal* (Armstrong, 2009).

In addition to the above, and being aware of the need to ensure the sustainability of rehabilitation while at the same time preventing degradation of other wetlands, government should also focus on developing sufficient capacity for enforcement, training, awareness and education with respect to wetland rehabilitation. The legal provision for incentives (such as conservation easements) that bind landowners and transgressors to maintaining the benefits of the prevention of degradation and to rehabilitation should also be an important consideration, as is control of utilization of wetland resources and services.

[1] South Africa acceded to the Ramsar Convention on 12 March 1975, and was one of the original seven Contracting Parties that brought the Convention into force on 21 December 1975.

1.6 Stakeholder involvement in rehabilitation

The long term sustainability of wetland rehabilitation project outcomes generally depends strongly on the meaningful participation of stakeholders, especially the owners and users of the wetland, as highlighted by Rutherfurd *et al*. (2000a and b) and the Convention on Wetlands (2002). The greater the participation of stakeholders, the greater is the likelihood of responsible aftercare of the rehabilitation interventions and the protection and wise use of the rehabilitated wetland. Any rehabilitation effort should ideally have the support of local authorities, institutions and individuals who control, are affected by, or will participate in the project. Local stakeholders include:

- local government and other local authorities operating within the context of national, provincial and local laws
- landowners, community organisations and other representative bodies
- commerce and industry
- individuals with an interest or a stake in the landscape and/or community, and
- those who will be affected by and/or derive benefits from any particular set of rehabilitation interventions.

Involvement of local stakeholders is critically important, especially where this may affect people's livelihoods. Involvement of stakeholders at a higher level (i.e. provincial and national) is also very important for the long term sustainability of a programme. Opportunities may also exist for encouraging and developing private sector partnerships when core funding is allocated by government, as is the case with the WfWetlands Programme. A number of private sector partnerships with WfWetlands have already been set up and more should be encouraged. These partnerships serve as examples to follow in supporting the long term sustainability of the national wetland rehabilitation programme.

For more detailed information on issues encompassed in stakeholder involvement

Box 2: Recognising where collaboration is needed most

Kareko *et al*. (2009) point out that although it is recognized that a collaborative approach is required generally, it is inefficient and inappropriate for 'everybody to be involved in everything'. True collaboration requires a high level of investment of resources (i.e. it is very resource intensive) (Kinnaman and Bleich, 2004). Therefore, where resources are limited, as is often the case, collaboration should be 'directed' to those situations most requiring it.

As highlighted in Figure 3.2, a rehabilitation project typically consists of a series of activities, each likely to require differing levels of involvement and types of organizational behaviour (i.e. how different individuals and organizations work together). Kinnaman and Bleich (2004) argue that where there is a high level of certainty between partners specified actions will produce certain outcomes, and where there is a high level of agreement regarding the appropriate course of action for the situation, then a 'command and control' type of behaviour is generally appropriate. However, where the level of certainty and/or agreement is low, collaborative behaviour will generally be more appropriate, as elaborated on in more detail in Kareko *et al*. (2009) using the framework of Kinnaman and Bleich (2004).

in wetland rehabilitation, and lessons learnt, readers are referred to a study of six individual wetland rehabilitation projects (Nxele and Kotze, 2009). The guidelines for assessing effective collaboration by Kareko *et al*. (2009) are also recommended, because working together in a cooperative or collaborative manner is central to the concept of involving different parties. The guidelines of Kareko *et al*. (2009) provide criteria and indicators for assessing effective collaboration, as well as a framework for focussing collaborative efforts where they are most required (Box 2).

In the context of a national works programme such as Working for Wetlands, two key issues relating to stakeholder involvement are identified. The first issue is that there is tension between resources allocated to physical rehabilitation interventions and to the process of involvement of stakeholders. On the one hand, if most of the resources are allocated to the physical rehabilitation outputs, there is a risk that key stakeholders will not be adequately involved, and aftercare and maintenance of the structure may be neglected, as will responsible wetland management. Thus the initial positive rehabilitation impacts may not be sustained. On the other hand there is the risk of allocating so many resources to the process of participation and involvement of interested and affected parties, that insufficient resources are available to implement the required physical rehabilitation measures.

The second key issue relates to the resources that the landowner should be expected to contribute to wetland rehabilitation. This contribution is assumed to enhance the long-term sustainable management of the rehabilitated wetlands because of an improved sense of ownership that it generally engenders. At the same time, however, incentives in the form of outside resources can also improve the management and sustainability of the rehabilitated wetlands where landowners lack the required resources. It may be the landowners and the outside programme (e.g. WfWetlands) meet 'half-way' (e.g. the landowner provides some materials such as rock and sand and transport, and WfWetlands provides the remaining resources). When deciding on the particular contribution to be made, the specific circumstances at the site need to be accounted for, as is elaborated in Section 3.10.2.

2. GENERAL PRINCIPLES OF REHABILITATION PLANNING

While it is recognized that each wetland rehabilitation project has its own particular set of circumstances, some general principles have been identified that should be relevant to most rehabilitation projects. These principles, which were derived from The Convention on Wetlands (2002); Society of Wetland Scientists Wetlands Concerns Committee (2000); Working for Wetlands (2005); and Nxele and Kotze (2009), are listed as follows:

1. Although comprehensive stakeholder engagement is often costly and time consuming and therefore not always practicable, wetland rehabilitation-planning should as far as possible be developed through open local and regional processes that incorporate the contribution of land holders or users and other key stakeholders (Table 2.1).
2. Rehabilitation of damaged wetlands should not divert attention away from protecting and using wisely those wetlands that are in good condition – it is generally more cost effective to protect what is still intact, particularly that which is of a high priority, than to rehabilitate what is damaged. Thus, protection, wise use and rehabilitation should go hand-in-hand in an integrated way within an overall programme.
3. Rehabilitation should be nested within a long-term stewardship approach, aimed at influencing behaviour and practices impacting on wetlands, which will ensure that causes as well as effects of degradation are jointly addressed, rather than focusing exclusively on engineering or technical solutions. Thus, an agree-upon plan for aftercare should be developed and implemented.
4. Wetlands should not be rehabilitated without demonstrated commitment from the owners and users of the wetland to sustaining the integrity of the rehabilitated wetland through wise use.
5. When prioritising wetland sites for rehabilitation, consideration must be given to the broader catchment and landscape context of the wetland, and be aligned with catchment and biodiversity conservation planning objectives.
6. Rehabilitation plans, including clearly stated measurable objectives, must be developed by a multidisciplinary team, including expertise in both the ecological functioning of wetlands and design and planning of rehabilitation interventions.
7. Rehabilitation objectives and measures should be in accordance with the natural ecological functioning of the wetland such that driving forces are reinstated in a way that is self-maintaining and in harmony with management of the surrounding landscape (Table 2.2).

Based upon the above principles, wetland rehabilitation should therefore be seen as a part of the broader management of a wetland and the catchment in which it is located (i.e. rehabilitation serves management rather than management being something that is 'tagged' onto a rehabilitation intervention) (Figure 2.1). Furthermore, structural rehabilitation is a subset of a broader range of rehabilitation interventions including physical interventions, both hard and soft, and adjustments to practices (e.g. burning frequency in the wetland).

The principles given in this section underpin the detailed planning process given in Section 3, and when applying this planning framework it is important to remain mindful of these principles.

Table 2.1: Some principles that may assist a programme such as Working for Wetlands meaningfully involve key stakeholders in wetland rehabilitation (adapted from Worth, 2006).

1. Partnerships	See stakeholders as partners
2. Equity	Give all key stakeholders opportunity to be involved, and deal fairly with all
3. A shared vision	Seek to jointly develop a vision
4. Communication	Maintain mechanisms for effective, open communication amongst stakeholders
5. Mutual benefits	Seek to optimise mutual benefits (i.e. reciprocity)
6. Learning together	Seek to learn together with landholders and other stakeholders, rather than focusing on trying to 'transfer knowledge'.
7. Trust	Remember that trust is not something that can be 'manufactured' but takes time to develop, and as trust develops, collaboration is enhanced

Note: Items 3, 4 and 5 form the basis of the framework of Kareko *et al.* (2009) for assessing effective collaboration amongst different parties. In the framework, for each item (e.g. effective communication), criteria and indicators for assessment are identified.

Table 2.2: Principles for aligning wetland rehabilitation with the functioning of a wetland (adapted from Society of Wetlands Scientists Concerns Committee, 2000).

General principle relating to wetland functioning	Related principle for implementing wetland rehabilitation
Wetlands result from several driving ecological forces, including geomorphological setting, hydrology, physical processes (e.g. fire, sediment movement etc.) biogeochemical processes (e.g. nutrient cycling) and biological processes (e.g. competition). These forces interact to result in the ecosystem services delivered by wetlands	Rehabilitation is the re-instatement of these driving forces to a level close to the original system (but generally not attaining it).
Wetlands are dynamic, changing on time scales of days, seasons, years, decades, millennia and longer. Given sufficient time (i.e. geological time spans) most wetlands will ultimately decline as others develop elsewhere in the landscape	The goal of wetland rehabilitation should not be to return and maintain the wetland in a static state but rather to achieve a persistent resilient system that is largely self maintaining and can respond to change with little human intervention
Wetlands are an integral part of catchments and landscapes and the nature and rates of processes affecting wetlands are therefore affected by human activities in catchments and landscapes.	Wetland rehabilitation and management must be integrated with management of the overall catchment/landscape if it is to address causes of wetland degradation and not just the symptoms

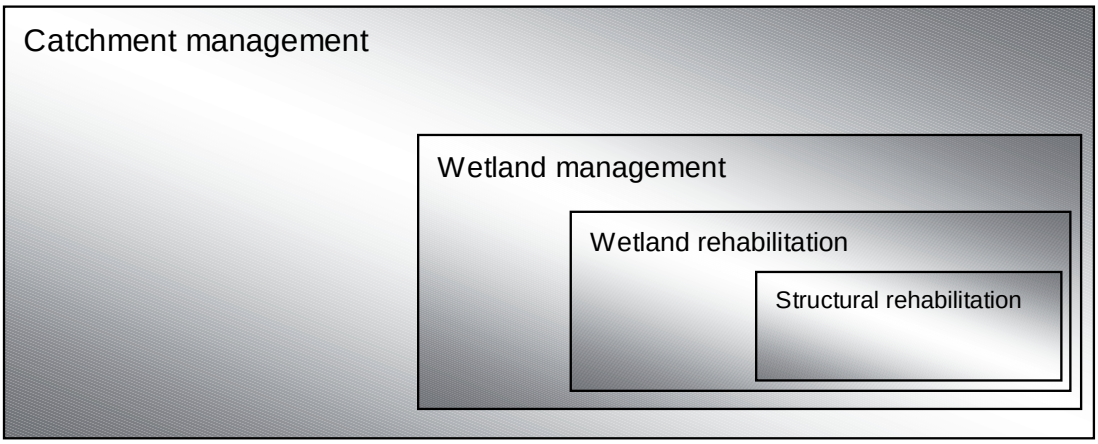

Figure 2.1: Wetland rehabilitation is seen as a subset of catchment and wetland management, and structural rehabilitation (e.g. concrete weirs) as a subset of a broader suite of rehabilitation interventions.

3. A FRAMEWORK FOR REHABILITATION PLANNING

3.1 An overview of the framework

Developing rehabilitation plans and having to consider the full context of the problems being experienced in a catchment may be daunting. The challenge is therefore not to let this task overwhelm one's ability to think rationally about the problems and to tackle them in a logical and structured manner. At the same time, one must not fall into the trap of over-simplification where intervention is based on too simple an interpretation of the problems (Rutherfurd *et al*., 2000a). The challenge is to ensure that the approach lies somewhere between these two extremes such that the limits and constraints of intervention are recognised and the rehabilitation opportunities are defined and understood in a way that is relevant to the problem being addressed.

Only once the problem is understood in the context of (1) the processes that lead to the formation of the wetland in the first place, and (2) the threats to the wetland as a result of broader scale problems, can realistic and achievable objectives be set for rehabilitation. This comes back to the need for planning and begs the question: Why rehabilitate - what purpose will it serve, what will it involve, and what and who will benefit from such rehabilitation? In order to answer these questions, it is useful to follow a structured approach.

A hierarchical structure to facilitate planning at different scales

Given that planning needs to take place at different scales, a stepwise, hierarchical framework for rehabilitation planning has been developed. This is summarized in Figure 3.1 as a single stream process, starting at the national programme level and proceeding down to the detailed planning of projects at individual wetland sites. In Figure 3.2, the framework is more fully represented, showing that from the highest level of the hierarchy to progressively lower levels, the number of 'streams' in which planning will be taking place increases. For example, Figure 3.2 indicates three catchments selected for rehabilitation, but it shows the detail of only one. Similarly, for the catchment represented in the figure, three wetlands are selected, but the planning details are presented for only one of the wetlands. The reader can appreciate that for all of the other catchments and wetlands, the same planning steps would be taking place in parallel to that represented.

Figure 3.1 and 3.2 also shows that there are several potential entry points to the framework, each at a different level. There are also some feedback loops in evaluating outputs and outcomes against the objectives originally set. For example, monitoring of individual projects will feed back to assessing whether a project workplan and objectives have been achieved. Monitoring individual projects will also feed back to a higher programme level (comprising several individual projects), making it possible to evaluate whether or not catchment or national level objectives are being met. For each individual step represented in Figure 3.2, the particular section of the framework covering this step is indicated, and the appropriate *WET-Tool* produced as part of this series is also indicated.

The steps and contents of the framework have drawn extensively from the work of others, including international literature (e.g. Rutherfurd *et al*., 2000a and b) and a planning framework for South African estuaries (Marneweck *et al*., 2004).

The running example

In order to provide the reader with a better sense for how each of the individual steps given in the guideline connect together in a real-life wetland rehabilitation process, a single example is presented which runs through all of the steps in the guideline. This example, which is presented as a box in each step, entitled 'The running example' allows the reader to track how, following a national and provincial-level planning process, an individual wetland was selected, the landowner engaged, and a project was planned, implemented and evaluated. The example, introduces some of the involved people and how they applied the different tools in the series at different points in the process.

