Implementation Manual

for Freshwater Ecosystem Priority Areas

Report to the
Water Research Commission

by

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WRC Report No. 1801/1/11
ISBN 978-1-4312-0147-1
Set No. 978-1-4312-0148-8

AUGUST 2011

This report forms part of a series of three reports. The other reports in the series are:
Atlas for Freshwater Ecosystem Priority Areas – Maps to support sustainable development of water resources (WRC Report No. TT 500/11), and
Technical Report for the Freshwater Ecosystem Priority Areas Project (WRC Report No. 1801/2/11)

Executive summary

This implementation manual is part of a suite of products of the National Freshwater Ecosystem Priority Areas project (NFEPA). NFEPA was a three-year partnership project between South African National Biodiversity Institute (SANBI), CSIR, Water Research Commission (WRC), Department of Environmental Affairs (DEA), Department of Water Affairs (DWA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). NFEPA map products provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as **Freshwater Ecosystem Priority Areas, or FEPAs**.

Other products of NFEPA are:

- **Atlas of Freshwater Ecosystem Priority Areas in South Africa**, which shows all maps developed by the NFEPA project, including FEPA maps per Water Management Area, national map products, and maps of input data layers. A brief explanation of each map is provided.
- A **technical report**, which explains the scientific methods and stakeholder engagement process used to create the map products and the analysis of legal and institutional mechanisms available for implementing NFEPA products.
- **NFEPA DVD**, which includes GIS shapefiles and metadata for all NFEPA spatial data layers, A3 PDFs of FEPA maps per Water Management Area, an open source map viewer, and slide presentations on NFEPA.

All of these products are available digitally on the NFEPA DVD or on SANBI's Biodiversity GIS (BGIS) website (http://bgis.sanbi.org). Please contact SANBI's Freshwater Programme if you need assistance in accessing the products (freshwater@sanbi.org.za).

The **purpose of this implementation manual** is to provide guidance on how to use the FEPA maps in the water sector, the biodiversity sector and other key sectors whose planning and decision-making impacts on freshwater ecosystems. FEPA maps provide a single, consistent national source based on best available science and the collective knowledge of South Africa's freshwater ecological community. They indicate how many rivers and wetlands, and which ones, should remain in good condition (equivalent to an A or B ecological category as defined by DWA).

Please note that the implementation manual **does not contain the FEPA maps**. An example of a portion of a FEPA map is shown in Figure 4. For the full set of FEPA maps and other map product please consult the atlas or NFEPA DVD.

The implementation manual is aimed at those involved with, or contributing to, any planning or decision-making process that should take freshwater ecosystems into account. **Intended users** include water resource planners and managers, land use planners and land-use decision-makers, and those involved in conservation and rehabilitation. These include:

- National government departments, especially:
  - Water Affairs,
  - Environmental Affairs,
  - Agriculture, Forestry and Fisheries,
  - Mineral Resources,
- Provincial government departments, especially:

  - Environmental affairs,
  - Agriculture,
- Catchment Management Agencies,
- Conservation authorities,
- Municipalities,
- Conservation NGOs,
- Environmental Assessment Practitioners,
- Biodiversity specialists and researchers,
- Rehabilitation practitioners,
- Landowners, farmers, developers, water user associations.

The implementation manual is **structured as follows**:

- Chapter 2 explains the **categories shown on the FEPA maps** (river FEPAs and associated sub-catchments, wetland FEPAs, estuary FEPAs, wetland clusters, fish sanctuaries and associated sub-quaternary catchments, Fish Support Areas and associated sub-quaternary catchments, and Upstream Management Areas).
- Chapter 3 answers a range of **frequently asked questions**.
- Chapter 4 outlines **roles and responsibilities of key implementers** of the FEPA maps, including DWA, DEA, SANBI, SANParks, provincial conservation authorities, and Catchment Management Agencies.
- Chapter 5 provides guidelines on **how to use the FEPA maps** in a range contexts, including:
  - Implementation mechanisms related to the National Water Act (such as Catchment Management Strategies, classification of water resources, reserve determination, resource quality objectives, water use authorisations and others),
  - Implementation mechanisms related to the Biodiversity Act (such as bioregional plans, listing of threatened ecosystems, biodiversity management plans, alien and invasive species regulations and others),
  - Implementation mechanisms related to the Protected Areas Act (such as protected area management plans, expansion and consolidation of the protected area network, and biodiversity stewardship programmes),
  - Implementation mechanisms related to the National Environmental Management Act (such as Environmental Impact Assessments, Environmental Management Frameworks, and biodiversity offsets),
  - Implementation mechanisms related to the Municipal Systems Act (such as Integrated Development Plans and Spatial Development Frameworks),
  - Decision-making related to mining, agriculture and aquaculture,
  - Delineation of buffers for rivers and wetlands,
  - Programmes for rehabilitation, conservation and management of freshwater ecosystems,
  - Monitoring freshwater ecosystems,
  - And others.
- Chapter 6 provides **ecosystem management guidelines** for river FEPAs, wetland FEPAs, sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas.
- Chapter 7 summarises **key messages and recommendations** of the NFEPA project.

Acknowledgements

The development of this implementation manual was part of the National Freshwater Ecosystem Priority Areas project (NFEPA), and represents a collaborative effort between the CSIR, South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Environmental Affairs (DEA), Department of Water Affairs (DWA), Worldwide Fund for Nature (WWF), South African Institute for Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks).

This manual reflects the collective inputs of many people. The authors wish to thank the members of the project reference group convened by the WRC (see below), as well as the following people: Mark Botha, Cate Brown, Lucinda Cedras, Christine Colvin, Brent Corcoran, Bridget Corrigan, Tracey Cumming, Pierre de Villiers, Dean Impson, Brian Jackson, Martine Jordaan, Wilna Kloppers, Inge Kotze, Mervyn Lotter, Doug MacFarlane, Christine Mentzel, Shoni Munzhedzi, Shane Naidoo, Harrison Pienaar, Nick Rivers-Moore, Francois Roux, Hermien Roux, Ramogale Sekwele, Susan Taljaard, Stanley Tshitwamulomoni, Johan van Rooyen, Jannie van Staaden and Lara van Niekerk.

The **freshwater ecosystem management guidelines** in Chapter 1 of the manual were developed through the lifetime of several projects, including the C.A.P.E. fine-scale biodiversity planning project and the City of Cape Town's biodiversity network project. Thanks go to C.A.P.E. and the City of Cape Town for funding the work on which the management guidelines presented here are built. An expert workshop was held in November 2010, and much useful discussion there led to the refinement of the guidelines. Thanks go to all of the participants and to those who provided comments but were unable to attend: Susie Brownlie, Liz Day, Charl de Villiers, Jeanne Gouws, Nancy Job, Wilna Kloppers, Donovan Kotze, Mervyn Lotter, Doug MacFarlane, Kerry Maree, Namhla Mbona, Dean Ollis, Sam Ralston and Barbara Weston. Thanks also to Liz Day and Dean Ollis for taking notes during the workshop, and to Belinda Day for typing these up. Others who contributed during informal and formal discussions include Sharon Pollard, Geordie Ractliffe, and Pat Holmes.

NFEPA reference group convened by the WRC

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Acronyms

BGIS	Biodiversity GIS (http://bgis.sanbi.org)
BMP	Biodiversity Management Plan
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
FEPA	Freshwater Ecosystem Priority Area
IDP	Integrated Development Plan
NBF	National Biodiversity Framework
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas project
NPAES	National Protected Areas Expansion Strategy
RQO	Resource Quality Objective
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SDF	Spatial Development Framework
WRC	Water Research Commission
WWF	Worldwide Fund for Nature

1. Introduction

PHOTO: K MURRAY

This implementation manual is part of a suite of products of the National Freshwater Ecosystem Priority Areas project (NFEPA). NFEPA was a three-year partnership project between South African National Biodiversity Institute (SANBI), CSIR, Water Research Commission (WRC), Department of Environmental Affairs (DEA), Department of Water Affairs (DWA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). NFEPA map products provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as **Freshwater Ecosystem Priority Areas, or FEPAs**. FEPAs were determined through a process of systematic biodiversity planning and involved collaboration of over 100 freshwater researchers and practitioners. FEPAs were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries, described in detail in the NFEPA Technical Report.

South Africa's freshwater ecosystems are diverse, ranging from sub-tropical in the north-eastern part of the country, to semi-arid and arid in the interior, to the cool and temperate rivers of the fynbos. "Freshwater ecosystems" refer to all inland water bodies whether fresh or saline, including rivers, lakes, wetlands, sub-surface waters and estuaries. Consistent with global trends, high levels of threat have been reported for freshwater ecosystems, with over half of the country's river and wetland ecosystem types considered threatened in the National Biodiversity Assessment 2011 (Nel *et al*., 2011). South Africa's freshwater fauna also display high levels of threat: at least one third of freshwater fish indigenous to South Africa are reported as threatened, and a recent southern African study on the conservation status of major freshwater-dependent taxonomic groups (fishes, molluscs, dragonflies, crabs and vascular plants) reported far higher levels of threat in South Africa than in the rest of the region (Darwall *et al*., 2009).

Urgent attention is needed to ensure that we conserve some representative natural examples of the different ecosystems that make up the natural heritage of this country for current and future generations. NFEPA responds to this need, providing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources.

FEPA maps and supporting information form part of a comprehensive approach to sustainable and equitable development of South Africa's scarce water resources. They provide a single, nationally consistent information source for incorporating freshwater ecosystem and biodiversity goals into

planning and decision-making processes. For integrated water resource management, the maps provide guidance on **how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition** to support the water resource protection goals of the National Water Act (Act No. 36 of 1998; RSA, 1998a). FEPA maps are therefore directly applicable to the National Water Act, feeding into Catchment Management Strategies, classification of water resources, reserve determination, and the setting and monitoring of resource quality objectives. FEPA maps are also directly relevant to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004; RSA, 2004) (hereafter referred to as the Biodiversity Act), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act. FEPA maps support the implementation of the National Environmental Management: Protected Areas Act (Act No. 57 of 2003; RSA, 2003) (hereafter referred to as the Protected Areas Act) by informing the expansion of the protected area network. They also inform a variety of other policies and legislation that affect the management and conservation of freshwater ecosystems, including at the municipal level.

There are few opportunities globally where such an open interface exists between scientific innovation, policy and implementation. The excellent science on which the FEPA maps are based can feed directly into the implementation of South Africa's excellent policy and legislation in both the water and biodiversity sectors.

This implementation manual is one of several products of the NFEPA project, including an Atlas of Freshwater Ecosystem Priority Areas, an NFEPA DVD, and the NFEPA Technical Report (see Section 1.4, Figure 2). It provides guidelines on how to use the FEPA maps in the water sector, the biodiversity sector and other key sectors whose planning and decision-making impacts on freshwater ecosystems. The implementation manual is structured as follows:

- Chapter 2 explains the categories shown on the FEPA maps,
- Chapter 3 answers some frequently asked questions,
- Chapter 4 outlines roles and responsibilities of key implementers of the FEPA maps,
- Chapter 5 provides guidelines on how to use the FEPA maps in a range contexts,
- Chapter 6 gives ecosystem management guidelines for FEPAs,
- Chapter 7 summarises key messages and recommendations of the NFEPA project.

Please note that the implementation manual **does not contain the FEPA maps**. An example of a portion of a FEPA map is shown in Figure 4. For the full set of FEPA maps and other map product please consult the atlas or NFEPA DVD (see Section 1.4 for more on the suite of NFEPA products and where to find them).

1.1 The importance of healthy freshwater ecosystems

Water affects every activity and aspiration of human society and sustains all ecosystems. Rivers, wetlands, lakes and estuaries have long inspired artists and musicians, enriching the human spirit with their beauty. Freshwater ecosystems provide for many of our fundamental needs: water for drinking and irrigation, food such as fish and water birds, and reeds for craftsmanship. Healthy ecosystems also provide important regulating ecosystem services, such as preventing floods and

easing the impacts of droughts. A healthy ecosystem supports functional communities of plants and animals that are able to remove excess nutrients and toxic substances from water, keeping it cleaner for drinking, irrigation and recreation. Healthy rivers, wetlands and groundwater systems also maintain water supply and buffer the effects of storms, reducing the loss of life and property to floods. Healthy river banks with natural vegetation help to trap sediments, stabilise river banks and break down pollutants draining from the surrounding land. Estuaries provide nursery areas for marine and estuarine animals, and supply fresh water and nutrients to the sea, which drive marine food webs and maintain important fisheries (Lamberth *et al*., 2009). A certain amount of water is also required to scour the mouth of most estuaries – without this scouring effect, sediments build up at the mouth and the risk of back-flooding during storms increases.

Water is also one of South Africa's most limited resources, constraining our future social and economic development. Its wise use is critical to the sustainable development of our emerging economy and the well-being of all our citizens, particularly the poorest, who depend directly on the health of natural resources for their livelihoods (Millennium Assessment, 2003). Yet this valuable national asset is in crisis. Pressures arising from social and economic needs have resulted in widespread degradation of freshwater ecosystems. In many regions of the country water demand outstrips supply, and water quality has declined due to increased pollution from industry, urban expansion, mining, power generation, agriculture, forestry and inadequate sewage treatment. The National Biodiversity Assessment 2011 revealed that over half of our river, wetland and estuary ecosystem types in South Africa are threatened (Nel *et al*., 2011). Such widespread degradation of freshwater ecosystems inevitably compromises ecosystem service delivery and results in more costly management interventions and the loss of resilience to changing circumstances. This current situation is even more alarming when future pressures on water resources are considered – the demand for water is predicted to escalate exponentially (DWAF, 2004) and many parts of the country are expected to become drier as a result of climate change, threatening our water supplies (Schulze, 2005).

A focus on sustainable development becomes crucial given these current and future pressures on water resources. It is widely accepted that social, ecological and economic systems are inextricably bound (Figure 1). Protection and utilisation of natural resources therefore need to work hand-in-hand to achieve sustainable development. In the context of water resource management, this means that catchments can be designed to support multiple levels of use, with natural rivers and wetlands that are minimally-used supporting the sustainability of hard-working rivers that often form the economic hub of the catchment. This concept is firmly embedded in the National Water Act, and forms the foundation of the water resource classification system (Dollar *et al*., 2010). Keeping some rivers and wetlands in the catchment in a natural or good condition serves a dual purpose of conserving South Africa's freshwater biodiversity, while promoting the sustainable use of water resources in the catchment. This is particularly important if we are to meet government objectives for both sustainable water resource development and freshwater biodiversity conservation. The question remains: which rivers and wetlands, and how many, should be maintained in a natural condition to support these two goals?

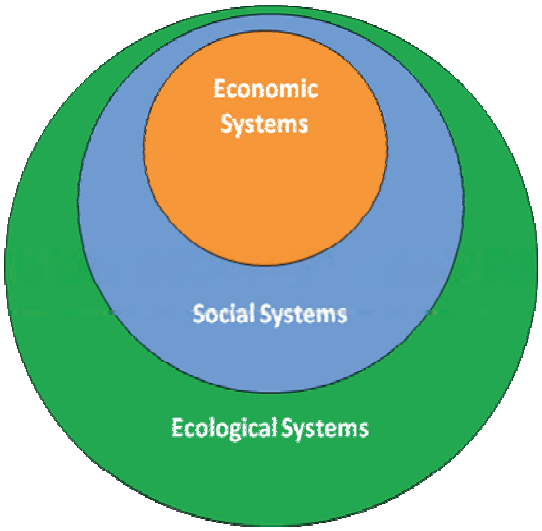

Figure 1: Economic, social and ecological systems are inextricably bound. The health of our ecological systems and associated natural capital underpins social and economic development.

The NFEPA project addresses this question by synthesising data and existing knowledge to identify strategic Freshwater Ecosystem Priority Areas for promoting sustainable water resource use and achieving the freshwater ecosystem goals of the country (Roux *et al*., 2006). The resulting maps and supporting information represent a joint effort between the water and biodiversity sectors for incorporating freshwater ecosystem goals into integrated water resource management in terms of the National Water Act.

1.2 Cross-sector policy objectives for freshwater ecosystems

Freshwater ecosystem management and conservation depends on the co-operation of a wide range of sectors at multiple levels of governance. Acknowledging the need for co-operative action, and the reality of overlapping and sometimes conflicting sectoral policy mandates, a process was initiated in 2005-2006 to develop cross-sector policy objectives for conserving South Africa's inland water biodiversity. Several South African government departments and national agencies participated in a series of small discussion groups and two larger workshops to debate their respective mandates and strategies for managing and conserving freshwater ecosystems. Participants included the national departments of Water Affairs, Environmental Affairs, Agriculture, Provincial and Local Government, and SANParks. The engagement process led to the development of a common national goal for conserving freshwater biodiversity linked to five policy objectives to achieve this goal, each with a set of principles and recommendations. The guidance provided by these cross-sector policy objectives was central to the development of the FEPA maps.

The goal, the five policy objectives and the 20 implementation principles appear below (Roux *et al*., 2006). NFEPA responds directly to Objectives 1, 2 and 3, and supports the achievement of Objectives 4 and 5.

National goal: *To conserve a sample of the full variety or diversity of inland water ecosystems that occur in South Africa, including all species as well as the habitats, landscapes, rivers and other water bodies in which they occur, together with the ecosystem processes responsible for generating and maintaining this diversity, for both present and future generations.*

Objective 1: Set and entrench quantitative conservation targets for freshwater ecosystems.

1. Set and endorse national targets for conservation of freshwater ecosystems
2. Disaggregate the national targets differentially to sub-national implementation levels.
3. Improve and refine national and sub-national targets over time.

Objective 2: Plan for representation of freshwater ecosystems.

1. Use surrogate measures as indictors to describe and classify freshwater ecosystems.
2. Define the appropriate scale.
3. Incorporate local ecological knowledge.

Objective 3: Plan for persistence of freshwater ecosystem processes.

1. Select freshwater ecosystems of high integrity.
2. Ensure connectivity.
3. Include large-scale ecosystem processes.
4. Select areas of sufficient size.

Objective 4: Establish a portfolio of freshwater conservation areas.

1. Legislate inland water conservation areas through complementary legal mechanisms.
2. Strive for optimal land-use efficiency.
3. Prioritise and initiate conservation actions timeously.
4. Conserve first where appropriate, rather than restore later.
5. Provide explicit selection options and management guidelines.

Objective 5: Enable effective implementation.

1. Facilitate stakeholder adoption of freshwater conservation targets and priority areas.
2. Reflect the conservation of freshwater ecosystems as an explicit function in institutional design.
3. Enable co-operative governance in the conservation and management of freshwater ecosystems.
4. Facilitate a science-management continuum.
5. Promote discovery, inventory and improved understanding of freshwater biodiversity.

1.3 Intended users of this manual

This implementation manual is aimed at those involved with, or contributing to, any planning or decision-making process that should take freshwater ecosystems into account. Contexts can range from reactive ("should a proposed development go ahead?") to strategic ("how should national government resources for freshwater conservation be apportioned among the 19 Water Management Areas?"). Intended users include water resource planners and managers, land use

planners and land-use decision-makers, and those involved in conservation and rehabilitation. These include:

- National government departments, especially:
  - Water Affairs
  - Environmental Affairs
  - Agriculture, Forestry and Fisheries
  - Mineral Resources
- Provincial government departments, especially:
  - Environmental affairs
  - Agriculture
- Catchment Management Agencies
- Conservation authorities
- Municipalities
- Conservation NGOs
- Environmental Assessment Practitioners
- Biodiversity specialists and researchers
- Rehabilitation practitioners
- Landowners, farmers, developers, water user associations

1.4 Summary of NFEPA products

As mentioned, this implementation manual is one of several products of the NFEPA project. The **main NFEPA products are shown in Figure 2**. All of these products are available digitally on the NFEPA DVD or on SANBI's Biodiversity GIS (BGIS) website (http://bgis.sanbi.org).

An **overview of the map products**, all of which are included in the Atlas of Freshwater Ecosystem Priority Areas, follows.

1.4.1 FEPA maps

A FEPA map has been developed for each of the 19 Water Management Areas in South Africa (Figure 3). Catchment Management Agencies are in the process of being established for Water Management Areas or groups of Water Management Areas. Water Management Areas have been delineated based on catchment boundaries, which do not match provincial or municipal boundaries. Descriptions of the categories shown on the FEPA maps are given in Chapter 2.

1.4.2 National map products

Six maps have been developed at the national level:

- ***Density of FEPAs per Water Management Area***, calculated as the percentage of the total area of that Water Management Area that has been identified as a FEPA
- ***Density of FEPAs per sub-Water Management Area***, calculated as the percentage of the total area of that sub-Water Management Area that has been identified as a FEPA

- ***Free-flowing rivers*** of South Africa, or rivers without dams that flow undisturbed from their source to the confluence with a larger river or to the sea
- ***High water yield areas***, which are sub-quaternary catchments (see Section 3.11) where mean annual runoff is at least three times more than the average for the related primary catchment
- ***High groundwater recharge areas***, which are sub-quaternary catchments where groundwater recharge is at least three times more than the average for the related primary catchment
- ***Fish sanctuaries*** for threatened fish species indigenous to South Africa

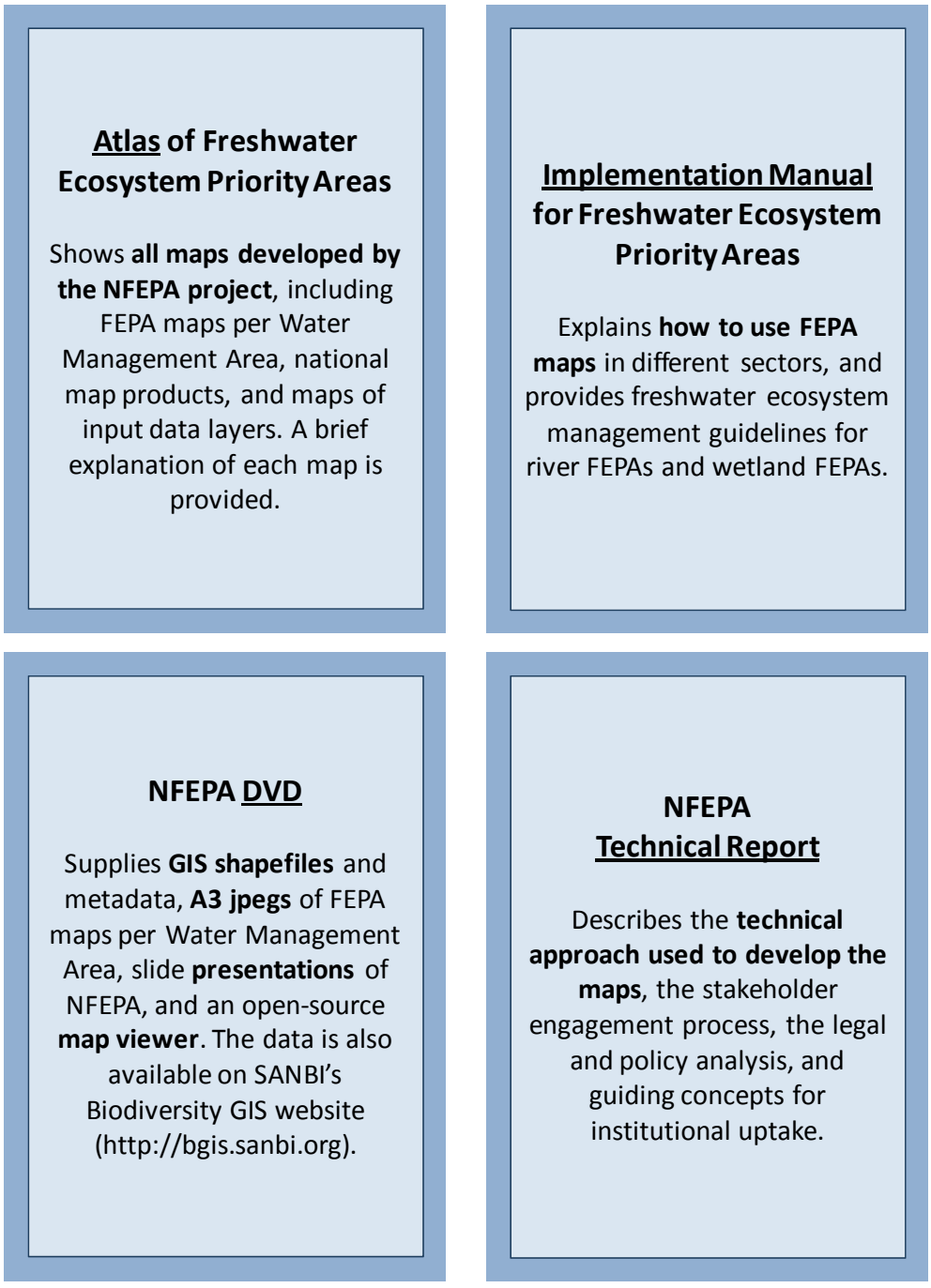

Figure 2: NFEPA products at a glance

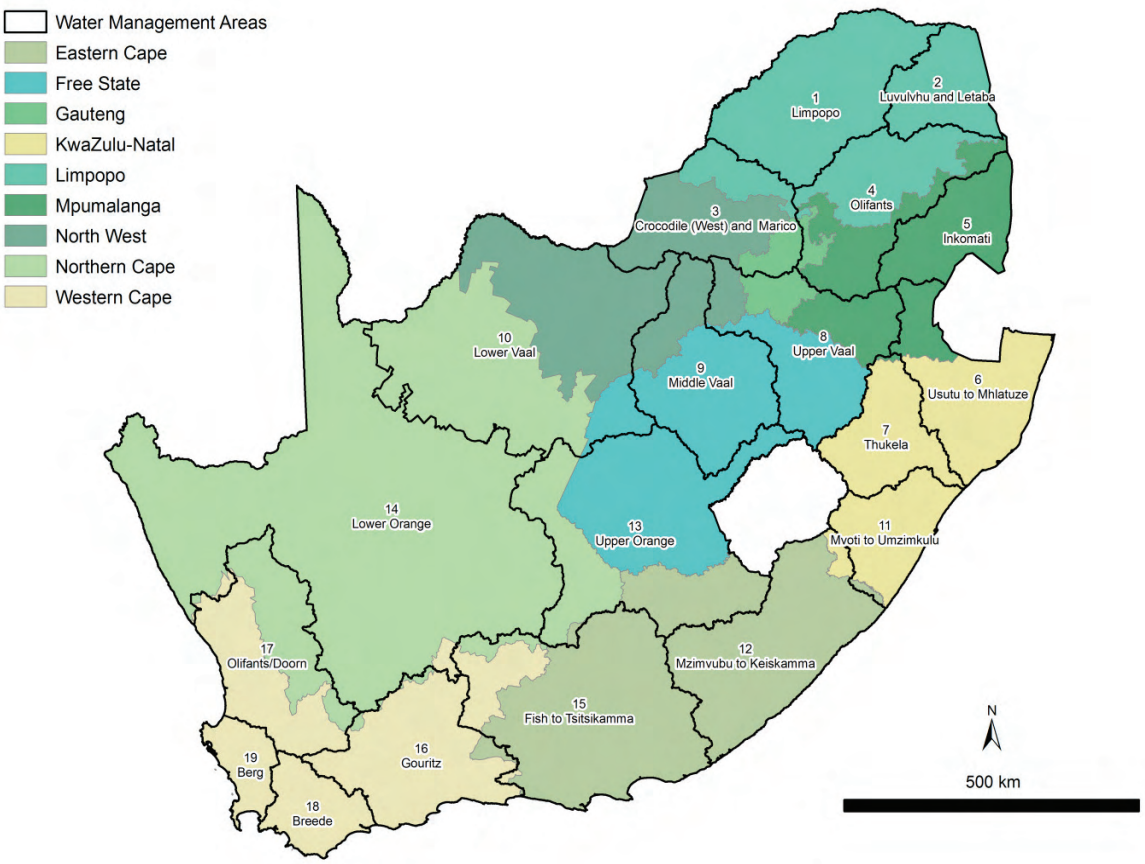

Figure 3: Water Management Areas and provinces in South Africa

1.4.3 Input data layers used for identifying FEPAs

- ***River ecosystem types*** comprising unique combinations of landscape features, flow variability and channel slope. River ecosystem types which were used for representing natural examples of the diversity of river ecosystems across the country.
- ***River condition*** that combines data on present ecological state of rivers (1999 and available updates), river health data, reserve determination data, expert knowledge and natural land cover data. Rivers had to be in a good condition (A or B ecological category) to be chosen as FEPAs.
- ***Wetland ecosystem types*** consisting of unique combinations of landforms (benches, slopes, valley-bottoms and plains) and vegetation types. These were used to represent the diversity of wetland ecosystems across the country.
- ***Wetland condition*** modelled using the proportion of natural vegetation in and around the wetland as an indicator of condition. Wetland condition was used to favour the selection of wetlands in good condition as FEPAs, although wetlands did not have to be in a good condition to be chosen as a FEPA.
- ***Priority estuaries*** as identified in the National Biodiversity Assessment 2011 based on a systematic biodiversity planning approach. These became FEPAs and were also used to favour the selection of associated river and wetland ecosystems as FEPAs.