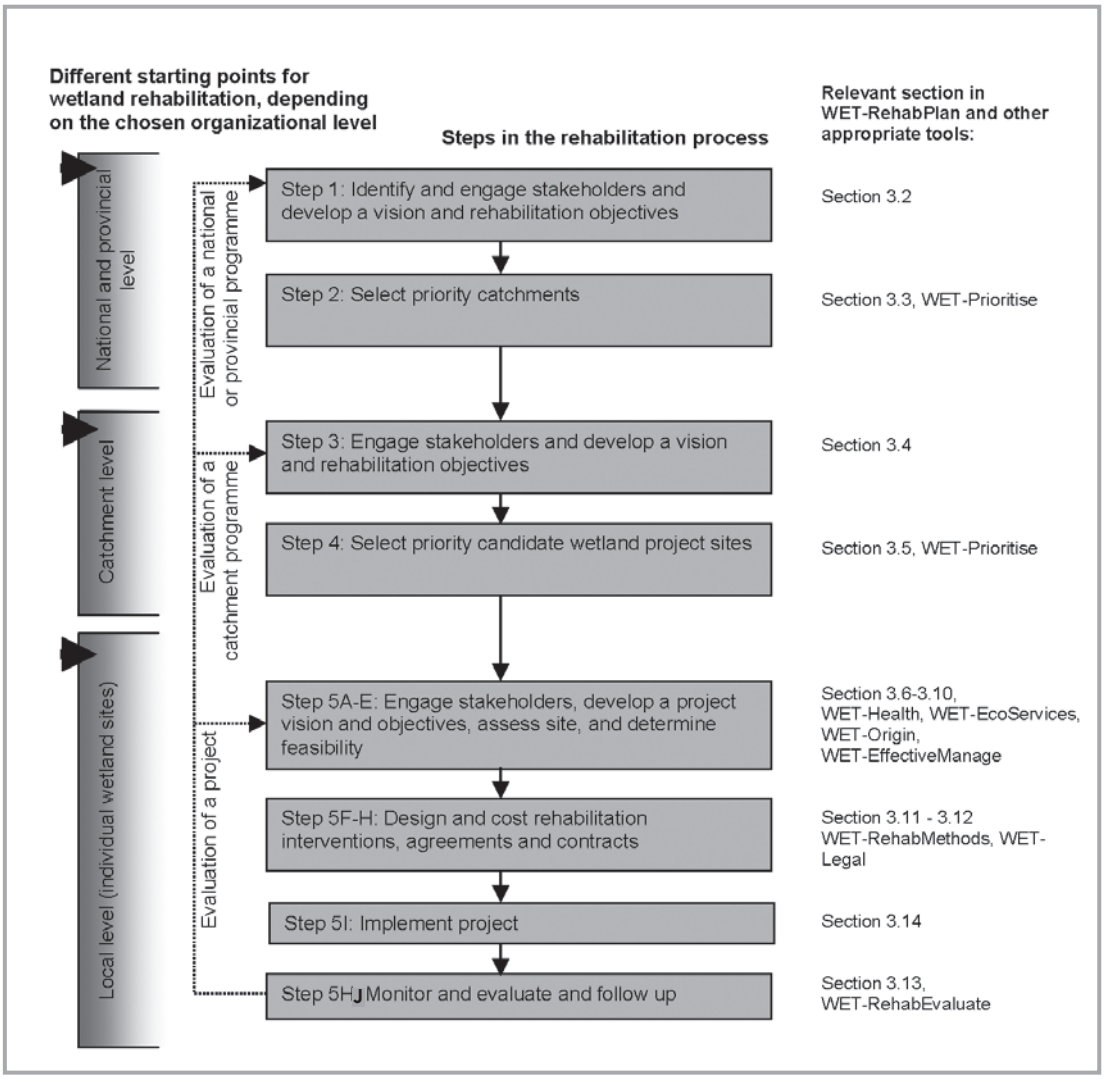

Figure 3.1: A summarised framework for planning of wetland rehabilitation activities from national to local scale, with an indication of the relevant *WET-Management* tools (for more detail of the framework see Figure 3.2)

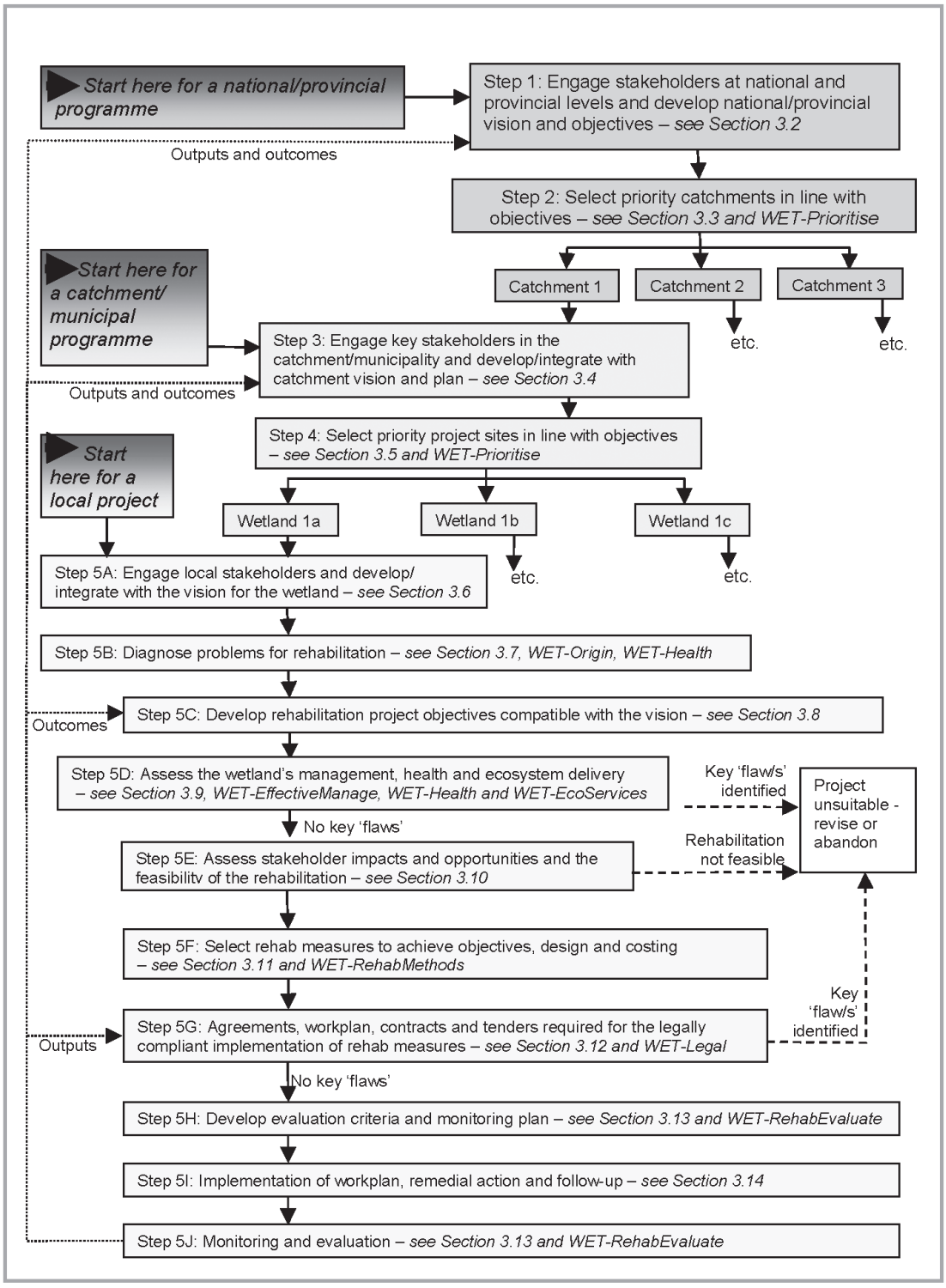

Figure 3.2: A framework for planning of wetland rehabilitation activities from national to local scale, showing individual steps and feedback loops.

The guidelines in *WET-RehabPlan* are presented as a linear sequence of actions to be carried out in a step-by-step process, starting at the national level (spatial and administrative) and progressing down to the local level. This structure is considered to be of value for a national programme comprising several individual local projects which need to be aligned to the objectives of the greater programme. The structure is also considered to be of value in outlining a sequence of steps which, based on past experience, are likely to help in promoting effective planning and implementation of individual rehabilitation projects, and enhancing the chances of successful rehabilitation. Users are therefore encouraged to follow the sequence of steps provided. However, the specific interests of users can be accommodated by a more flexible approach. Flexibility of use can be introduced in several different ways:

Starting at different levels

Users should not feel compelled to have to work through all organisational levels (i.e. national, regional and local). As already emphasized, it is not necessary to pass through all levels, and there can be different entry points. In many cases, the user will start at the local level, and the process would largely be contained within this level.

Backtracking

Where users have chosen to start in the middle or lowest level, the user may sometimes wish to backtrack to a higher level, e.g. as the user explores how his/her local project relates to, and could potentially establish links with, broader scale-initiatives.

Changing the sequence of activities

Users should also not feel compelled to follow the exact sequence of steps given in the guidelines. For example, the user may choose to do an assessment before stakeholder engagement in order to provide better information and context with which to engage the stakeholders. There will, however, be some steps that need to happen at a particular sequence, and which cannot be shifted (e.g. the design of rehabilitation interventions needs to take place before implementation).

'Dipping into' the guidelines when required

It is anticipated that rather than closely following the linear sequence of steps that the system provides, some individuals will use it by 'dipping into' the series when they need assistance in addressing particular questions with which he/she is grappling. In order to allow such users to access the information that he/she seeks as easily as possible, an index is provided in *WET-RoadMap* (Dada *et al*., 2007) as well as Table 2P in the preface of some typical questions that users may have when approaching the series and a listing of the sections relevant to common questions.

Remaining responsive

As a rehabilitation project progresses through the steps of the planning framework, various organizations and individuals will be required to give their input and work together. Each will have their own particular interests and circumstances, which applies particularly to the land-holders, and it will generally not be possible to predict exactly how each is likely to respond and act. Thus, some of the details of the guidelines may often need to be modified to account for the particular circumstances and responses. *WET-RehabPlan* serves only as a guideline rather than something to be followed in a rigid 'recipe-book' fashion, and is not a substitute for a responsive teamwork approach to planning for the rehabilitation of wetlands.

As with any such process, incorporation of the framework into broader wetland rehabilitation initiatives will need to be supported by training of practitioners. Furthermore, provision should be made for the incremental improvement of the framework based on lessons learnt from its application. As highlighted in

the principles, a long-term stewardship approach is required aimed at influencing behaviour and practices impacting on wetlands, and to do this requires that one remains open to learning and adapting to new understanding.

3.2 Engage stakeholders and develop a vision at national and provincial level (Step 1)

At whatever scale, involvement of stakeholders contributes to a sense of co-ownership of the programme/project. This is critical to the long term sustainability of a programme or project's outcomes, as highlighted in Section 1.6. Stakeholder involvement and prioritisation are closely linked. It is assumed that if stakeholders are involved in the prioritisation process then wetlands and wetland issues would be identified that the stakeholders consider important. Therefore the stakeholders are likely to be more committed to the chosen wetlands in the long term than if wetlands were chosen which had no particular importance to the stakeholders.

A critical step in the framework is the development of a national vision for wetland protection, rehabilitation and wise use, since this will establish the broad parameters and goals under which wetland management (including rehabilitation) should be undertaken in order to meet national and international obligations. Part of this step involves developing a commitment by national stakeholders to the vision. This necessarily involves the participation of stakeholders, including those who support the initiative of wetland rehabilitation, as well as those who might, for whatever reason, oppose it.

According to the Working for Wetlands strategy (Working for Wetlands, 2005) WfWetlands must act as a co-ordinated expression of the respective wetland-related mandates of its three national 'parent' departments; the Departments of Environmental Affairs and Tourism (DEAT), Agriculture (DoA) and Water Affairs and Forestry (DWAF); as well as provincial and local government structures that have concurrent functions with these departments. Partnerships beyond government are also critical, requiring collaboration and co-operation with a wider range of stakeholders and

The running example

WfWetlands developed a national vision and strategy for wetlands through a process that involved considerable stakeholder input, and included holding a series of eight different stakeholder workshops across the country (Working for Wetlands, 2005). Relevant government departments, NGOs, user sectors and civil society organisations participated in these workshops. Thus, Step 1 was completed, although it must be highlighted that the vision and strategy that have been developed are not an endpoint in themselves but a basis for encouraging ongoing co-governance (Box 3). During the process of developing a national vision, reference was made to WET-RehabPlan to see how a national vision could best be translated into individual projects involving actions on the ground.

Box 3: Working for Wetlands and co-governance

According to the Working for Wetlands strategy (Working for Wetlands, 2005) WfWetlands must act as a co-ordinated expression of the respective wetland-related mandates of its three national 'parent' departments; the Departments of Environmental Affairs and Tourism (DEAT), Agriculture (DoA) and Water Affairs and Forestry (DWAF); as well as provincial and local government structures that have concurrent functions with these departments. Partnerships beyond government are also critical, requiring collaboration and co-operation with a wider range of stakeholders and role players in the wetlands arena.Working for Wetlands is mandated under the South African National Biodiversity Institute (SANBI) in terms of Sections 11. (1) (c), (j), (l), (m) (i) and (n) (i) and (ii) of the National Environmental Management: Biodiversity Act (No 10 of 2004) to undertake activities which include rehabilitation and protection of wetlands. The three national government departments (DEAT, DWAF and DoA) each have certain mandates that are reflected in the programme's strategy, so there needs to be an effective mechanism through which the objectives defined in terms of these individual mandates can be met. To achieve effective co-governance, the WfWetlands strategy lists the following activities, which also have general relevance outside of Working for Wetlands:

- Identify areas in the mandates of the three parent departments to which the programme could contribute.
- Formalise mandates with national departments which detail: scope of work; level of authority; and, extent and nature of the accountability of the programme.
- Develop an appropriate mechanism and format for the programme to report on its performance in relation to the implementation of the strategy and fulfilment of mandates from the parent departments.
- Develop mechanisms of joint accountability and communication between the programme, its three national parent departments and SANBI.
- Investigate and interpret existing legislation to determine the powers and authority afforded the programme for the achievement of its strategic objectives.
- Formalise the duties of the programme with respect to the implementation of incentives and disincentives for the rehabilitation, protection and promotion of sustainable use of wetlands.
- Identify the most appropriate provincial and local structures, or foster the formation of new structures to ensure the co-ordinated implementation of wetland rehabilitation, protection and sustainable use projects; and support the objectives of provincial and local government organs that have concurrent functions with the parent departments.
- Conduct ongoing regular monitoring of the programme's performance in terms of its mandates from the three parent departments and internal strategy, and ensure that the results of monitoring are incorporated into revisions of the strategy and business plans and accurately reported to the parent departments.

role players in the wetlands arena.Working for Wetlands is mandated under the South African National Biodiversity Institute (SANBI) in terms of Sections 11. (1) (c), (j), (l), (m) (i) and (n) (i) and (ii) of the National Environmental Management: Biodiversity Act (No 10 of 2004) to undertake activities which include rehabilitation and protection of wetlands. The three national government departments (DEAT, DWAF and DoA) each have certain mandates that are reflected in the programme's strategy, so there needs to be an effective mechanism through which the objectives defined in terms of these individual mandates can be met.To achieve effective co-governance, the WfWetlands strategy lists the following activities, which also have general relevance outside of Working for Wetlands:

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- Develop mechanisms of joint accountability and communication between the programme, its three national parent departments and SANBI.
- Investigate and interpret existing legislation to determine the powers and authority afforded the programme for the achievement of its strategic objectives.
- Formalise the duties of the programme with respect to the implementation of incentives and disincentives for the rehabilitation, protection and promotion of sustainable use of wetlands.
- Identify the most appropriate provincial and local structures, or foster the formation of new structures to ensure the co-ordinated implementation of wetland rehabilitation, protection and sustainable use projects; and support the objectives of provincial and local government organs that have concurrent functions with the parent departments.
- Conduct ongoing regular monitoring of the programme's performance in terms of its mandates from the three parent departments and internal strategy, and ensure that the results of monitoring are incorporated into revisions of the strategy and business plans and accurately reported to the parent departments.

3.3 Prioritise catchments (Step 2)

As emphasized in the principles (Section 2), the underlying philosophy of the manual is that the catchment should be the basic unit in which wetland management and rehabilitation planning takes place. This is because the catchment is a natural feature that can and should be managed in an integrated way in order to provide the quantity and quality of water required for the environment and for people's needs. Since activities in catchments affect the timing and quantity of water that enters a stream, as well as the solute loads in groundwater, streams and wetlands, the catchment should form the basis for planning at national, provincial and local level.

WET-Prioritise (Rountree *et al.*, 2009) is recommended for prioritising catchments for wetland rehabilitation. *WET-Prioritise* provides a GIS-based model for prioritising down to tertiary catchment level. The tool allows end-users to create different scenarios for prioritising wetland rehabilitation at the tertiary catchment level based on specific combinations of national level, socio-economic and biophysical criteria that can be weighted depending upon user needs and national or regional priorities. It is a dynamic model that allows criteria to be combined and scenarios to be tested and evaluated in the process of prioritising tertiary catchments.

Once priority tertiary catchments have been identified, it is necessary to scale down to a sub-catchment level and prioritise at the quaternary catchment level. *WET-Prioritise* provides protocols for undertaking this step such that the criteria identified at the tertiary catchment scale are realised at the more detailed scale, but incorporating constraints and opportunities for rehabilitation within each of the quaternary sub-catchments. *WET-Prioritise* recognizes that there are seldom many resources available for the collection of large quantities of new data. Thus, prioritisation amongst quaternary catchments will often be based on existing knowledge and priorities of stakeholders (e.g. as specified in provincial systematic conservation plans or catchment management strategies). This, in itself, helps develop links with stakeholders, which is likely to contribute positively to the long term sustainability of the initiative.

Regarding opportunities, it is important, as far as possible, to nest rehabilitation projects within broader initiatives, because in supporting the objectives of these initiatives, some reciprocal support from these initiatives can generally be expected, which is likely to contribute to the long term sustainability of the rehabilitation outcomes. Opportunities may be linked with the goals of external agencies such as DWAF and/or Catchment Management Agencies, who may be concerned with water security or water quality, or with conservation planning agencies and processes such as the restoration of habitat for an endangered species, or the needs of local people with respect to wetland resource availability or with limited opportunities for food production. It may also have to do with the willingness of landowners to participate in wetland rehabilitation. Therefore, at the level of the quaternary sub-catchments, provincial and local agencies should be involved in the prioritisation process, together with local stakeholders such as farmers, local tourism initiatives and individual landowners. Such involvement may best be co-ordinated through provincial wetland forums.

3.4 Engage stakeholders and develop a vision at catchment level (Step 3)

Stakeholder engagement is initiated by establishing whether there is any forum through which catchment management issues in the sub-catchment are addressed and whether a vision/objectives exist for the sub-catchment. The starting point is to make contact with the relevant Catchment Management Agency (CMA). The National

The running example

In a stakeholder workshop for the Free State, the potential criteria used in the GIS-based model of WET-Prioritise for prioritising tertiary catchments were presented. Each participant in the workshop then 'voted' on the relative weighting that they considered should be given to each criterion, taking into account the national vision as well as specific interests in the province. The 'votes' were all counted to arrive at a 'consensus view' of the weightings, which were then used in the GIS-model to identify the priority catchments in the province. At a follow-up workshop of the Free State Wetland Forum, the initial selection was modified by placing particular importance on catchment water supply. Consideration was also given to whether rehabilitation work had already been conducted in the catchment. Based on this selection, the Muel River tertiary catchment was selected as the priority catchment for the Free State. Next, the Free State Wetland Forum selected within the Muel River catchment, two priority quaternary catchments as those highest in the tertiary catchment, where the mean annual precipitation was much higher than those lower quaternary catchments (This process is described in more detail in WET-Prioritise, Rountree et al., 2009).

Water Act (1998) provides legislation on the setting of priorities and objectives for wetlands in a catchment context in the chapter on 'Resource Directed Measures for the Protection of Water Resources'. According to the Water Act, wetlands are a type of Water Resource. CMAs are the key organisation through which priorities and objectives for water resources in a catchment are set. CMAs are required in terms of the National Water Act to establish a Catchment Management Strategy, which will direct the manner in which water resources, including wetlands, are managed (including protection, rehabilitation and wise use). This is all elaborated upon in detail by Dickens *et al*. (2003), who provide guidelines for integrating wetlands into catchment management within the context of the National Water Act.

Presently, CMAs are still in the process of being established, but other catchment fora, e.g. a water users association may exist in the catchment, and should be engaged as soon as possible. If no such forum exists, call a meeting of stakeholders in the catchment in order to identify catchment management needs. Engaging stakeholder interest, reaching a common vision and setting objectives can be a lengthy and sometimes difficult process, largely dependent on local stakeholders taking ownership of the process, and it would be unrealistic always to expect this to be achieved.

Rutherfurd *et al*. (2000a and b) list a number of techniques that can be used to assist with the task of building support for the vision as follows:

- Make sure that the vision is clear, and be committed to it. Remember the first rule of selling: 'If you don't love the product – nobody else will', but also remain open-minded and capable of seeing the interests and perspectives of other role players and stakeholders.
- Encourage stakeholders to identify the problems for themselves. For example, take people into the catchment and discuss the perceived problems and consequences of these.
- Successful or even unsuccessful rehabilitation implemented elsewhere could serve to convince people that a certain strategy may or may not work. Demonstration sites could also be useful in this regard.
- Encourage individuals that demonstrate enthusiasm and strong, inspirational leadership (Anderson, 1999).

As important as winning support in the initial stages of the rehabilitation plan is maintaining support. One of the dangers facing rehabilitation is unrealistic expectations (Rutherfurd *et al*., 2000a and b). It can take decades, or even centuries, for some wetlands to recover, and it is therefore important to keep people informed of what is happening in order to maintain their interest, involvement and commitment. The inclusion of project evaluation in the overall procedure goes some way towards making this possible. However, continued communication with stakeholders is essential in this regard.

The running example

No Catchment Management Agency or any catchment management forum was in place at the time the two priority catchments were selected. Although a meeting was called of relevant government departments and stakeholder groups such as the local farmers association, it was difficult to develop a broadly supported vision for wetlands within these catchments without any existing forum in place. Nevertheless, general agreement was reached amongst the relevant government departments, and key stakeholders were kept informed through consultation.

3.5 Prioritise wetlands within the chosen catchment (Step 4)

At the end of Step 3, a quaternary sub-catchment will have been identified as the most suitable subcatchment in which to rehabilitate wetlands given the objectives identified at the tertiary catchment scale and the opportunities and constraints for rehabilitation in the different sub-catchments (including the particular priorities of the stakeholders). It is now necessary to prioritise wetlands in which to work. This step is undertaken according to the protocols described in *WET-Prioritise*, which highlight that no single approach is suitable for all situations. Instead, the approach needs to be tailored to the particular objectives for rehabilitation in the catchment and the specific circumstances present there. *WET-Prioritise* provides general guidelines for undertaking this, together with three case study examples that illustrate a range of issues involved and approaches that can be used in prioritisation. The guidelines of Dickens *et al*. (2003) for integrated wetlands into catchment also have relevance

The end product of the prioritisation of wetlands in the catchment will be a set of candidate wetlands. In many cases these would have been based on desktop analysis (e.g. recent aerial photographs) together with some field verification. The cost would have limited. fieldwork However, in order to narrow down the set of candidate wetlands, each will need to be surveyed in the field as part of Step 5B. To do so, landowners need to be engaged (Step 5A).

3.6 Engage stakeholders at the local level (Step 5A)

The stakeholder engagement carried out for the catchment is likely to prepare the way for the site level assessments and engagement. Section 3.2 is relevant here. Clearly the most important local stakeholder is the landholder, who may be a single private owner or multiple communal owners. The right approach is required in dealing with the landholder, and the principles given in Section 2, particularly those captured in Table 2.1, have relevance. It is important to approach a landowner as a partner rather than someone who needs to be told what to do, and it is important not to rush the process. Thus, there is likely to be an overlap with the following step (Step 5B).

Establish contact with landholders

When establishing contact with the landholder, it is important to remember the principle stated earlier that rehabilitation must be coupled with promoting wetland stewardship amongst landholders (to be a good steward of a wetland is to look after it well, i.e. to use the wetland sustainably). Rehabilitation should be something that fits into a broader process of stewardship/wise use, rather than trying to hurriedly 'tag on' stewardship/wise use to rehabilitation. Here, it is critical to emphasize that building stewardship is not a process that should be rushed. Experience has shown that the approach of the outside expert imparting knowledge to the landholder and telling him/her what to do, on the assumption that this knowledge will soon lead to raised awareness, which, in turn, will change behaviour for the better, seldom works well (J Taylor, 2007, *Pers. comm*. Wildlife and Environment Society of South Africa, Umgeni Valley, Howick).

A more effective approach is to begin by finding out what knowledge the landholder already has about the wetland, and together to build understanding about the system. This approach, which starts with the landholder and emphasizes learning together, will be more conducive to improving land-use practices. It is appreciated that learning and changing perceptions and behaviour may require a

lot of time, particularly in situations of communal tenure where there may be many different users involved, each with potentially divergent perspectives.

Thus, when contacting the landowner, see if there are any local extension services who may have already established long term relationships with the landowners, and establish contact through these extension services. The particular organization providing the extension will vary from place to place: it may be the provincial nature conservation body, Department of Agriculture or even an NGO such as the Endangered Wildlife Trust. Working through existing structures is preferable to 'coming in cold' as an outsider.

Often, however, there is a wetland for which rehabilitation is identified to be critical at a national or provincial level, but there is complete absence of any extension work promoting stewardship or wise use. What is to be done then? If the wetland is important to the province, for example, then the province should be committed to providing extension support. This highlights the importance of the rehabilitation programme establishing good partnerships at provincial and national levels through which it can leverage the necessary support. In some cases severe capacity constraints may exist, such that even if a province has identified the site as priority, it may be unable to support implementation. If this is the case, then additional support will need to be sought (e.g. through an

The running example

Resources were limited for conducting a survey of the wetlands in the selected catchments. Thus, a two step procedure was applied to reduce the required resources.

- *A preliminary screening of all individual wetland sites in the selected catchments in terms of the potential of each wetland for structural rehabilitation, based on observation from a light aircraft and examining recent 1: 30 000 aerial photos, resulted in a preliminary set of candidate sites.*
- *Within the preliminary set sites, a detailed field-based assessment was undertaken in order to narrow down the set to those likely to yield the greatest rehabilitation returns on investment (preliminary set).*

The team of 'spotters' and the volunteer pilot from the Bateleurs involved in the air survey (for more information see WET-Prioritise, Rountree et al., 2009).

NGO providing direct initial support and assisting in building the capacity of provincial government officials).

If the rehabilitation programme is already working in the general area, then the contacts already established with other landowners and the work undertaken on their properties should, unless there were major problems with the work, help build the credibility of the programme in the local area. Through local social networks potential new landowners that might participate in the programme will hear about the existing work and will also be able to see, first hand, existing local projects. This process should be encouraged, such as through open days. The local service provider for WfWetlands who has been working in the local area will often become 'the face' of the programme, which also helps build trust amongst local people in the programme. Again, this will depend on how effectively the implementer is carrying out his/her work, together with how well they interact with local people.

Therefore, by concentrating in a particular local area where a programme has a long term commitment, new landowners are likely to be much more cost-effectively engaged, than if work is carried out in small, widely scattered projects. Communal land tends to be more complex than private land, particularly given that there are generally many individual wetland users, who are often not grouped into a formal organisation, and each using different portions of the wetland. Nevertheless, the same advantages of focusing on a particular 'neighbourhood', as described above, are likely to still apply.