- ***Landforms*** that categorise the country's landscape into hill tops, slopes, valley-bottoms and plains. Landforms were used in identifying wetland ecosystem types.
- ***Wetland vegetation groups*** that are based on groupings of national vegetation types expected to share similar types of wetlands. They were used in combination with the landform map to identify wetland ecosystem types.

2. Descriptions of FEPA map categories

PHOTO: C GELDERBLOM

FEPA maps show various different categories, each with different management implications. The categories include river FEPAs and associated sub-quaternary catchments, wetland FEPAs, wetland clusters, Fish Support Areas and associated sub-quaternary catchments, fish sanctuaries, phase 2 FEPAs and associated sub-quaternary catchments, and Upstream Management Areas. An example of a FEPA map and FEPA map legend is shown in Figure 4 and 5. See Section 3.11 for a definition of sub-quaternary catchments.

A sub-quaternary catchment code is also provided on the FEPA maps. This code can be used to look up further information about the river FEPAs and Fish Support Areas in each sub-quaternary catchment. This additional information is useful for developing site specific management plans, and is available in the look-up table on the NFEPA DVD or on SANBI's Biodiversity GIS website (http://bgis.sanbi.org).

This chapter briefly describes the categories shown on the FEPA maps. The atlas and technical report (see Figure 2) describe in more detail the criteria used to identify each FEPA category (e.g. ecosystem and species data used, biodiversity targets set, rules applied in the biodiversity planning process).

2.1 River FEPA and associated sub-quaternary catchment

River FEPAs achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category, see Table 1). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources.

For river FEPAs the **whole sub-quaternary catchment is shown in dark green**, although FEPA status applies to the actual river reach within such a sub-quaternary catchment. The shading of the whole sub-quaternary catchment indicates that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition (A or B ecological category) of the river reach.

It is important to note that river FEPAs currently in an A or B ecological category may still require some rehabilitation effort, e.g. clearing of invasive alien plants and/or rehabilitation of river banks. From a biodiversity point of view, rehabilitation programmes should therefore focus on securing the

ecological structure and functioning of FEPAs before embarking on rehabilitation programmes in Phase 2 FEPAs (or other areas).

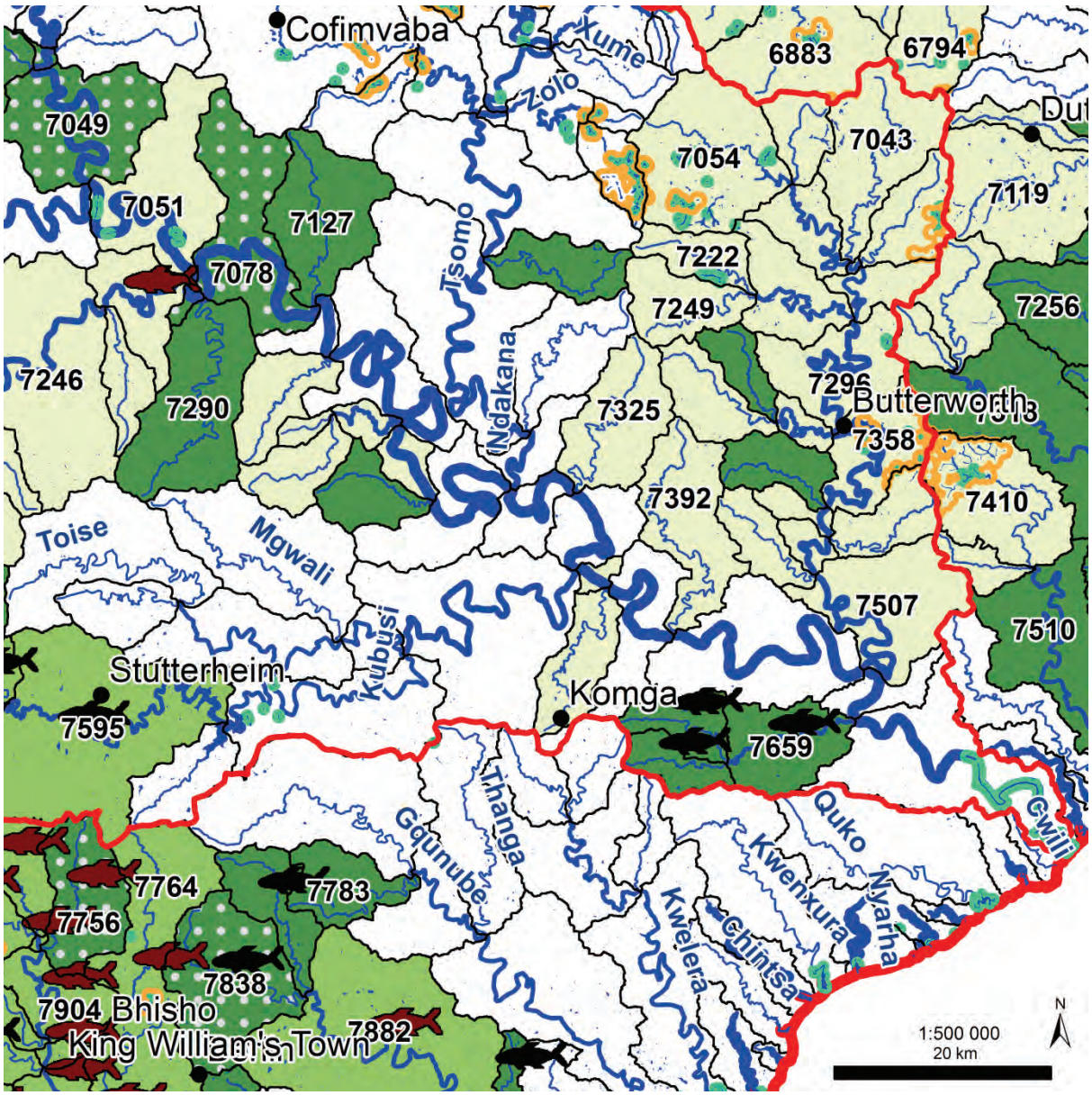

Figure 4: Example of a FEPA map, showing a portion of the Mzimvubu Water Management Area.

Figure 5: FEPA map legend

Table 1: Present ecological state categories used to describe the current and desired future condition of South African rivers (after Kleynhans, 2000). For NFEPA, rivers in an A and B category were regarded as being in good condition.

Ecological category	Description
A	Unmodified, natural.
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions have occurred.
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions are extensive.
F	Critically/Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.

2.2 Wetland or estuary FEPA

For wetland and estuary FEPAs, **only the actual mapped wetland or estuarine functional zone is shown on the map as a FEPA, indicated by a turquoise outline around the wetland or estuary**. The associated sub-quaternary catchment is not shown in dark green (unless it contains a river FEPA).

Connected freshwater ecosystems and surrounding land that need to be managed in order to maintain wetland and estuary FEPAs in good condition need to be identified at a finer scale and in management plans for individual wetland or estuary FEPAs. In some cases it may be the whole sub-quaternary catchment and in others it may be a smaller area.

Wetland FEPAs were identified using ranks that were based on a combination of special features and modelled wetland condition. Special features included expert knowledge on features of conservation importance (e.g. extensive intact peat wetlands, presence of rare plants and animals) as well as available spatial data on the occurrence of threatened frogs and wetland-dependent birds. Wetland condition was modelled using the presence of artificial water bodies as well as by quantifying the amount of natural vegetation in and around the wetland (within 50m, 100m and 500m of the wetland). Based on these factors, wetlands were ranked in terms of their biodiversity importance. Biodiversity targets for wetland ecosystems were met first in high-ranked wetlands, proceeding to lower ranked wetlands only if necessary.

Although wetland condition was a factor in selection of wetland FEPAs, wetlands did not have to be in a good condition to be chosen as a FEPA. Wetland FEPAs currently in a good ecological condition should be managed to maintain this condition. Those currently not in a good condition should be rehabilitated to the best attainable ecological condition.

Estuary FEPAs are the national priority estuaries identified in the National Biodiversity Assessment 2011 (Van Niekerk and Turpie, 2011). The functional zone for each estuary is shown on the map, which includes the main channel or open water as well as the zone to which the estuary may expand during flood (guided largely by the 5m coastal contour line). Estuary FEPAs are shown on the map in the same way as wetland FEPAs, with turquoise outlines. The recommended ecological category for priority estuaries is listed in Van Niekerk and Turpie (2011). It varies according to importance, sensitivity and feasibility of implementation, and is not necessarily an A or B ecological condition.

2.3 Wetland cluster

Wetland clusters are groups of wetlands embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands. In many areas of the country, wetland clusters no longer exist because the surrounding land has become too fragmented by human impacts.

An orange outline is shown around groups of wetlands that belong to a wetland cluster. Wetlands do not have to have FEPA status to belong to a wetland cluster (although clusters with a high proportion of wetland FEPAs were favoured in identifying wetland clusters).

2.4 Fish sanctuary and associated sub-quaternary catchment

Fish sanctuaries are rivers that are essential for protecting threatened and near-threatened freshwater fish that are indigenous to South Africa. The associated sub-quaternary catchment is **marked with a red or black fish symbol on the map**. A red fish indicates that there is at least one

population of a critically endangered or endangered fish species within that sub-quaternary catchment. A black fish indicates the presence of vulnerable or near-threatened fish populations. Some fish sanctuaries are FEPAs, with their associated sub-quaternary catchments shown in dark green; others are Fish Support Areas, with their associated sub-quaternary catchments shown in medium green (see explanation of Fish Support Areas below).

A goal of NFEPA is to keep further freshwater species from becoming threatened and to prevent those fish species that are already threatened from going extinct. In order to achieve this, there should be no further deterioration in river condition in fish sanctuaries and no new permits should be issued for stocking invasive alien fish in farm dams in the associated sub-quaternary catchment.

Fish management plans should be developed for all fish sanctuaries to protect the fish they contain, with priority given to those fish sanctuaries containing critically endangered or endangered fish species (indicated by the red fish symbol on the map). These plans should address issues such as management of a particular stretch of river habitat within the sub-quaternary catchment, the construction of weirs to keep invasive alien fish species to a minimum (following an environmental impact assessment), and managing aquaculture and angling to ensure no further introduction of invasive alien fish species. In some cases it may be appropriate to publish a formal Biodiversity Management Plan for a fish species in terms of the Biodiversity Act, as discussed in some detail in Section 5.2.4. Please contact the South African Institute for Aquatic Biodiversity (SAIAB) for further guidance if you intend to develop a fish management plan.

2.5 Fish Support Area and associated sub-quaternary catchment

Fish sanctuaries in a good condition (A or B ecological category) were identified as FEPAs, and the whole associated sub-quaternary catchment is shown in dark green. The remaining fish sanctuaries in lower than an A or B ecological condition were identified as Fish Support Areas, and the associated sub-quaternary catchment is **shown in medium green**. Fish Support Areas also include sub-quaternary catchments that are important for migration of threatened or near-threatened fish species – these are not marked with a fish symbol.

2.6 Upstream Management Area

Upstream Management Areas, **shown in very pale green**, are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. Upstream Management Areas do not include management areas for wetland FEPAs, which need to be determined at a finer scale.

2.7 Phase 2 FEPA

Phase 2 FEPAs were identified in moderately modified rivers (C ecological category), only in cases where it was not possible to meet biodiversity targets for river ecosystems in rivers that were still in good condition (A or B ecological category). The river condition of these Phase 2 FEPAs should not be

degraded further, as they may in future be considered for rehabilitation once FEPAs in good condition (A or B ecological category) are considered fully rehabilitated and well managed. Phase 2 FEPAs and their associated sub-quaternary catchments are **shown in dark green with white dots**.

2.8 Free-flowing river

Free-flowing rivers are rivers without dams. These rivers flow undisturbed from their source to the confluence with a larger river or to the sea. Dams prevent water from flowing down a river and disrupt ecological functioning, with serious knock-on effects for downstream river reaches and users. Free-flowing rivers are a rare feature in the South African landscape and part of our natural heritage.

Free-flowing rivers are *not* shown on the FEPA maps, but are mapped separately (see Part 3 of the atlas). Nineteen flagship free-flowing rivers were identified based on their representativeness of free-flowing rivers across the country, as well as their importance for ecosystem processes and biodiversity value. These flagship rivers should receive top priority for retaining their free-flowing character. Flagship free-flowing rivers are listed in the atlas and the technical report, and coded in the river shapefile on the NFEPA DVD.

3. Frequently asked questions

PHOTO: K MURRAY

3.1 What do we mean by freshwater ecosystems?

Freshwater ecosystems refer to all inland water bodies whether fresh or saline, including rivers, lakes, wetlands, sub-surface waters and estuaries. The term “inland water ecosystems” is sometimes preferred, as “freshwater ecosystems” may be understood to exclude saline ecosystems such as estuaries and brackish pans and streams. However, for the purposes of NFEPA “freshwater ecosystems” is used in its broad sense.

3.2 What is a FEPA?

FEPAs are strategic spatial priorities for conserving freshwater ecosystems and supporting sustainable use of water resources. FEPAs were determined through a process of systematic biodiversity planning and were identified using a range of criteria for conserving ecosystems and associated biodiversity of rivers, wetlands and estuaries (see question 3.3). Future refinement of FEPAs should seek to include groundwater considerations more explicitly.

FEPAs are often tributaries and wetlands that support hard-working large rivers, and are an essential part of an equitable and sustainable water resource strategy. FEPAs need to stay in a good condition to manage and conserve freshwater ecosystems, and to protect water resources for human use. This does not mean that FEPAs need to be fenced off from human use, but rather that they should be supported by good planning, decision-making and management to ensure that human use does not impact on the condition of the ecosystem. The current and recommended condition for all river FEPAs is A or B ecological category (see Table 1 for description of ecological categories). Wetland FEPAs that are currently in a condition lower than A or B should be rehabilitated to the best attainable ecological condition. Recommended ecological condition for priority estuaries is listed in Van Niekerk and Turpie (2011).

3.3 What criteria were used to identify FEPAs?

FEPAs were identified based on:

- Representing ecosystem types for rivers and wetlands,

- Representing threatened fish species and associated migration corridors,
- Representing free-flowing rivers,
- Selecting priority estuaries identified in the National Biodiversity Assessment 2011 (Van Niekerk and Turpie, 2011),
- Maintaining water supply areas in sub-quaternary catchments with high water yield and high groundwater recharge,
- Identifying connected systems wherever possible,
- Preferentially choosing river and wetland FEPAs that overlapped with:
    - Any free-flowing river,
    - Priority estuaries identified in the National Biodiversity Assessment 2011,
    - Existing protected areas and DEA's focus areas for protected area expansion (Government, 2010),
    - Threatened frogs,
    - Wetland-dependent birds.

3.4 Why use FEPA maps?

FEPA maps and supporting information represent a joint effort between the water and biodiversity sectors for incorporating freshwater ecosystem goals into planning and decision-making processes. The maps form a single nationally consistent information source for a wide variety of policy and legislative contexts (see Chapter 5). This minimises *ad hoc* local and regional decision-making that may conflict with national goals. The maps also provide the best available science that summarises existing data and on-the-ground knowledge of the freshwater ecology community in South Africa, representing over 1000 person-years of collective knowledge and experience. This information was synthesised using a sound scientific framework based on systematic biodiversity planning, which is a field of science with over three decades of experience in research and practice.

3.5 What's the difference between NFEPA and FEPA?

NFEPA refers to the project, which produced a range of outputs (see Section 1.4 and Figure 2). FEPA maps are one of the outputs of the NFEPA project. River FEPAs and wetland FEPAs are categories on the FEPA maps.

3.6 Why systematic biodiversity planning?

Systematic biodiversity planning is a strategic and scientific approach to identifying those areas that are essential for biodiversity conservation. The key objectives of systematic biodiversity planning are to facilitate the adequate representation of biodiversity in a region, to plan for its persistence, and to do this in a way that makes efficient use of limited resources (Margules and Sarkar, 2007). Three key principles underpin systematic biodiversity planning:

- The need to conserve a representative sample of biodiversity pattern, such as species and habitats (the **principle of representation**),

- The need to conserve the ecological and evolutionary processes that allow biodiversity to persist over time (the **principle of persistence**),
- The need to set quantitative **biodiversity targets** that tell us how much of each biodiversity feature should be conserved in order to maintain functioning landscapes and seascapes. Biodiversity targets should ideally be based on best available science and may be refined as new information becomes available. Biodiversity targets define what resource planners and managers should aim for and provide a basis for the monitoring that is so important to good management.

There are two further principles that guide the process of systematic biodiversity planning:

- **Efficiency**, or striving to meet biodiversity targets in the smallest area (or shortest river length) possible. Efficiency goes together with *complementarity*, which is the extent to which an area contributes biodiversity features not represented elsewhere in a region (i.e. sensibly complements the choice of other areas).
- **Transparency**, or documenting clear rationale for decisions, enabling them to be repeated and/or critically reviewed.

3.7 What resources do I need to use FEPA maps?

To use the FEPA maps you need a copy of the relevant FEPA map for your area and this implementation manual. Ideally you also need the advice or input of an aquatic ecologist who knows the area (see question 3.8). SANBI is able to advise on the interpretation of biodiversity planning products such as FEPA maps (freshwater@sanbi.org.za).

The FEPA maps are available in various electronic and hardcopy forms:

- An A3 PDF file of the FEPA map is available for each Water Management Area.
- The NFEPA DVD provides shapefiles and metadata that explain the different map categories. It also contains an easy-to-install map-viewer that allows the user to zoom into a region of interest and click data layers on and off. This map-viewer is simple to operate and does not require extensive computer specifications.
- Shapefiles of the FEPA maps and input layers, as well as the PDF maps and supporting information, can be downloaded from SANBI's Biodiversity GIS website (http://bgis.sanbi.org). This website also offers a map-viewing option that is user-friendly, allowing users to zoom into a region of interest and click data layers on and off.
- The Atlas of Freshwater Ecosystem Priority Areas packages the maps and supporting information into a user friendly, hardcopy product. It includes FEPA maps for each Water Management Area, national map products, and maps of input data layers. It is available from the Water Research Commission, as well as on SANBI's Biodiversity GIS website and the NFEPA DVD.

3.8 How easy is it to use FEPA maps?

Chapter 2 of this manual explains the different categories on the FEPA maps, Chapter 5 gives guidance on how to use FEPA maps in a variety of policy and legal contexts, and Chapter 6 provides

ecosystem management guidelines for river FEPAs, wetland FEPAs, sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas. Ideally someone with an aquatic ecological background should be consulted to help interpret the maps and advise on how they should be used in a particular case.

The objective for using FEPA maps will partly determine how the maps should be used and which FEPA map categories are most useful. For example, the use of FEPA maps in reactive decision-making processes such as water use authorisations and environmental impact assessments will be different from the use of FEPA maps for proactive planning processes such as catchment visioning, classification of water resources, provincial biodiversity planning, development of biodiversity sector plans or bioregional plans, or development of a fish management plan.

3.9 How good are FEPA maps?

The FEPA maps are most appropriately applied as a proactive planning tool at the water management area level or the national level. Such proactive planning processes include catchment visioning, classification of water resources, provincial biodiversity planning, and development of biodiversity sector plans or bioregional plans. For reactive decision-making processes (e.g. water use authorisations and environmental impact assessments) and local-level planning at municipal or finer scales, FEPA maps should ideally be ground-truthed by someone with aquatic ecological knowledge of the area concerned (see question 3.10).

3.10 At what scale do FEPA maps apply?

FEPA maps are suitable to use at a desktop level for planning and decision-making processes at the national or water management area level. In general, confidence in the FEPA maps at a national level is high but decreases at more local levels of planning (see Figure 6). For local-level planning and decision-making it becomes more important to ground-truth FEPAs, and potentially to refine them with additional local data and knowledge.

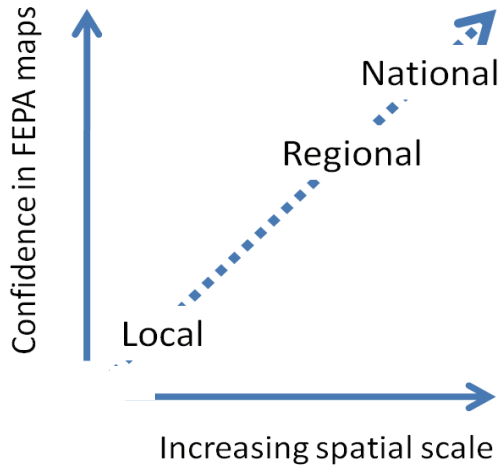

Figure 6: Schematic illustration of confidence in FEPA maps as a function of spatial scale

River FEPAs were identified at a sub-quaternary catchment scale (see question 3.11), in other words a river reach passing through a sub-quaternary catchment could be selected as a FEPA. River reaches were defined as the sections or portions of river between confluences of rivers in DWA's 1:500 000 river network GIS layer (http://www.dwaf.gov.za/iwqs/gis_data/river/rivs500k.html). Sub-quaternary catchments were delineated as the drainage basin around each river reach. If a river ecosystem was identified as a FEPA, then its associated sub-quaternary catchment was shaded on the FEPA map, to indicate that it is not just the 1:500 000 river reach within the sub-quaternary catchment that needs to be managed, but also the surrounding land and finer stream network that flows into that river reach. River reaches identified as fish sanctuaries (i.e. FEPAs and Fish Support Areas containing threatened or near-threatened fish) were also identified at sub-quaternary catchment scale.

Wetland FEPAs were identified at the scale of the best available wetland inventory data, which varies across the country (from a minimum mapping unit of 30m in the National Land Cover, to approximately 1:10 000 for the fine-scale wetland data that was available in some parts of the country). The NFEPA wetland map represents the best available wetland inventory data for the country, and delineates over 100 000 wetlands. However, not all wetlands have been mapped and there are substantial gaps. Ideally at a local level of assessment and planning, a more comprehensive approach to wetland mapping is necessary to capture all wetlands. The national wetland inventory based at SANBI collates spatial wetland data. To facilitate and co-ordinate updates, users are encouraged to contact the inventory with any additional data collected (freshwater@sanbi.org.za).

3.11 What is a sub-quaternary catchment?

A catchment or watershed is a topographically represented area which is drained by a stream or river network. South Africa has a system of catchment delineations used extensively in water resources assessment, planning and management. These catchments are nested hydrological units from the primary drainage basin, through to secondary and tertiary catchments, with the smallest operational unit being the quaternary catchment (Midgley *et al*., 1994). Currently, the finest spatial level of data resolution is restricted to the quaternary catchment. The quaternary catchments include Swaziland, Lesotho and South Africa resulting in 1 946 fourth level or quaternary catchments. They are relatively large units within which the landscape, climate and stream network are highly heterogeneous.

Recent emphasis has been placed on the need for delineating smaller sub-catchments, which are nested within the quaternary catchments, and which are better able to represent the physical and biological variability within a quaternary catchment. For NFEPA, sub-quaternary catchment boundaries were delineated around each river reach (the portion of river between each 1:500 000 river confluence) which resulted in 9 417 sub-quaternary catchments. These are roughly nested within the 1 946 quaternary catchments in South Africa. The size of the sub-quaternary catchments is variable but they are on average five times smaller than quaternary catchments. Sub-quaternary catchments have a mean size of 135 km^2 compared with 650 km^2 for quaternary catchments.

3.12 In what contexts can FEPA maps be used?

FEPA maps can be used both in proactive planning processes and in reactive decision-making processes. These are dealt with further in Chapter 5, and include:

- Strategic national planning processes, e.g. informing the National Water Resource Strategy and National Planning Commission processes;
- Catchment-wide planning processes, e.g. catchment visioning, classification of water resources;
- Water use regulation, e.g. water use authorisations;
- Land use regulation, e.g. environmental impact assessments, agricultural authorisations;
- Strategic planning for conservation and rehabilitation programmes, e.g. Working for Water, Working for Wetlands, Biodiversity and Wine Initiative;
- Strategic planning for monitoring programmes, e.g. River Health Programme, siting of water resource nodes for monitoring resource quality objectives.

3.13 Is there legislation supporting FEPA maps?

Although the FEPA maps themselves have no formal legal status, several of the processes they inform do. The primary means of securing FEPAs and giving effects to FEPA maps is through the classification of water resources in terms of the National Water Act. Other legal processes that should be informed by FEPA maps include publication of bioregional plans and listing of threatened ecosystems in terms of the Biodiversity Act, declaration of protected areas in terms of the Protected Areas Act, environmental impact assessments in terms of the National Environmental Management Act, and development of Spatial Development Frameworks in terms of the Municipal Systems Act. See Chapter 5 for further discussion on all of these.

Decision-makers applying a range of regulations typically have to consider, balance and sometimes trade-off a range of economic, social, ecological and cultural factors. FEPA maps inform the biodiversity or ecological assessment in these instances. FEPA maps assist all organs of state to consider biodiversity in their decision-making, which is a requirement in terms of the National Environmental Management Act.

3.14 What do we mean by “conservation” and “protection”?

The terms “conservation” and “protection” have different meanings when used in land-use and water resource contexts in South Africa, sometimes causing confusion.

- **In the water resource context:**
    - “Protection” of water resources means managing the resource and associated ecosystem according to a level that ensures sustainable use. This term emphasises the need to balance protection and utilisation in a sustainable and equitable manner through appropriate water resource management. Protection is therefore an inclusive strategy, applicable to all water resources, and does not apply only to formally protected areas.

- "Conservation" generally refers to the efficient use and saving of water, achieved through measures such as water saving devices, water-efficient processes, water demand management and water rationing.

- **In the land-use context:**
  - "Protection" is generally used for formal protection recognised in terms of the Protected Areas Act, and implies the establishment of a protected area managed mainly for biodiversity conservation purposes.
  - "Conservation" recognises the need for an inclusive approach which balances utilisation and sustainable development across the entire landscape through appropriate land-use management. Conservation goals can be achieved not only through formal protection but also through a range of other management approaches and tools outside the network of formal protected areas.

In general, NFEPA uses the phrase 'management and conservation of freshwater ecosystems' to mean the equivalent of the 'protection' terminology used by the water sector and the 'conservation' terminology used by the land-use sector. When providing guidelines relevant to a specific piece of legislation, NFEPA adopts the terminology used by the legislation.

3.15 What are Critical Biodiversity Area maps, biodiversity sector plans and bioregional plans, and how do FEPAs relate to these?

A ***Critical Biodiversity Area map*** is a map of Critical Biodiversity Areas and Ecological Support Areas based on a systematic biodiversity plan. Critical Biodiversity Areas and Ecological Support Areas are areas that require safeguarding to ensure the continued existence of biodiversity, ecological processes and ecosystem services. A Critical Biodiversity Area map, often developed at provincial level, provides the basis for a biodiversity sector plan.

A ***biodiversity sector plan*** consists of a Critical Biodiversity Area map for a municipality or group of municipalities, together with land- and resource-use guidelines for the Critical Biodiversity Areas and Ecological Support Areas. It usually takes the form of a booklet or handbook and a wall poster. A biodiversity sector plan provides the biodiversity sector's input into a range of multi-sectoral planning and assessment processes to inform land-use planning and decision-making. It is often the precursor to a bioregional plan which can be gazetted in terms of the Biodiversity Act.

A ***bioregional plan*** is a Critical Biodiversity Area map for a municipality or group of municipalities, with accompanying land- and resource-use guidelines, which has been published in terms of the Biodiversity Act. A bioregional plan must meet the requirements in the Guideline for Bioregional Plans (DEAT, 2009a). It must be based on a systematic biodiversity plan (ideally at a scale of 1:50 000 or finer), and serves the same purpose as a biodiversity sector plan. Municipalities must be consulted in the process of publishing of a bioregional plan. After its publication, the bioregional plan must be taken into account in all future planning by a municipality.