Visit the candidate wetland with the landholder

Visiting the candidate wetland with the landholder provides an opportunity to learn from the landowner as he/she shares his/her local knowledge and for the landowner to learn from the wetland specialist. During the discussions between the two parties, find out from the landowner the history of the wetland and how it may have changed over the years (some landholders may have known the wetland for a considerable time). Also ask the landowner to point out what he/she considers to be key management or wetland health issues. This will form a key part of diagnosing the problems in the wetland (Section 3.7)

Briefly assess management effectiveness of candidate wetland/s

Work through with the landowner the 15 key questions relating to the management of the candidate wetland given in *WET-EffectiveManage* (Kotze and Breen, 2009). These questions are designed to account for situations on private, communal and state-owned land. Assessment of management effectiveness should preferably be done after the field assessment of health, but can also be completed telephonically at a later stage. If the prospects for long-term sustainability are low (e.g. uncontrolled land-use practices harmful to the wetland are taking place extensively and no management objectives or management plan exist for the wetland) then this highlights that the site is unlikely to be 'ready' for a rehabilitation project. Until the key issues highlighted by the management effectiveness assessment have been addressed,[2] there is no point in continuing any further with assessing such a site because this would be contrary to the principles of stewardship and sustainable

[2] By assisting in highlighting those areas of the management system that need to be improved, *WET-EffectiveManage* can contribute to the enhanced management of the wetland. However, it does not provide detailed assistance on how these improvements could potentially be made. It also does not provide any land-use guidelines (e.g. appropriate timing for grazing of a wetland). Such guidelines will be developed over the next few years as part of the sustainable use component of the WRC Wetland Management Research Programme.

use. It is recognized, however, that once measures have been taken to address these key management problems, then the wetland could be considered again for rehabilitation.

3.7 Diagnose problems in the candidate wetland (Step 5B)

Problems here are defined as processes and activities that degrade or threaten the health of the wetland and the goods and services delivered by wetland/s in the catchment being considered (Rutherfurd *et al*., 2000a and b). It is important to remember that the goods and services and the problems causing their degradation can improve, stay the same, or deteriorate. Developing an understanding of this interaction is essential when it comes to assessing the feasibility of pursuing rehabilitation options. Such information is necessary in order to consider which goods and services might need protecting, whether recovery should and can be augmented or sped up, or whether or not one should intervene at all if the natural rate of recovery is satisfactory (Rutherfurd *et al*., 2000a and b). Three key questions can assist in trying to establish this. These are:

- How has the problem developed over time?
- Does experience or knowledge of the problem suggest a likely cause?
- Is the problem likely to change (improve or deteriorate) in the future?

Problems may also change over time, either through the natural recovery of the system or alternatively through alleviation of the pressure due to other factors such as market forces or changes in land-use practices. Changes in management can also change the trajectory of a problem. For example, enforced control of point source discharges may speed up or reduce the rate at which a particular system is eroding. Typical mistakes that can be made in assessing problems include the following:

- Identifying as a problem something that may actually be a natural attribute of the system, e.g. plugging a channel, which occurred naturally in the wetland.
- Wasting time and effort focusing on problems that would have fixed themselves with time, e.g. an erosion feature that is naturally filling with sediment;
- Treating something that is not actually a real or threatening problem for the system, such as putting great effort into promoting diffuse flow from a minor gully in a wetland dominated by groundwater seepage from the surrounding hillslopes; and
- Identifying the wrong problem as being the reason for the degradation, such as blaming an abundance of alien trees in a section of the catchment for reducing flows in the system when really water abstraction is the main problem.
- WET-Health is useful to help correctly diagnose problems because a key element of this tool is to examine the links between problems (e.g. diminished water retention) in the wetland and any human activities causing the problem (e.g. artificial drainage channels).

It is also important that an assessment of the cause of a certain problem considers the dynamics of the system concerned. One must therefore be careful of misdiagnosis based on once-off assessments. For example, bank erosion is often assessed on the basis of how bare a bank looks and whether or not there are signs of bank slumping and so on. These factors may, in fact, be poor indicators of erosion rates, and it is the rates that are of most interest. In stream rehabilitation for example, bank stability is one of the most common issues subject to misdiagnosis because it is so obvious. Rushing in and stabilising a bank without an understanding of the dynamic of the

system may have all sorts of negative effects, such as changing the natural sediment dynamic. It is generally more useful to assess changes in condition over time. Such dynamic assessments need not be very expensive or difficult to do and thus should be considered in condition assessments and monitoring. *WET-Origins* (Ellery *et al*., 2009) and *WET-Health* (Macfarlane *et al*., 2009) should help in identifying natural dynamics as opposed to processes that are caused by human intervention.

The running example

The WfWetlands implementer, through working in a nearby catchment, had previously had contact with the landowner. After being introduced to the landowner by the implementer, the WfWetlands provincial coordinator (PC) explained how the WfWetlands programme operated. The owner already had a reasonable understanding of the programme based on what he had seen in the nearby catchment. Next, the WfW PC visited the wetland with the landowner, and they discussed problems to be rehabilitated in the field. The key problem was an actively eroding headcut threatening a large intact portion of the wetland. Uncontrolled grazing in the wetland by livestock was also identified as a problem.

The running example

The landowner in the photo below highlights what he sees as an important problem in the wetland.

The WfWetlands PC then ran through the 15 key questions contained in *WET-EffectiveManage* with the landowner to establish how effectively the wetland was being managed. This highlighted that there were key elements of management which needed improving. In particular, there was no management plan and no monitoring system in place, no controls over stocking rate of the wetland.

The Free State Department of Tourism, Environmental and Economic Affairs (FSDTEEA) official returned to discuss with the farmer the improvements in the management system and in the specific way that the wetland was used. A common vision was reached with the landowner about maintaining the integrity of the wetland, but before specific rehabilitation objectives could be developed, a detailed diagnosis of the problems in the wetland was required (which was undertaken in the following step).

The running example

The Free State Department of Tourism, Environmental and Economic Affairs (FSDTEEA), the WfWetlands PC and a wetland specialist contracted by WfWetlands undertook a baseline description of the wetland by applying WET-Health and WET-EcoServices. They were initially accompanied by the landowner, who was able to answer questions relating to historical changes in the wetland. In the assessment, the results of which are reported on in Step 5D, the present ecological state of the wetland was established and the principle factors contributing to degradation of the wetland were identified.

3.8 Develop an aim and objectives of the proposed project (Step 5C)

A fundamental assumption of the *WET-RehabPlan* is that rehabilitation takes place within the context of an institutionalized management system.[3] As highlighted in Section 2, rehabilitation is a sub-component of the overall management of the wetland. Therefore, when developing the aims and objectives for a specific rehabilitation project it is important that these are aligned with the aim and objectives for the overall management of the wetland.

An essential step in the process of developing a rehabilitation plan is specifying exactly what the rehabilitation project is setting out to achieve (the aim). In specifying the aim of the rehabilitation project both the final outcome/s as well as the reason/s behind it/them should be well articulated. For example, 'enhance flood attenuation of the wetland through the promotion of diffuse flow' rather than simply the 'promotion of diffuse flow'. The aim should also focus on the single most important (or the two most important) outcome/s of rehabilitation as it is seldom possible to achieve multiple high order aims for individual projects (Mitsch and Gosselink, 2000; Galatowitsch and van der Valk, 1998).

Objectives of rehabilitation also deal with the rehabilitation outcomes, but at a lower level than the aim, and describe the outcomes that will contribute to the aim being achieved. For example, the aim may be to reinstate Wattled Crane breeding habitat in a degraded wetland. The objectives would be to raise the water table in the identified area, halt erosion, and promote the growth of suitable vegetation following the change in hydrology. Objectives do not describe the specific interventions (e.g. a concrete or gabion weir) used to achieve the specified outcomes (These are dealt with in Section 3.10.2). Rehabilitation objectives must be stated in a way that is SMART (Box 4).

[3] An institution refers to a set of rules which are based on accepted principles, and which are being applied. Management refers to a process of implementation. Thus, institutionalized management would be management that is directed and ordered by a set of principles and rules that have become accepted and applied.

Box 4: Objectives for rehabilitation of wetlands should be SMART

Specific:	Clear and unambiguous, and specify clearly what will be achieved
Measurable:	One will not know what has been achieved if it cannot be measured
Achievable:	Realistic and attainable with the resources that are available
Relevant:	Must be a key part of the vision and problems being addressed
Time-bound:	Must have a starting point, ending point and a time frame over which the objectives will be met

The running example

Refer also to WET-Origins to better understand the key factors explaining the origin and evolution of the wetland.

The photo shows a baseline survey of the wetland underway, with soils being one of the key aspects examined

For some projects, the rehabilitation aim and objectives may be clear-cut, but for others they will not be clear-cut. For example, how does one create good crane habitat? The best that one might do is address hydrological and geomorphological issues in the hope of creating the right habitat for suitable plant communities and therefore cranes, making it difficult to set measurable objectives. In order to be able to evaluate the rehabilitation project, one should thus set objectives that are intended to be met, and describe the range between what would be considered a very disappointing result, and what would be considered a great success. This will depend largely on the problems being dealt with, but in many cases the best one can do is describe the intended path and outcomes. The end product may lie somewhere between the best one can expect and a result that is at least acceptable but not ideal.

Alternatively, objectives may need to be set in terms of maintenance rather than improvement. That is, when protecting an existing service, the objective may need to be based on maintaining a certain condition rather than allowing it to deteriorate. It is also important to specify the scale applicable to each objective where this is not implicit in the objective. For example, specifying certain water quality criteria for a point source input may only be applicable to a section of a wetland within 500 m of the point of input.

The benefits of setting clear objectives are highlighted in Box 5.

Since there are no guidelines available for setting objectives for a given aim, it is likely that objectives will need to be predictive and based on the current levels of understanding about wetland systems. It is likely that the understanding around these issues will be developed incrementally as experience is accumulated. A key aspect of this is ensuring that the time periods against which results can be expected are short enough in order to keep the stakeholders interested in the project. Also remember to be careful of setting objectives that are too ambitious to be met, which can easily lead to dampening of the enthusiasm of those involved. A successful project can

Box 5: Benefits of setting objectives

Defined and measurable objectives:

- force one to work out exactly what would be considered a success
- are a prerequisite for designing specific intervention strategies
- are a prerequisite for evaluation
- allow one to set the scope and scale of the project
- reveal where objectives are contradictory or in conflict with one another. For example, re-creating certain habitats for one species may not allow one to meet the objectives with respect to another; and
- Add rigour and accountability to rehabilitation.

appear unsuccessful because of over-ambitious objectives.

Most recovery is measured in years or decades, and thus it is essential that objectives reflect the time that it is likely to take for recovery, and that all participants are fully aware of that time. Objectives should therefore include a time frame within which they will be achieved. Having a series of objectives may help with this since these can be used to track the recovery of the system. One may set the objectives based on, for example, an improvement in water quality after one year, and further improvements after three years and so on.

3.9 Assess the potential ecosystem benefits likely to result from rehabilitation of the wetland (Step 5D)

As elaborated in *WET-RehabEvaluate* (Cowden and Kotze, 2009), when evaluating the ecological outcomes of a project, it is of little value to simply report on the spatial area rehabilitated. It is important to examine the level to which the integrity of the rehabilitated wetland area and its delivery of ecosystem services are affected by rehabilitation. This can be done by assessing and comparing two scenarios, the situation without rehabilitation (i.e. no intervention) and the situation with rehabilitation. Sometimes, it may be necessary to assess several alternative rehabilitation scenarios. An approach and 'currency' is described below for assessing these scenarios. Two case-study examples are also given to illustrate the approach

Effect of rehabilitation on wetland health

As explained in more detail in *WET-RehabEaluate*, the health of a wetland, scored on a scale of 0 (pristine) to 10 (critically altered), is determined based on hydrology, geomorphology and vegetation using *WET-Health* (Macfarlane *et al.*, 2009). The benefit achieved in terms of health would be determined by comparing the health score for the 'with rehabilitation' and the 'without rehabilitation' scenarios. Based on the size of the wetland area affected by the rehabilitation, the change in health can then be expressed in terms of 'hectare equivalents' of intact wetland, which provides a common currency for comparing different rehabilitation projects or scenarios.

For areas threatened by headcut erosion which are to be rehabilitated by halting the propagation of the headcut, the benefits in terms of health would be determined based on the difference between the current health and the predicted health if the headcut proceeded to erode through the threatened wetland area. As elaborated upon in detail in *WET-Health*,

the prediction is based on factors such as the headcut size and historical rate of advance. Halting the propagation of the headcut (e.g. with erosion control structures) may be assumed to maintain the current health situation.

Delivery of ecosystem services

As highlighted in *WET-RehabEvaluate* (Cowden and Kotze, 2009), the fact that a wetland is currently delivering a high level of goods and services does not make it a good candidate for rehabilitation. Rather, it is the level to which the delivery of ecosystem services will be improved by rehabilitation that is most important. This can be done by predicting the level of delivery of ecosystem services under a rehabilitated state compared with the level of delivery without any rehabilitation. This prediction is based on the extent to which rehabilitation will affect key characteristics, determining the delivery of services, as given in *WET-EcoServices* (Kotze *et al.*, 2009). For example, the pattern of low flows in a wetland has an important effect on the wetland's effectiveness in assimilating pollutants (the more diffuse the flow, the better). If by plugging drains, for example, the flow patterns in a wetland can be converted from very concentrated to very diffuse, then the effectiveness of the wetland in assimilating pollutants is likely to be markedly enhanced.

The running example

The aim of the proposed wetland rehabilitation project was identified as follows: 'To prevent the decline of health of a 40 ha area wetland and maintain the hydrological and erosion control services that the wetland area supplies in the catchment.' This was to be achieved through the objectives of: (1) halting the advance of the eroding headcut (which will result in major sediment loss and desiccation of the wetland) and will impact upon the entire 40 ha of wetland and (2) implementing a controlled grazing system.

The photo below shows the erosion headcut that threatens 40 ha of upstream wetland at the site.

If a vision and objectives exist for the catchment in which wetlands are being prioritised then particular attention should be given to those ecosystem services relevant to the catchment vision and objectives. For example, the supply of good quality water may be very important in a particular catchment, requiring that particular attention be given to the hydrological services assessed by *WET-EcoServices*. In another case, biodiversity may be the most important consideration.

As elaborated upon in *WET-RehabEvaluate*, a *WET-EcoServices* assessment is conducted for the '*with* rehabilitation situation' and the '*without* rehabilitation situation', considering the predicted change in ecosystem health with and without rehabilitation respectively. A full example of such an assessment is given in *WET-RehabEvaluate*. However, for the purposes of planning the rehabilitation interventions, there may not be sufficient time to carry out these two assessments, in which case, a more rapid assessment is conducted, with each of 15 ecosystem services listed in *WET-EcoServices* scored for the area affected by rehabilitation compared to the same area without rehabilitation (Table 3.2 and 3.3).