FEPAs are identified at a scale coarser than 1:50 000 (see question 3.10). They also focus on freshwater ecosystems only, whereas maps of Critical Biodiversity Areas, biodiversity sector plans and bioregional plans integrate terrestrial and aquatic priority areas. **FEPAs should feed into the development of Critical Biodiversity Area maps**, and hence biodiversity sector plans and bioregional plans. A suggested framework for achieving this is included in the technical report. Also see Section 5.7.7 on provincial spatial biodiversity plans.

3.16 What about rivers, wetlands and estuaries that aren't FEPAs?

The ecological condition of different rivers, wetlands and estuaries can be managed along a continuum, from natural (A ecological category) to heavily modified (D ecological category), to accommodate multiple levels of use. In terms of the National Water Act, freshwater ecosystems should not be allowed to degrade to an unacceptably modified condition (E or F ecological category). While FEPAs should be maintained in a good condition (A or B ecological category), it may be acceptable to manage other rivers and wetlands not identified as FEPAs in a C or D ecological category. Other factors can also be taken into account, including whether the river or wetland in question has been given a high Ecological Importance and Sensitivity (EIS) score by DWA (Kleynhans, 2000). In considering a development application, rivers and wetlands that are not FEPAs may still require a biodiversity assessment because knowledge of special ecological features or species of special concern is incomplete, and it is therefore critical to verify that they do not occur on the site.

3.17 How do I deal with new and better data?

It is likely that FEPA maps will be updated only every ten years. During this time, improved data and knowledge for some areas is likely to become available. For example, some provinces may undertake additional freshwater data gathering to inform their provincial spatial biodiversity plans, or Catchment Management Agencies may undertake more detailed freshwater ecosystem mapping and assessments. If new and better data becomes available, it should be used to ***supplement*** the existing FEPAs rather than replace them. In a few cases, there may be new evidence that provides a sound justification to replace a FEPA in one place with a new FEPA in another place. Ideally, the decision should also be based on the impact this change will have on achieving biodiversity targets for river and wetland ecosystem types as well as fish species. Clear reasons for the change should be provided and documented.

3.18 What about our neighbouring countries?

South Africa shares a significant number of water resources with neighbouring countries. NFEPA was a national spatial prioritisation exercise for South Africa, and it was not appropriate to identify priorities for other countries. There are substantial issues related to managing for connectivity of freshwater ecosystems, and these need to be taken up within the appropriate international forums and structures, which include:

- Lesotho Highlands Water Commission (LHWC) between Lesotho and South Africa;
- Swaziland/South African Joint Water Commission;
- Limpopo Watercourse Commission (LIMCOM) between Botswana, Mozambique, South Africa and Zimbabwe;
- Inkomati Tripartite Permanent Technical Committee (TPTC) between South Africa, Mozambique and Swaziland; and
- Orange-Senqu River Commission (ORASECOM) between Botswana, Lesotho, Namibia and South Africa.

3.19 Who can I contact for help?

FEPA maps and associated products are available on SANBI's Biodiversity GIS website (http://bgis.sanbi.org, bgishelp@sanbi.org.za). If you need further support, contact SANBI's Freshwater Programme (freshwater@sanbi.org.za).

4. Roles and responsibilities of key implementers

PHOTO: K MURRAY

The mandate for managing and conserving freshwater ecosystems is shared between the Department of Water Affairs and the Department of Environmental Affairs, with key roles for several additional government departments and entities at national and sub-national level. This chapter briefly outlines the roles and responsibilities of these different departments and entities.

Clarifying the roles and responsibilities for managing and conserving freshwater ecosystems is important *because* of this shared mandate between the water and biodiversity sectors. Both the National Water Act and the Biodiversity Act provide explicit mechanisms for protection and conservation of freshwater ecosystems. However, in practice the biodiversity sector tends to have a terrestrial focus and the water sector tends to focus on managing water resources for use.

Given that DWA is the national custodian of inland water resources and DEA the national custodian of biodiversity (see Figure 6), conservation of freshwater biodiversity can only be realised effectively through proper interfacing of strategic objectives between these two departments. Freshwater ecosystems sit in the overlap between these two mandates, making it especially important to be clear about who should be doing what to manage and conserve them. If the management and conservation of freshwater ecosystems receives insufficient attention from either the biodiversity or water sector, it can easily slip through the cracks.

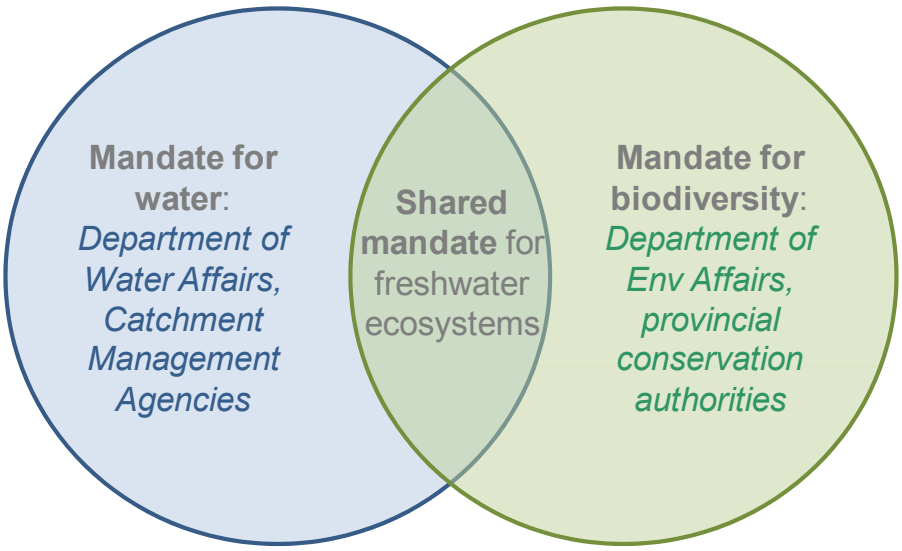

Figure 7: The shared mandate for managing and conserving freshwater ecosystems

Below is an outline of some of the key roles and responsibilities of the major departments and entities responsible for managing and conserving freshwater ecosystems. It is not intended to be exhaustive but rather to provide a basis for a more detailed discussion between the organisations involved. Many of the points are dealt with more comprehensively in Chapter 5.

An important institutional mechanism to achieve further clarity on roles and responsibilities for managing and conserving freshwater ecosystems is likely to be the **Interdepartmental Liaison Committee on Inland Water Ecosystems**, which was newly established at the time of writing. This Liaison Committee is convened by DWA, and provides a forum for the various key role-players in freshwater ecosystem management and conservation to establish shared objectives and to collaborate actively.

4.1 Department of Water Affairs

The Department of Water Affairs' roles and responsibilities in relation to managing and conserving freshwater ecosystems include:

- Incorporating freshwater ecosystem priorities through integrated water resource management, including:
    - National strategic planning for water resources (e.g. development and review of the National Water Resource Strategy),
    - Classification of all significant water resources,
    - Determination of ecological water requirements, in particular the ecological Reserve, and ensuring its successful implementation,
    - Setting of resource quality objectives and ensuring their successful implementation,
    - Water use authorisations, including through conditions attached to water use licences.
- Monitoring programmes which include monitoring the condition of freshwater ecosystems.

4.2 Department of Environmental Affairs

The Department of Environmental Affairs' roles and responsibilities in relation to managing and conserving freshwater ecosystems include:

- Co-ordinating the implementation of the National Biodiversity Framework, which includes Priority Actions 14, 22 and 23 relating to FEPAs.
- Leading the process of listing of threatened or protected ecosystems, including threatened river ecosystems, threatened wetland ecosystems and threatened estuary ecosystems.
- Supporting the publication of bioregional plans in terms of the Biodiversity Act, which should include Critical Biodiversity Areas for both terrestrial and aquatic features.
- Supporting the publication of biodiversity management plans in terms of the Biodiversity Act, which could be developed for particular river FEPAs, wetland FEPAs, fish sanctuaries or free-flowing rivers.

- Leading the development and review of the National Protected Area Expansion Strategy, which includes a focus on freshwater ecosystems.
- Supporting the application of biodiversity stewardship tools and methods to conserving freshwater biodiversity as well as terrestrial biodiversity.
- Leading the development of Regulations for Alien and Listed Invasive Species in terms of the Biodiversity Act, particularly relevant for river FEPAs, fish sanctuaries and free flowing rivers. The regulations deal with preventing the unauthorised introduction and spread of alien species, managing and controlling invasive species to prevent or minimise harm to the environment, and where possible and appropriate eradicating invasive species that may cause such harm.
- Leading the process of developing regulations for the sustainable utilisation of threatened species, including freshwater species.
- Reporting on the state of the environment, including freshwater ecosystems, through the South African Environmental Outlook report which is published periodically.
- Implementing and reporting on the Delivery Agreement for Outcome 10: Environmental Assets and Natural Resources Protected and Continually Enhanced, entered into between the Minister of Water and Environmental Affairs and the Presidency. Includes outputs, activities and indicators relating to freshwater ecosystems.
- Leading the processes of designating wetlands of international importance in terms of the Ramsar Convention, and co-ordinating the monitoring of their ecological character.
- Contributing to the implementation of the Convention of Biological Diversity's (CBD's) Programme of Work on Inland Waters, and reporting on South Africa's activities and progress in this regard.

4.3 SANBI

SANBI's role and responsibilities in relation to managing and conserving freshwater biodiversity conservation include:

- Co-ordinating a Freshwater Programme, one of a suite of multi-partner bioregional and ecosystem programmes dealing with biomes and ecosystems under threat. This may include support to Catchment Management Agencies to integrate freshwater biodiversity priorities in their strategies and programmes, for example through providing technical support and opportunities for sharing and capturing lessons.
- Reporting on the state of biodiversity, including the state of freshwater biodiversity, for example through the National Biodiversity Assessment. (This is high-level national reporting; SANBI is not involved in on-the-ground monitoring efforts.)
- Providing technical support to DEA in developing the list of threatened freshwater ecosystems based on best available science.

- Providing technical support to DEA in developing lists of threatened freshwater species.
- Providing technical support to DEA in developing and reviewing the National Protected Area Expansion Strategy, which includes a focus on freshwater ecosystems.
- Providing technical support to provinces involved in developing provincial spatial biodiversity plans, to ensure that these are based on best available science and reflect freshwater ecosystem priorities.
- Providing technical support to provinces and municipalities involved in developing and publishing bioregional plans, to ensure that these are based on best available science and reflect freshwater ecosystem priorities with accompanying land- and resource-use guidelines.
- Providing technical support to DEA and others involved in the development of biodiversity management plans for species and ecosystems, including freshwater species and ecosystems.
- Providing technical support to DEA in developing regulations for alien and listed invasive species.

4.4 SANParks

SANParks' role and responsibilities in relation to identified Freshwater Ecosystem Priority Areas include:

- Ensuring that freshwater ecosystem priorities inform the establishment, expansion and consolidation of national parks, as well as the delineation of buffer zones and other activities around parks.
- Ensuring that freshwater ecosystem priorities inform the development and implementation of management plans for national parks.
- Engaging with the development of national to local water management strategies (e.g. Catchment Management Strategies) and participating in co-operative water governance in catchment areas relevant for national parks.
- Promoting and championing the role of parks within the multi-use landscape of freshwater conservation and management.
- Contributing to the understanding of social-ecological linkages and feedbacks within wider catchment or bioregional scales and to establishing working models of adaptive management processes relating to freshwater conservation (which often start at and around parks but can effectively influence cooperation, management and governance across broader landscapes).

4.5 Provincial conservation authorities

The roles and responsibilities of provincial conservation authorities[1] in relation to managing and conserving freshwater ecosystems include:

- Commenting on development applications, including environmental impact assessments, mining and prospecting applications, and recreational fishing and aquaculture permit applications. This includes providing specialist freshwater ecological input, and advising on mitigation measures and appropriate river and wetland buffers.
- Participating actively in DWA-led reserve determination processes and the classification of water resources, to ensure that freshwater ecosystem priorities and their freshwater requirements are taken into consideration.
- Participating actively in processes led by Catchment Management Agencies, including the development of Catchment Management Strategies. Provincial conservation authorities should play a leading role in providing a regional freshwater ecological perspective as well as technical advice and input on the incorporation of FEPA maps into the work of Catchment Management Agencies.
- Monitoring the condition of freshwater ecosystems, with a particular focus on regular monitoring of FEPAs. This requires close collaboration with the River Health Programme (see Section 5.9).
- Identifying FEPAs that should be included in the consolidation and expansion of the provincial protected area network, including through biodiversity stewardship programmes.
- Ensuring that freshwater ecosystem priorities inform the development and implementation of management plans for protected areas.
- Interacting with Working for Water, Working for Wetlands, and LandCare to direct these programmes towards rehabilitating freshwater ecosystem priority sites.
- Initiating and/or participating in the development of biodiversity management plans in terms of the Biodiversity Act, for priority freshwater ecosystems and species.
- Verifying all FEPAs, fish sanctuaries and free-flowing rivers that occur in the relevant province, and confirming their status (for example, ground-truthing their ecosystem type and condition).
- Filling in gaps in knowledge of freshwater ecosystems and species, for example:

[1] Provincial conservation authorities take different institutional forms in different provinces. They include provincial conservation agencies (such as CapeNature, Ezemvelo KZN Wildlife), provincial parks agencies (such as Eastern Cape Parks, Mpumalanga Parks and Tourism Agency), and conservation sections within provincial environmental affairs departments (such as Northern Cape Department of Environment and Nature Conservation; North West Department of Economic Development, Environment, Conservation and Tourism).

- Mapping wetlands that have not yet been included in the national wetland map, and contributing these to the national wetland inventory co-ordinated by SANBI (freshwater@sanbi.org.za),
- Properly surveying the distribution of threatened fish populations.

Provincial conservation authorities play a particularly pivotal role in implementing and monitoring freshwater ecosystem priorities, as they have the major line function responsibility for ecosystem management and conservation. At the time of writing, most provincial conservation authorities had very little human resource or financial capacity to fulfil their roles and responsibilities in relation to freshwater ecosystems. Provincial conservation authorities ideally require at least six to eight aquatic scientists and technicians, with expertise in limnology, hydrology, fish biology, aquatic invertebrate biology, aquatic plant biology and other aspects of aquatic ecology, in order to play an effective role in managing and conserving freshwater ecosystems. Strengthening freshwater capacity within provincial conservation authorities is a strong recommendation of NFEPA.

4.6 Catchment Management Agencies

The roles and responsibilities of Catchment Management Agencies in relation to managing and conserving freshwater ecosystems include:

- Ensuring that freshwater ecosystem priorities are meaningfully reflected in the development and implementation of Catchment Management Strategies.
- Ensuring that freshwater ecosystem priorities are meaningfully reflected in the development and implementation of plans and programmes at the sub-Water Management Area scale.
- Contributing to monitoring the condition of freshwater ecosystems, ensuring that the monitoring strategy takes FEPAs into account.

5. Using FEPA maps

PHOTO: K MURRAY

FEPA maps provide the information needed for three broad categories of land and water resource use decisions:

1. Reactive decision-making, such as environmental impact assessment (EIA), agricultural land-use decisions, water-use licensing, and other development control decisions e.g. through provincial land-use legislation;
2. Proactive forward planning, such as informing the National Water Resource Strategy, National Planning Commission processes, Integrated Development Plans (IDPs), Spatial Development Frameworks (SDFs) and zoning schemes;
3. Proactive conservation and rehabilitation, such as biodiversity stewardship, land acquisition for protected areas, clearing of invasive alien plants, and rehabilitating wetlands.

This chapter gives guidance on how maps of FEPAs can be implemented using a range of legal and policy tools. The main legal vehicles for implementing FEPAs are the National Water Act and the Biodiversity Act. Others include the National Environmental Management Act (including the EIA Regulations) and the Protected Areas Act. There are several other pieces of legislation and various programmes that have an important role to play. Specific advice about each of these is given below.

5.1 Implementation mechanisms related to the National Water Act

The National Water Act (Act No. 36 of 1998; RSA, 1998a) provides the legal framework for the effective and sustainable management of our water resources. In line with the international trend of integrated water resource management, the National Water Act aims to manage rivers, dams, wetlands, surrounding land, groundwater, as well as human activities that influence them, in an integrated way. It provides for the protection, use, development, conservation, management and control of water resources as a whole.[2] Each of these aspects requires the development of a strategy at the national level (the National Water Resource Strategy) and sub-national level (the Catchment Management Strategies).

[2] In Section 2 of the National Water Act, which deals with the purpose of the Act, the need to protect "aquatic and associated ecosystems and their biological diversity" is explicitly acknowledged (S2(g)).

FEPA maps inform several of these planning and regulatory processes, the specifics of which are outlined below. All these planning and decision-making processes should allow for the inclusion of an aquatic ecologist on the team and ideally also a biodiversity planner.

5.1.1 National Water Resource Strategy

The National Water Act requires the development of a National Water Resource Strategy, which must be updated at least every five years. The National Water Resource Strategy is the overarching strategy that describes how the water resources of South Africa will be protected, used, developed, conserved, managed and controlled in accordance with the requirements of the National Water Act. It sets out strategies, objectives, plans, guidelines and procedures for the overall management of the national water resource. It also provides a framework for the preparation of Catchment Management Strategies, which must be relevant to local conditions and circumstances but not be in conflict with the National Water Resource Strategy.

Reference to the use of FEPAs should be made in any review of the National Water Resource Strategy, with the intention of embedding the consideration of FEPAs in both national and local water resource planning and decision-making processes. At the time of writing, the review of the 2004 National Water Resource Strategy was underway.

The National Water Resource Strategy should refer to FEPAs in the following contexts:

- ***Water resource protection strategies related to Resource Directed Measures:*** The FEPA maps are a planning tool that directly supports the three core concepts of Resource Directed Measures, namely classification of water resources, reserve determination and resource quality objectives.

  In undertaking each of these Resource Directed Measures processes, provision should be made for the inclusion of an aquatic ecologist and the relevant provincial conservation authority to serve as advisers and technical members of the planning process. It is not sufficient to devolve the consideration of FEPA maps to stakeholder participation processes, as the technical expertise required to integrate them meaningfully into water resource protection and management is then unlikely to be accessed. More detail can be found below on the specific use of FEPA maps in relation to classification of water resources (Section 5.1.3), reserve determination (Section 5.1.4) and resource quality objectives (Section 5.1.5).

- ***Strategies for authorising water use****:* Water use licensing should give effect to protecting FEPAs. See Section 5.1.6 for further detail.

- ***Sectoral strategies related to control of invasive alien plants:*** FEPAs, together with the maps of high water yield areas and high groundwater recharge areas (see Section 1.4 and atlas), should be used to inform the identification of priority catchments for the control of invasive alien plants. These summarise best available information on the most important catchments for freshwater biodiversity and catchment water supply. See Section 5.2.5 for further detail.

- ***Monitoring and information:*** FEPAs should be used to inform the process of prioritising the allocation of resource monitoring nodes, which should be sited immediately downstream of FEPAs. See Section 5.9 for further detail.

- ***Capacity building in the water sector:*** Implementing authorities require scientific capacity in aquatic ecology and conservation to use the FEPA maps to their full effectiveness. This is a key recommendation of the NFEPA project.

- ***National planning and co-ordination:*** Realising the potential of FEPAs on the ground will require co-operation between organs of state and relevant stakeholders. National planning and co-ordination strategies should make explicit the need for strong co-operation conserving and managing freshwater ecosystem management, particularly between DEA and DWA. The recent establishment of the Inter-departmental Liaison Committee for Inland Water Ecosystems, as mentioned in Chapter 4, is a key opportunity in this regard.

5.1.2 Catchment Management Strategies

A Catchment Management Strategy describes how a Catchment Management Agency will manage the water resources in its Water Management Area (or group of Water Management Areas). The strategy promotes integrated water resource management at the lowest possible level in terms of the National Water Act, since Catchment Management Agencies are representative of the communities and stakeholders within their specific Water Management Areas. Catchment Management Strategies must be locally relevant, but aligned with the National Water Resource Strategy.

NFEPA products form the core of the biodiversity sector inputs into the biophysical situation assessment, catchment visioning, water resource protection strategy, and scenario planning as set out in the Guidelines for the Development of Catchment Management Strategies (DWAF, 2007a). Terms of Reference for consultants involved in the preparation of a Catchment Management Strategy should include explicit mention of the need to incorporate FEPAs. Those responsible for incorporating FEPAs should refer to the descriptions of the different FEPA map categories (Chapter 2). The following aspects of the Catchment Management Strategy should make use of FEPAs:

- ***Stakeholder participation process:*** During the development of the Catchment Management Strategy, representatives from provincial conservation authorities should be consulted. They generally have a more landscape-wide perspective of the region compared to conservancies and environmental action groups. In some cases, more than one provincial conservation authority will need to be involved. Ideally, the person from the provincial conservation authority who is involved in the development of the Catchment Management Strategy should be an aquatic ecologist, but if this is not possible an ecologist with a landscape-wide perspective should be a minimum requirement.

- ***Situation assessment:*** NFEPA products inform the biophysical situation assessment. Where possible the information should be augmented with local data, particularly on ecological condition.

- ***Catchment visioning and scenario planning:*** The location and condition of FEPAs, Fish Support Areas and Upstream Management Areas must be taken into account. The desired condition of estuaries plays a pivotal role in determining how water resources are developed in a catchment. For estuary FEPAs, the recommended condition should preferably be incorporated into the ecologically sustainable base configuration scenario. The recommended ecological condition for estuary FEPAs is set out in the National Biodiversity Assessment 2011 (Van Niekerk and Turpie, 2011). It varies according to importance, sensitivity and feasibility of implementation, and is not necessarily an A or B ecological condition.

- ***Strategic objectives supporting aquatic ecosystem protection:*** FEPA maps should guide the development of strategic objectives concerning aquatic ecosystem protection. This should form part of the water resource protection sub-strategy within the Catchment Management Strategy.

  During the NFEPA project, a Catchment Management Strategy for the Breede-Overberg Catchment Management Agency was developed. Strategic objectives for aquatic ecosystem protection (or freshwater conservation and management) were developed with input from the NFEPA project team. A template based on this input given to the Breede-Overberg Catchment Management Strategy is provided in an Appendix, and may form a useful basis for inputs to water resources protection sub-strategies in other Catchment Management Strategies.

  In developing the water resources protection sub-strategy of a Catchment Management Strategy, the FEPA maps need to be translated into descriptions of locally significant features. For example, wetland, estuary and river FEPAs need to be named and their local and national significance described. This requires technical expertise and knowledge of the aquatic ecology of the region, for which time and resources need to be budgeted. Simply including a map of FEPAs is not sufficient integration.

- ***Classification of water resources, reserve determination, resource quality objectives, monitoring, capacity development and co-ordination:*** In preparing these components of the Catchment Management Strategy, recommendations for the use of NFEPA products are similar to those provided for the National Water Resource Strategy (see Section 5.1.1, as well as further detail in Sections 5.1.3, 5.1.4, 5.1.5 and 5.9) (DWAF, 2004).

5.1.3 Classification of water resources

Classification of water resources is a consultative process that sets a 'Class' for every significant water resource. The class defines objectives for the water resource, which describe the desired condition of the resource and the extent to which it can be utilised. There are three classes (minimally used, moderately used and heavily used), each with a set of guidelines on the required configuration of ecological categories within a catchment for achieving the assigned class (Table 1).

Classification of water resources is the primary means of securing FEPAs and giving effect to the FEPA maps.

A water resource classification system has been developed to guide the process of classifying water resources and assist in the process of maintaining a balance between protecting our national water resources and using them to meet economic and social goals (DWAF, 2007b; DWA, 2010). The formal water resource classification process will result in the setting of the class and associated Reserve and resource quality objectives (RQOs) by the Minister or delegated authority. This will be binding on all authorities or institutions. This is a lengthy process, and preliminary classification of water resources is being undertaken as an interim measure until the formal classification process has been concluded. FEPAs should inform the water resource classification system and process in the following way:

- River, wetland and estuary FEPAs should be regarded as significant water resources. Note that there may be some scale issues for river FEPAs where ecological condition has been generalised to an entire sub-quaternary catchment but does not reflect variation within the sub-quaternary catchment.
- The location of FEPAs should be used to prioritise the allocation of resource unit nodes, which should be sited immediately downstream of the FEPA. This is often at a scale finer than the nodes that currently exists, and may therefore require the addition of new nodes. Where no hydrological data exist, the methods outlined in DWAF (2007b) can be used to extrapolate from other nodes in similar ecosystem types. River and wetland ecosystem types (see atlas and NFEPA DVD) are very useful in this regard.
- Water-use scenarios should include at least one scenario that achieves the desired condition for FEPAs (i.e. A or B ecological category). These scenarios should preferably be discussed with a biodiversity planner, and the degree of achievement of FEPAs in different scenarios as well as the extent to which they meet biodiversity targets should be explicitly considered. The desired condition of estuaries plays a pivotal role in the configuration of the scenarios. For estuary FEPAs, the recommended condition should preferably be incorporated into the ecologically sustainable base configuration scenario. The recommended ecological condition for estuary FEPAs is set out in the National Biodiversity Assessment 2011 (Van Niekerk and Turpie, 2011). It varies according to importance, sensitivity and feasibility of implementation, and is not necessarily an A or B ecological condition.
- In examining the social, economic and ecological trade-offs of different water-use scenarios (and the impact each will have on future ecological condition of significant water resources), the consequences of not protecting a FEPA should be factored into the ecological assessment. This would include assessing whether the biodiversity target that the FEPA is fulfilling can be achieved elsewhere in the Water Management Area concerned, and if not, elsewhere in the country. Many river FEPAs constitute the last remaining option for representing natural examples of the country's river, wetland or estuary ecosystems and associated biodiversity. Degrading the desired condition in these FEPAs compromises national goals for managing and conserving freshwater ecosystems.

The third and fourth tasks above require technical input from a biodiversity planner, preferably one familiar with freshwater biodiversity planning, as well as input from the relevant provincial conservation authority(/ies), preferably from aquatic ecologists within these authorities. Time and resources need to be allocated for this in the water resource classification process.

5.1.4 Reserve determination

The Reserve refers to the quantity and quality of water required (a) to satisfy basic human needs and (b) to protect the aquatic ecosystems to secure ecological sustainable development and use of the relevant water resource. The following recommendations apply when using FEPAs in the context of reserve determinations:

- FEPAs should be used in identifying priority water resources for reserve determination and should be afforded a higher confidence reserve determination than desktop or rapid approaches (or at least a Rapid III level). FEPAs should be prioritised for reserve determination especially in areas where demand and conflict for water resources is high.
- FEPAs should be visited to confirm their location, extent and ecological condition.
- The location of FEPAs should inform the determination of Resource Units or Water Quality Sub-Units and the selection of reserve determination sites, prioritising the allocation of resource nodes immediately downstream of FEPAs.
- Recommended ecological category or condition should be A or B for river FEPAs, and never below the current ecological category.

5.1.5 Resource quality objectives

Resource quality objectives provide numerical or descriptive statements about the biological, chemical and physical attributes that characterise a resource for the level of protection defined by its class. Resource quality objectives therefore may include, for example, the quantity, pattern and timing of instream flow; water quality; the character and condition of riparian habitat; and the characteristics and condition of the aquatic biota. Resource quality objectives must take account of user requirements and the class of the resource.

FEPAs should influence the setting and monitoring of resource quality objectives in the following ways:

- FEPAs should be used to prioritise the allocation of resource unit monitoring nodes, which should be sited immediately downstream of the FEPA.
- The ecological requirements for setting resource quality objectives, as outlined in DWA's guidelines for developing and implementing resource quality objectives (DWA, 2011), should be prioritised for FEPAs.
- The delegated authority should ensure that monitoring and analysis of results takes place and feeds into adaptive management, compliance and enforcement, and future updates of FEPA maps.

5.1.6 Water use authorisations

Water use in terms of the National Water Act relates to the consumption of water, as well as activities that may affect water quality and the condition of the resource itself (e.g. discharge of water, altering a river course). Authorisation of all water use in terms of a licence is conditional on the requirements of the Reserve being taken into account when determining the water available for allocation. A licence to use water may have a range of conditions attached to it and must be reviewed by the responsible authority at least every five years.

FEPAs should be considered in the water use authorisation process as follows:

- FEPAs should be regarded as ecologically important and as generally sensitive to changes in water quality and quantity, owing to their role in protecting freshwater ecosystems and supporting sustainable use of water resources.
- The water use licence application guidelines should be amended to reflect the consideration of FEPAs. The impact of a licence application on the ecological condition of the FEPA should ideally be assessed. The ecosystem management guidelines in this manual (Chapter 6) can be used as a starting point for assessing the impact of the proposed application on the FEPA. In some cases further assessment, e.g. through seasonal field surveys, may be required.
- If a licence application is approved in a FEPA, stringent conditions should be attached to the licence to prevent degradation of ecological condition and to strive towards rehabilitation of FEPAs where necessary. These conditions should draw on the freshwater ecosystem management guidelines in this manual (Chapter 6), and may include requirements for managing water quality, riparian and wetland buffers (see Section 5.7.5), erosion and sedimentation, and ecosystem connectivity, as well as monitoring and reporting requirements.

5.1.7 General authorisations

General authorisations grant limited, conditional water use without requiring a licence to be issued. However, such use is subject to specified conditions. Limits are placed on water use under general authorisations depending on the nature of the use and the capacity of the resource to accommodate the use without significant degradation.

General authorisations should be applied with caution within FEPAs. The validity of general authorisations after the final date of publication in the Government Notice is five years, with review at intervals of three years. Future review of general authorisations should consider excluding certain general authorisations within FEPAs, particularly those that may not be consistent with maintaining FEPAs in an A or B ecological category.

5.2 Implementation mechanisms related to the Biodiversity Act

The National Environmental Management: Biodiversity Act (Act No. 10 of 2004; RSA, 2004) provides for the management and conservation of South Africa's biodiversity; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological

resources; and the establishment and functions of the South African National Biodiversity Institute (SANBI).

The Biodiversity Act provides several tools that are relevant for the management and conservation of freshwater ecosystems, including the National Biodiversity Framework, listing of threatened ecosystems, publication of bioregional plans and biodiversity management plans, and regulations dealing with alien and invasive species. The relationship of FEPAs to each of these is discussed below.

5.2.1 National Biodiversity Framework

The Biodiversity Act requires the development of a National Biodiversity Framework (NBF), which must be reviewed every five years. The NBF provides a framework to co-ordinate and align the efforts of the many organisations and individuals involved in conserving and managing South Africa's biodiversity, in support of sustainable development. The NBF 2008 (DEAT, 2009b) identifies 33 priority actions for the period 2008 to 2013, which provide an agreed set of priorities to guide the work of the biodiversity sector in South Africa. The following priority actions are directly relevant for freshwater ecosystems:

NBF Priority Action 14: *Support the development and strengthening of bioregional and ecosystem programmes*. These are multi-institutional, multi-sector, landscape-scale programmes co-ordinated by SANBI. The establishment of a Freshwater Programme is highlighted as an urgent priority.

NBF Priority Action 22: *Proceed with implementation of the cross-sector policy objectives for conservation of inland water biodiversity*. NFEPA builds directly on these cross-sector policy objectives (see Section 1.2), and the use of FEPA maps will ensure that the objectives are being implemented. The 2013 target for this priority action requires that a portfolio of freshwater ecosystem priority areas be identified (this has been achieved through NFEPA), and that mechanisms for implementing appropriate management of these areas are being piloted in at least three Water Management Areas.

NBF Priority Action 23: *Incorporate biodiversity conservation objectives in the work of Catchment Management Agencies.* This priority action includes a focus on the integration of freshwater ecosystem priorities in Catchment Management Strategies. See Section 5.1.2 for advice on how to achieve this.

5.2.2 Bioregional plans and biodiversity sector plans

The Biodiversity Act allows for the publication of bioregional plans. A **bioregional plan** is a map of Critical Biodiversity Areas with accompanying land-use guidelines, to guide planning and decision-making in a range of sectors that impact on biodiversity. A **biodiversity sector plan** is a bioregional plan that has not yet been published in terms of the Biodiversity Act. Its purpose is the same as a bioregional plan, but it has no formal legal status. (See Section 3.15 for more on Critical Biodiversity Area maps, bioregional plans and biodiversity sector plans.)

The Department of Environment Affairs has published a Guideline for Bioregional Plans (DEAT, 2009a). A bioregional plan must show terrestrial *and aquatic* features in the landscape which are critical for conserving biodiversity and maintaining ecosystem functioning, and which must remain in a natural or near-natural state. Bioregional plans and biodiversity sector plans are intended to support integrated management of terrestrial and aquatic ecosystems.

Bioregional plans and biodiversity sector plans are usually based on provincial spatial biodiversity plans, which provinces are encouraged to develop in terms of the National Biodiversity Framework (see Section 5.7.7). FEPAs should be favoured in the identification of Critical Biodiversity Areas and Ecological Support Areas. All river and wetland FEPAs should at least be considered to be Ecological Support Areas. See Section 5.7.7 and the technical report for further discussion on how FEPA maps should be integrated into provincial spatial biodiversity plans.

5.2.3 Listing threatened ecosystems

The Biodiversity Act provides for listing of threatened or protected ecosystems, by notice in the Gazette. The purpose includes preventing further degradation and loss of structure, function and composition of threatened ecosystems. Threatening processes in such ecosystems can also be identified.

A draft list of threatened terrestrial ecosystems was published for public comment in November 2009 (DEA, 2009), and publication of the final list was imminent at the time of writing. The list of threatened terrestrial ecosystems is based on clear criteria and informed by best available science. The data and analysis undertaken to produce FEPA maps (especially river ecosystem types and river condition) provides key information for the development of a list of threatened river ecosystems for publication in terms of the Biodiversity Act. River ecosystems for which it is no longer possible to meet the biodiversity target should be listed as Critically Endangered ecosystems.

5.2.4 Biodiversity management plans

The Biodiversity Act allows for the development and publication of Biodiversity Management Plans (BMPs) for ecosystems or species. A BMP may be submitted by any person or organisation for approval by the Minister, and should be aimed at the long-term survival in nature of the species or ecosystem concerned. Norms and standards to guide the development of BMP for species (BMP-S) have been developed and published by DEA, and norms and standards for BMP for ecosystems (BMP-E) are in the process of being developed.

Biodiversity Management Plans for Species

Norms and Standards for BMP-S were gazetted in 2009 (DEAT, 2009c). The aim of a BMP-S is the long-term survival in the wild of the species to which the plan relates. The Norms and Standards call for extensive stakeholder participation which ensures involvement from both the private sector and government in the development of a BMP-S. The BMP-S document is submitted for approval to the Minister of Environmental Affairs, and once approved, the actions required to protect a species become legally binding on the implementing agent(s) of the BMP-S. This process can therefore be a powerful tool to protect threatened species if implemented correctly and effectively. With the

growing number of threatened fishes in South Africa (Tweddle *et al.,* 2009), it is seen as a potential vehicle to help save the most threatened among them from extinction.

The first BMP-S for a fish was developed for a widespread species, the Southern Barred minnow (*Opsaridium peringuyi*), but it is more likely that BMP-Ss will be developed at provincial level, as species that are more widespread are unlikely to be high priority candidates for a BMP-S. It is therefore critical to establish provincial priorities for fish conservation. The best way to do this is to use the IUCN Red List that has recently been updated for fish (Tweddle *et al*., 2009; IUCN, 2007). It is important to note that some species that are adequately protected in protected areas, or above weirs or natural barriers, might not urgently need a BMP-S. The need for a BMP-S also depends on the particular threats to the survival of the species. Species that are threatened by a multitude of threats that will require many different stakeholders to work together are particularly high priorities for BMP-S development. It will also be important to consider other species or the general environment that will benefit from a BMP-S, but in most cases, preventing the extinction of a single species will be the focus of a BMP-S.

For the development of the first BMP-S in a province or region, a high priority species for which information is available and which has relatively simple actions required by relatively few stakeholders to improve its conservation status should be chosen. This will allow the conservation authority or implementing agent to develop capacity and experience in developing a BMP-S and leading the necessary stakeholder engagements. For the second BMP-S, the highest priority species that may be more complex to conserve can be addressed, as there will be increased capacity and relevant experience within the conservation organisation.

FEPA maps and fish sanctuary maps (Section 2.4) can help in several ways to help prioritise species that require a BMP-S. Firstly, all the viable populations and potential rehabilitation areas for Critically Endangered and Endangered species have been mapped in the fish sanctuary map. The geographic distribution of these populations can be compared to several other spatial layers that can help to determine whether a BMP-S will benefit the species and whether the development of a BMP-S is a high priority. Typical questions that can be at least partially answered with FEPA maps and fish sanctuary maps include:

- How many sub-quaternary catchments should be included in the plan and which potential implementing agents, partners and stakeholders have a presence in these sub-quaternary catchments?
- Are there large Upstream Management Areas with many different stakeholders that will need to be consulted?
- Do any of the populations occur in formally protected areas?
- What does the river health status in the fish sanctuary suggest about threats in the catchment and how easy will it be to rectify the situation?
- Are there other important biodiversity features (e.g. river types as surrogates for other aquatic biodiversity) or physical features (e.g. free-flowing rivers or the presence of wetlands) that can be leveraged to support a BMP-S?
- What are the land use patterns in the area (natural, agricultural, urban or rural) and what does that mean in terms of stakeholder engagement?
- In which sub-quaternary catchment(s) can the BMP-S have the most impact and are there opportunities to align objectives of different stakeholders and/or projects (e.g. co-ordinating with Working for Wetlands or Working for Water projects)?

Once species and populations have been prioritised, the development of a BMP-S follows clear procedures set out in the Norms and Standards, including an expert workshop and two stages of stakeholder participation during which the desired state for the species is determined and threats are identified and prioritised. Management interventions and potential implementing agents are identified during the stakeholder participation process. Once all parties are in agreement, the BMP-S is submitted to the Minister for approval.

The BMP-S process also allows for an annual audit to determine the effectiveness with which the implementing agent(s) have executed the management interventions or objectives. A critical aspect of the implementation of a BMP-S will be the capacity and enthusiasm of the implementing agent(s) to follow the agreed actions and associated timelines. Conservation authorities and other implementing agents likely do not have the capacity to develop a BMP-S for most of the threatened fishes in the short-term, but with FEPA maps and maps of fish sanctuaries providing the necessary information to prioritise which species, populations, catchments and actions need to considered, it is possible that the most critical actions can be taken relatively soon.

Biodiversity Management Plans for Ecosystems

The draft norms and standards for BMP-E have been designed for terrestrial and freshwater ecosystems (although not for estuarine ecosystems, for which estuary management plans may be developed in terms of the Integrated Coastal Management Act, as discussion in Section 5.5). The principles that should guide the development of BMP-Es include integrated management of terrestrial and freshwater ecosystems. BMP-Es should address both terrestrial and freshwater aspects related to the management of the ecosystems concerned, taking into account the links between freshwater and terrestrial ecosystems.

FEPAs, fish sanctuaries, high water yield areas and free-flowing rivers are all identified in the draft norms and standards for BMP-E as ecosystems of special concern for which the development of a BMP-E may be appropriate.

5.2.5 Alien and invasive species regulations

Draft alien and invasive species (AIS) regulations were published in terms of the Biodiversity Act in April 2009, but had not yet been finalised at the time of writing. The main purpose of the draft regulations is to protect biodiversity and the environment against the negative impacts of alien and invasive species that have been specifically listed. To achieve this, the draft regulations allow only low risk economically important activities associated with listed invasive species to continue.

The draft regulations specifically address invasive alien fish, which disrupt freshwater ecosystems and threaten indigenous fish species – see the discussion on invasive alien fish in Section 5.7.4 on the regulation of aquaculture.

Some economically important alien and invasive fish species (such as bass and trout) are already widely used and can be controlled only by geographic area. They have therefore been included in list 3 category 2, where activities associated with them will be managed according to four broadly defined geographic zones:

- An “open zone” where most activities are possible without a permit,
- A “cautionary zone” where most activities are not possible without a permit,

- A “closed zone” where no activities are permitted unless otherwise stated,
- A “conservation zone” where fine-scale surveys are needed to assess the indigenous range in the case of species that have a native range in South Africa, before a decision about permits can be made (the threatened or protected species regulations (see Section 5.2.6) will apply to the native range).

In general, these zones and the regulations will attempt to prevent the unauthorised introduction and spread of listed invasive species to ecosystems and habitats where they do not occur naturally, manage and control alien invasive species to prevent or minimise harm to the environment, and where possible and appropriate enable the eradication of listed species that may cause such harm.

For fish species, the zones were mapped using the same sub-quaternary layer that was used by NFEPA, which makes the FEPA maps and the AIS maps for fish directly comparable in GIS analyses. Attempts were made in both sets of maps to optimise the best areas for biodiversity protection on the one hand and economic activities on the other. Conservation authorities should therefore use the two sets of maps to avoid issuing new permits for stocking invasive alien fishes in river FEPAs, in Fish Support Areas, or in farm dams in the sub-quaternary catchments associated with river FEPAs and Fish Support Areas, unless there is a high degree of confidence that the particular species will not establish and have a negative impact on the natural environment. CapeNature is piloting this approach and preliminary assessments show that the maps work very well in areas where there is high confidence. This allows for desk-top assessments of permit applications. For more complicated areas such as the “cautionary” or “conservation” zones, risk assessments and additional field surveys are required. This can place additional strain on the limited capacity of the conservation authority; however, if capacity to undertake these risk assessments can be found, the AIS maps for fish can be refined and improved in future.

5.2.6 Threatened or protected species regulations

Threatened or Protected Species (TOPS) Regulations were published in 2007 (DEAT, 2007). These regulations contain listed species (amphibians, birds, mammals and reptiles) for which permits have to be issued should the species concerned be subject to any restricted activity as defined in the Biodiversity Act. These regulations and species lists were in the process of being substantially amended at the time of writing, which may result in a number of the restricted activities being exempted from permit requirements.

5.3 Implementation mechanisms related to the Protected Areas Act

The National Environmental Management: Protected Areas Act (Act No. 57 of 2003; RSA, 2003) provides for the protection and conservation of ecologically viable areas representative of South Africa’s biodiversity and its natural landscapes and seascapes. It distinguishes between several categories of protected area: special nature reserves, national parks, nature reserves, and protected environments. Protected areas can be declared on state-owned land or through contractual agreements with private or communal landowners. In other words, protected areas need not be owned and managed by government. This has led to the development of biodiversity stewardship programmes (see Section 5.3.3).

South Africa's current protected area network is insufficient to conserve biodiversity and ecological processes effectively. This is because of the ad hoc way the protected area network has developed over time, protecting some ecosystems well and others hardly at all. Freshwater, estuarine and offshore marine ecosystems are especially poorly included in the protected area network. Where rivers are included in a protected area, they often form the boundary of the protected area and are thus not really protected.

The protected environment category allows for more flexibility in land use than the other categories of protected area, and could be important for protecting freshwater ecosystems and estuaries.

5.3.1 Management plans for protected areas

The Protected Areas Act requires that every protected area have a management plan, which must be submitted to the Minister or MEC for approval. The objectives, implementation measures and indicators in such a management plan should include explicit statements about river and riparian conditions within the protected area, highlighting FEPAs that occur within the protected area. It may also be appropriate for the management plan to deal with freshwater issues that extend beyond the boundaries of the protected area itself, for example impacts from upstream catchments, regional groundwater issues, or transboundary issues.

5.3.2 National Protected Areas Expansion Strategy

The National Protected Areas Expansion Strategy (NPAES) (Government, 2010), although not required by the Protected Areas Act, provides priorities for expanding the protected area network for ecological sustainability and for increasing resilience to climate change. It sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. The first NPAES was produced in 2008, and will be reviewed every five years.

The NPAES 2008 identified 42 **focus areas for land-based protected area expansion**. These are large, intact and unfragmented areas suitable for the creation or expansion of large protected areas, and were designed taking draft freshwater priority areas from NFEPA into account. The final NFEPA map products will inform the revision of the NPAES in 2013.

In addition to the 42 focus areas for land-based protected area expansion, **free-flowing rivers** (especially flagship free-flowing rivers) should be considered priorities for protected area expansion. Free-flowing rivers often lend themselves to a biodiversity stewardship approach (see Section 5.3.3).

The NPAES makes specific suggestions for designing **freshwater-friendly protected areas**. Most land-based protected areas are designed to protect terrestrial ecosystems, yet some simple changes could help to make protected areas work better for both freshwater and terrestrial ecosystems, for example:

- Avoid using a river as the boundary of a protected area.
- Encourage expansion of existing protected areas to incorporate whole river reaches that are currently only partially protected. Sometimes this is possible with a relatively modest adjustment to an existing protected area boundary.

- Incorporate natural large-scale catchment processes into protected areas where possible.
- Ensure that rivers are well managed within protected areas, enabling them to recover from the impact of activities upstream as they flow through the protected area.
- Avoid development of visitor infrastructure on priority freshwater ecosystems in protected areas.
- Promote new protected areas for the last remaining free-flowing rivers.

5.3.3 Biodiversity Stewardship Programmes (including contract protected areas)

The fact that the Protected Areas Act allows for protected areas to be declared on private and communal land, not only on state land, opened the way for the development of biodiversity stewardship programmes in which conservation authorities enter into contracts with private and communal landowners in order to consolidate and expand the protected area network.

Biodiversity stewardship programmes are run by provincial conservation authorities. Currently two provinces (Western Cape and KwaZulu-Natal) have well-established biodiversity stewardship programmes, with fledgling programmes in several other provinces (Mpumalanga, Gauteng, Northern Cape, Eastern Cape). Owing to provincial capacity constraints, NGOs with aligned objectives often play a role in supporting the various provincial agencies in implementing biodiversity stewardship programmes. A national biodiversity stewardship technical working group is convened by SANBI, bringing together all the provincial biodiversity stewardship programmes. A Biodiversity Stewardship Guideline Document has been developed, and a Biodiversity Stewardship Policy is in the process of being finalised.

Biodiversity stewardship programmes provide a hierarchy of categories of biodiversity stewardship agreements which landowners may enter into, shown in Figure 8. The biodiversity importance of the site increases as one moves up the hierarchy, as does the degree of commitment required from the landowner and the degree of support provided by the provincial conservation authority. All biodiversity stewardship contracts require a management plan to be developed and implemented for the site concerned. Fiscal incentives (property rates exclusions and income tax deductions) are available to landowners who enter into biodiversity stewardship agreements in the top two categories, Nature Reserves and Protected Environments, which are recognised in terms of the Protected Areas Act. Income tax deductions (but not property rates exclusions) are available to landowners who enter into Biodiversity Management Agreements in terms of the Biodiversity Act.

The National Protected Area Expansion Strategy 2008 (Government, 2010) identifies contract protected areas, including through biodiversity stewardship programmes as a key mechanism for expanding the protected area network, often much more cost effective than acquisition of land. The National Biodiversity Framework 2008 (DEAT, 2009b) supports the establishment and strengthening of provincial biodiversity stewardship programmes (Priority Action 31).

Biodiversity stewardship has the potential to play a key role in protection of freshwater ecosystems, especially FEPAs, by providing a range of options for landowners or groups of landowners who wish to contribute to managing and conserving rivers and wetlands on their land. As noted in Section

5.3.2, free-flowing rivers in particular should be considered priorities for protected area expansion, and often lend themselves to a biodiversity stewardship approach.

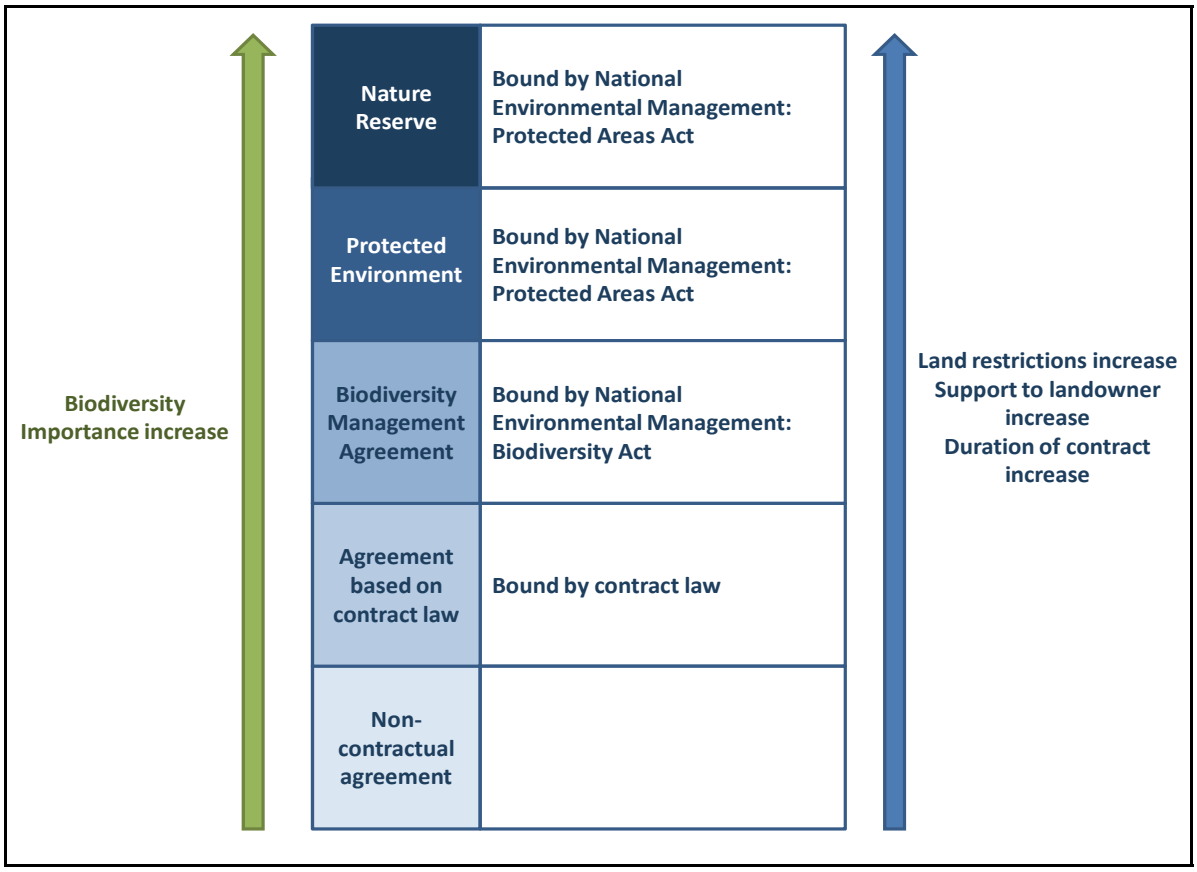

Figure 8: Hierarchy of categories for biodiversity stewardship agreements

5.4 Implementation mechanisms related to the National Environmental Management Act

The National Environmental Management Act (Act No. 107 of 1998; RSA 1998b) (NEMA) is broad framework legislation with guiding principles for environmental decision-making, intended to enhance co-operative governance between various organs of state. Section 24 of NEMA, together with regulations on Environmental Impact Assessments (EIA Regulations) and regulations on Environmental Management Frameworks (EMF Regulations), deals with environmental authorisations.

Below are guidelines for how FEPAs should be taken into account in EIAs and EMFs.

5.4.1 Environmental Impact Assessments

Environmental Impact Assessments, required by NEMA, assess environmental implications of proposed developments and inform decisions relating to their authorisation.

The current EIA Regulations (R543, R544, R545, R546 of 2010)[3] were promulgated in June 2010 and came into effect on 2 August 2010. They are intended to streamline the environmental authorisation process for developers and for competent authorities (usually provincial environmental affairs departments on behalf of MECs for the environment).

The EIA Regulations include three lists of activities that require environmental authorisation:

- Listing Notice 1: activities that require a basic assessment (R544 of 2010),
- Listing Notice 2: activities that require scoping and environmental impact report (EIR) (R545 of 2010),
- Listing Notice 3: activities that require a basic assessment in specific identified geographical areas only (R546 of 2010).

DEA and some provincial environmental affairs departments have developed guidelines on the interpretation of listed activities, which should be consulted for more detail.

FEPAs provide an important input into EIAs, informing decision makers on freshwater ecosystems that need to be taken into account in environmental assessments and authorisations. In summary, FEPAs should inform the EIA process in the following way:

- The presence of a FEPA means that a freshwater specialist must be consulted for the assessment.
- An anticipated impact on a FEPA that may result in an ecological condition lower than A or B should be ranked as having medium to high significance.
- Any activity that will have an overall residual impact on wetland or river FEPAs and their immediate surrounds greater than a low negative significance, is not acceptable from the point of view of managing and conserving freshwater ecosystems, and must be avoided.
- The cumulative effect of development impacts should ideally be considered in the case of sub-quaternary catchments associated with FEPAs (i.e. the specialist should be aware of other developments in the sub-quaternary catchment that are likely in the near future and should highlight possible cumulative impacts).
- Unavoidable development must require special mitigation measures that would reduce the overall impact of the activity or development to low negative significance, or must require a biodiversity offset (see Section 5.4.3).

The following four-step process should be followed for taking FEPAs into account in EIAs. The steps provided here are not necessarily linear – the order may vary depending on the type of activity being proposed and the type of FEPA. These steps may be included in the terms of reference for specialist input in the EIA process.

Step 1: Consult the FEPA map

- Make an initial desktop assessment of whether the proposed activity is likely to impact on the FEPA as mapped.

[3] Government Gazette No. 33306, 18 June 2010, as corrected on 30 July 2010 (R660 of 2010) and 10 December 2010 (R1159 of 2010).

Step 2: Site assessment

- Visit the site. Verify that the river/wetland ecosystem types or fish sanctuary for which the FEPA has been selected exist on the ground. Check that the FEPA or fish sanctuary is not heavily modified.
- Ground-truth the location of the FEPA (e.g. the river, the associated sub-quaternary catchment, and any wetland FEPAs that fall within the sub-quaternary catchment);
- Type the FEPA according to the river and wetland ecosystem types used by NFEPA;
- Examine the surrounding sub-quaternary catchment, looking at the condition and location of other FEPAs, and other freshwater ecosystems in good condition, and/or of apparent ecological importance and/or sensitivity;
- Determine current condition (present ecological state) and compare with modelled condition: EcoStatus (Present Ecological State) for rivers, WET-Health for wetlands or the rapid Wetland Index of Habitat Integrity (WET-IHI) for valley bottom and floodplain wetlands – *primary data should be collected wherever possible*.

Step 3: Delineate the ecosystem

- Map the extent of the FEPA accurately, using the DWA protocol for delineation of wetlands and riparian areas (DWAF, 2005);
- Determine the appropriate buffer width, using accepted national protocols (see Section 5.7.5).

Step 4: Assess the significance of the impact of the proposed development

- Determine ecological importance and sensitivity (EIS) using DWA protocol, and compare with FEPA status – examine the reasons why ecosystem has achieved FEPA status, and check whether these are correct and complete, if so, these should be used in the determination of EIS – *primary data should be collected wherever possible*;
- Assess the significance of impacts. The degree of significance will depend on the degree of deterioration in ecological condition that would result from the proposed development as well as its reversibility (e.g. whether the impact is short-term, medium-term or long-term). Deterioration of a FEPA from a B ecological condition to a C condition might be considered an impact of medium significance but should never be considered of low significance.

Step 5: Make recommendations

- Consult the NFEPA ecosystem management guidelines, and apply these to the development application;
- Develop suitable and realistic mitigation measures;
- Determine rehabilitation requirements, in order to meet management objectives for FEPAs;
- Design a monitoring programme that aims to track the impacts associated with the development and how these affect the condition of the affected FEPAs.

5.4.2 Environmental Management Frameworks

NEMA Section 24(3) provides the basis for the development of Environmental Management Frameworks, for which regulations have been published (R547 of 2010) (DEA, 2010). An EMF is an environmental planning tool that highlights environmentally sensitive areas, and specifies areas

where certain land uses are most compatible or incompatible with environmental opportunities and constraints in the landscape. It deals with 'environment' in the broad sense, including the biophysical, socio-economic and cultural environment as well as heritage and sense of place.

FEPAs are an environmental attribute that should inform the determination of environmental sensitivity in an EMF, with restrictions on any deterioration of ecological condition within FEPAs, and appropriate restrictions on land-use in sub-quaternary catchments associated with FEPAs.

5.4.3 Biodiversity offsets, including wetland mitigation banking

A biodiversity offset is a condition attached to an environmental authorisation, requiring the applicant to offset loss of biodiversity as a result of the proposed development by securing or rehabilitating biodiversity of equivalent or greater value elsewhere. A national biodiversity offsets policy framework is currently being developed, led by the Department of Environmental Affairs with technical support from SANBI.

In implementing biodiversity offsets, the hierarchy of avoiding, minimising, mitigating and remedying impacts should be followed. A biodiversity offset is considered a remedy, in other words a last resort to compensate for impacts that cannot be avoided, minimised or mitigated. Biodiversity offsets for impacts on FEPAs may be appropriate in some cases and may involve offsite rehabilitation. In cases where a FEPA is the last remaining option for meeting a biodiversity target, the impact should preferably be avoided i.e. a biodiversity is not likely to be appropriate. FEPAs should be considered as receiving areas for biodiversity offsets.