The running example

A prediction was made of the likely benefits that would result *with* rehabilitation halting the advance of the headcuts, based on the *WET-Health* assessment (Table 3.1), which highlighted that the gains for all three components of integrity would be great, particularly geomorphic integrity. Based on the extent of the area impacted and the loss score for the impacted area, this would equate with 22 ha ((10-2)/10 x 40 ha minus (10-7.5)/10 x 40 ha) of hydrological integrity, 28 ha ((10-1)/10 x 40 ha minus (10-8)/10 x 40ha) of geomorphic integrity and 20 ha ((10-2)/10 x 40 ha minus (10-7)/10 x 40 ha) of vegetation integrity that would be saved by the rehabilitation.

The running example

Table 3.1: Predicted level of integrity of the affected area with rehabilitation (i.e. if the advancing erosion headcut is halted) and without rehabilitation

Integrity component		Score	Rationale
Hydrology	with	2.0	Assuming that the headcut is halted and grazing controlled, impacts on the hydrology of the threatened area will be relatively low and result from slightly altered catchment runoff and reduced roughness.
	without	7.5	The predicted deep erosion gully will effectively intercept flow and greatly reduce water retention in the wetland, although the hydraulic conductivity of the clayey soil will to some extent limit the gully's draining effect.
Geo-morphology	with	1.0	Assuming that the headcut is halted and grazing controlled, the impacts on the geomorphology of the affected area will be very low.
	without	8.0	The gully is predicted to advance throughout the threatened area, resulting in considerable loss of sediment based on the dimensions of the and level of activity of the headcut.
Vegetation	with	2.0	Although close to its natural state, the abundance of pioneer species is moderate on the wetland margins, probably resulting from past heavy grazing practices.
	without	7.0	Although some of the dominant species are likely to persist, the high level of reduction in wetness will result in a significant change in vegetation. Trampling by livestock as a result of poorly timed grazing is also likely to contribute slightly to reduced vegetation integrity.

Table 3.2: Scores for ecosystem services if rehabilitation goes ahead compared to if it does not go ahead, for the area of wetland likely to be affected by rehabilitation.

Score	Description of effect of rehabilitation on ecosystem service delivery
- 2	Substantial loss anticipated
- 1	Slight loss anticipated
0	No significant effect anticipated
1	Slight improvement anticipated
2	Substantial improvement anticipated

The running example

Of the 15 ecosystem services examined, it was found that a substantial gain of ecosystem service delivery was expected for 5 ecosystem services, slight gains anticipated for a further 2 ecosystem services and no significant effect anticipated for 8 ecosystem services. A brief motivation was provided for each, with this illustrated for 3 of the selected ecosystem services in Table 3.3.

Table 3.3: Likely effect of rehabilitation on the delivery of 4 selected ecosystem services in the example wetland

Ecosystem service	Score	Comments
Flood attenuation	2	1. Flows will be afforded more opportunity to be spread across the wetland. 2. Roughness will significantly increase as it is naturally moderately high and would increase when wetted.
Streamflow regulation	1	Level of wetness (currently temporary to seasonal) will be increased. By blocking the erosion gully diffuse flow of water through the wetland is promoted.
Sediment trapping	2	The flood attenuating capacity of the wetland will be increased resulting in a corresponding increase in sediment trapping. In addition, the headcut erosion will be halted.

Individual services (0=no significant gains anticipated; 1=slight gains anticipated; 2=substantial gains anticipated)

3.10 Assess stakeholder impacts and opportinities and the feasibility of the project (Step 5E)

3.10.1 Stakeholder assessment

Identify key stakeholders in relation to the objectives and outcomes

Identify key stakeholders based upon the objectives and predicted outcomes of the project. For example, if one of the objectives was to enhance the capacity of the wetland to assimilate pollutants then an important stakeholder group would be downstream water users who would benefit from the improved water quality. Next, ask the initial group of stakeholders if there are any other important stakeholders that they think have been omitted. Owners and users of the wetland would always be stakeholders. But remember it can become very onerous if there are many different stakeholders represented. Furthermore, some stakeholder groups may consist of many individuals. Consequently, large stakeholder groups may need to elect representatives who will be actively involved in all the necessary processes.

Interview stakeholders to determine interests

Identify into which broad stakeholder grouping the stakeholders belong and what are their specific interests in the wetland, recognizing that some stakeholders may belong to more than one group (e.g. a private farmer may be the user, owner

and authority of the wetland). Possible groupings are:

- Land-users
- Land owners
- Local land authority
- People living adjacent to the wetland
- Neighbours
- Downstream water users
- Government departments
- NGOs working in the area.

Identify their specific interest in the wetland in terms of the following factors.

- Benefits that they receive
  - Direct (e.g. grazing for livestock, harvested reeds for thatching, a scenic site that enhances their property value etc.).
  - Indirect (e.g. prolonged life of an impoundment downstream of the wetland as a result of the wetland trapping sediment that would otherwise wash down into the dam and reduce its storage capacity; enhanced quality of water downstream of the wetland as a result of the assimilation of pollutants by the wetland).
- Costs that they bear (e.g. mosquitoes; increased ease with which criminals can hide in the local neighbourhood).
- Legally-mandated responsibility (e.g. responsibility of Department of Agriculture under the Conservation of Agricultural Resources Act for controlling agricultural use of wetlands).
- Other responsibility (e.g. responsibility of an NGO for promoting the conservation of cranes and their wetland habitats).

Assess the impact of the planned rehabilitation on different stakeholders, modify objectives and plan accordingly

The impact of the planned rehabilitation interventions on different stakeholders must be determined based on their specific interests assessed in Step 5A. This may confirm that the project as it stands will generally meet the stakeholders' interests. Alternatively, it may reveal that modification to the plan is required.

For example, by re-wetting the wetland, the frequency of flooding of the landowner's cultivated lands on the margins of the wetland may be increased. This may not be in the interests of the owner. Assuming that the cultivation is legal and that it is not unduly impacting upon the wetland, the rehabilitation plan could be adjusted to reduce the area that will be re-wetted. This may be only a slight modification, allowing much the same intended rehabilitation outcomes to be achieved. Alternatively, the modification may be so great as to render the project no longer viable. Sometimes a compromise may be reached (e.g. where the landowner would be willing to forego some production in order that the rehabilitation is carried out).

3.10.2 Develop and determine the feasibility of possible interventions aimed at meeting the objectives

The purpose of this step is to identify a range of possible interventions for meeting the rehabilitation objectives and to determine the feasibility of these. It is important to point out that, at this stage, one is only interested in general intervention type, rather than detailed intervention design. One

The running example

An assessment was conducted of stakeholders likely to be negatively affected by the proposed project, and this revealed none. Initially one of the neighbouring landowners raised an objection to the fact that there would be outside labour employed on the project, but this was shown to be unfounded given that local labour was to be used.

also does not have to consider how feasible the strategy is until later on in the process. It may be too easy to discard a strategy because it seems too hard to achieve, when in fact it may be the most sensible, or even the only, intervention available for dealing with a certain problem. The purpose of this step is therefore to identify a general strategy, or range of strategies, aimed at meeting the objectives.

This may translate into identifying what tools are available for protecting existing, and for improving degraded, services or sites. These may include possible engineering, planning or legislative tools appropriate for addressing the priorities identified. The strategies that one will develop will depend on whether the intention is to maintain or improve wetland integrity. A successful strategy for rehabilitation is also likely to include some form of incentive-based approach.

What makes a suitable strategy for protecting or improving a wetland or service that the wetland is performing will also depend on the problems that are threatening or causing the damage and the specific objectives of the rehabilitation. If for example, the problem relates to erosion, the strategy may require physical intervention such as the building of a structure. However, in other cases, where the threats are from livestock (over-grazing for example), strategies are likely to require compensation, management adjustments, law enforcement, or even social interventions. It is also important to remember that rehabilitation will only really be successful if it works over the long-term (decades). A strategy aimed at short-term improvement is unlikely to be feasible in the long term unless the objectives are defined on the basis of only a short-term improvement.

Three rehabilitation objectives that typically require physical interventions are given in Table 3.4. This illustrates that determining the solution is typically a two step process. Firstly, the specific purpose that the intervention must serve to achieve the objective is identified and secondly the type of intervention able to fulfil the purpose is identified. The physical interventions given in Table 3.4 are covered in considerable detail in *WET-RehabMethods* (Russell, 2009) where further guidance is provided, e.g. in deciding between concrete or gabion weirs.

In many instances therefore, continual intervention may be required to ensure continual improvement or the maintenance of the improved condition. In the development of the strategy, one should therefore distinguish between ensuring sustained improvement through limited intervention, and sustained improvement through continual intervention. Developing a strategy based on the former is preferable. The latter is likely to be more costly in the long-term. On the other hand, the benefits may be so large that the long-term cost implications may be justified, rendering the latter approach feasible.

Determining the feasibility of the strategies developed and the likelihood that these will attain the objectives is critical to the overall success of the project. It may be the case that some of the strategies or actions proposed to tackle the priorities identified may not be feasible because of cost, legislative or administrative constraints, or social or other economic issues.

It should also be pointed out that whilst feasibility is usually measured in terms of costs, it is equally measured in terms of resolve and passion (Rutherfurd *et al*., 2000a). For example, while the costs may seem high, it may be that the stakeholders feel the expense is justified based on enthusiasm for the project and a passion for certain of the aspects being addressed. Stakeholders may also be committed to partnering, raising funds, or even helping to sponsor certain of the rehabilitation activities.

The feasibility of a proposed rehabilitation intervention meeting its objectives needs to be examined from three different

perspectives: Is it feasible from:

- a technical perspective?
- a cost-effectiveness perspective?
- an environmental impact perspective?

The proposed intervention should satisfy a minimum level of acceptability for all these three perspectives. For example, it is of very little value if a proposed intervention scores very highly from a technical perspective but is unacceptable from an ecological impacts perspective (e.g. because it will disrupt the movement of aquatic fauna). If found to be unacceptable, consider whether the intervention can be adjusted to improve its acceptability (e.g. the inclusion of a fishway to allow for the movement of aquatic fauna). Remember that the adjusted alternatives will generally increase the cost.

Table 3.4: A general guide to assist in choosing, for a particular objective, an appropriate intervention type based on the purpose that the intervention must serve in order to achieve the objective

Objectives commonly encountered in wetland rehabilitation projects	**Specific purpose that the** intervention must serve in order to achieve the objective	Type of intervention **potentially able to fulfil the** purpose	Some potential limitations and general comments[1]
Halt advancement of headcut erosion[2]	Create a 'water cushion' against the headcut	1. A weir (typically concrete) downstream of the headcut to flood back into the headcut during periods of high flow[3]	Level needs to be adequately high. May be no suitable location downstream
	Allow the water flow to drop safely into the gully	2. A weir (concrete or gabions) flush against the headcut	Built by cutting into headcut
	Reduce slope and provide 'armouring' of surface	3. Concrete chute	Large surfaces of concrete
	Reduce slope and provide good vegetative cover over this slope	4. Sloping and re-vegetation	High risk of failure in high discharge situations
Reinstate a more naturally diffuse flow in the wetland by routing flow out of a drain, erosion gully or incised stream channel[4]	Remove drain or gully	5. Fill in the drain/ gully	Requires available fill
	Raise water level on the drain/ gully/channel	6. Weir/s across the drain/gully/ channel	
		7. Sediment fence or plug across the drain/gully/ channel	Sediment fences require high sediment supply. Both not suitable for high discharge situations
	Direct flow that has spilled out of the drain	8. Spreader canal/diversion berm	May require high maintenance
Raise the water table in the wetland[5]	Remove drain or gully	8. Fill in the drain/ gully	Requires available fill
	Raise water level on the drain/ gully/channel	1. See (6) and (7) above	

[1]Potential negative environmental impacts associated with each of the different interventions and the relevant legislation is dealt with in *WET-Legal* (Armstrong, 2009).

[2]Controlling erosion in a wetland may have considerable benefits in terms of securing the integrity of the wetland and the many different ecosystem services provided by the wetland. This is particularly important given that in South Africa gully erosion is one of the most prominent factors drying out wetlands.

[3]These may also be constructed to protect upstream structures.

[4]Reinstating a high level of wetness may have considerable benefits in terms of securing the integrity of a wetland and the many different ecosystem services provided by a wetland, e.g. carbon storage, given that hydrology is central to the functioning of wetlands.

[5]Reinstating a more naturally diffuse pattern may have considerable benefits in terms of securing the integrity of the wetland and the many different ecosystem services provided by the wetland, e.g. nitrate assimilation.

It is important to emphasize that answering the above three questions is a difficult task, requiring the input of different disciplines. The decision usually must be made with few resources for investigation. Thus, it is preferable to draw on the experiences of at least two or three individuals from different backgrounds to answer these questions. Below are some pointers to help deal with the three questions.

Is it feasible from a technical perspective?

To answer this question requires examining whether the intervention will survive for an appropriate period considering the investment (i.e. it will not be washed away in the first storm). Consider the particular type of intervention against the features of the site, notably the stability of the substrate, permanence of flow and the magnitude of flood discharges. For example, a gabion structure with un-ameliorated soil proposed for an erosion headcut with highly dispersive soil or permanent flow and high discharges would not be acceptable. This is because rapid loss of the dispersive soil is likely to occur at the face of the structure, leading to it being undermined. A valuable tool to assist in making these decisions is *WET-RehabMethods* (Russell, 2009), which provides general decision trees to assist in selecting an appropriate intervention as well as providing details about the site requirements for different types of interventions.

Is it feasible from a cost-effectiveness and budgetary perspective?

To answer this question, which is likely to be the most complex of the three questions, one needs to have described the anticipated outcomes (Section 3.8) and then to have made a rough estimate of cost, based on general norms rather than on a detailed estimate of costs. An intervention costing a great deal may have high outcome benefits and could therefore still be relatively cost-effective compared with a cheaper intervention having much lower outcome benefits. It is important to remember that if the technical feasibility of a site is high, it will not automatically mean that the outcome benefits will be high. For example, a planned structure in a drainage channel may have the design and materials to match the site requirements and have been built to effectively spread flows in the channel. However, if the drainage channel carries flows very infrequently (e.g. because of extensive upstream water abstraction) there may be no water to spread and the cost effectiveness of the intervention would be very low!

Finally, it is important to also examine cost alone in relation to the available budget because an intervention might be considered cost-effective but be beyond the available budget.