5.5 Implementation mechanisms related to the Integrated Coastal Management Act

The National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008; RSA, 2008a) includes a number of provisions that can be supported by FEPA maps. Among them are the development of a national estuarine management protocol and estuarine management plans (Chapter 4 of the Act), and the development of national, provincial and municipal coastal management programmes (Chapter 6 of the Act).

The development of a national estuarine management protocol, which will provide strategic guidance on the management of estuaries, was underway at the time of writing, led by DEA's Oceans and Coasts branch. This protocol should reinforce the national set of priority estuaries identified in the National Biodiversity Assessment 2011 (Van Niekerk and Turpie, 2011). As discussed in Section 2.2, these priority estuaries have been identified as estuary FEPAs.

The development of estuary management plans in terms of the Integrated Coastal Management Act should be prioritised for estuary FEPAs (i.e. for national priority estuaries). A generic framework for estuarine management plans is available (CSIR, 2009). It includes nine supporting documents that give additional guidance on specific estuary management issues such as water quality and fishing. The framework and supporting documents are available on the CSIR's website (www.csir.co.za).

National, provincial and municipal coastal management programmes must be developed for the coastal zone and must set out objectives and priorities for coastal management, including identifying sensitive coastal areas that should not be developed. The coastal zone is often under high pressure and subject to accumulated impacts from upstream catchments and surrounding land, which impacts directly on coastal freshwater ecosystems. Coastal management programmes should highlight river and wetland FEPAs that occur within the coastal zone, as well as estuary FEPAs, and should take into account the need for their management and protection as well as monitoring. FEPAs within the coastal zone should be treated in a similar way to other sensitive coastal habitats. The freshwater ecosystem management guidelines in Chapter 6 provide further detail that may be useful for coastal management programmes.

5.6 Implementation mechanisms related to the Municipal Systems Act

The Local Government: Municipal Systems Act (Act No. 32 of 2000; RSA, 2000) requires that municipalities develop Integrated Development Plans (IDPs) and Spatial Development Frameworks (SDFs).

5.6.1 Integrated Development Plans

The IDP is a comprehensive five-year plan for a municipal area that gives an overall framework for development, land use and environmental protection. It reflects multi-sectoral planning at the municipal level, and must comply with the 'Environmental Right' of the Constitution (Section 24) and the NEMA principles. In order to ensure environmental sustainability, an IDP usually includes an Environmental Sector Plan (or Integrated Environmental Management Programme). Part of the Environmental Sector Plan can comprise a range of environmental management tools to promote sustainability and compliance with various pieces of legislation. FEPA maps should be used as the input from the biodiversity sector into the Environmental Sector Plan.

IDPs should also include a Water Services Development Plan. However, this is often a gap in IDPs. To the extent that IDPs do deal with water-related issues, they tend to focus on issues of water provision, sanitation and water treatment works, and not on issues related to the health of freshwater ecosystems.

In identifying the development path of the municipality, IDPs should take account of FEPAs and their associated sub-quaternary catchments in the following ways:

- IDPs should use FEPA maps to help identify potential sites for projects such as local economic development and rural development projects, for example clearing invasive alien plants and rehabilitating wetlands. Such projects could form part of the Expanded Public Works Programme (see Section 0 and 5.8.2).
- IDPs should be aware of which land uses are not compatible with maintaining the ecological condition of FEPAs (see Section 5.6.2)

If consultants are employed to develop or review the IDP, it is important that their terms of reference explicitly refer to the need to reflect freshwater ecosystem priorities in the IDP and to use the FEPA maps to inform the IDP in the ways listed above.

5.6.2 Spatial Development Frameworks

The SDF is a compulsory core component of an IDP that must guide and inform land development and management by providing future spatial plans for a municipal area. SDFs indicate desired patterns of land-use and provide strategic guidance in the location and nature of development. The SDF should be the spatial depiction of the IDP, and should be the tool that integrates spatial plans from a range of sectors. In practice SDFs tend to focus on towns within the municipality and to deal with the rural parts of the municipality in less detail.

If a biodiversity sector plan or bioregional plan (see Section 5.2.2) exists and takes FEPAs into account, then that plan should be used in the SDF. Otherwise, FEPA maps should be used directly.

To ensure that river and wetland FEPAs stay healthy, sub-quaternary catchments within the municipality can be zoned for varying degrees of use and impact. For example, FEPAs should be zoned for low impact activities; surrounding secondary zones can allow moderate impact activities; and heavily impacting activities such as high-intensity agriculture, plantation forestry and mining, should be restricted to high impact zones. In addition, buffers of natural vegetation around all freshwater ecosystems support the maintenance of healthy freshwater ecosystems (see Section 5.7.5).

FEPA maps should inform SDFs in the following ways:

- FEPAs should be reflected spatially in the SDF report (i.e. the FEPA map should be included, or the relevant biodiversity sector plan or bioregional plan if it incorporates FEPAs).
- FEPAs should be used to inform the desired patterns of land use set out in the final SDF map which integrates information and priorities from different sectors.
- Any land use planned by the municipality in their SDF should be consistent with the management objectives of FEPAs, i.e. FEPAs should be reflected in spatial planning categories or zones with appropriate restrictions on land uses.
- Ecological corridors along large river corridors and wetland clusters should be established and managed.
- In some cases it may be appropriate to incorporate FEPAs in the municipal conservation network.

If consultants are employed to develop or review the SDF, it is important that their terms of reference explicitly refer to the need to include freshwater ecosystem priorities in the SDF and to use the FEPA maps to inform the SDF in the ways listed above.

5.7 Other implementation mechanisms

5.7.1 Mountain Catchment Areas Act

The Mountain Catchment Area Act (Act No. 63 of 1970; RSA, 1970) recognises the important roles of mountain catchment areas and provides for their conservation, use, management and control. It focuses on integrated catchment management, and provides a range of instruments to enable co-operation and the involvement of private landowners. However, there is lack of clarity about the status of the Act, and no consensus on its administration or on the responsible regulating authority for mountain catchment areas.

A key recommendation of NFEPA is that the Mountain Catchment Area Act be revitalised, that clarity on responsibility for its implementation be achieved, and that further mountain catchment areas be proclaimed. High water yield areas identified by NFEPA (see atlas) should be considered priorities for declaration as mountain catchment areas, given the vital role they play in water provision.

The National Protected Area Expansion Strategy 2008 (Government, 2010) notes that the status of the Mountain Catchment Areas Act is an important matter to resolve, given the significant contribution that mountain catchment areas make to protected area targets and their important role in providing ecosystem services.

5.7.2 Mining-related implementation mechanisms

The Department of Mineral Resources (DMR) is the responsible national authority for granting mining application permits. In addition, NEMA and the National Water Act stipulate that a party responsible for a mining operation has to take all reasonable measures to prevent pollution or degradation from taking place. According to the Mineral and Petroleum Resources Development Act (Act No 28 of 2002; RSA, 2002), the holder of a mining right or permit is responsible for any environmental damage and pollution and the rehabilitation of the environment affected by mining to its natural state until a closure certificate has been issued. Some shortcomings of this Act have been addressed in the Mineral and Petroleum Resources Development Amendment (Act No. 49 of 2008; RSA 2008b).

Impacts of mining on freshwater ecosystems

Impacts on freshwater ecosystems are varied and depend on: the type of terrain and associated climatic features (including the scarcity of water); the type of rock and ore being mined; the stage of mining activity; the scale of the mine; and the efficiency and effectiveness of any environmental management systems that are deployed by mine management. Most mining operations share similar sets of activities or materials that generate contaminants and lead to pollution of surface water resources. Water quality changes are widely considered to be the most significant consequence of mining activities, although water quantity is also an issue particularly in catchments where water demand is high relative to availability. Table 2 summarises the potential environmental impacts associated with different phases of mining activities. Six key areas of impact that mining may have on water resources are:

- ***Acid mine drainage***: When iron sulphides (often associated with minerals such as gold, coal and nickel) are exposed to the atmosphere during mining and excavation, they react with oxygen and water to form sulphate, resulting in acid mine drainage. Certain bacteria promote this reaction. Potential sources of acid mine drainage include surface runoff from open cast mining areas, seepage from leach ponds, runoff from residue dumps or ore stockpiles, and drainage from underground workings. The low pH has several direct ecological consequences, killing aquatic plants and animals, and inhibiting ecological processes (e.g. photosynthesis and nutrient cycling). More importantly acid mine drainage may initiate the release of heavy metals into the water. These heavy metals can affect human health and crops, as well as the health of freshwater ecosystems and associated biota. They include: aluminium, beryllium, cadmium, copper, cobalt, chromium, mercury, manganese, nickel, lead, vanadium, zinc, cobalt, iron, magnesium, nickel and uranium.

- ***Release of metals:*** Apart from acid mine drainage, various other processes associated with mining (e.g. salinisation, altered flow regimes and sedimentation) alter the proportion of different forms of metals, which have varying levels of toxicity to humans and stream biota.

- ***Addition of cyanide:*** This highly toxic substance is used in the gold refining process and is left behind in tailings dams (residue/waste ponds) once the gold is retrieved. Depending on where these tailings dams are situated, this may seep into surface-water and/or groundwater systems.

- ***Siltation:*** Mining operations produce large quantities of dust and finely powdered rock, which become mine dumps. Plants often fail to establish on these infertile dumps, and fine particles are removed by rain and wind action into nearby rivers and wetlands, leading to a build up of suspended solids and ultimately siltation.

- ***Water use:*** Mining operations are major users of water. In arid and semi-arid areas such as South Africa, the quantity of water used by a mining operation places it in direct competition for water with other water users, especially domestic, agriculture and the aquatic environment. This “competition” becomes heightened when the mining operation is also responsible for any deterioration in water quality as a result of effluent discharges.

- ***Reduced groundwater quality and quantity:*** Groundwater quality is affected by the inappropriate placement of mining waste disposal facilities such as tailings dams and slurry ponds on surface or in open pits. These not only lower water quality, but can also change the rate and direction of groundwater movement. Most of the changes in groundwater quantity that are attributed to mining are linked to dewatering activities, where the mines extract large volumes of water are removed and discharged into surface streams and rivers so that the underground mining operation may proceed. The environmental effects of dewatering include lowering of water tables (which in turn can affect wetlands and riverine vegetation), the formation of sinkholes and localized subsidence.

Using FEPA maps in mining authorisations

The Department of Mineral Resources is the responsible authority for granting an environmental authorisation prior to the issuing of a mining permit or right. FEPAs provide mining decision-making processes with a strategy for freshwater ecosystem management and conservation by identifying areas where mining operations will result in significant loss of freshwater biodiversity. In almost all cases, mining in or near a river or wetland, or in the associated sub-quaternary catchment, is not consistent with maintaining an A or B ecological category. DMR should collaborate with the DWA and DEA in assessing the impacts of a mining application on the condition of FEPAs, Fish Support Areas and Upstream Management Areas. Two pieces of legislation, NEMA and the National Water Act, are particularly pertinent:

Environmental authorisations and environmental management programmes in terms of NEMA: The mining permit or right applicant has to draw up an environmental management programme before an environmental authorisation can be issued. The impact of all stages of the mining life-cycle should be assessed including prospecting, mine construction and testing, mine operations, stockpiling and refining, waste management, transport and mine closure. Even though prospecting occurs at a much smaller scale than the operational stage, activities at multiple sites within a region can have a large cumulative impact on the condition of the resources, usually resulting in a degradation of ecosystem condition. The impact of mining-related activities on downstream and downwind FEPAs should also be assessed.

Water management and pollution control: All water use associated with mining operations has to be authorised by DWA before the water use activity can commence. An assessment of the impacts of mining-related activities on water and freshwater ecosystems should form part of the environmental assessment report and the environmental management programme. The location of residue stockpiles, residue dumps and tailings dams should be carefully evaluated with regard to the likely pollution of water resources through, for example acid mine drainage and seepage into water resources.

Table 2: Overview of the potential environmental impacts associated with different phases of mining activities (from Ashton *et al.*, 2001)

Mining phase	Activities	Potential environmental impacts
Exploration and Surveying (Prospecting)	• Geochemical, geophysical and airborne surveys • Drilling and trenching • Blasting of exploration adits • Exploration camp housing • Vehicle and machinery parks, fuel points and service bays • Access road construction • Waste disposal (garbage) • Camp sanitation systems	• Vegetation removal, damage and destruction • Habitat disturbance due to noise / vibration • Disturbance to wildlife and local residents • Soil erosion along trenches and transects • Dumping of drill cores and waste • Demand on local water resources • Discharge or spillage of contaminants • Contamination of local ground waters by drilling muds and exposed ores • Restricted public access

Mining phase	Activities	Potential environmental impacts
Mine development start-up; sourcing and stockpiling of raw materials	• Mine construction • Stripping / storing of soil "overburden" • Installation of power lines • Surveying and levelling of sites for buildings and plant • Installation of mine and surface water treatment plants • Construction of mine facilities, offices and roads • Construction of processing plant, smelter and refinery • Construction of storage facilities • Landscaping of site • Construction of staff housing, infrastructure and recreational facilities • Construction of railway lines and sidings	• Fauna and flora habitat loss and disturbance • Reduction in biodiversity on site • Potential loss of heritage sites • Decreased aesthetic appeal of site • Altered landforms due to construction • Altered drainage patterns and runoff flows • Increased erosion of site area • Increased siltation of surface waters • Contamination of surface and ground waters by seepage and effluent discharges • Discharge of contaminants via mine de-watering activities • Methane emissions from mine contributes to greenhouse gases • Increased demand on local water resources • Seepage / discharge of acid rock drainage • Ground and surface water contamination from seepage and radionuclides • Contamination from fuel spills and leakages • Increased demand for electrical power
Removal and storage of ores and waste materials	• Stripping / storing of soil "overburden" • Waste rock stockpiles • Low grade ore stockpiles • High grade ore stockpiles	• Land alienation from waste rock stockpiles and disposal areas • Disturbance from vehicle and machinery noise and site illumination • Acceleration of acid rock drainage through exposure of ores to air and water • Spontaneous combustion of coal fines • Increased erosion and siltation of nearby surface waterbodies (rivers and lakes) • Contamination of local ground waters
Blasting, milling and grinding	• Blasting of rock to release ores • Transport of ore to crusher • Extraction and preliminary crushing of ore • Milling and grinding of ore • Flotation and chemical concentration / leaching of ore and final product • Transport of ores to smelter	• Ground surface disturbance • Disturbance due to noise and vibrations • Dust and fumes from explosives, mine vehicles and transportation systems • Contamination from explosive residues • Discharge of contaminated water • Windborne dust and radionuclides • Sulphur dioxide emissions from roasters and acid plants • Metal vapour emissions from smelters
Smelting, refining and beneficiation	• Mineral processing through smelting, roasting and other methods for refining ore • Replenishment of refinery plant processes /solutions • Stockpiling of final product	• Discharge of contaminants to air, including heavy metals, organics and SO_2 • Leakages from electrolytic plant leading to site contamination • Spillage of corrosive liquids • Requirement for electrical power

Mining phase	Activities	Potential environmental impacts
Transport of final product to markets	• Packaging / loading of final product into transportation • Transport of final product via rail link	• Disturbance due to noise, vibration and site illumination • Dust and fumes from exposed product stockpiles
Mine closure and post-operational waste management	• Decommissioning of roads • Dismantling buildings • Reseeding/planting of disturbed areas • Re-contouring pit walls/waste dumps • Water quality treatment • Fencing dangerous areas • Monitoring of seepage	• Subsidence, slumping and flooding of previously mined areas • Underground fires in abandoned coal mines • Acid rock drainage from exposed ores • Continuing discharge of contaminants to ground and surface water via seepage • Fauna and flora habitat loss and disturbance • Windborne dust, including radionuclides • Dangerous areas that pose health risks and possible loss of life (e.g. shafts, pits, etc.)

5.7.3 Agriculture-related implementation mechanisms

Agriculture has major impacts on freshwater ecosystems. Irrigated agriculture is extremely water intensive, currently using over 60% of South Africa's water. In addition, impacts of agriculture often include the following: clearing or wetlands (especially floodplains) for cultivation or grazing; damming of wetlands; and removing natural vegetation from river banks for cultivation (e.g. by ploughing or bulldozing). Removing natural vegetation from river banks causes erosion, and also reduces filtering capacity of the riparian area and riverine vegetation, which means that more pesticides and herbicides end up in the river, reducing water quality. Floodplains are often fertile areas that are targeted for cultivation. Barriers put up to prevent the river from accessing the cultivated floodplain alter the flow of the river and cause erosion, which can cause severe drops in the water table and reduce water availability on the surrounding land.

The Department of Agriculture, Forestry and Fisheries (DAFF) is the responsible national authority. The Conservation of Agricultural Resources Act (Act No. 43 of 1983; RSA, 1983) (CARA) provides for control over the utilisation of natural agricultural resources in order to promote the production potential of the land, conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants. Regulation 7 of CARA deals specifically with the utilisation and protection of vleis, marshes, water sponges and watercourses. The Conservation of Agricultural Resources Act will be replaced by the Sustainable Utilisation and Protection of Agricultural Resources Bill, which is currently under development.

FEPAs should inform the granting of **permits for cultivation of virgin land**. Cultivation permits should not be granted in wetland FEPAs or their buffers, in the buffers of river FEPAs, or in the wetlands and streams that drain into river FEPAs or the buffers of those wetlands and streams. See Chapter 6 for more detailed management guidelines related to agricultural activities in FEPAs and associated sub-quaternary catchments.

The National Land Care Programme. This is a community-based and government-led initiative aimed at improving the ability of land users and communal farmers to manage their natural resources in a sustainable and self-reliant manner. FEPAs should help to inform priority areas for LandCare activities, including clearing of invasive alien plants and associated rehabilitation of river banks. Some LandCare activities, such as construction of berms and barriers to river flow, may be detrimental for freshwater ecosystems, and should be carefully assessed, especially in FEPAs and associated sub-quaternary catchments.

5.7.4 Regulation of aquaculture

Aquaculture includes the breeding, stocking and trade of fish for recreational or commercial purposes. It can be highly destructive for freshwater ecosystems, in part because it usually involves invasive alien fish, and in part because it generates waste that is harmful to ecosystem functioning and water quality if not treated properly.

Invasive alien fish, such as trout, bass and carp, disrupt ecosystem functioning and are the number one threat to indigenous fish species. Invasive alien fish are now extensive in most large rivers in South Africa, and impact on indigenous freshwater plants and animals through altering habitats, competing for resources and eating indigenous plants and animals. They have led to local extinctions of indigenous fish species in some river systems, and have also been associated with loss of invertebrates such as dragonflies. Un-invaded streams (often the smaller tributaries of large rivers) frequently serve as the last remaining refuges for indigenous freshwater species.

The following guidelines are recommended for the regulation of aquaculture:

- All aquaculture facilities should be **off-stream**, whether or not they are in a FEPA, to prevent direct impacts on rivers.
- Even when they are off-stream, invasive alien fish can still escape from aquaculture facilities, and no facilities can ever be considered to be completely escape-proof. The **choice of species** is therefore a critical aspect to enable environmentally friendly aquaculture production. If the species can establish in the local catchment or the wider river system and have an environmental impact, it should not be allowed. Other species should be considered, or another location should be found where the species will not have an impact. The invasive alien species may be allowed for aquaculture if the local catchment has already been invaded, unless it has been earmarked for future rehabilitation for threatened species.
- Another important consideration is **natural or human-made barriers to fish movement**. Invasive alien fishes can often be allowed below a migration barrier, but should be excluded from areas where indigenous fish populations survive or where there are good opportunities for rehabilitation. Before barriers such as weirs are constructed, an assessment of their environmental impact on the entire freshwater ecosystem should be done.
- There are already large numbers of sub-quaternary catchments that have been invaded by invasive alien fish suitable for recreational angling or commercial use. Any new aquaculture

facilities for fisheries developments should be located in these sub-quaternary catchments, and **should not be permitted in currently un-invaded sub-quaternary catchments**.

When the alien and invasive species regulations are finalised (see Section 5.2.5), they will include maps for most of the economically important species, showing three categories of areas:

- areas delineated for future economic development,
- restricted areas where more information is required before permits can be issued,
- areas where the alien fishes will be prohibited to protect indigenous aquatic biodiversity and freshwater ecosystems.

FEPA maps in combination with the alien and invasive species maps and regulations for the management of activities associated with invasive alien fishes, will provide conservation authorities with much more advanced information than what was previously available. This will support better decision-making to allow for sustainable and environmentally friendly fisheries and aquaculture development, whilst at the same time protecting South Africa's rich aquatic biodiversity heritage.

Preventing invasions of alien fish in un-invaded streams is crucial, as controlling or eradicating invasive alien fish is difficult and expensive. Weirs can be useful for preventing upstream invasions, although an assessment of the environmental impact of the weir to the entire freshwater ecosystem should be done prior to construction.

5.7.5 Delineation of buffers for rivers and wetlands

Buffers of vegetation, especially natural vegetation, around rivers, wetlands and estuaries protect freshwater habitats and their associated plants and animals. They are known to filter pollutants from the surrounding landscape thereby helping to avoid deterioration in water quality of the river or wetland. For example, in the hard-working Olifants catchment in Mpumalanga Province, riparian buffers have been shown to significantly improve water quality and mitigate the impacts of mining activities in the catchment (Oberholster *et al*., 2009).

For this reason, buffers around rivers, wetlands and estuaries are a common mitigation measure recommended in environmental impact assessments in terms of NEMA. Although there is no legislation regarding buffers around rivers or wetlands in the National Water Act, the application of buffers is aligned to sustaining water quality, and may therefore be applied to water use applications. The Integrated Coastal Management Act recommends that the 5m contour line be used as a buffer applied around all estuaries.

The width of a buffer around a river or wetland depends on many factors such as the risk the proposed development poses to the water resources and receiving environment, the sensitivity of the water resource to diffuse-source impacts, the impact on other water users, and the requirements of the associated biodiversity – to name but a few.

A national protocol for buffer determination around rivers, wetlands and estuaries has been developed to provide guidance on the width of a buffer (MacFarlane *et al*., 2010). It is a spreadsheet tool that scores a river, wetland or estuary according to the risk posed by the proposed development and the ability to reduce this risk if appropriate mitigation measures are implemented. The risk posed by the development is based on factors such as a threat rating for the type of activities (e.g.

mining, building a freeway, planting an irrigated crop), and the sensitivity of the water resource (e.g. conservation importance, slope, susceptibility to soil erosion). The tool can be applied at a low-confidence desktop level or a higher confidence site-based level. Determining the width of a buffer to a reasonable level of confidence requires a site visit and collection of specific information. Buffer determination at the site-based level requires that wetlands and riparian areas are accurately delineated – a minimum mapping scale of 1:10 000 is recommended, rather than a 1:50 000 scale which is considered too coarse.

Ideally, river and wetland FEPAs and Fish Support Areas should be flagged for buffer determination at the site-based level. The national protocol for buffer determination must be followed when available (MacFarlane *et al*., 2010). At a minimum (i.e. whether desktop or site-based), the biodiversity requirements of FEPAs should be regarded as high and the buffer width should be adjusted to take this into account. Where specific species and habitat requirements are known, these should be factored in (e.g. the presence of species that require habitat connectivity). A precautionary approach should also be adopted for reducing buffer width through estimating the effectiveness of mitigation measures. For Upstream Management Areas, buffer widths should be sufficiently wide to ensure that water quality issues that may arise from the proposed development do not impact downstream FEPAs and Fish Support Areas.

In the absence of a national protocol, a generic 100m buffer should be established around river and wetland FEPAs and Fish Support Areas. This 100m buffer is considered adequate from a water quality perspective in providing functional filtering capacity to the river or wetland. However, additional biodiversity information should be taken into consideration to ensure that the buffer adequately addresses risks to the receiving environment, e.g. Wattled Cranes require large areas of connected natural habitat around wetlands and a 100m buffer will be insufficient in this case. This generic buffer has the potential to be reduced following a site-based level assessment and consideration of risk of proposed development and the proposed mitigation measures.

5.7.6 National Planning Commission

The National Planning Commission was established to improve government's long-term planning efforts and to mobilise society around a common set of objectives and priorities to drive development over the longer term. The Commission will address a series of key cross-cutting issues, one of which is "conservation, biodiversity and climate change mitigation and adaptation". It will be important that biodiversity in freshwater ecosystems is adequately addressed in that investigation.

The NFEPA maps showing density of FEPAs per Water Management Area (see atlas) provide a strategic national perspective on which Water Management Areas are most important for supporting the ecological sustainability of freshwater ecosystems. This strategic national perspective is a useful starting point for discussing whether fiscal or other mechanisms may be appropriate to support Catchment Management Agencies in Water Management Areas with high densities of FEPAs to achieve national goals for managing and conserving freshwater ecosystems.

5.7.7 Provincial spatial biodiversity plans

Provincial spatial biodiversity plans identify spatial priority areas for terrestrial and aquatic ecosystems. They inform land-use planning and land-use decision-making (including EIAs) and form the basis for provincial protected area expansion strategies.

These plans are not referred to directly in the Biodiversity Act but they underpin biodiversity sector plans and bioregional plans (see Sections 3.15 and 5.2.2). Priority Action 16 of the National Biodiversity Framework encourages provinces to develop provincial spatial biodiversity plans.

Provincial spatial biodiversity plans should use FEPA maps as the basis for their freshwater component as follows:

- FEPAs should be favoured in the identification of Critical Biodiversity Areas and Ecological Support Areas. All river and wetland FEPAs should at least be considered to be Ecological Support Areas.
- Ecological corridors along large river corridors and wetland clusters should be established and managed.
- If a province already has its own finer-scale freshwater input layers and priorities, these can be used to refine priorities identified in FEPA maps. If not, such finer-scale data can be gathered to improve on existing data:
- Wetland delineation can be improved by manual mapping either using desktop imagery or in the field.
- A more detailed river network, e.g. 1:50 000, can be used.
- Mapping of wetland and river condition can be improved upon. In transformed landscapes condition will drive the selection of areas (by virtue of the fact that few choices of selecting good condition ecosystems exist).
- Explicit targets for species other than fish can be included.
- River ecosystem types can be refined.

For more detailed discussion of how to integrate FEPA maps into provincial spatial biodiversity plans, biodiversity sector plans and bioregional plans, see the technical report.

5.8 Using FEPA maps in programmes for rehabilitation, conservation and management of freshwater ecosystems

Several programmes exist that focus on rehabilitation, conservation and management of freshwater ecosystems, undertaken by a range of government and civil society role players. FEPA maps can provide a common framework for prioritising efforts, so that resources of different programmes can be clustered or layered in agreed priority areas, with potential for synergies and enhanced impacts of these combined interventions.

5.8.1 Working for Water

The Working for Water programme spearheads the fight against invasive alien plants that threaten South Africa's biodiversity, water security, the ecological functioning of natural systems and the productive use of land. Working for Water forms part of government's Expanded Public Works Programme which strives to draw unemployed people into the productive sector of the economy.

The programme is globally recognised as one of the most outstanding environmental conservation initiatives on the continent (it has achieved 25 international awards). It enjoys sustained political support for its job creation efforts and the fight against poverty.

FEPA maps, along with a range of socio-economic factors, can inform prioritisation of Working for Water's activities. The most important FEPA map categories to prioritise are river FEPAs and associated sub-quaternary catchments, high water yield areas, and high groundwater recharge areas.

5.8.2 Working for Wetlands

Working for Wetlands champions the protection, rehabilitation and sustainable use of South Africa's wetlands through co-operative governance and partnerships. It forms part of government's Expanded Public Works Programme.

FEPA maps, along with a range of socio-economic factors and management considerations, can inform prioritisation of Working for Wetlands' activities. The most important FEPA map categories to prioritise are wetland FEPAs and wetland clusters. Because there are so many small wetland FEPAs around the country, a pragmatic starting point may be to focus especially on wetland clusters with a high proportion of wetland FEPAs, and/or wetlands that have a rank of 1 or 2 (see Section 2.2 and the wetland shapefile, which includes an attribute giving wetland ranks).

5.8.3 Adopt-a-River Programme

The Programme's aim is to create awareness and an understanding amongst all South Africans of the need to care for our scarce water resources and to facilitate their participation in the protection and management these resources in an integrated manner.

There may be opportunities for free-flowing rivers and river FEPAs to inform the selection of rivers for this programme.

5.8.4 NGO-led freshwater conservation programmes

Several conservation NGOs have programmes that focus on freshwater ecosystems, notably WWF South Africa (a partner in the NFEPA project) and the Endangered Wildlife Trust (EWT). FEPA maps can provide a useful starting point for prioritising the efforts of NGOs, which often face the challenge of limited resources in relation to the number of the opportunities that exist for action and engagement.

WWF South Africa

WWF-SA has a programme of work on catchment and freshwater conservation in South Africa, working with government, business and individuals to protect and conserve our freshwater heritage. This work is informed by the best available knowledge and science and WWF initiates concerted efforts in catchments where the most impact can be achieved.

FEPA maps are a critical planning tool that summarises our knowledge of conservation needs and will help direct critical catchment conservation campaigns. The national overview provided by NFEPA will be used by WWF in advocating planning for sustainable growth with national and local government and business. WWF's initiatives work with agriculture and mining to minimise impacts in our most important water source areas and vulnerable catchments, and NFEPA clearly shows at a national level where these conservation efforts should be focused. These maps will support WWF in achieving its goal of mainstreaming good water stewardship into the development agenda in South Africa. WWF will use these maps to catalyse collective action at the catchment level by using these and other tools to engage key stakeholders. FEPA maps will specifically inform WWF's work with large water users in priority catchments, to help them understand their water related risks and how they can work with other stakeholders to mitigate their shared risks.

EWT's Healthy Rivers Programme and African Crane Conservation Programme

These EWT programmes actively address the need to conserve threatened freshwater species and ecosystems, through linking a range of stakeholders involved in various aspects of river and wetland health and ecology. Focused projects are developed and executed in key areas to implement conservation action along entire catchments and in key wetlands. Public awareness of river and wetland ecosystem health and water conservation is a priority focus as well as opposition to inappropriate developments and promotion of "best practice" measures to ensure that river and wetland systems are not adversely affected.

The EWT Healthy Rivers Programme's Crocodile-Marico Catchment Conservation Project has already used FEPA maps to prioritise its efforts and is aiming to secure the headwaters of the Groot Marico River (one of the flagship free-flowing rivers identified by NFEPA) through biodiversity stewardship (see Section 5.3.3). This project also intends to secure other FEPA areas in the catchment through biodiversity stewardship to expand the network of protected areas in the future. The EWT's African Crane Conservation Programme provided much-needed data on existing wetlands and threats to key wetlands and is continuing with efforts to protect and secure key wetland areas, notably the Chrissiesmeer wetland system, in partnership with various other stakeholders in the area.

5.8.5 Business and biodiversity initiatives

Business and biodiversity initiatives work with the private sector to manage living landscapes, e.g. the Biodiversity and Wine Initiative, Green Choice, and Water Neutral (www.wwf.org.za). These initiatives focus on implementing mechanisms in production landscapes to protect remnant habitats or threatened species, and to manage ecological processes that maintain functioning landscapes (e.g. ensuring connectivity of natural habitat in the landscape, ensuring that buffers are employed to mitigate the impacts of land-based activities).

All FEPA map categories (river and wetland FEPAs, wetland clusters, Fish Support Areas and Upstream Management Areas) should be considered in formulating a strategy that identifies catchments, or specific rivers and wetlands, on which to focus. While it is desirable to prioritise action in FEPAs, this may not be a very useful option for production landscapes. This is because rivers and wetlands in production landscapes are often modified, which means there is often only a limited number of FEPAs these landscape (only ecosystems in a natural or near-natural condition are chosen as FEPAs). Wetland clusters, Fish Support Areas and Upstream Management Areas are likely to be more common map categories in production landscapes and should therefore also be used in determining priority areas for action. Improvements that can be made to water quality and quantity (e.g. through clearing of invasive alien plants, replanting of riparian vegetation) in Upstream Management Areas will contribute to the management and conservation of downstream FEPAs.

Determining strategic priority areas for action will ultimately depend on the objectives of a specific business and biodiversity initiative. In identifying priority areas on which to focus, the following FEPA map categories are recommended in order of importance:

- Where river and wetland FEPAs exist in a production landscape, they should be weighted highest in influencing the identification of priority areas;
- Fish Support Areas for critically endangered and endangered fish species (denoted by the red fish) are the next most important;
- The remaining Fish Support Areas and all Upstream Management Areas are next in the list, and both should receive an equivalent rating. There are many Upstream Management Areas in the FEPA maps. Arguably, those Upstream Management Areas with the highest pressures from the surrounding landscape could be identified and given a higher importance than other Upstream Management Areas.

In determining strategic priority areas for action, FEPA maps should ideally be augmented with other biodiversity information at finer scale (e.g. maps of Critical Biodiversity Areas and Ecological Support Areas, wetlands delineated at finer scales, threatened plants and animals other than indigenous freshwater fish).

NFEPA products also have the potential to be used in business and biodiversity initiatives to provide justification and context for the geographic areas within which the initiative currently works. If any of the above FEPA map categories occur in areas where current projects are underway, this lends support to the importance of the area in terms of its freshwater ecosystems.

The freshwater ecosystem management guidelines in this manual (Chapter 6) provide more specific recommendations for managing different FEPA map categories.

5.8.6 Payments for Ecosystem Services

Payments for ecosystem services involve payments from a willing buyer to a willing seller for an ecosystem service (such as water provision, carbon sequestration, biodiversity conservation or a combination of these) or a land use likely to secure the ecosystem service. Internationally, the most common ecosystem services sold through PES schemes are watershed services, sometimes bundled with carbon and biodiversity services. The kinds of land use or land management that landowners

are paid for are, for example, clearing invasive alien plants, preventing soil erosion by employing suitable grazing and burning regimes, or keeping natural habitat intact by foregoing other opportunities such as cultivation of crops. PES can be an effective tool for protecting the provision of ecosystem services, conserving biodiversity, and, depending on how the programme is designed, contributing towards poverty alleviation and rural development.

Several pilot projects are currently underway in South Africa to test the feasibility of PES and to learn lessons about how PES could be implemented more widely. Initial discussions about the development of a national mechanism to support PES are underway. These discussions should explore whether PES may be able to play a role in financing CMAs with a high proportion of FEPAs.

5.9 Using FEPA maps in monitoring freshwater ecosystems

Water resource and freshwater ecosystem monitoring often gets a raw deal especially when faced with limited finances and capacity. However, sound scientific monitoring with results that are communicated effectively and transparently can be a powerful positive basis for participatory water resource management. Effective monitoring can be a powerful way of quantitatively demonstrating effective service delivery and facilitating informed decision-making relating to freshwater ecosystem management. It can also facilitate and encourage collaboration between the wide range of stakeholders involved in freshwater ecosystem management.

The location of FEPAs should inform the design of national, regional and local monitoring programmes (e.g. relating to water quality, water quantity, habitat and biota). In particular, FEPA maps can help prioritise the location of monitoring points (e.g. within, downstream and upstream of FEPAs). In some cases they may also help to identify appropriate monitoring variables.

River and wetland FEPAs can be considered the closest we have to reference condition for these ecosystems. The collection of baseline data from these systems should be a priority for initiatives such as the River Health Programme (see Section 5.9.1), provincial wetland forums, etc.

Where the Reserve has been determined, Reserve monitoring programmes should be developed, as described for Intermediate and Comprehensive Reserve Determination procedures. The purpose of Reserve monitoring is (DWAF, 2008a):

- To ensure ecological objectives are being met (in terms of ecological categories and ecological specifications, or EcoSpecs),
- To identify the causes of potential problems,
- To determine the required actions according to a monitoring Decision Support System, if ecological objectives are not met.

Provincial conservation authorities have a crucial role to play in monitoring the health of freshwater ecosystems, especially FEPAs, as discussed in Section 4.5. This should be undertaken in close collaboration with the River Health Programme. Most River Health Programme monitoring sites are currently not on FEPAs, so in some cases provincial conservation authorities may choose to focus on monitoring FEPAs while the River Health Programme focuses on other sites. In other cases provincial conservation authorities and the River Health Programme may choose to combine teams to sample

FEPA sites and other sites. As discussed below, the River Health Programme should be strengthened and expanded.

5.9.1 River Health Programme

The River Health Programme is a national monitoring programme of DWA initiated in response to the need for information on the ecological state of aquatic ecosystems (http://www.dwaf.gov.za/iwqs/rhp/naehmp.htm) (DWAF, 2008b) . The purpose is to measure, assess and report on the general state of rivers at a national level with particular emphasis on habitat and biota. A key recommendation of NFEPA is to strengthen and expand the scope of the River Health Programme.

- **Strengthening the River Health Programme:** There is a need to seek ongoing investment from the national level to maintain the clusters of provincial departments and agencies that implement the River Health Programme and generate the State-of-Rivers reporting across the country. One of the primary objectives of the State-of-Rivers reporting is to provide information on the ecological state of South Africa's rivers to enable resource managers to make informed decisions and take appropriate action. This information must furthermore show whether previous decisions were successful or failed to improve river health. For this to happen, monitoring and reporting must be repetitive to reveal trends and to establish whether appropriate management actions have taken place and have been successful. State-of-Rivers reports are available for several catchments across the country and a frequency of reporting every three years is recommended. However, none of the catchments has been revisited for full follow-on surveys and reporting. It is therefore not possible to say with certainty whether the health of these rivers has improved or declined. The initial surveys and State-of-Rivers reports were facilitated with national assistance (both technical and financial) and were received with enthusiastic support from the regional agencies. The intention was that regions would initiate and lead their own follow-on reporting. However, this has not happened. A lesson is to seek some ongoing investment from the national level, as this could lead to significant returns.

- **Expanding the scope of the River Health Programme:** There are two issues to expanding the scope of the programme to better support freshwater ecosystem management and conservation:
    - ***Additional monitoring sites for monitoring the condition of FEPAs***. Currently, river health monitoring focuses on measuring cumulative impacts over entire catchments. Monitoring sites are therefore generally established on mainstem rivers which reflect cumulative impacts in the tributaries. Monitoring the health of river FEPAs and their associated Upstream Management Areas will require a minimum of one monitoring node within or immediately upstream of a river FEPA and its associated sub-quaternary catchment. River FEPAs and Upstream Management Areas should therefore be prioritised in identifying future monitoring nodes.
    - ***Extend the entire programme to wetlands.*** According the National Biodiversity Assessment 2011, wetlands and estuaries are the most threatened ecosystems in South Africa. It is critical to extend monitoring to wetlands, and to roll this out at a provincial

level, drawing on the model used by the River Health Programme. Wetland FEPAs should be prioritised in identifying nodes for monitoring wetland health.

6. Freshwater ecosystem management guidelines

PHOTO: K MURRAY

This chapter provides freshwater ecosystem management guidelines linked to FEPAs and their associated sub-quaternary catchments. The guidelines deal with inland wetlands and rivers, but do not include guidelines for estuaries. As mentioned in Section 5.5, a generic framework for estuary management plans is available, together with nine supporting documents dealing with specific estuarine management issues such as water quality and fishing (CSIR, 2009). The ecosystem management guidelines presented here also do not include guidelines for managing fish sanctuaries or free-flowing rivers. The development of management plans for fish sanctuaries is discussed in Section 2.4. Wherever possible free-flowing rivers should maintain their free-flowing character and should be managed as FEPAs.

6.1 Purpose of the ecosystem management guidelines

The purpose of these management guidelines is to provide recommendations on how to manage FEPAs appropriately. The guidelines provide additional detail to supplement the FEPA maps, focusing on:

- whether particular land-use practices or activities are compatible with the overall management objective for FEPAs,
- how to minimise the risk of impacting negatively on the condition of FEPAs when undertaking particular land-use practices or activities.

The recommendations given are general (i.e. they apply throughout the country) and can be used as the foundation for more detailed and regionally specific site assessments or management plans for particular river reaches, wetlands or sub-quaternary catchments.

The purpose of freshwater ecosystem management is to conserve biodiversity pattern (i.e. species numbers and distributions) and ecological processes (e.g. sediment supply, hydrological regime, organic matter inputs), and to maintain natural variability (Frissell and Bayles, 1996). Freshwater ecosystems are vulnerable to human activities throughout the catchment, and these activities can lead to irreversible damage (e.g. introduction of invasive alien plants, species extinctions) or to long-term, gradual, cumulative changes (e.g. accelerated erosion and sedimentation, pollution).

Management should aim to prevent the occurrence of large-scale damaging events, as well as the repeated, chronic, persistent, subtle events (which can have a more serious impact on ecosystems than the discrete large-scale events) (Frissell and Bayles, 1996). Ultimately, we want to manage the

stresses affecting FEPAs, and how these impact negatively on ecological pattern and processes, and reduce the risks that these represent.

A list of intended users of this implementation manual is given in Section 1.3. The ecosystem management guidelines in this chapter are likely to be especially useful for the following subset of users:

- environmental Assessment Practitioners and officials reviewing EIAs,
- officials and consultants involved in forward planning e.g. for stormwater management, placement of wastewater treatment works,
- officials involved in setting conditions attached to licences,
- those involved in proactive conservation and rehabilitation programmes.

Ecosystems are complex, and management of ecosystems needs to acknowledge that ecosystems do not behave predictably. Often the processes being managed are variable, and the end point is not a fixed state or even an equilibrium state. This inherent uncertainty means that those involved in managing freshwater ecosystems need to proceed even though the outcome is not certain, monitor closely, and adapt actions on the basis of this feedback. This requires a decision-making environment that supports adaptive management and learning by doing. (See the technical report for more on complex systems and the implications of complexity for management.)

6.2 How the management guidelines are structured

The guidelines link specific land-use practices and activities to three categories of stresses on rivers and wetlands. The land-use practices and activities highlighted in the guidelines are known to influence the drivers of ecosystem condition (hydrology, geomorphology, water quality), which in turn determine habitat attributes (e.g. habitat availability and condition), which in turn determine biological responses (Kleynhans and Louw, 2007).

The three categories of stresses are:

- changes in water quality,
- changes in water quantity,
- changes in habitat and biota.

The guidelines are structured according to these three stress categories, with a range of land-use practices and activities dealt with in each category. Some land-use practices or activities lead to changes in more than one of these stress categories, so when using the guidelines be aware that you may need look in more than one place to determine the management guidelines for a particular land-use practice or activity.

This approach of structuring the guidelines according to stress categories rather than land uses or activities aligns with the approach used in the guidelines for setting and monitoring resource quality objectives (DWA, 2011).

The units of management addressed by the guidelines are **wetland FEPAs** (including wetland clusters), **river FEPAs**, **sub-quaternary catchments associated with river FEPAs**, and **Upstream Management Areas**.

Buffers of vegetation, especially natural vegetation, are an important management tool for freshwater ecosystems, and are referred to frequently in the management guidelines that follow. A **generic buffer** of 100m should be established around wetland and river FEPAs. For wetland FEPAs, the buffer is 100m measured from the outside edge of the wetland. For river FEPAs, the buffer is the greater of the delineated riparian area or 100m measured from the top of bank. This **generic buffer can be refined** based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5. For more detail on the role of river and wetland buffers and their delineation see Section 5.7.5.

6.3 Management guidelines for wetland FEPAs

Overall management objective for wetland FEPAs:

Wetlands FEPAs that are in a good condition (equivalent to an A or B ecological category) should remain so. Wetlands FEPAs that are not in a good condition should be rehabilitated to their best attainable ecological condition.

This means that:

- Land-use practices or activities that will lead to deterioration in the current condition of a wetland FEPA are not acceptable.
- Land-use practices or activities that will make rehabilitation of a wetland FEPA difficult or impossible are not acceptable.

Below are more detailed management guidelines for specific land-use practices and activities that impact on wetland FEPAs by causing changes in water quantity, changes in water quality, or changes in habitat and biota.

6.3.1 Water quantity

Management objective: Water quantity (i.e. flow and inundation regime) must support keeping wetland FEPAs in good condition (equivalent to an A or B ecological category) if they are currently in a good condition, or best attainable ecological category if they are currently not in good condition (equivalent to C ecological category or lower).

This means that:

- For wetland FEPAs currently in a good condition, changes in flow or inundation regime that will lead to a deterioration in current condition are not acceptable.
- For wetland FEPAs that are not currently in good condition, changes in flow or inundation regime that will prevent achievement of the best attainable condition through rehabilitation are not acceptable.

Motivation: The hydrological regime of a wetland has a strong influence over the biological communities inhabiting the system. For instance, seasonal wetlands have been found to support significantly different biotic communities compared with permanently inundated wetlands. Similarly, the hydrological regime influences the physico-chemical characteristics of the wetland. Land-use

practices that lead to a change in the natural hydrology of a wetland FEPA could lead to irreversible modification of the system.

Table 3: Guidelines for land-use practices or activities that impact on water quantity in wetland FEPAs

Land-use practice or activity	Management guidelines
Drainage for cultivation, road-building etc	• Wetland FEPAs or portions thereof should not be drained or filled in. • Cut-off drains should be located in such a way that the zone of influence (the area affected by the drain – these drains divert surface and sub-surface flow in a certain direction, and lead to drawdown over a wide area) is well away from any wetland FEPAs. The area of influence should be determined by a hydrogeologist. • No roads should be constructed through or around more than 20% of the edge of wetland FEPAs or their buffers. • Existing wetland drains should be plugged (i.e. filled with soil, rocks, etc.) and natural patterns of water flow restored. • No land-user should drain or cultivate any wetland or area within the flood zone of any watercourse (including its buffer), except in terms of a written permit in terms of the National Water Act. • The diversion of natural stormwater runoff away from wetland FEPAs and into a stormwater management system should be avoided wherever possible.
Damming and obstruction of flow	• Wetland FEPAs and their buffers should not be dammed, unless this is for the purposes of rehabilitation. • Wetland FEPAs should be considered priorities for reserve determination. • Reserve determinations for wetland FEPAs should be done at the highest confidence level possible. It is recommended that at least a Rapid III Reserve Determination should be completed prior to new abstraction permits being considered for wetland FEPAs. • Weirs should preferably not be built in, within 1km downstream of, or within 2km upstream of a wetland FEPA, unless for the purposes of rehabilitation. • Wetland FEPAs and their buffers should not be flooded, either permanently or temporarily, as a result of a downstream dam or weir. • Flood control berms should not be placed in or close to (less than 100m from) wetland FEPAs or their buffers. • No roads or railway lines should be constructed through or around more than 20% of the edge of wetland FEPAs. • The laying of pipelines through wetland FEPAs and their buffers should be avoided.

Land-use practice or activity	Management guidelines
Canalisation and concentration of flow	• Wetland FEPAs and their buffers should not be canalised. • Channels, and other interventions that lead to the concentration of surface water flow into, through or out of a wetland FEPA, should not be permitted. • Water flow through a wetland FEPA should not be constricted through culverts or pipes, unless this is a temporary measure during rehabilitation. • Particular attention should be given to unchannelled wetlands, which are vulnerable to channelisation through the concentration of surface flows.
Input of stormwater, treated effluent or irrigation return flows	• Stormwater runoff generated from developed areas that exceeds 1:5 year flood volumes may be conveyed directly into a wetland FEPA. Stormwater runoff from smaller floods should be directed elsewhere or treated outside of the wetland, such that it is dissipated to a degree where it has no negative impact on wetland hydrology. • The diversion of natural stormwater runoff away from wetland FEPAs and into a stormwater management system should be avoided wherever possible. • Irrigation return flows should not be discharged directly into wetland FEPAs. • Wetland FEPAs should not be used for discharge of treated waste water through irrigation.
Abstraction of surface or groundwater for consumption (irrigation, potable water etc)	• Abstraction of water from a wetland FEPA should be avoided. Any abstraction of surface or groundwater from a wetland FEPA requires a water use permit or registration of water use (according to the General Authorisation) and compliance with the procedures required for such an application. • Wetland FEPAs should be considered priorities for reserve determination. • Reserve determinations for wetland FEPAs should be done at the highest confidence level possible. It is recommended that at least a Rapid III Reserve Determination should be completed prior to new abstraction permits being considered for wetland FEPAs. • Where water is currently abstracted from a wetland FEPA, this should take place only during the wet season, and subject to the Reserve. • Well-points and boreholes should not be located in or close to (less than 250m from) a wetland FEPA or its buffer, even where there is sufficient evidence to show that the wetland is not sustained by groundwater. • If a new borehole is proposed closer than 250m to a wetland FEPA buffer, a hydrogeological investigation should establish the dependence of the wetland on groundwater sources, or whether the wetland may be an important groundwater discharge point. If groundwater dependence

Land-use practice or activity	Management guidelines
	is established, or if the wetland is an important groundwater discharge point, the borehole should be located at least 250m away from the edge of the wetland FEPA buffer.
Mining and prospecting	• Mining in any form should not be permitted in wetland FEPAs, or within 1km of a wetland FEPA buffer. • No prospecting should occur in wetland FEPAs or within 1km of a wetland FEPA buffer. • Care should be taken to reduce the risks of aquifer penetration when drilling, wherever this occurs.
Afforestation and removal of indigenous plant species	• The removal of indigenous plant species from a wetland FEPA or its buffer should be strictly controlled in order to reduce the impact on the hydrological regime. Sustainable harvesting of plants, if deemed to have a negligible impact on species diversity and wetland functioning, may be acceptable within wetland FEPAs. • Afforestation with invasive alien tree species should not occur in wetland FEPAs or their buffers. • Plantation trees that invade wetland FEPAs or their buffers should be removed. • Burning regimes appropriate to the vegetation type should be allowed, under strict control and management.
Invasive alien plant invasion	• Invasive alien plants (either terrestrial or aquatic) should be removed from wetland FEPAs. • Wetland FEPAs should be considered priorities for invasive alien plant removal programmes or campaigns.

6.3.2 Water quality

Management objective: Water quality must support keeping wetland FEPAs in good condition (equivalent to an A or B ecological category) if they are currently in a good condition, or best attainable ecological category if they are currently not in good condition (equivalent to C or lower).

This means that:

- For wetland FEPAs currently in a good condition, changes in water quality that will lead to deterioration in current condition are not acceptable.
- For wetland FEPAs that are not currently in good condition, changes in water quality that will make rehabilitation of a wetland FEPA difficult or impossible are not acceptable.
- Seasonal variability in water quality in wetland FEPAs must be retained, especially in seasonally inundated/saturated systems.
- A generic buffer of 100m, measured from the outside edge of the wetland, should be established around wetland FEPAs. This buffer can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5.

Motivation: Along with water quantity, water quality is a major driver of biological responses within freshwater ecosystems. Freshwater ecosystems are particularly vulnerable to land-use practices throughout the catchment that may have an impact on quality of either surface or subsurface water. Wetlands often act as "sinks" for the accumulation of materials mobilised within the catchment, either through natural processes or human activities. A precautionary approach is required to protect the health of wetlands from the risks of water quality impairment, and to ensure that wetlands continue to provide critically important water quality related ecosystem services (e.g. nutrient cycling, primary production).

NOTE: Generic water quality boundary values for maintaining wetlands in their current condition were being developed at the time of writing as part of a Water Research Commission project. When these become available, they should be used to determine acceptable deviations in physico-chemical variables away from natural (i.e. the reference condition). Where sufficient reference condition data exist, the generic boundary values can be adjusted to account for regional differences. At least one year's worth of data (one hydrological cycle) is considered sufficient.

Table 4: Guidelines for land-use practices or activities that impact on water quality in wetland FEPAs

Land-use practice or activity	Management guidelines
Point- or diffuse-source discharge of waste or water containing waste	• Residential, industrial or mining effluent (either treated or untreated) should not be discharged directly into wetland FEPAs or their buffers, unless this practice satisfies the Ecological Specifications or Resource Quality Objectives where these have been set for the Resource Unit, or, where RQOs have not been set, Target Water Quality Range for protection of the receiving wetland (i.e. DWA Special Limits are not sufficient for the protection of a wetland FEPA). • New or upgraded waste water treatment works should preferably not be located within 500m of a wetland FEPA or its buffer. • Septic tanks and soakaways should be located at least 100m from wetland FEPA buffers. • Mining and industrial runoff should not be discharged into wetland FEPAs or their buffers. • If feasible, treatment wetlands should be constructed to allow for polishing of water quality before discharge of polluted runoff into a wetland FEPA. Treatment wetlands may be located within the buffer. • Polluted stormwater runoff from golfing greens, fairways and tees, and other areas where fertilizers, herbicides and pesticides are likely to be used, should be conveyed away from wetland FEPAs and treated elsewhere to acceptable quality for re-use. (However, it is not acceptable to irrigate wetland FEPAs or their buffers with treated runoff).

Land-use practice or activity	Management guidelines
	• Where feasible, wetland FEPAs should be protected from polluted runoff by cut-off drains and/or similar interventions (refer to Section 6.3.1 on changes in water quantity for cautions regarding diversion of natural runoff away from wetlands). • Residential stormwater runoff that exceeds the 1:5 year flood volumes can be conveyed directly into a wetland FEPA or buffer, if of acceptable quality. All other stormwater runoff, including runoff from the first seasonal rains (where feasible – such as for new developments), should be directed elsewhere or treated outside of the wetland, such that the water quality has been polished to an acceptable standard.
Irrigation with treated wastewater	• Wetland FEPAs and their buffers should not be irrigated with any category of wastewater.
Irrigation return flows	• Polluted agricultural runoff, such as irrigation return flows from fertilized fields, should be conveyed overland for some distance (at least 100m) before flowing into a wetland FEPA. • Herbicides and pesticides should generally not be used within 500m of wetland FEPAs, with the exception of managed invasive alien plant removal.
Mining and prospecting	• Mining in any form should not be permitted in wetland FEPAs, or within 1km of a wetland FEPA buffer. • No prospecting should occur in wetland FEPAs or within 1km of a wetland FEPA buffer. • The potentially harmful effects of acid mine drainage (which may occur at locations far from the mine) should be considered and appropriate mitigation (and compaction) measures implemented.
Cultivation and organic pollution from livestock	• Cultivation of wetland FEPAs should not be permitted. • Cultivated fields should not encroach into wetland FEPA buffers. • Livestock access to wetland FEPAs should be avoided, where possible, in order to prevent excessive nutrient loading.
Increased sedimentation, erosion and turbidity	• Modifications to the bed and banks of wetland FEPAs should be avoided. No excavation and/or removal of substrate material should be allowed, unless this is for rehabilitation purposes. • The construction of erosion control measures (such as gabion weirs) in wetland FEPAs should be done with caution – a freshwater ecologist should be involved in the design of such structures. The impact of these control structures should be monitored. • Livestock access to wetland FEPAs or parts of wetland FEPAs prone to erosion should be avoided – this includes areas of channelled flow, and those with unstable soils.

6.3.3 Habitat and biota

Management objective: Species diversity and health of biotic communities supported by wetland FEPAs should be maintained. This includes the feeding, breeding and movement of fauna and flora.

This means that:

- For wetland FEPAs currently in a good condition, loss of habitat availability and/or condition that leads to deterioration in the current condition is not acceptable.
- For wetlands FEPAs that are not currently in good condition, loss of habitat availability and/or condition that will make rehabilitation of a wetland FEPA difficult or impossible is not acceptable.
- A generic buffer of 100m, measured from the outside edge of the wetland, should be established around wetland FEPAs. This buffer can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5.

Motivation: Wetlands can perform an important function as natural ecological corridors, allowing movement of fauna and flora within the landscape, as well as providing many other goods and services (such as flood attenuation, erosion control). Habitat integrity is considered to be a surrogate for diversity pattern and processes. Maintaining habitat integrity can be assumed to translate into maintenance of wetland biodiversity.