When estimating cost, it is important to consider the following specific costs:

- *Planning*: the greater the social and/or technical complexity of the intervention, the greater the resources that are likely to be required;
- *Authorisation*: authorisation potentially can take a lot of time and resources to acquire for interventions that require legal authorisation such as interfering with the flow of streams (see *WET-Legal*: Armstrong, 2009).
- *Establishment:* getting machinery and material to the site is costly for projects involving engineering interventions, and while these costs should be included in the tender price of implementation, labour-intensive alternatives to the use of machinery should be sought, which is the approach of WfWetlands.
- *Maintenance:* 'High maintenance rehabilitation' that involves the re-establishment of certain processes through continual intervention is generally very costly. Sustainable

rehabilitation projects should have low-to-no maintenance costs in the long-term. Consideration should be given to theft and vandalism, with some materials (e.g. wire) being particularly susceptible.

- *Monitoring and evaluation costs*: this can be very costly, particularly where regular monitoring of high maintenance measures is required.
- *Other costs*: such as stakeholder meetings and site visits to problem areas, while all essentially part of the planning process, are costs that are often underestimated in the rehabilitation strategy (Rutherfurd *et al.*, 2000a and b).

When assessing the cost effectiveness of proposed rehabilitation strategies, it is useful to ask the question: are the individual interventions in the strategy working well together to cost-effectively produce the desired outcome? If a strategy consists of several interventions, it is helpful here to screen each of the proposed interventions in terms of their contribution to the rehabilitation objectives. In so doing, it may be revealed that some of the interventions are contributing much less to the overall objectives than others, and consideration could be given to omitting these. However, it is important to remember that although most interventions contribute directly, some interventions are designed to give support to other interventions, and therefore contribute indirectly to the rehabilitation objectives.

When examining the cost-effectiveness of a rehabilitation project, it is useful to examine the cost per hectare equivalent of re-instated or maintained wetland integrity (as described in Section 3.9). Once the cost per re-instated or maintained hectare has been calculated, this value can be compared against the standard given in Table 3.5. This standard was derived from examining the cost effectiveness of several rehabilitation projects planned for Working for Wetlands, and using 2007 costings. When using this standard, it must, be remembered that some wetlands and some particular problems are more costly to rehabilitate than others. For example, as a general rule it is more cost effective to prevent health declining (i.e. maintain health) than to re-instate health in areas that have already lost their health. The 'cost per hectare equivalent of re-instated or maintained wetland integrity' should by no means be seen as the only criterion on which to judge the returns on investment of a rehabilitation project. Nevertheless, it provides a useful check to, at the very least, raise a 'red flag' on proposed projects which are likely to have a low cost-effectiveness. If, for example, a project costs R550 000 per re-instated hectare equivalent and there are no especially notable improvements in anticipated ecosystem service delivery then this immediately raises a question about the cost effectiveness of the project.

At the same time, however, it is also recognized that the relationship between wetland integrity and ecosystem service delivery may vary considerably from one site to the next depending on the particular circumstances and context of the wetland. For example, a rehabilitation project may be securing one of the few remaining sites in the wild of a critically endangered species, in which case even a million rand per ha equivalent maintained may be considered an acceptable price to pay.

Is it feasible from an environmental impact perspective?

The intention of wetland rehabilitation is generally to improve the ecological state and ecosystem service provided by a wetland. However, poorly planned rehabilitation interventions can cause more harm than good, even though this was not planned or intended. Rehabilitation interventions vary considerably in terms of their potential to result in unintended environmental impacts and the magnitude of such impacts is also extremely variable. Environmental impacts include impacts on the natural environment as well as social impacts (e.g. impacts on local livelihoods

Table 3.5: A standard for assessing the cost-effectiveness of a rehabilitation project in terms of cost, based on 2007 costings, per hectare equivalent of maintained/re-instated intact wetland

Cost of rehabilitation interventions per hectare of re-instated/ maintained intact wetland	Likely cost effectiveness
< R50 000 per ha	The cost effectiveness of the project is likely to be high
R50 000 - R150 000 per ha	The cost effectiveness of the project is likely to be intermediate to high.
R150 001 - R300 000 per ha	The cost effectiveness of the project is likely to be moderate but can be justified if returns in terms of ecosystem system delivery are moderate to high.
R300 001 - R500 000 per ha	The cost effectiveness of the project is likely to be low to intermediate, but can be justified if benefits are high. Therefore, benefits would need to be well justified.
>R500 000 per ha	The cost effectiveness of the project is likely to be low. Such a project would need to be extremely well motivated such that it could only be justified if benefits are exceptionally high

dependent on the wetland). It is appropriate that all wetland rehabilitation projects are scrutinized in terms of their potential to cause unintended negative environmental impacts, which includes social impacts.

Potential negative environmental impacts of wetland rehabilitation include both those associated with the completed interventions (e.g. a concrete weir that has a negative visual impact) and those associated with the construction of the interventions (e.g. compaction of the soil by vehicles bringing rehabilitation materials to the site). *WET-Legal*, (Armstrong, 2009) assists in evaluating both of these potential impacts, together with potential means of avoiding or mitigating these impacts.

The protection of wetlands is covered in a number of pieces of legislation, each of which describes particular activities for which authorisation is required (e.g. one of the listed activities in terms of NEMA (National Environmental Management Act) is the excavation of more than 5 m^3 of soil from a wetland). A key issue is to know which specific rehabilitation interventions may require authorisation, and under which act, in order for rehabilitation to be legally compliant. *WET-Legal* also assists in this by indicating authorisations potentially required for each type of intervention.

Assessing negative environmental impacts of rehabilitation interventions is often most difficult when there are several parties with rights to use the same wetland, as typically occurs in wetlands under communal tenure regimes. In some cases, re-wetting of a wetland may favour some parties, such as those involved in community-based tourism, but disadvantage those parties cultivating in the wetland.

3.11 Design and cost rehabilitation interventions to achieve the objectives (Step 5F)

At this point in the process, the priority wetland/s for rehabilitation have been identified, problems diagnosed, objectives for rehabilitation defined, and what appears to be a feasible strategy for achieving the objective identified, including preliminary costing of the rehabilitation interventions involved in the strategy. Now, the strategy needs to be expanded upon by developing detailed designs for the interventions, together with more accurate cost estimates of the designs. A wide variety of intervention types (Table 3.4) and different 'variations on the theme' for the different types are available, and it is important that the intervention chosen is able to perform the specific rehabilitation function that is needed. *WET-RehabMethods* (Russell, 2009) provides detailed guidance on choosing an appropriate intervention type

The running example

Given the nature of the advancing headcut (comprising a main headcut 2.2 m deep and 14 m wide), it was decided that in order to halt the advancing headcut, two weirs would likely be appropriate to allow the water flow to drop safely into the gully. A further weir to support the two 'drop-inlet' weirs was also identified as being necessary.

The proposed three interventions were found to be feasible from a technical perspective based on the availability of suitable foundation material, the estimated peak discharge and the moderate dimensions of the headcut. The option of sloping and vegetating was considered, but this was found not to be feasible because the discharge was too high.

Taking into account the dimensions of the headcut and gully and the estimate of discharge, a preliminary estimate was made of the volume of the three structures, and from this a preliminary costing of the structures was derived. By comparing this with the anticipated ecological outcomes assessed in Step 5D, cost effectiveness was estimated as R90 000 per hectare equivalent of maintained/re-instated intact wetland, which compares favourably against the national norms in Table 3.5. The site was also found to be the most cost effective relative to the other candidate sites. The proposed three interventions were also found to be feasible from an environmental impact perspective. Although concrete structures would have a potential visual impact, the structures are not in a nature reserve, and the only stakeholder that would regularly see them would be the landowner, who indicated that he would find it acceptable. Thus, overall, the feasibility of the project was considered to be high.

and the specific considerations to take into account when designing the chosen intervention (e.g. what to consider when designing an appropriate spillway width).

It is important to highlight that not all interventions are physical things that must be built or put in place. They may also include a change in management practices, typically relating to a change in the frequency and timing of burning and the intensity of grazing by livestock. The projects will be problem and often site- or area-specific. This step may require specialist input, whether for assisting with the design of engineered structures, choice of species or methods of re-vegetation and/or erosion control, the development of tender specifications, the suitability and methods of ecological manipulation, and legal or social aspects. Another important consideration is that wherever suitable, one should try to use the establishment of vegetation in structure design in order to increase the sustainability of the rehabilitation. Most engineered structures have a finite design life and in many cases will therefore require maintenance. Engineered structures in combination with other rehabilitation procedures such as bio-remediation (e.g. using gabions in combination with re-vegetation) may have positive effects on the system that will continue well beyond the life of the structures (e.g. when the structures rot away, the vegetation may be well enough established to control erosion).

It is also important to consider secondary effects that may have management

implications with respect to rehabilitation (Rutherfurd *et al.*, 2000a and b). For example, sediment traps in storm water canals may require periodic cleaning. The sediment and rubbish removed will need to be disposed of and this may have other implications or long-term management requirements. The structures may also require specific designs in order to facilitate such sediment removal. Guidelines for detailed project design are shown in Box 6.

It is important that the designs are clear and unambiguous, that the specific rehabilitation function of each intervention also needs to be described briefly, and how these work together to produce the intended outcome. The implementer of the intervention is usually different to the designer of the intervention. As can be appreciated from Table 3.4, interventions of a similar type and design may serve different purposes in different rehabilitation projects. For example the main purpose of a weir constructed in a channel of 'Project A' may be to raise the water level in the channel and slow the velocity of flow down the channel, while in 'Project B', the main purpose of a similar structure is to 'push' high flows out of the channel across the surface of the wetland. It is important for two reasons for implementers to know what specific purpose is being served by the intervention that they are constructing.

Firstly, it allows for the errors or required adjustments to be detected more timeously. If the implementer knows the purpose of the structure (e.g. to spread low flows out of the drainage channel) then if there is an error (e.g. it is being built too low) the implementer is more likely to detect this before proceeding too far. Similarly, if in a series of structures after one has been built, and it becomes apparent that its influence does not extend as far as anticipated, an adjustment could be made by moving the second structure slightly nearer.

Secondly, it gives the implementer a greater understanding of the specific contribution of his/her structure towards the project objectives, likely to engender a stronger feeling of being part of the process than if this understanding were lacking. It is also more likely to contribute to the competency of the implementer.

In addition to explaining the purpose of each individual intervention, the plan must convey a sense of how all the individual interventions work together as a whole. A sketch map is often useful, particularly when reference is made to the objectives influencing the pattern of flow. The sketch map shows the location of the structures and the area/s over which flow is to be spread. Some structures will be designed to spread only high flows while others will be designed to spread low flows as well, and these respective flows must be indicated on the sketch, shown in the example in Figure 3.3.

The rehabilitation plan also needs to specify the sequence in which the interventions should be constructed, since it is important to consider environmental and operational risks. For example, it will often be necessary to schedule work with the highest risk from erosion (caused by flooding of interventions still under construction) in the least risky time of the year (the dry season). There may also be good operational reasons for building structures in a particular order, especially if one structure is designed to flood back to the other structure.

Finally, the rehabilitation plan must include an environmental management plan, indicating how potential environmental impacts associated with construction/ implementation of the interventions are to be dealt with. Table 3.6, highlights some potential negative environmental impacts that one should look out for, as well as suggesting some possible means of avoidance or mitigation. *WET-Legal* (Armstrong, 2009) expands upon this Table by highlighting specific pieces of legislation relevant to the activities listed, and Section 3.12 highlights the importance of clearly defining individual responsibilities for

Box 6: Guidelines to assist with detailed project design

- Design the project to enhance the natural recovery of the system (work with natural processes and dynamics)
- As far as reasonably possible, try to avoid designs that require long-term maintenance or continual intervention
- Wherever suitable, use bio-engineering in structure design in order to increase the sustainability of the rehabilitation
- Always consider secondary effects that may have management implications with respect to rehabilitation
- Where economically possible, try to include labour-intensive designs for engineered structures, in order to provide added benefits with respect to job creation. This is particularly relevant to the unskilled sectors of local communities who might benefit from the project
- Use tried and tested strategies and designs wherever appropriate before considering new designs
- Wherever possible, design a strategy to compliment other existing strategies or management measures appropriate to the problem or area
- Similarly, wherever possible, try to use existing strategies or structures in the detailed design. For example, it may be possible simply to upgrade an existing storm water canal outlet rather than build a new one
- Where a specific project involves motivating for a change in practice or behaviour, try to use strategies designed around the cultural, social and economic characteristics of those it is intended to motivate.