Table 5: Guidelines for land-use practices or activities that impact on habitat and biota in wetland FEPAs

Land-use practice or activity	Management guidelines
Habitat fragmentation and loss of connectivity (resulting from e.g. loss of natural vegetation, building of dams and weirs)	• Wetland FEPAs and their buffers should not be fragmented or reduced in extent. • Wetland clusters should not be fragmented, but should be managed as a unit. • Wetland FEPAs should not be disconnected from their buffers. • Wetland buffers and the vegetation between individual wetlands in prioritised wetland clusters should be maintained in a natural and healthy condition so as to support the movement of flora and fauna. • Rehabilitation of wetland FEPAs and their buffers should be encouraged where landscape connectivity has been interrupted, especially when the wetland occurs as part of a wetland cluster. • Wetland FEPAs should not be treated as isolated features but should be incorporated into catchment-wide strategies, plans or programmes. • No roads or railway lines should be constructed through or around more than 20% of the edge of a wetland FEPA or its buffer. Construction of bridges over wetland FEPAs should be avoided. If the construction of bridges is unavoidable, bridge design should take the location and condition of wetland FEPAs and their buffers into account. Input from a

Land-use practice or activity	Management guidelines
	freshwater specialist should be sought during bridge design. Bridges should span the entire wetland area, where possible, and should at least avoid the wettest parts of wetlands, and areas of channelled flow. • The laying of pipelines through wetland FEPAs and their buffers should be avoided. • Fences should not be constructed through or around more than 20% of the perimeter of wetland FEPAs or their buffers. Where the construction of fences is unavoidable (e.g. in order to protect a wetland from livestock trampling), care should be taken to ensure that this does not obstruct the movement of fauna and flora. Fencing should be designed to allow for movement of the largest indigenous mammal likely to require access. • There should be no impoundment of wetland FEPAs or their buffers, as these structures restrict the movement of fish and invertebrates and alter inundation characteristics (flood duration etc). • Water flow through a wetland FEPA should not be constricted through culverts or pipes, for any reason. There should be no canalisation or channelisation of flow into, through or out of the wetland. • Where a road or other diversion structure must run through or close to a wetland FEPA or its buffer, runoff should be discharged through multiple discharge points with energy-dispersing structures. These drains should be small, dispersed low-volume, low-velocity, ground-level structures, discharging into vegetated areas.
Modifications to bed and banks	• Modifications to the bed and banks of wetland FEPAs should be avoided. No excavation and/or removal of substrate material should be allowed from the wetland or its buffer, unless this is for rehabilitation purposes. • The construction of erosion control measures (such as gabion weirs) in wetland FEPAs should be done with caution – a freshwater ecologist should be involved in the design of such structures. The impact of these control structures should be monitored. • Livestock access to wetland FEPAs or parts of wetland FEPAs prone to erosion should be avoided – this includes areas of channelled flow, and those with unstable soils.
Canalisation	• Wetland FEPAs and their buffers, and watercourses feeding into wetland FEPAs, should not be canalised.
Cultivation	• Cultivation of wetland FEPAs should not be permitted. • Cultivated fields should not encroach into wetland FEPA buffers.

Land-use practice or activity	Management guidelines
Grazing	• It is generally unacceptable to allow grazing of wetland FEPAs. • Where this is deemed acceptable, stock grazing capacities of the affected vegetation types within the regional context, and the location of erodible portions of the wetland, should be taken into account. • Livestock should not be allowed to graze in the wettest parts of the wetland, or in and around areas of channelled flow, or in areas with unstable soils.
Invasive alien species	• The stocking of wetland FEPAs, or farm dams in the surrounding sub-quaternary catchment, with invasive alien plant or animal species should not be permitted. • Invasive alien plants (either terrestrial or aquatic) should be removed from wetland FEPAs and their buffers. • Wetland FEPAs and their buffers should be considered priorities for invasive alien species removal programmes or campaigns.
Afforestation and removal of indigenous plant species	• The removal of indigenous plant species from a wetland FEPA or its buffer should be strictly controlled in order to reduce the impact on the hydrological regime. Sustainable harvesting of plants, if deemed to have a negligible impact on species diversity and wetland functioning, may be acceptable within wetland FEPAs. • Afforestation with invasive alien tree species should not occur in wetland FEPAs or their buffers. • Plantation trees that invade wetland FEPAs or their buffers should be removed.
Burning of wetlands	• Managed burning regimes appropriate to the vegetation type should be allowed in wetland FEPAs, under strict control and management.

6.4 Management guidelines for river FEPAs

Overall management objective for river FEPAs:[4]

River FEPAs are currently in a good condition (A or B ecological category) should remain so.

This means that:

- Land-use practices or activities that will lead to deterioration in the current condition of a river FEPA are not acceptable.

[4] Management guidelines are not given for Phase 2 FEPAs, but in general the guidelines for river FEPAs also apply to Phase 2 FEPAs. At the very least the current condition of Phase 2 FEPAs should be maintained.

Below are more detailed management guidelines for specific land-use practices and activities that impact on river FEPAs by causing changes in water quantity, changes in water quality, or changes in habitat and biota.

6.4.1 Water quantity

Management objective: Flow regime and hydrology must support keeping river FEPAs in an A or B ecological category.

This means that:

- Changes in flow regime that will lead to deterioration in the current condition of a river FEPA are not acceptable.
- There should be no change in the natural hydrology (baseflows and floods) of a river FEPA – e.g. from seasonal to perennial, or from ephemeral to seasonal, or from perennial to non-perennial.

Motivation: The hydrological regime of a river has a strong influence over the biological communities inhabiting the system. For instance, seasonal rivers support significantly different biotic communities compared with perennial river systems. In the case of naturally ephemeral systems, decreases in flow could result in their alteration to mainly terrestrial systems. Land-use practices that lead to a change in the natural hydrological regime could lead to irreversible modification of the riverine system.

Table 6: Guidelines for land-use practices or activities that impact on water quantity in river FEPAs

Land-use practice or activity	Management guidelines
Damming and obstruction of flow	• The construction of new weirs or dams on river FEPAs should be avoided. Where construction of dams is unavoidable, these should be off-channel structures. • River FEPAs should be considered priorities for reserve determination. • Reserve determinations for river FEPAs should be done at the highest confidence level possible. It is recommended that at least a Rapid III Reserve Determination should be completed prior to permits being considered for impoundment. • Where the Reserve has been determined, it should be implemented. Compliance with the requirements of the Reserve should be closely monitored. • Flood control berms should not be placed in river FEPAs, their riparian areas, or their buffers. • The construction of road or railway crossings over river FEPAs, their riparian areas or their buffers should be avoided. Where these are unavoidable, bridges are preferable to culvert crossings or drifts. • The laying of pipelines through river FEPAs, their riparian areas or their buffers should be avoided.

Land-use practice or activity	Management guidelines
Canalisation and concentration of flow	• River FEPAs should not be canalised or channelised. • Surface flows in a river FEPA should not be constricted through culverts or pipes, unless this is a temporary measure during rehabilitation, or unavoidable construction activities.
Input of stormwater, treated effluent or irrigation return flows	• Stormwater runoff generated from developed areas that exceeds 1:5 year flood volumes may be conveyed directly into a river FEPA. Stormwater runoff from smaller floods should be directed elsewhere or treated outside of the river's riparian area, such that it is dissipated to a degree where it has no negative impact on river hydrology. • The diversion of natural stormwater runoff away from river FEPAs and into a stormwater management system should be avoided wherever possible. • Irrigation return flows should not be discharged directly into river FEPAs. Irrigation runoff should be allowed to flow across a vegetated buffer wide enough to ensure that discharge into the river is minimised. • Areas irrigated for discharge of treated waste water should be located at least 500m outside the riverine buffer.
Abstraction of surface or groundwater for consumption (irrigation, potable water etc)	• Abstraction of water from a river FEPA should be avoided. Any abstraction of surface or groundwater from a river FEPA requires a water use permit or registration of water use (according to the General Authorisation) and compliance with the procedures required for such an application. • River FEPAs should be considered priorities for reserve determination. • Reserve determinations for river FEPAs should be done at the highest confidence level possible. It is recommended that at least a Rapid III Reserve Determination should be completed prior to new abstraction permits being considered for river FEPAs. • Where the Reserve has been determined, it should be implemented. Compliance with the requirements of the Reserve should be closely monitored. • Well-points and boreholes should not be located in or close to (less than 250m from) a river FEPA or its buffer, even where there is sufficient evidence to show that the river is not sustained by groundwater. • If a new borehole is proposed closer than 250m to a river FEPA buffer, a hydrogeological investigation should establish the dependence of the river on groundwater sources, or whether the river may be an important groundwater discharge area. If groundwater dependence is established, or if the river is an important groundwater discharge system, the borehole should be located 250m away from the edge of the riverine buffer.

Land-use practice or activity	Management guidelines
Mining and prospecting	• Mining in any form should not be permitted within 1km of a riverine buffer. • No prospecting should occur within 1km of a riverine buffer. • Care should be taken to reduce the risks of aquifer penetration when drilling, wherever this occurs.
Afforestation and removal of indigenous plant species	• The removal of indigenous plant species from a river FEPA, its riparian area or its buffer should be strictly controlled in order to reduce the impact on the hydrological regime. Sustainable harvesting of plants, if deemed to have a negligible impact on species diversity and riverine functioning, may be acceptable within river FEPAs. • Afforestation with invasive alien tree species should not occur in river FEPAs, their riparian areas, or their buffers. New plantations should be located at least 100m away from the riverine buffer. • Plantation trees that invade river FEPAs, their riparian areas, or their buffers should be removed. • Burning regimes appropriate to the vegetation type should be allowed, under strict control and management.
Invasive alien plant invasion	• Invasive alien plants (either terrestrial or aquatic) should be removed from river FEPAs. • River FEPAs should be considered priorities for invasive alien plant removal programmes or campaigns.

6.4.2 Water quality

Management objective: Water quality must support keeping river FEPAs in an A or B ecological category.

This means that:

- Changes in water quality that will lead to deterioration in the current condition of a river FEPA are not acceptable.
- Seasonal variability in water quality in river FEPAs must be retained, in permanent, seasonal and ephemeral river systems.
- A generic buffer of 100m, measured from the top of bank, should be established around river FEPAs. This buffer can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5.

Motivation: Along with water quantity, water quality is a major driver of biological responses within freshwater ecosystems. Freshwater ecosystems are particularly vulnerable to land-use practices throughout the catchment that may have an impact on quality of either surface or subsurface water. Rivers are often the lowest point in the landscape, where materials mobilised within the catchment, either through natural processes or human activities, may accumulate. A precautionary approach is required to protect the health of rivers from the risks of water quality impairment, and to ensure

that rivers continue to provide critically important water quality related ecosystem services (e.g. nutrient cycling).

NOTE: Generic water quality boundary values have been determined for maintaining rivers in their current condition (DWAF, 2008a). These should be used to determine acceptable deviations in physico-chemical variables away from natural (i.e. the reference condition). Where sufficient reference condition data exist, the generic boundary values can be adjusted to account for regional differences. At least one year's worth of data (one hydrological cycle) is considered sufficient.

Table 7: Guidelines for land-use practices or activities that impact on water quality in river FEPAs

Land-use practice or activity	Management guidelines
Point- or diffuse-source discharge of waste or water containing waste	• Residential, industrial or mining effluent (either treated or untreated) should not be discharged directly into river FEPAs or their buffers, unless this practice satisfies the Ecological Specifications or Resource Quality Objectives, where these have been set for the Resource Unit, or, where RQOs have not been set, Target Water Quality Range for protection of the receiving rivers (i.e. DWA Special Limits are not sufficient for the protection of a river FEPA). • New or upgraded waste water treatment works should preferably not be located within 500m of a river FEPA or its buffer. • Septic tanks and soakaways should be located at least 100m from riverine buffers. • Mining and industrial runoff should not be discharged into river FEPAs or their buffers. • If feasible, treatment wetlands should be constructed to allow for polishing of water quality before discharge of polluted runoff into a river FEPA. Treatment wetlands may be located within the riverine buffer. • Polluted stormwater runoff from golfing greens, fairways and tees, and other areas where fertilizers, herbicides and pesticides are likely to be used, should be conveyed away from river FEPAs and treated elsewhere to acceptable quality for re-use. (However, it is not acceptable to irrigate riverine buffers or riparian areas with treated runoff). • Where feasible, river FEPAs should be protected from polluted runoff by cut-off drains and/or similar interventions (refer to Section 6.4.1 on changes in water quantity for cautions regarding diversion of natural runoff away from rivers). • Residential stormwater runoff that exceeds the 1:5 year flood volumes can be conveyed directly into a river FEPA or buffer, if of acceptable quality. All other stormwater runoff, including runoff from the first seasonal rains (where feasible – such as for new developments), should be directed elsewhere or treated outside of the riverine buffer, such that the water quality has been polished to an acceptable standard.

Land-use practice or activity	Management guidelines
Irrigation with treated wastewater	• River FEPAs, riparian areas or buffers should not be irrigated with any category of wastewater.
Irrigation return flows	• Polluted agricultural runoff, such as irrigation return flows from fertilized fields, should be conveyed overland at least 100m before flowing into a river FEPA. • Herbicides and pesticides should not be used within 500m of river FEPAs, with the exception of managed invasive alien plant removal.
Mining and prospecting	• Mining in any form should not be permitted within 1km of a riverine buffer. • No prospecting should occur within 1km of a riverine buffer. • Care should be taken to reduce the risks of aquifer penetration when drilling, wherever this occurs. • The potentially harmful effects of acid mine drainage (which may occur at locations far from the mine) should be considered and appropriate mitigation (and compaction) measures implemented.
Cultivation and organic pollution from livestock	• Cultivation of river FEPAs and their buffers should not be permitted. • Cultivated fields should not encroach into riverine buffers. • Livestock access to river FEPAs should be minimised, where possible, in order to prevent excessive nutrient loading.
Increased sedimentation, erosion and turbidity	• Modifications to the bed and banks of river FEPAs should be avoided. No excavation and/or removal of substrate material should be allowed, unless this is for rehabilitation purposes. • The construction of erosion control measures (such as groynes, gabion weirs) in river FEPAs should be done with caution – a freshwater ecologist should be involved in the design of such structures. The impact of these control structures should be monitored. • Livestock access to river FEPAs should be minimised, as river banks are particularly prone to erosion.

6.4.3 Habitat and biota

Management objective: Species diversity and the health of biotic communities supported by river FEPAs should be maintained. This includes the feeding, breeding and movement of fauna and flora.

This means that:

- Loss of habitat availability and/or condition that leads to deterioration in the current condition of a river FEPA is not acceptable.
- A generic buffer of 100m, measured from the top of bank, should be established around river FEPAs. This buffer can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5.

Motivation: Rivers perform an important function as natural ecological corridors, allowing movement of fauna and flora within the landscape, as well as providing many other goods and services. Habitat integrity is considered to be a surrogate for biodiversity pattern and processes. Maintaining habitat integrity can be assumed to translate into maintenance of riverine biodiversity. Rivers are affected by longitudinal, latitudinal and vertical processes. Thus, they are sensitive to up- and downstream activities, and activities in the catchment as a whole.

NOTE: The South African Scoring System (SASS) uses macro-invertebrate data as an indicator of habitat integrity. Guidelines exist for the interpretation of macro-invertebrate data collected from rivers using SASS (Dallas, 2007). These guidelines provide "biological bands" for each of the ecological categories (A to E/F), according to the total SASS score and average score per taxon (ASPT). These bands are based on modification of macro-invertebrate communities from the natural or reference condition, and differ for different ecoregions and geomorphic zones (for example mountain streams, foothill streams, lowland rivers). An example of the bands for an upper foothill stream in the Highveld is shown in Figure 8. Similar guidelines have been developed for algal communities and primary production (DWAF, 2008).

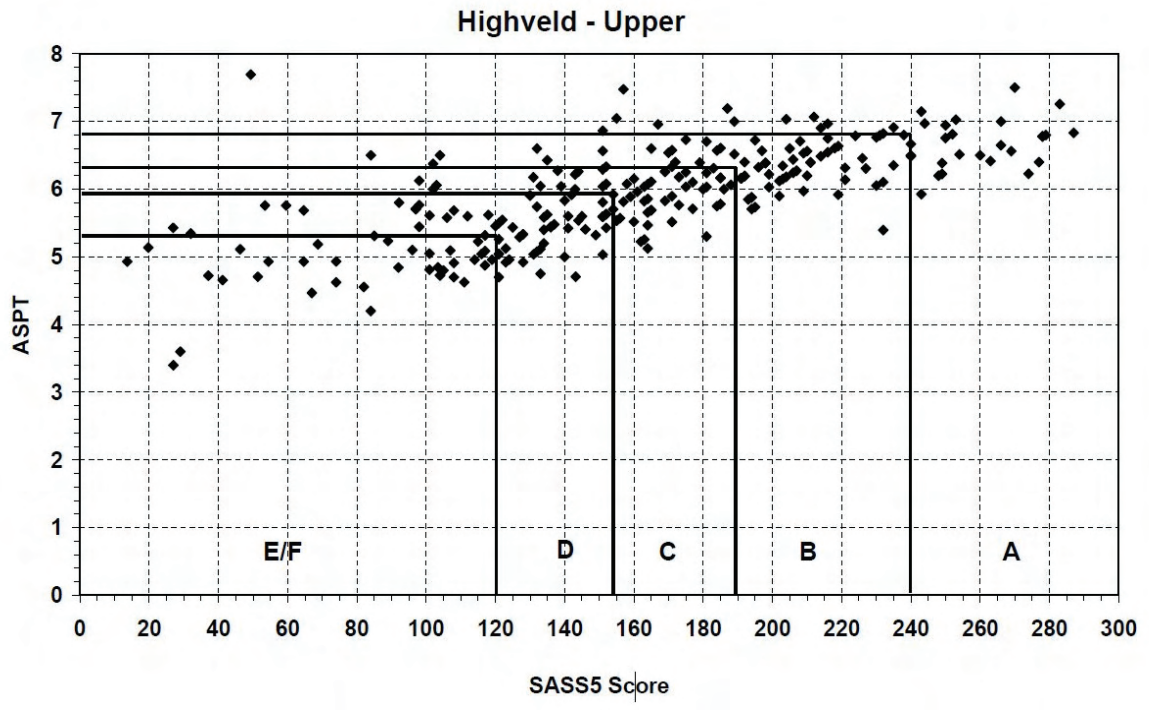

Figure 9: Biological bands for the Highveld-Upper zone, calculated using percentiles (from Dallas, 2007)

Table 8: Guidelines for land-use practices or activities that impact on habitat and biota in river FEPAs

Land-use practice or activity	Management guidelines
Habitat fragmentation and loss of connectivity (resulting from e.g. loss of natural vegetation, building of dams and weirs)	• River FEPAs should not be disconnected from their buffers, or their valley floors or floodplains. • River FEPAs should not be treated as isolated features but should be incorporated into catchment-wide strategies, plans or programmes. • Riverine buffers should be maintained in a natural and healthy condition so as to support the movement of flora and fauna. • River crossings (roads or railway lines) over river FEPAs should be avoided or minimised. Where these are unavoidable, bridges are preferable to culvert crossings or drifts. Bridge design should take the location and condition of river FEPAs, riparian areas and their buffers into account. Input from a freshwater specialist should be sought during bridge design. • Fences should not be constructed through or along the edge of river FEPAs. Where the construction of fences is unavoidable (e.g. in order to protect a riverine corridor from livestock trampling), care should be taken to ensure that this does not obstruct the movement of fauna and flora. Fencing should be designed to allow for movement of the largest indigenous mammal likely to require access. • The laying of pipelines through river FEPAs, riparian areas or riverine buffers should be avoided. • There should be no impoundment of river FEPAs, as these structures restrict the movement of fish and invertebrates and alter flow characteristics (baseflows, flood duration etc). • Surface flows in a river FEPA should not be constricted through culverts or pipes, unless this is a temporary measure during rehabilitation or unavoidable construction activities. • There should be no canalisation or channelisation of river FEPAs, or of tributaries flowing into river FEPAs.
Modifications to bed and banks	• Modifications to the bed and banks of river FEPAs should be avoided. No excavation and/or removal of substrate material from river FEPAs, riparian areas or buffers should be allowed, unless this is for rehabilitation purposes. • The construction of erosion control measures (such as groynes, gabion weirs) in river FEPAs should be done with caution – a freshwater ecologist should be involved in the design of such structures. The impact of these control structures should be monitored. • Livestock access to river FEPAs should be minimised.
Canalisation	• River FEPAs should not be canalised or channelised.

Land-use practice or activity	Management guidelines
Cultivation	• Cultivation of river FEPAs should not be permitted. • Cultivated fields should not encroach into riverine buffers.
Invasive alien species	• The stocking of river FEPAs, or farm dams in the surrounding sub-quaternary catchment, with invasive alien plant or animal species should not be permitted. • Invasive alien plants (either terrestrial or aquatic) should be removed from river FEPAs, riparian areas and their buffers. • River FEPAs, riparian areas and their buffers should be considered priorities for invasive alien species removal programmes or campaigns.
Afforestation and removal of indigenous plant species	• The removal of indigenous plant species from a river FEPA, riparian area or buffer should be strictly controlled in order to reduce the impact on the hydrological regime. Sustainable harvesting of plants, if deemed to have a negligible impact on species diversity and riverine functioning, may be acceptable within river FEPAs, riparian areas and buffers. • Afforestation with alien tree species should not occur in river FEPAs, riparian areas or their buffers. • Plantation trees that invade river FEPAs, riparian areas or their buffers should be removed.
Burning of riparian areas and riverine buffers	• Managed burning regimes appropriate to the vegetation type should be allowed, under strict control and management.

6.5 Management guidelines for sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas

Overall management objective for sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas:

Management of land-use practices within the associated sub-quaternary catchment and Upstream Management Areas must aim to maintain river FEPAs in their current condition.

In managing the condition of a river FEPA, it is important to manage not just the river FEPA itself but also the **network of streams and wetlands** in the sub-quaternary catchment and Upstream Management Area **that drain into the river FEPA**. **A proportion of these streams and wetlands need to remain healthy and functional** in order for the river FEPA to maintain its A or B ecological condition. This requires managing the cumulative impacts of land-use in the surrounding sub-quaternary catchment and in Upstream Management Areas. Impacts tend to be more immediate in the associated sub-quaternary catchment than in an Upstream Management Area, but cumulative impacts from Upstream Management Areas have the potential to be very large and can be difficult to manage.

This means that:

- Land-use practices or activities in the sub-quaternary catchment associated with a river FEPA, and not just at the site of the river FEPA itself, need to be managed. Land-use practices or activities in the sub-quaternary catchment that will lead to deterioration in the current condition of the river FEPA are not acceptable.
- Cumulative impacts of land use practices or activities in sub-quaternary catchments associated with river FEPAs and in Upstream Management Areas need to be managed. It may be acceptable for some streams and wetlands to be impacted, but only if the cumulative impacts do not result in deterioration of the condition of the downstream river FEPA.

6.5.1 Water quantity

Management objective: Flow regime in the sub-quaternary catchment associated with a river FEPA and in Upstream Management Areas should support the maintenance of river FEPAs in a good condition (A or B ecological category).

Motivation: Land-use practices that lead to changes in surface and groundwater flow regimes may lead to deterioration in the current condition of freshwater ecosystems within the sub-quaternary catchment or Upstream Management Area. Generally, buffers are considered ineffective at mitigating the water quantity impacts. Management of land-use practices is more effective for reducing these impacts.

Analyses by Allan (2004) found that streams in agricultural catchments usually remain in good condition until the extent of agriculture in the catchment exceeds 30-50%. Similarly, for every 10% of altered catchment land use, a correlative 6% loss in freshwater diversity was noted, as a linear relationship (Weitjers *et al*., 2009).

Table 9: Guidelines for land-use practices and activities that impact on water quantity in sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas

Land-use practice or activity	Management guidelines
Damming and obstruction of flow	• A high proportion of streams in the sub-quaternary catchment associated with a river FEPA should not be impounded, even off-channel. • The construction of new weirs or dams in streams or wetlands in Upstream Management Areas should be minimised. Where construction of dams is unavoidable, these should preferably be off-channel structures. • Sub-quaternary catchments associated with river FEPAs should be considered priorities for reserve determination, especially those that are threatened or water-stressed. • Where the Reserve has been determined, it should be implemented. Compliance with the requirements of the Reserve should be closely monitored.

Land-use practice or activity	Management guidelines
Input of stormwater, treated effluent or irrigation return flows	• Stormwater runoff generated from developed areas should not exceed pre-development volumes. The principles of Sustainable Urban Drainage Systems (SUDS) should generally be applied. • Stormwater runoff generated from developed areas should generally not be discharged directly into streams or wetlands draining into river FEPAs. Where runoff is polluted, it should be treated elsewhere before being returned to rivers or wetlands. • Natural stormwater runoff should not be diverted away from streams or wetlands draining into river FEPAs if those streams and wetlands may depend on this as a primary water source. • Polluted return flows should not be discharged directly streams or wetlands draining into river FEPAs, but allowed to flow across a vegetated buffer wide enough to ensure that discharge into the ecosystem is minimised.
Abstraction of surface or groundwater for consumption (irrigation, potable water, etc.)	• Sub-quaternary catchments associated with river FEPAs should be considered priorities for reserve determination, especially those that are threatened or water-stressed. • Surface water abstraction and use from streams or wetlands draining into river FEPAs should be monitored (e.g. existing abstractions should be checked against permitted water use) and managed so that ecological integrity of the freshwater ecosystems is not adversely affected. • Groundwater abstraction and use in sub-quaternary catchments associated with river FEPAs and in Upstream Management Areas should be monitored. The permitted and future number of boreholes, and current rates and volumes of abstraction should be assessed for the whole sub-quaternary catchment. • Well-points and boreholes should preferably not be located in or close to streams and wetlands draining into FEPAs.
Mining and prospecting	• Mining or prospecting in any form should not be permitted in sub-quaternary catchments associated with river FEPAs. • In Upstream Management Areas, mining or prospecting should not take place in rivers, streams or wetlands or their buffers. • Care should be taken to reduce the risks of aquifer penetration when drilling, wherever this occurs.

Land-use practice or activity	Management guidelines
Afforestation and removal of indigenous plant species	• The removal of indigenous plant species from streams and wetlands draining into river FEPAs, and from their buffers, should be strictly controlled in order to reduce impacts on hydrological regimes. Sustainable harvesting of plants, if deemed to have a negligible impact on species diversity and ecological functioning, may be acceptable. • Afforestation with invasive alien tree species should not occur in streams or wetlands draining into river FEPAs. New plantations should be located outside the buffers of streams and wetlands draining into river FEPAs. • Plantation trees that invade streams or wetlands draining into river FEPAs, or their buffers, should be removed. • Burning regimes appropriate to the vegetation type should be allowed, under strict control and management.
Invasive alien plant invasion	• Invasive alien plants (either terrestrial or aquatic) should be removed from streams and wetlands draining into FEPAs and from mountain catchments. High water yield areas (see atlas) are considered priorities for invasive alien plant removal.

6.5.2 Water quality

Management objective: Water quality in the sub-quaternary catchment associated with a river FEPA and in Upstream Management Areas should support the maintenance of river FEPAs in a good condition (A or B ecological category).

This means that:

- Generic buffers of 100m should be established around streams and wetlands draining into river FEPAs. These buffers can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5.

Motivation: Land-use practices that lead to changes in water quality may lead to deterioration in the current condition of freshwater ecosystems within the sub-quaternary catchment or Upstream Management Area.

Table 10: Guidelines for land-use practices and activities that impact on water quality in sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas

Land-use practice or activity	Management guidelines
Point- or diffuse-source pollution	• Residential, industrial or mining effluent (either treated or untreated) should not be discharged directly streams or wetlands draining into river FEPAs, unless this practice satisfies the Ecological Specifications or Resource Quality Objectives, where these have been set for the Resource Unit, or, where RQOs have not been set, Target Water Quality

Land-use practice or activity	Management guidelines
	Range for protection of the receiving rivers (i.e. DWA Special Limits are not sufficient for the protection of a river FEPA). • If feasible, treatment wetlands should be constructed to allow for polishing of water quality before discharge of polluted runoff streams or wetlands draining into rivers FEPAs. Treatment wetlands may be located within the buffer. • Residential stormwater runoff that exceeds the 1:5 year flood volumes can be conveyed directly into streams or wetlands draining into river FEPAs, or their buffers, if of acceptable quality. All other stormwater runoff, including runoff from the first seasonal rains (where feasible – such as for new developments), should be directed elsewhere or treated outside of the buffers of the streams and wetlands, such that the water quality has been polished to an acceptable standard.
Mining and prospecting	• Mining or prospecting in any form should not be permitted in sub-quaternary catchments associated with river FEPAs. • In Upstream Management Areas, mining or prospecting should not take place in rivers, streams or wetlands or their buffers. • The potentially harmful effects of acid mine drainage (which may occur at locations far from the mine) should be considered and appropriate mitigation (and compaction) measures implemented. • Care should be taken to reduce the risks of aquifer penetration when drilling, wherever this occurs.
Cultivation and organic pollution from livestock	• Cultivation of streams or wetlands draining into river FEPAs, and their buffers, should not be permitted. • Cultivated fields should not encroach into the buffers of streams or wetlands draining into FEPAs. • Livestock access to streams or wetlands draining into river FEPAs should be minimised, where possible, in order to prevent excessive nutrient loading.
Increased sedimentation, erosion and turbidity	• Modifications to the bed and banks of streams and wetlands draining into river FEPAs should be avoided. No excavation and/or removal of substrate material should be allowed, unless this is for rehabilitation purposes. • Livestock access to streams and wetlands draining into river FEPAs should be minimised.