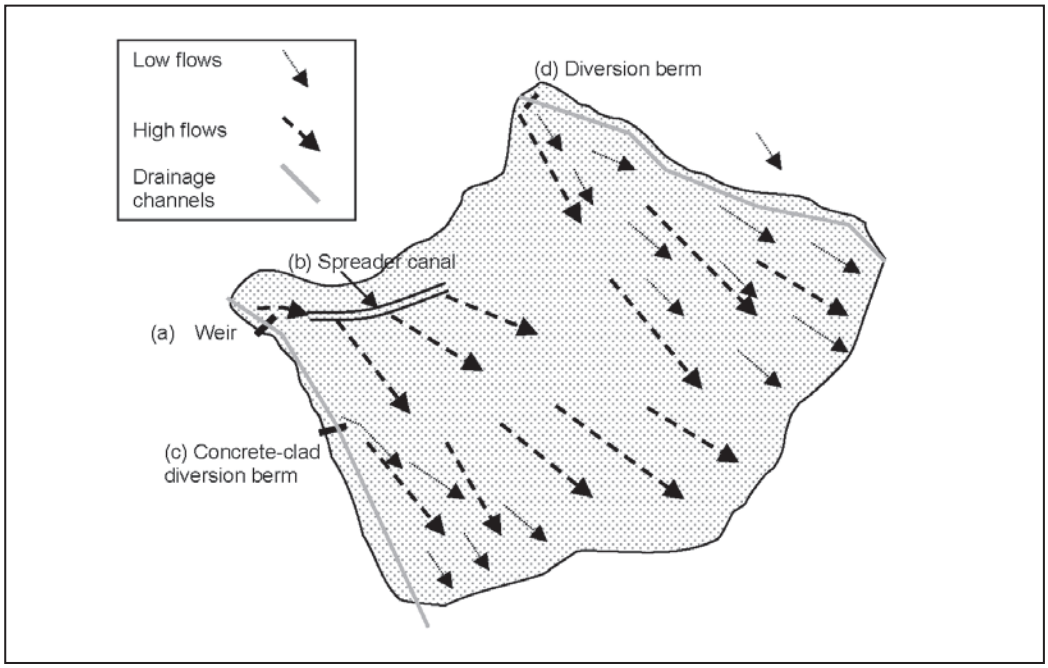


Figure 3.3 Sketch map of Kruisfontein wetland, indicating the location of interventions (a to d) and the intended low and high flows

Table 3.6: Potential environmental impacts associated with construction/ implementation of the interventions, and means of avoiding or mitigating these impacts

Construction activities	Potential negative environmental impacts	Means of avoidance or mitigation
Access to the site and to the specific interventions within the site	Soil compaction and disturbance and vegetation disturbance.[1]	As far as possible, use existing roads and tracks. In very wet areas obtain foot access using boards. Rehabilitate access paths when work complete (e.g. loosen compacted areas).
Storage of materials	Disturbance of vegetation.[1] Visual impact.	Remove all material on completion of the work. Rehabilitate site when work complete.
Mixing of concrete	Local contamination of the soil.	Confine mixing of concrete to designated area/s outside of flooded areas in the wetland.
Human waste associated with site toilets	Contamination of water.	Locate any toilets outside of the wetland.
Disturbance associated with the noise and presence of many people	Disturbance of fauna, particularly breeding Red Data species.	Timing of activities. Screening with shade-cloth, if required.
Fuel spills or leaks	Contamination of soil and water.	Maintain any machines (e.g. pumps) being used at the site in good working order, and any stored fuel should be located outside of the wetland.
Temporary diversion channel	Temporary drying out (usually not great, and of a short duration).If not properly rehabilitated, the diversion could become the focus of long term erosion.	Ensure that the diversion channel is fully blocked, in-filled and re-vegetated once work is complete.
Removal of plugs of vegetation from donor sites	Potential exposure of donor sites to erosion. Disturbance of sensitive areas.	Remove plugs where the threat of erosion is low and the site is not considered sensitive.
Excavation of soil (for the foundations of structures)	Disturbance of soil and vegetation. Erosion and washing of sediment into downstream habitats.[1]	Where the site is located in water flow paths, particularly where discharges are high, confine activity to the dry season. Divert flow until the intervention is well stabilized. Encourage rapid re-vegetation. Exclude livestock until vegetation well established.
Cutting and filling (e.g. in order to slope a gully head or sides)		
Collection of rocks from the local environment	Loss of habitat from rock removal.	Do not collect rocks from a stream channel bed.
Collection of local sand	Disturbance of vegetation[1], possible increase in risk of erosion.	Collect sand where risk of erosion is low and in areas where pioneer vegetation dominates.
Use of sand and stone from an outside supplier	Donor sites potentially poorly managed.	Ensure that sand or stones are from an authorized supplier.

[1] In all cases of disturbance of soil or vegetation, the opportunities for invasive alien species to invade are increased, although the probability of this occurring will vary greatly from site to site.

The running example

Once the specific problems requiring rehabilitation intervention had been identified, the WfWetlands provincial coordinator returned with an engineer contracted by WfWetlands to plan the rehabilitation interventions.

The engineer referred to *WET-RehabMethods* in deciding on the best type of intervention, as well as obtaining information from the landowner regarding how perennial was the flow over the headcut, which was an important factor to consider in deciding whether to build the structure from gabions or concrete. The engineer also referred to *WET-RehabMethods* in deciding on the width of the spillway.

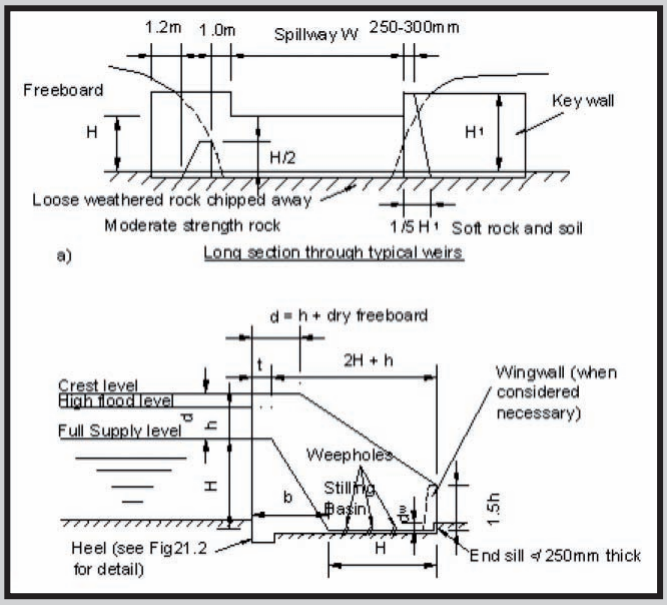
In the photo below the landowner explains the seasonality of flow through the problem area of the wetland.

The running example

Three interventions were planned to halt the advance of the headcut:
(1) a drop-inlet concrete weir at the face of the main headcut, subject to perennial flow
(2) a drop inlet gabion weir in the secondary headcut, subject to ephemeral flow
(3) a supporting concrete weir structure 30 m down the gully.

Here is a plan of the third structure.

- Bill of quantities
- Concrete
- Sand
- Reinforcing rods etc.



3.12 Workplans, agreements and roles and responsibilities (Step 5G)

3.12.1 The workplan

It is important to remember that implementation in its own right also demands a high level of planning. A detailed plan for implementation (i.e. a workplan) is important because it forces one to think through exactly what needs to happen during implementation (Rutherfurd *et al*., 2000a and b). This helps to avoid exceeding the budget, makes ongoing management easier, and helps keep the people involved committed to the project, the objectives and the deadlines set for starting and completing tasks. Scheduling is critical in this regard in order to ensure the deliverables meet funding and other timing requirements. Tasks should also be scheduled so that the work undertaken flows logically and efficiently. One could, for example, potentially save costs by allowing certain tasks to overlap or run concurrently.

As highlighted in Section 3.11, it is important that the interventions be constructed in the sequence specified in the rehabilitation plan in order to ensure that those with the highest risks are constructed during the least risky time of the year (which in the case of wetlands is generally the dry season).

Another key aspect covered in the workplan is minimizing potential environmental impacts associated with implementation of the project. This concerns aspects such as demarcating areas for stockpiling building materials, accessing the site, mixing of concrete and handling fuel. These are covered in detail in *WET-RehabMethods* (Russell, 2009) in the chapter 'Working on site' as well as in *WET-Legal* (Armstrong, 2009) which lists potential environmental impacts associated with construction/ implementation of the interventions, means of avoiding or mitigating these impacts, and authorisations potentially required.

3.12.2 Clarify the roles and responsibilities of the different involved parties

Once the detailed rehabilitation plan is complete, the roles and responsibilities of the different stakeholders must be clarified in relation to the implementation, monitoring, evaluation, and aftercare of rehabilitation interventions, and post intervention management of the wetland. This step is informed by Step 5E, where stakeholders indicate their desired involvement. Many stakeholders would have a passive role, largely requiring to just be kept informed of progress. Some, however, would be very actively involved in one or more of the different phases of the project. The landowner would typically be actively involved during the planning phase in providing information and ideas, and then again during the monitoring phase, given that the landholder is most familiar with the wetland and is generally very close geographically to the wetland.

The running example

The workplan specified that all three interventions be constructed in the same year, and construction commence at the beginning of the dry season. Based on the level of risk facing the structures, the sequence in which they should be constructed was specified as Intervention 1, Intervention 3 and then Intervention 2. The workplan also specified that access should be using an existing farm road, and indicated where materials should be stockpiled and concrete should be mixed, and how these areas should be rehabilitated once construction of the three structures was complete.

Where other opportunities for involvement also exist, these should be encouraged. As indicated earlier, it is assumed generally that the greater the local involvement, the greater will be the sustainability of the rehabilitation in the long term. Landowner contributions may be financial, materials (e.g. rocks), equipment (e.g. tractor and trailer to transport the rocks) and time.

An important aspect to agree upon at this stage is the contribution that will be made by the landholder/s towards the rehabilitation. It may not be possible to prescribe a set amount. Instead, the specific circumstances at the site need to be accounted for. When doing so it may be helpful to consider: (1) the direct benefits that the landowner will receive from the rehabilitation; (2) the legal responsibility of the landowner for undertaking the rehabilitation; and (3) the costs of the rehabilitation in relation to the means of the landowner.

In some rehabilitation projects, landowners may receive little direct tangible benefits from the rehabilitation, and in some cases, rehabilitation may, in fact, diminish the benefits that they receive. For example, re-wetting an area could be to the disadvantage of a livestock farmer. Such a situation could exist where blocking of drains that maintained a temporarily wet condition now re-instates a permanently wet condition, rendering the area too wet for livestock grazing. In this case it may be the downstream users who benefit most from the rehabilitated wetlands, mainly though the provision of water of enhanced quality. However, in other rehabilitation projects, the direct benefits that the landowner receives may be considerable, such as where the rehabilitation project halts erosion that is actively eroding into a portion of wetland that naturally serves as a very valuable resource for livestock grazing.

The legal responsibility of the landowner concerning rehabilitation of wetlands can range from a clearly defined responsibility to no *legal* responsibility as illustrated by the following examples. If wetland drainage took place prior to the enactment of CARA (Conservation of Agricultural Resources Act) in 1983, and this is not significantly impacting on water quality and erosion, then there is unlikely to be any legal justification for the landowner to stop cultivation in the area. This would contrast with a situation where the landowner drained a wetland after the enactment of CARA, with no legal authority having been granted. To treat both of these landowners in the same manner would clearly be incorrect.

Although all landowners should be expected to contribute something within their means, landowners are likely to vary considerably in terms of the material means that they have available. Some will be struggling merely to subsist, while others may have considerable material means at their disposal.

3.12.3 The landowner agreement, authorisations and contracts

At this stage it is necessary to enter into agreements with landowners and obtain the necessary environmental authorizations. The legal terrain is complex and requires familiarity with the South African Constitution, commitments that are internationally binding through international agreements such as the Ramsar Convention, and a host of acts such as the National Environmental Management Act (NEMA), the Conservation of Agricultural Resources Act (CARA) and the Water Act. In some cases there are laws that demand action and that mandate landowners or statutory organisations to act by rehabilitating damaged natural systems. Navigation of this terrain is described in *WET-Legal* (Armstrong, 2009). It is important to note that allowance needs to be made for the fact that applications for environmental authorisations will often take several months for the approval process to be completed.

The running example

Five potential role-players likely to have a particular interest in the project were identified as the landowner, WfWetlands, the implementer, FSDTEEA, Department of Agriculture (DoA), and their level of involvement in the different aspects of the project was clarified as follows.

	Planning	Implementation	Monitoring and evaluation	Aftercare
Landowner	**	*	*	***
WfWetlands	***	*	***	*
Implementer	*	***	*	
FSDTEEA	*		*	
DoA	*			*

Level of involvement: *=slight, **=moderate, ***=high

Where rehabilitation is being undertaken by an outside programme, it is important that an agreement be signed between the programme and the landowner, wherein the responsibilities of the two parties are clearly indicated. The next formal agreements to be made are between the party providing the resources for undertaking the rehabilitation and the party implementing the work. Depending on the particular circumstances, this may require that the work be put out to tender.

If the rehabilitation is being undertaken as part of a programme such as WfWetlands, a committee should be constituted on which stakeholders will be represented, to oversee implementation of the project. If there is an existing structure that could perform this function, then this should be used in preference to creating a totally new structure. The committee would often be required to deal with appointment of workers, but would not deal with the details of the project's day to day operations, except in helping address key conflicts that may emerge during the implementation process.

3.13 Monitor and evaluate (Steps 5H and 5J)

3.13.1 Establish evaluation criteria and a monitoring plan

Establishing evaluation criteria and a monitoring plan is a critical step in any rehabilitation project (The Federal Interagency Stream Restoration Working Group, 2001). With no formal check on the outcome of a project, it is difficult to assess whether the objectives of the project are being (or have been) met. Evaluation also allows one to improve the techniques and approach used. *WET-RehabEvaluate* (Cowden and Kotze, 2009) provides comprehensive guidelines for the monitoring and evaluation of wetland rehabilitation projects. The tool assists in selecting appropriate criteria for evaluation based on the rehabilitation objectives, and also in designing an appropriate monitoring plan. Finally, *WET-RehabEvaluate* highlights that a key component of the monitoring plan is for the partners involved in the rehabilitation project to specify who will be undertaking all of the different tasks outlined in the plan, and what will be their specific responsibilities.

The running example

Once the designs and workplan had been completed and had been examined and understood by the landowner, a landowner agreement which specified clearly the legal responsibilities of the involved parties was completed and signed. The designs and workplans were included as an appendix to the agreement.

Based on WET-Legal it was recognized that authorisation was required in terms of Regulation 4 of GNR 398 given that more than 5 m^3 of soil was to be excavated for the construction of the structures. An application for environmental authorization was made to Department of Environmental Affairs and Tourism (DEAT), which included a description of the planned activities (as contained in the designs and workplan), together with anticipated benefits, potential negative environmental impacts and the means of mitigating these. DEAT was satisfied that the applicant should be authorized, and did so subject to compliance with a set of conditions (e.g. that the work should be conducted within two years of approval).

Finally, a small committee comprising a representative from the local municipality, the landowner and a representative from FSDTEEA was established to oversee the project and an implementer for carrying out the work, Central Wetland Rehabilitation, was appointed.

3.13.2 Implement the monitoring

This step is self explanatory. As long as the guidelines listed above are followed and due consideration is given to the development of the monitoring strategy, then one can go ahead and implement the monitoring plan. It will, of course, be dependent on individuals fulfilling their specified responsibilities for implementing the different tasks.

3.13.3 Assess the outputs and outcomes of the project

Although reported here, it should be noted that assessing outputs and outcomes would follow Step 5I (Implementation). *WET-RehabEvaluate* (Cowden and Kotze, 2009) provides detailed guidelines for assessing both the outputs (e.g. physical structures put in place) and the outcomes of the rehabilitation interventions (e.g. effect of the structures on the distribution and retention of water in the wetland). *WET-RehabEvaluate* also provides a structured approach for undertaking an overall assessment of the returns on investment of a rehabilitation project and identifying areas of improvement in the project. *WET-RehabEvaluate* emphasizes the importance of undertaking a baseline survey before rehabilitation starts in order that a reference point is available for assessing rehabilitation outcomes.

3.14 Project implementation, including remedial action and follow up (Step 5I)

3.14.1 Implementation of the physical rehabilitation interventions

Implementation includes all the activities necessary to execute the rehabilitation and achieve the objectives. The details of these activities are specified in the rehabilitation intervention designs and workplan. As highlighted in Section 3.12 a workplan is required because

The running example

The baseline survey undertaken in Step 5B when diagnosing the health of the wetland served as the baseline for monitoring. In addition, precise GPS coordinates to 1 metre accuracy were recorded of the location of the headcuts and fixed-point photographs were taken according to the specifications given in WET-RehabEvaluate. Monitoring of the structural integrity of the three interventions and the locations of the headcuts by WfWetlands according to the guidelines given in WET-RehabEvaluate took place at the following intervals following completion and signing off of the interventions: 6 months, 1 year, 3 years. In addition, the landowner checked the interventions several times during each wet season in the three years following completion.

At the end of the third year, the health and ecosystem delivery of the wetland was surveyed, with the same factors assessed as in the baseline survey. Comparing the results of the two surveys revealed that the health of the 40 ha of wetland under threat from headcut erosion had been maintained, and up to that date the project had successfully achieved its objectives. The results of the evaluation were also used in an evaluation of the WfWetlands programme when the project was randomly chosen as one of the sites from the Free State to feed into an overall evaluation of four years work of the programme.

implementation in its own right demands careful planning.

Because rehabilitation involves natural wetland systems and different people working together, and since rehabilitation is a relatively new and developing practice in South Africa, unexpected consequences of intervention actions can occur. Thus, even though most potential flaws or limitations to the project should have surfaced during the planning stages, unanticipated problems will often be encountered along the way. Such problems may relate to the wetland's physical state as well as to the human dimension of rehabilitation. An example of a physical change in the wetland is a headcut that advances in the period between designing and implementing the intervention to deactivate the headcut. This may require that the structure be moved to the 'further-advanced' location, as well as being modified if, for example, the headcut has increased in size. Without fine-level hydraulic modelling, which would be prohibitively expensive for most rehabilitation projects, it is often not possible to predict how different rehabilitation structures will affect the exact distribution of water across the wetland. It is only once they are in place that this will become evident, and at this point some modifications may be identified. For example, a spreader canal designed to assist in distributing artificially confined flow across the wetland surface as diffuse flow, may be found to be too short and therefore requiring extension.

Human-related problems that may emerge during the rehabilitation include difficult stakeholders who were not previously involved or interested, and/or other more practical problems, such as servitudes or access issues not previously considered.

The Federal Interagency Stream Restoration Working Group (2001) suggests there are four basic options for

dealing with unexpected consequences arising as a result of specific interventions. These are:

- *No action*
  If the rehabilitation is generally progressing as expected or if progress is slower than expected but will probably meet the objectives within a reasonable amount of time, no action is appropriate;
- *Maintenance*
  Additional intervention may be required to keep the rehabilitation on course;
- *Adding, abandoning, or decommissioning plan elements*
  Significant changes in parts of the implemented rehabilitation plan might be needed. These might entail revisiting the overall plan as well as considering changes in the design of individual components and types of intervention planned; and
- *Modification of the objectives*
  Monitoring might indicate that the rehabilitation is not progressing towards meeting the objectives, but is progressing toward a system that has other desirable functions or goods and services. In this case, the participants might decide that the most cost-effective action would be to modify the objectives of the rehabilitation rather than to make extensive intervention changes to meet the original objectives.

The project manager will therefore need to deal with these issues as and when they arise. In the case of a national programme such as WfWetlands, any changes to the plan will need authorization. For local initiatives it would still be advisable to keep stakeholders informed of any changes to a plan.

Taking effective remedial action really amounts to adaptive management, which involves adjusting the type and direction of management or intervention actions as new information becomes available (see Section 3.1 and Kotze and Breen, 2009). The process is about planning, implementing, monitoring, evaluating and then acting in response to unforeseen circumstances or events that are affecting the project's ability to achieve its objectives. Applying this requires a willingness to experiment scientifically and prudently and to accept occasional failures (The Federal Interagency Stream Restoration Working Group, 2001). Participants and stakeholders must be willing to accept, acknowledge and learn from failures. Kondolf (1995) emphasises that even if rehabilitation efforts fail, they provide valuable experimental results that can help in the planning and design of future efforts. It is however also important to emphasise that this does not excuse poor planning and implementation in rehabilitation projects. It refers mainly to unexpected consequences of the intervention or unforeseen factors that may influence the success of the rehabilitation actions. One could still be held accountable if it can be proved that the project was poorly planned and the implementation poorly executed. Evaluation is also a key tool for establishing this.

In summary, if performance standards are not satisfied, one may need to take remedial actions, establish new evaluation criteria, or perhaps even re-visit the objectives for the project. Whatever the case, planning for the possibility of having to undertake remedial actions should form part of the overall rehabilitation planning exercise.

The running example

In this photo the landowner points out to WfWetlands where undercutting had started to develop around one of the structures, during a particularly wet period in the second year after the structure had been built. The landowner did well to detect this before the structure's integrity had been compromised. This highlights the valuable role that the landowner can play in early detection of problems. Based on an inspection by WfWetlands, it was identified that the problem could be addressed by a short wing-wall constructed from earth, which was undertaken successfully.

3.14.2 Follow-up

The final step, which should not be overlooked, is to maintain contact with the landholder after the rehabilitation interventions are complete. It is advisable to visit the landholder and the site at least once a year for the first two years after the rehabilitation interventions are complete. This should be a joint visit by a representative from the rehabilitation programme together with a local extension worker. The more clustered projects are in a local area, the easier it is logistically for a rehabilitation programme to conduct such follow-up visits, again highlighting the value of clustering projects. After the two years, the onus will lie primarily with the local extension services to maintain contact with the landholder. In addition, the rehabilitation programme should remain as accessible (e.g. via telephone and email) as possible to the extension services and landholders. This contact will also be important for long term monitoring of the rehabilitation interventions, as explained in *WET-RehabEvaluate* (Cowden and Kotze, 2009).

4 References

Armstrong A, 2009. *WET-Legal: Wetland rehabilitation and the law in South Africa.* WRC Report No. TT 338/09. Water Research Commission, Pretoria.

Anderson S, 1999. The 'Science' of Consultation: a Tasmanian Experience.' In: Rutherfurd I and Bartley R (eds.) *Second Australian Stream Management Conference*, Adelaide. Cooperative Research Centre for Catchment Hydrology, pp. 9-13.

Convention on Wetlands, 2002. Resolution VIII.16 Principles and guidelines for wetland restoration. In: 8th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands (Ramsar, Iran, 1971).

Cowden C and Kotze DC, 2009. *WET-RehabEvaluate: Guidelines for the monitoring and evaluation of wetland rehabilitation projects.* WRC Report No. TT 342/09. Water Research Commission, Pretoria.

Dickens C, Kotze D, Mashigo S and Graham M, 2003. *Guidelines for integrating the protection, conservation and management of wetlands into catchment management planning.* WRC Report No.TT220/04. Water Research Commission, Pretoria.

Dada R, Kotze DC, Ellery WN and Uys MC, 2007. *WET-RoadMap: A guide to the Wetland Management Series*. WRC Report No. TT321/07, Water Research Commission, Pretoria.

Dini J, 2004. Restoring wetlands and healing a nation: South Africa's Working for Wetlands Programme. *National Wetlands Newsletter*, 26: 7-10.

Ellery WN, Grenfell MC, Grenfell SE, Kotze DC, McCarthy TS, Tooth S, Grundling P-L, Beckedahl H, le Maitre D and Ramsay L, 2009. *WET-Origins: Controls on the distribution and dynamics of wetlands in South Africa.* WRC Report No. TT 334/09. Water Research Commission, Pretoria.

Galatowitsch SM and van der Valk AG, 1998. *Restoring prairie wetlands*. Institute for Wetland and Waterfowl Research, Iowa State University Press, Ames.

Grenfell MC, Ellery WN, Garden SE, Dini J and Van der Valk AG, 2007. The language of intervention: A review of concepts and terminology in wetland ecosystem repair. *Water SA*, 33: 43-50.

International Waterfowl and Wetlands Research Bureau (IWRB) Publ. 37, Information Press, Cambridge, pp 76-112.

Jordan WR (III), Gilpin ME and Aber JD, 1987. Restoration Ecology: ecological restoration as a technique for basic research. In: Jordan WR (III), Gilpin ME and Aber JD (eds.) *Restoration Ecology: A synthetic approach to ecological research*, Cambridge University Press, Cambridge, pp. 3-21.

Kareko J, Breen CM, Kotze DC and Ellery WN, 2009. Collaboration amongst organizations involved in wetland rehabilitation. In: Kotze DC, Breen CM, Nxele IZ and Kareko J (eds.) *WET-ManagementReview: The impact of natural resource management programmes on wetlands in South Africa.* WRC Report No. TT 335/09. Water Research Commission, Pretoria.

Kinneman ML, and Bleich MR, 2004. Collaboration: aligning resources to create and sustain partnerships. *Journal of Professional Nursing*, 20: 310-322.

Kondolf GM, 1995. Five elements for effective evaluation of stream restoration. *Restoration Ecology*, 3(2): 133-136.

Kotze DC and Breen CM, 2009. A framework for assessing the effectiveness of wetland management (*WET-EffectiveManage*) as described and applied to 21 wetlands. In: Kotze DC, Breen CM, Nxele IZ and Kareko J (eds.) *WET-ManagementReview: The impact of natural resource management programmes on wetlands in South Africa.* WRC Report No. TT 335/09. Water Research Commission, Pretoria.

Kotze DC, Marneweck GC, Batchelor AL, Lindley DS and Collins NB, 2009. *WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands*. WRC Report No. TT 339/09. Water Research Commission, Pretoria.

Kusler JA and Kentula ME (eds.) 1990. *Wetland Creation and Restoration: The Status of the Science*. Island Press, Washington, DC. 594pp.

Macfarlane DM, Kotze DC, Ellery WN, Walters D, Koopman V, Goodman P and Goge M. 2009. *WET-Health: A technique for rapidly assessing wetland health.* WRC Report No. TT 340/09. Water Research Commission, Pretoria.

Marneweck GC, Batchelor AL and Uys AC, 2004. Guidelines for estuarine rehabilitation. In: Breen C, Adams J, Cowley P, Marneweck C, McGwynne L, McKenzie M, Ngulube P, Paterson A, Sihlophe N, Taljaard S, Turpie J, van Niekerk L, Wood A, Lamberth S, Boyd A and Morant P (eds.) *Protocols contributing to the management of estuaries in South Africa, with a particular emphasis on the Eastern Cape Province Vol II, Report A*. WRC Report No 1246/1/04. Water Research Commission, Pretoria.

Mitsch WJ, and Gosselink JG, 2000. *Wetlands*. Van Nostrand Reinhold, New York.

Millennium *Ecosystem Assessment, 2005. Ecosystems and human well-being: wetlands and water synthesis*. World Resources Institute. Washington DC.

Nxele IZ and Kotze DC, 2009. Stakeholder participation in wetland rehabilitation: Six case-study wetlands examined. In: Kotze DC, Breen CM, Nxele IZ and Kareko J (eds.) *WET-ManagementReview: The impact of natural resource management programmes on wetlands in South Africa*. WRC Report No. TT 335/09. Water Research Commission, Pretoria.

Rountree MW, Thompson M, Batchelor AL, Kotze DC and Marneweck GC, 2009. *WET-Prioritise: Guidelines for prioritising wetlands at national, regional and local scales*. WRC Report No.337/09. Water Research Commission, Pretoria.

Russel WB, 2009. *WET-RehabMethods: National guidelines and methods for wetland rehabilitation*. WRC Report No. TT 341/09. Water Research Commission, Pretoria.

Rutherfurd ID, Jerie K and Marsh N, 2000a. *A Rehabilitation Manual for Australian Streams, Volume I*. Cooperative Research Centre for Catchment Hydrology and Land and Water Resources Research and Development Corporation.

Rutherfurd, ID, Jerie K and Marsh N, 2000b. *A Rehabilitation Manual for Australian Streams, Volume II*. Cooperative Research Centre for Catchment Hydrology and Land and Water Resources Research and Development Corporation, Canberra. Available from www.rivers.gov.au

Society of Wetland Scientists Wetlands Concerns Committee, 2000. *Position paper on the definition of wetland restoration*. Society of Wetland Scientists. http://www.sws.org/wetlandweblinks.htm

The Federal Interagency Stream Restoration Working Group, 2001. *Stream Corridor Restoration: Principles, Processes and Practices*. Natural Resources Conservation Service. www/usda.gov/stream_restoration.

Winstanley TJ, 2000. Analysis of the legislative and institutional context of wetland rehabilitation. In: *A manual for wetland rehabilitation*. Report to the Department of Environmental Affairs and Tourism, South Africa.

Worth S, 2006. *Working for Wetlands Stakeholder engagement strategy*. Unpublished report submitted by LRI to Working for Wetlands, Pretoria.

Working for Wetlands - Draft Strategic Plan, 2003. Department of Environmental Affairs and Tourism and Department of Water Affairs and Forestry, South Africa.

Working for Wetlands, 2005. *Working for Wetlands Strategy*. Working for Wetlands, Pretoria.

Working for Wetlands

Working for Wetlands (WfWetlands) uses wetland rehabilitation as a vehicle for both poverty alleviation and the wise use of wetlands, following an approach that centres on cooperative governance and partnerships. The Programme is managed by the South African National Biodiversity Institute (SANBI) on behalf of the departments of Environmental Affairs and Tourism (DEAT), Agriculture (DoA), and Water Affairs and Forestry (DWAF). With funding provided by DEAT and DWAF, WfWetlands forms part of the Expanded Public Works Programme (EPWP), which seeks to draw unemployed people into the productive sector of South Africa's economy, gaining skills while they work and increase their capacity to earn income. Rehabilitation projects maximise employment creation, create and support small businesses, and transfer relevant and marketable skills to workers.

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