6.5.3 Habitat and biota

Management objective: Species diversity and health of biotic communities supported within **sub-quaternary catchments associated with river FEPAs** should be maintained, as these are refugia for supplying FEPAs. This includes the feeding, breeding and movement of fauna and flora. In **Upstream Management Areas**, conserving natural habitat and biota is not the primary objective; the emphasis is rather on maintaining functional ecosystems that are able to absorb impacts and that do not degrade downstream FEPAs.

This means that:

- Generic buffers of 100m should be established around streams and wetlands draining into river FEPAs. These buffers can be refined based on a site visit and application of the spreadsheet tool discussed in Section 5.7.5.
- Land use practices or activities that are not consistent with keeping natural habitat and biota intact in sub-quaternary catchments associated with river FEPAs are not acceptable.

Motivation: Habitat integrity is considered to be a surrogate for biodiversity pattern and processes. Maintaining habitat integrity can be assumed to translate into maintenance of aquatic and semi-aquatic biodiversity.

Table 11: Guidelines for land-use practices or activities that impact on habitat and biota in sub-quaternary catchments associated with FEPAs, and Upstream Management Areas

Land-use practice or activity	Management guidelines
Habitat fragmentation and loss of connectivity (resulting from e.g. loss of natural vegetation, building of dams and weirs)	• Streams and wetlands draining into river FEPAs should not be disconnected from their buffers, or their valley floors or floodplains. • Wetland clusters should be managed as a unit. • Streams and wetlands draining into river FEPAs should not be treated as isolated features but should be incorporated into catchment-wide strategies, plans or programmes. • Buffers and riparian areas should be maintained in a natural and healthy condition so as to support the movement of flora and fauna. • Impoundments restrict the movement of fish and invertebrates and alter flow characteristics (baseflows, flood duration etc). A high proportion of streams in the sub-quaternary catchment associated with a river FEPA should not be impounded, even off-channel. • The construction of new weirs or dams in streams or wetlands in Upstream Management Areas should be minimised. Where construction of dams is unavoidable, these should preferably be off-channel structures. • Where the construction of fences is necessary (e.g. around protected areas), this should be done ensuring that fences/walls do not obstruct the movement of fauna and flora.

Land-use practice or activity	Management guidelines
Modifications to bed and banks	• Modifications to the bed and banks of streams and wetlands draining into river FEPAs should be avoided. No excavation and/or removal of substrate material from streams or wetlands draining into river FEPAs, or their buffers, should be allowed, unless this is for rehabilitation purposes. • Livestock access to FEPAs should be minimised.
Canalisation	• Streams flowing into river FEPAs should not be canalised or channelised.
Cultivation	• Cultivation of streams or wetlands draining into river FEPAs should not be permitted. • Cultivated fields should not encroach into the buffers of streams or wetlands draining into river FEPAs.
Invasive alien species	• The stocking of streams or wetlands draining into river FEPAs, or farm dams in the surrounding sub-quaternary catchment, with invasive alien plant or animal species should not be permitted. • Invasive alien plants (either terrestrial or aquatic) should be removed from FEPAs, riparian areas and their buffers. • FEPAs, riparian areas and their buffers should be considered priorities for invasive alien species removal programmes or campaigns.
Afforestation and removal of indigenous plant species	• The removal of indigenous plant species from streams and wetlands draining into river FEPAs, or from their buffers, should be strictly controlled in order to reduce the impact on the hydrological regime. Sustainable harvesting of plants, if deemed to have a negligible impact on species diversity and ecological functioning, may be acceptable. • Afforestation with invasive alien tree species should not occur in streams or wetlands draining into river FEPAs, or in their buffers. • Plantation trees that invade streams or wetlands that drain into river FEPAs, or their buffers, should be removed.
Burning of riparian areas and riverine buffers	• Managed burning regimes appropriate to the vegetation type should be allowed, under strict control and management.

7. Key messages and recommendations

PHOTO: K MURRAY

These messages and recommendations follow from key findings of NFEPA (see the technical report). Further messages and the rationale for them can also be found in Parts 1 and 3 of the atlas.

7.1 Key messages

Freshwater Ecosystem Priority Areas are a valuable national asset

Managing FEPAs in a good condition is not just about conserving freshwater plants and animals – it should also be regarded as a comprehensive approach to sustainable and equitable development of water resources. Keeping strategically-chosen freshwater ecosystems in a good condition serves a dual purpose of meeting government objectives for both sustainable water resource development (National Water Act) and freshwater biodiversity conservation (Biodiversity Act).The current and recommended ecological category for all river FEPAs is A or B. Wetland FEPAs that are currently in a condition lower than A or B should be rehabilitated to the best attainable ecological condition.

Freshwater inputs are critical to estuarine and marine environments

Fresh water flowing to estuaries and the sea maintains important ecological processes that keep our marine resources healthy. Healthy marine and coastal ecosystems sustain commercial and recreational fish stocks, and provide a source of food to poor coastal communities that depend directly on marine resources for food. A certain amount of water is also required to scour the mouth of most estuaries – without this scouring effect, sediments build up at the mouth and the risk of back-flooding during storms increases. Artificial breaching of an estuary mouth to minimise this risk is expensive and damages estuarine ecosystems. This is why water running out to sea should not be considered wasted.

Free-flowing rivers should be regarded as part of our natural heritage

A free-flowing river is a large river that has not been dammed. It flows undisturbed from its source to the confluence with another large river or to the sea. Today there are very few large rivers that remain dam-free, or “free-flowing”, in South Africa and globally. Free-flowing rivers are rare features in our landscape and an important part of our natural heritage. They offer considerable social,

economic and conservation value, supporting the livelihoods of people in the catchment. Poor rural populations with close livelihood links to the river are likely to be impacted most and benefit least from dams. The flagship free-flowing rivers identified by NFEPA should receive top priority for maintaining their dam-free status.

Healthy tributaries and wetlands support the sustainability of hard-working rivers

With effective planning, freshwater ecosystems in a catchment can be designed to support multiple levels of use, with natural rivers and wetlands that are minimally used supporting the sustainability of heavily used rivers, wetlands and estuaries that often form the economic hub of the catchment.

Healthy buffers of natural vegetation mitigate the impact of land-based activities

Freshwater ecosystems are generally the lowest point in the landscape, making them the "receivers" of wastes, sediment and pollutants in runoff. This combined with the strong connectivity of freshwater ecosystems means that they are highly susceptible to upstream, downstream and upland impacts. Managing land-based impacts is therefore essential. While it is seldom feasible or desirable for entire catchments to be "locked away" from human use, catchments can be designed to incorporate varying levels of use and impacts on freshwater ecosystems. Buffers of vegetation surrounding all freshwater ecosystems, even heavily used ones, go a long way to reducing the effects of deleterious land-use practices. The effective width of the buffer should be determined on a site-specific basis. This implementation manual provides some recommendations for delineating buffers (see Sections 5.7.5 and 6.2).

Groundwater sustains river flows particularly in dry seasons

Groundwater abstracted from river beds, close to streams, and from shallow alluvial aquifers has a very direct influence on river flow, and should be not be viewed as an additional water resource. Such groundwater plays an important role in sustaining wetlands and river flows ("base flows") and supporting refuge pools in the dry season. Apart from the human benefits of maintaining river flows in the dry season, refuge pools in seasonal rivers support water-dependent animals that would otherwise not survive when the rivers dry up. Healthy riparian areas, which filter pollutants that drain from the land, are also often maintained by groundwater. It is only when groundwater has very weak links to surface water (such as in deep, confined aquifers) that it may be possible to abstract it without significantly impacting on river flow; however, long-term impacts are not well understood.

Mountain catchment areas play a critical role in securing our water supplies

High water yield areas and high groundwater recharge areas generally occur in mountain catchment areas. These are the "water factories" of the catchment and generate a large proportion of the

water for human and ecological use. Maintaining these areas in a healthy state will allow for the use of clean water downstream that can also maintain ecosystem functioning and biodiversity.

Healthy freshwater ecosystems support adaptation to climate change

Healthy natural ecosystems can increase resilience to the impacts of climate change, by allowing ecosystems and species to adapt as naturally as possible to the changes and by buffering human settlements and activities from the impacts of extreme weather events. Freshwater ecosystems are likely to be particularly hard hit by rising temperatures and shifting rainfall patterns, and yet healthy, intact freshwater ecosystems are vital for maintaining resilience to climate change and mitigating its impact on human wellbeing. In the western part of South Africa, which is likely to become dryer, intact rivers and wetlands will help to maintain a consistent supply of water; in the eastern part of the country, which is likely to become wetter, intact rivers and wetlands will be important for reducing flood risk and mitigating the impact of flash floods.

7.2 Key recommendations

This section draws together and highlights some of the key recommendations that have emerged from NFEPA, with cross-references to the relevant sections of the implementation manual where most of them have been discussed in more detail.

- **Employ aquatic ecologists in provinces, Catchment Management Agencies and municipalities** to promote sustainable water development decisions. A concerted effort is required to improve management of freshwater ecosystems if we are to halt and reverse the deterioration of freshwater ecosystems and ensure sustainable use of water resources. A good understanding of aquatic ecosystem functioning is needed. As discussed in Section 4.5, provincial conservation authorities play an especially pivotal role in implementing and monitoring freshwater ecosystem priorities, as they have the major line function responsibility for ecosystem management and conservation. Provincial conservation authorities ideally require at least six to eight aquatic scientists and technicians, with expertise in limnology, hydrology, fish biology, aquatic invertebrate biology, aquatic plant biology and other aspects of aquatic ecology, in order to play an effective role in managing and conserving freshwater ecosystems. At the time of writing, most provincial conservation authorities had only one aquatic scientist. It is also essential to employ aquatic scientists in Catchment Management Agencies, and preferably in municipalities.

- Set up mechanisms to **support uptake of FEPA maps, especially by provincial conservation authorities and Catchment Management Agencies**. SANBI's freshwater programme has an important role to play in co-ordinating, catalysing and facilitating the use of FEPA maps, and in convening relevant stakeholders to share knowledge and lessons. However, this programme has limited resources. See Section 4.3.

- **Use FEPA maps in assessing EIA applications** and making land-use decisions, as discussed in Sections 5.4 and 5.6.

- **Use FEPA maps in water resource development processes**, including classification of water resources, ecological reserve determinations, resource quality objectives, water use authorisations, and development of Catchment Management Strategies, as discussed in Section 5.1.

- **Applications for mining and prospecting** in FEPAs and associated sub-quaternary catchments should be subject to rigorous environmental and water assessment and authorisation processes, as mining has a widespread and major negative impact on freshwater ecosystems. See Section 5.7.2, as well as those aspects of the ecosystem management guidelines in Chapter 6 that relate to mining and prospecting.

- Pilot **formal mechanisms for the management and protection of FEPAs**, including the use of biodiversity stewardship programmes and fiscal incentives. See Section 5.3.3.

- **Revive the Mountain Catchment Areas Act**, which has the potential to play a much larger role in protecting our water supply areas. See Section 5.7.1.

- **Review general authorisations** of the National Water Act in relation to their impact on FEPAs. See Section 5.1.7.

- Strengthen and expand the scope of the **River Health Programme** to include wetlands and actively target FEPAs as new monitoring sites. See Section 5.9.1.

- **Strengthen collaboration of DWA and DEA** around managing and conserving freshwater ecosystems. The single Minister for the two departments provides an ideal opportunity for formalising co-operation around freshwater ecosystem management, and NFEPA provides tools on which to focus such combined efforts. The NFEPA stakeholder engagement process went some way towards developing and strengthening the necessary relationships between stakeholders in the water and biodiversity sectors. The recently established **Inter-Departmental Liaison Committee for Freshwater Ecosystems** provides an opportunity for the various key role-players in freshwater ecosystem management and conservation to establish shared objectives and to collaborate actively, and to tease out respective roles and responsibilities in more detail. See Chapter 4.

Glossary

Best attainable ecological category: The ecological category that is most close to natural (category A) to which an ecosystem can be rehabilitated/restored. See “ecological category” and “rehabilitation/restoration”.

Biodiversity: The diversity of genes, species, ecosystems and landscapes on Earth, and the ecological and evolutionary processes that maintain this diversity.

Bioregional plan (published in terms of the Biodiversity Act): A map of biodiversity priority areas (Critical Biodiversity Areas and Ecological Support Areas), for a municipality or group of municipalities, accompanied by contextual information, land- and resource-use guidelines and supporting GIS information. The map must be produced using the principles and methods of systematic biodiversity planning. A bioregional plan represents the biodiversity sector’s input to planning and decision-making in a range of other sectors. The development of a bioregional plan is usually led by the relevant provincial conservation authority or provincial environmental affairs department. A bioregional plan that has not yet been published in the Government Gazette in terms of the Biodiversity Act is referred to as a **biodiversity sector plan**.

Canal: An open structure, that is lined or reinforced, for the conveying of a liquid or that serves as an artificial watercourse.

Catchment: The area (a geographical region) where water from rain (or snow) becomes concentrated and drains downhill into a river or lake. The term includes all land surface, streams, rivers, and lakes between the source and where the water enters the ocean.

Catchment Management Agency: A water management institution which is a statutory body governed by a board representing the interests of users, local and provincial government and environmental interest groups. It manages all water resources within a defined Water Management Area.

Catchment visioning: Visioning is a process of articulating society’s aspirations for the future – in this case, the “basket” of benefits to be derived from aquatic ecosystem services and the costs associated with their use. The visioning process begins with the generation of a vision statement that addresses our commitment to achieving equity, sustainability and efficiency in Integrated Water Resources Management. Balancing costs and benefits of resource use must include both water resource quality and quantity components, thus both are incorporated into the formulation of a statement of the desired future conditions of resource use and protection. A vision statement must be converted into, and explicitly linked with, objectives that are useful at the operational level. Unless a vision is linked to practical end-points, or explicit objectives for management, it will not be supported by those involved in the water allocation and licensing process.

Channel: An open conduit with clearly defined margins that (i) continuously or periodically contains flowing water, or (ii) forms a connecting link between two water bodies.

Condition: The ecological health or integrity of an ecosystem, assessed using categories that describe the degree of modification from natural condition. For NFEPA, condition was assessed using

all available data, including present ecological state data (Kleynhans, 2000), River Health Programme data, reserve determination data and modelling of land cover where no other data existed, as well as expert knowledge. (Also see “ecological category”)

Critical Biodiversity Areas: Those areas required to meet quantitative targets for biodiversity, as determined by an integrated terrestrial and aquatic systematic biodiversity plan. These areas are critical for conserving biodiversity and maintaining ecosystem functioning in the long term. These areas differ from FEPAs in that they are usually determined at a finer, sub-national scale and integrate terrestrial and aquatic priority areas.

Cut-off drain: A sub-surface drain designed to divert flow away from a certain area.

Ecological category: A simplified measure of the extent that an ecosystem has been altered from natural condition due to human impact. There are six ecological categories (Table 1)) ranging from A (natural) to F (critically/extremely modified), derived using expert assessment of specific criteria. Also referred to as Present Ecological State or EcoStatus. (Also see “condition”)

Ecological integrity: Used to describe the extent that ecosystems have been altered by humans from their original natural condition. (Also see “condition” and “ecological category”)

Ecological processes: The processes that operate to maintain and generate biodiversity and ensure the continued functioning of ecosystems. Ecosystems function because they are maintained by ecological processes such as nutrient cycling, natural disturbance regimes (e.g. flow regime), groundwater recharge, filtering of pollutants and migration of species. Systematic biodiversity plans seek to map and set targets for spatial components of these ecological processes, such as large-scale landscape corridors, groundwater recharge areas or the buffer of natural vegetation area around a wetland or river. Ecological processes often form the foundation of ecosystem service delivery for people.

Ecological specifications or EcoSpecs (DWAF, 2008a): Clear and measurable specifications of ecological attributes (e.g. water quality, flow, biological integrity) that define the ecological category and serve as an input to Resource Quality Objectives (RQOs). EcoSpecs refer explicitly and only to ecological information whereas RQOs include economic and social objectives.

Ecological Support Areas: Those areas that play a significant role in supporting ecological functioning of Critical Biodiversity Areas and/or delivering ecosystem services, as determined in a systematic biodiversity plan.

Ecological water requirements: The quantity and quality of water of that resource that is required to maintain that water resource in its assigned ecological category.

Ecologically sustainable base configuration scenario: In the context of the national water resource classification system, this means the lowest acceptable level of protection required for the sustainable use of the entire integrated unit of analysis. Integrated units of analysis are socio-economic zones aligned to watershed boundaries.

EcoStatus (Iversen *et al.* (2000), cited in Kleynhans and Louw (2007)): The totality of features and characteristics of the ecosystem that bear upon its ability to provide a variety of goods and services.

Ecosystem: Refers to the assemblage of living organisms, the interactions between them and with their physical environment. Every ecosystem is characterised by its composition (living and non-living components of which it consists), the structure (how the components are organised in space and time) and the ecological processes (functions such as nutrient cycling) that maintain the structure and composition and so maintain the ecosystem as a functioning unit. Ecosystems can operate at different scales – from very small (a pond) to whole landscapes (an entire Water Management Area).

Ecosystem services: The benefits that people obtain from ecosystems, including provisioning services (such as food, water, reeds), regulating services (such as flood control), cultural services (such as recreational fishing), and supporting services (such as nutrient cycling, carbon storage) that maintain the conditions for life on Earth.

Freshwater ecosystems: All inland water bodies whether fresh or saline, including rivers, lakes, wetlands, sub-surface waters and estuaries.

General Authorisations: various forms of water use may be "generally authorised" for particular areas or catchments, and under specified conditions, by means of a general notice in the Gazette. These are larger volumes of water than those of Schedule 1 of the Water Act, with some potential for negative impacts on the water resource. This exempts such users from having to apply for a licence for that use, but they are required to register the use, and pay for that registration.

Protected areas: Areas of land or sea that are formally protected by law (i.e. recognised in terms of the Protected Areas Act) and managed mainly for biodiversity conservation.

Quaternary catchment: South Africa has a system of catchment delineations used extensively in water resource assessment, planning and management. These catchments are nested hydrological units from the primary drainage basin, through to secondary and tertiary catchments, with the smallest operational unit being the quaternary catchment (Midgley *et al*., 1994).

Ramsar wetland: A wetland listed under the Convention on Wetlands of International Importance, which gives it recognition by the international community as being of significant value, not only for the country, but for humanity as a whole (see www.ramsar.org).

Rehabilitation/restoration: The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed, which involves the repair of the natural environment to a state close to its original state. For example, this can be achieved through the removal of invasive alien plants, or the repair of eroded sites and the replanting of indigenous plants. Restoration involves not only the rehabilitation of ecosystem processes, productivity and services, but also the re-establishment of species composition and community structure.

River ecosystem types: River reaches with similar physical features, comprising unique combinations of landscape features, flow variability and channel slope. Rivers with the same ecosystem type are expected to share similar biological responses under natural conditions. For NFEPA, river ecosystem types were used to represent natural examples of the diversity of river ecosystems across the country. They were mapped using unique combinations of Level 1 ecoregions (Kleynhans *et al*., 2005), slope categories (Rowntree and Wadeson, 1999) and permanence of flow (DLA, 2005-2007).

Reference condition: Set of selected measurements or conditions of unimpaired or minimally impaired freshwater ecosystems, characteristic of a region.

Reserve: The Reserve refers to water quality and quantity for two components: water for basic human needs, known as the Basic Human Needs Reserve, and water to maintain aquatic ecosystems, known as the Ecological Reserve. The Basic Human Needs Reserve provides for the essential needs of individuals served by the water resource in question and includes water for drinking, for food preparation and for personal hygiene. The Ecological Reserve is captured through reserve determinations. The Reserve refers to both the quantity and quality of the water in the resource, and will vary depending on the class of the resource. The Minister is required to determine the Reserve for all or part of any significant water resource. If a resource has not yet been classified, a preliminary determination of the Reserve may be made and later superseded by a new one. Once the Reserve is determined for a water resource it is binding in the same way as the Class and the Resource Quality Objectives. The Reserve is the only right to water use in the National Water Act, and water must be assigned to meet the requirements of the Reserve before water can be allocated to other uses. As such, a Reserve must be determined before any water use can be authorised. A preliminary Reserve can be determined before a comprehensive reserve determination.

Resource Directed Measures: Resource Directed Measures, together with Source Directed Controls are the key strategic approaches designed under the National Water Act (RSA, 1998) to achieve equity, sustainability and efficiency is Integrated water Resources Management in South Africa. These measures comprise the classification system, the Reserve and Resource Quality Objectives. They are described in Chapter 3 of the National Water Act, and together are intended to ensure comprehensive protection of all water resources.

Resource Quality Objective: A numerical or descriptive statement of the conditions which should be met in the receiving water resource, in order to ensure that the water resource is protected.

Resource Units: Ecologically significant river reaches (aligned to Integrated Unit of Analysis boundaries).

Resource Water Quality Objectives: RWQOs are the water quality components of the Resource Quality Objectives (RQOs) which are defined by the National Water Act as “clear goals relating to the quality of the relevant water resources.” In the document, “Policy on the Resource Directed Management of Water Quality”, RWQOs are defined as numeric or descriptive in-stream (or in-aquifer) water quality objectives typically set at a finer resolution (spatial or temporal) than RQOs to provide greater detail upon which to base the management of water quality.

Riparian areas or habitat: The area that is directly influenced by the river. Includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

Sub-quaternary catchment: These are sub-catchments that are broadly nested in the quaternary catchments used by DWA (Midgley *et al*., 1994). The watershed is delineated around each river

reach, where a river reach is defined as the portion of river between the confluences on the 1:500 000 river network GIS layer. (Also see “quaternary catchment”)

Target Water Quality Range: the range of concentrations or levels of water quality variables within which no measurable adverse effects are expected on the health of aquatic ecosystems, and should therefore ensure their protection. This represents a management objective, which has been derived from quantitative and qualitative criteria. DWA strive to protect South Africa's water resources by maintaining water quality within the TWQR.

Water Management Area: South Africa has 19 Water Management Areas used as administrative and management units for implementing water policy and legislation. Catchment Management Agencies are in the process of being established for Water Management Areas or groups of Water Management Areas. Water Management Areas are delineated using catchment boundaries and do not match provincial or municipal boundaries.

Wetland: an area of marsh, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tides does not exceed ten meters [adaptation of Ramsar definition, which is far broader than the definition of a wetland according to the National Water Act].

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Appendix: Example of strategic objectives for aquatic ecosystem protection for a Catchment Management Strategy

Strategic objectives for aquatic ecosystem protection (or freshwater conservation and management) were developed for the Breede-Overberg Catchment Management Strategy with input from the NFEPA project team. A template based on this input is shown below, and may form a useful basis for inputs to water resources protection sub-strategies in other Catchment Management Strategies.

INTRODUCTION

The Water Resource Protection Strategy of the Breede-Overberg Catchment Management Strategy identifies three strategic areas for achieving water resource protection in the Breede-Overberg: Environmental Flow Requirements, Water Quality Requirements, and Aquatic Ecosystem Protection. The section below focuses on the third strategic area, providing a Conservation Management Strategy for aquatic ecosystem protection.

Aquatic ecosystem protection is not just about protecting freshwater plants and animals but should rather be regarded as a comprehensive approach to sustainable and equitable development of the catchment's scarce water resources. Keeping some aquatic ecosystems in a good condition serves a dual purpose of promoting the sustainable use of water resources in the catchment, while conserving its associated biodiversity. A healthy ecosystem supports functional communities of plants and animals that are able to remove nutrients and toxic substances from water, keeping it cleaner for drinking, irrigation and recreation. Healthy rivers, wetlands and groundwater systems also maintain water supply and buffer the effects of storms, reducing the loss of life and property in the event of floods. Healthy riparian zones help trap sediments, stabilise river banks and break down pollutants draining from the surrounding land. Estuaries provide nursery areas for marine and estuarine animals, and supply fresh water and nutrients to the sea, which drive marine food webs and maintain important fisheries. A certain amount of water is also required to scour the mouth of most estuaries – without this scouring effect, sediments build up at the mouth and the risk of back-flooding during storms increases. Aquatic ecosystem protection is therefore an essential component to meeting government objectives for both sustainable water resources development (National Water Act) and freshwater biodiversity conservation (Biodiversity Act).

STRATEGIC OBJECTIVES

Strategic Objective 1: Incorporate Freshwater Ecosystem Priority Areas (FEPAs) into planning and decision-making processes that impact on aquatic ecosystems

- Take Freshwater Ecosystem Priority Areas (FEPAs) into consideration in catchment visioning, water resource classification, reserve determination, setting and monitoring of resource quality objectives, and water-use license applications
- Take Critical Biodiversity Areas and Ecological Support Areas into consideration in decisions regarding water resource development

- Establish a process whereby the Breede Overberg Catchment Management Agency (BOCMA) can comment on development applications in collaboration with CapeNature and the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP)
- Promote a catchment approach to development in municipal integrated Development plans (IDPs) and Spatial Development Frameworks (SDFs)
- Facilitate coordination of planning processes amongst implementing agencies that manage or impact on aquatic ecosystem protection

Strategic Objective 2: Develop and implement estuary management plans

- Support the development and implementation of estuary management plans under the Integrated Coastal Management Act
- Assist in the establishment of estuary management forums required to implement these plans
- Clarify roles and responsibilities of the different implementing agencies in estuary management, particularly between the CMA, Department of Water Affairs, CapeNature and local municipalities
- Include estuary management forum representatives in CMA planning and decision-making processes
- Promote the policy of no new development in the estuarine functional zone (defined largely according to the 5 m contour line)

Strategic Objective 3: Develop and implement management plans for priority wetlands

- Identify which wetlands need most urgent attention using wetland Freshwater Ecosystem Priority Areas (FEPAs) as a starting point
- Delineate extent of these wetlands and the management buffers that will be required for their protection
- Form a collaboration with relevant implementing agencies to support the development and implementation of management plans for these wetlands
- Engage with the relevant land owners to ensure that they comply with the protection of these priority wetlands (e.g. through working with Department of Agriculture LandCare and the Biodiversity Stewardship Programmes)

Strategic Objective 4: Develop and implement management plans for priority rivers

- Prioritise the development of management plans for Freshwater Ecosystem Priority Areas (FEPAs)
- Identify the smaller streams and habitats within the river Freshwater Ecosystem Priority Area (FEPA) that require protection and delineate management buffers that will be required for their protection
- Form a collaboration with relevant implementing agencies to support the development and implementation of management plans for these river habitats
- Engage with water user associations to support the protection of these priority river habitats
- Engage with the relevant land owners to ensure that they comply with the protection of these priority river habitats (e.g. through working with Department of Agriculture LandCare and CapeNature's Biodiversity Stewardship Programme)

Strategic Objective 5: Management of riparian and alien vegetation

- Identify priority areas for re-establishment of the riparian zone
- Assist existing extension services (e.g. Western Cape Department of Agriculture and Biodiversity and Wine Initiative extension officers) to prevent further ploughing in riparian zones
- The principle of no ploughing in riparian zones should be adopted and the rehabilitation/re-establishment of riparian zones should be supported
- Identify priority areas for clearing of invasive alien vegetation

- Assist in the development of contractual mechanisms for clearing on private land that include stringent mechanisms to ensure follow-up treatment
- Coordinate clearing of alien plants in priority sites on private land with Working for Water, SANParks and CapeNature
- Help capacitate local landowners and contractors in clearing of invasive plants

Strategic Objective 6: Management of threatened fish sanctuaries

- Develop fish management plans for threatened fish species, using the NFEPA fish sanctuaries as a starting point and aligning with CapeNature development plans
- Avoid stocking of invasive alien fish, whether for aquaculture or recreational fishing, in FEPAs (e.g. by partnering with CapeNature's permitting processes for alien invasive fish species on private land)
- Produce a clear policy statement for the CMA on freshwater and estuarine aquaculture, aligned to CapeNature's policies on utilization of indigenous, utilisation of alien invasive fish, and the use of rotenone in the eradication of alien invasive fish

Strategic Objective 7: Monitoring the state of freshwater ecosystems

- Clarify roles and responsibilities of monitoring agencies, including the CMA, Department of Water Affairs and local municipalities
- Align CMA monitoring activities with all enforcement partners, working towards having a monitoring node immediately downstream of every FEPA
