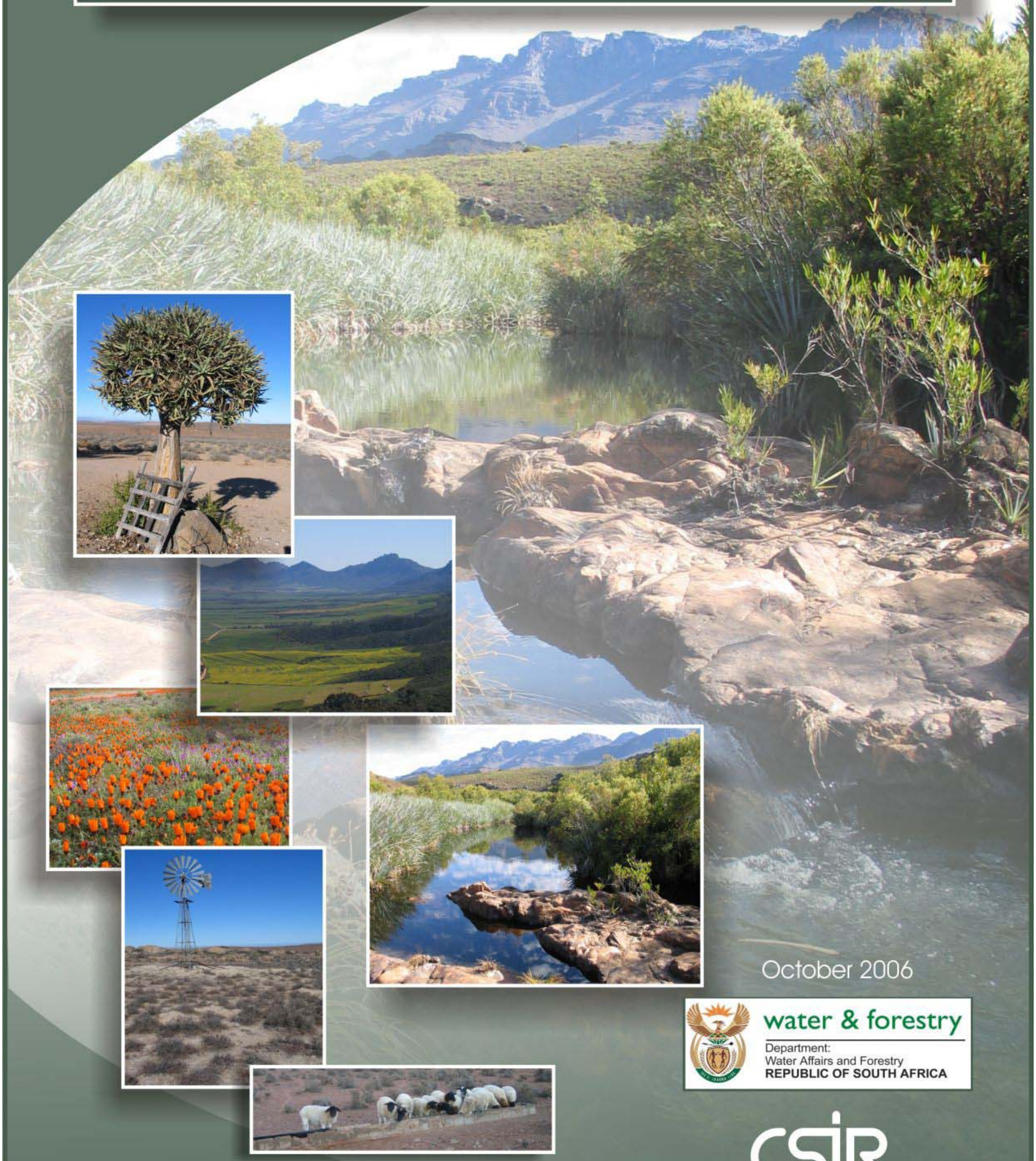
# Conservation Assessment of Freshwater Biodiversity in the Olifants/Doorn Water management Area



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# Executive Summary

This study forms part of a broader project (DWAF project 2005-170) by the Department of Water Affairs and Forestry (DWAF) which aims to develop a planning capacity for freshwater conservation in South Africa. A conservation assessment was conducted in the Olifants/Doorn Water Management Area to identify spatial priorities for freshwater ecosystems. The study focussed on the four following objectives, as agreed in the contract between the CSIR and DWAF:

- Conserve and maintain a sample of the freshwater biodiversity and associated ecosystem processes, with a focus on biodiversity of regional significance;
- Provide systematic and strategic guidance regarding the trade-offs between conservation and development;
- Direct future conservation and development opportunities; and
- Provide strategic perspective to decision-makers at the scale of a water management area.

The technical planning approach adopted for this study is based on systematic conservation planning principles and methods (Margules and Pressey 2000; Roux *et al.* 2006). This report presents the systematic approach that was followed, its outcomes in the form of a portfolio of conservation areas, and broad management actions to promote the implementation of the suggested portfolio.

The areas included in this conservation portfolio are not intended as formal protected areas only. Rather, they reflect areas that need to be managed appropriately to conserve the full spectrum of freshwater biodiversity for both present and future generations. Identification of these areas alone is not enough to catalyse conservation action, and this study should not be seen as a completed conservation planning exercise. These spatial priorities need to be verified and then coupled to an implementation strategy developed in collaboration with the key stakeholders in the area (Driver *et al.* 2003, Knight et al. 2006). A major value of systematic assessments lies not only in the selected conservation areas they identify, but also in the **mechanism they provide for stakeholder collaboration** around conservation action. Providing such a mechanism for collaboration is immensely important in conserving freshwater ecosystems, which can be considered one of the greatest governance challenges faced by modern societies, since water affects every activity of human society and everyone needs to be part of the solutions for conserving freshwater ecosystems.

One of the most appropriate frameworks within which to implement this conservation portfolio would be the Catchment Management Agencies under the auspices of the DWAF. The Olifants/Doorn Water Management Area is a relatively well-resourced area, and there is considerable momentum towards establishing a Catchment Management Agency (DWAF 2005c), with the mobilisation of 11 catchment management forums. Strategies and plans for these forums are in the process of development, providing an excellent opportunity for incorporating aspects of this conservation plan into the strategies and business plans of these forums. Given this institutional readiness, combined with the importance of the Olifants/Doorn Water Management Area in terms of its biodiversity, it is recommended, that we capitalise on this opportunity, and develop an implementation strategy to accompany this conservation assessment as a matter of urgency.

An important step during the development of the implementation strategy is to field verify the conservation portfolio, and in turn refine the implementation strategy where necessary. This latter step is very important as many selected areas are based on best available data, some of it modelled, and each data set has its limitations. A summary of the GIS layers that were used in designing the portfolio of conservation areas is provided below (cross-referenced to the particular section of the report), along with a short description on how these were applied in the design, and the limitations to their application:

| **GIS layer** | **Description & how it was used in the conservation portfolio design** | **Limitations** |
|---|---|---|
| Sub-quaternary catchments (Section **Error! Reference source not found.**) | These are catchments nested within quaternary catchments, used as planning units (units of selection) within the conservation portfolio. | The approach used to derive this GIS layer produced large catchment size variability. Future refinements should attempt to derive sub-quaternary catchments of a more uniform size. |
| Special features (Section **Error! Reference source not found.**) | Features of special biodiversity or scenic significance mapped by regional experts. These included intact river gorges, which serve as evolutionary barriers, zones of rejuvenation and natural barriers to alien fish invasion; rivers free of alien fish; and a large intact wetland system on the Matjies River. All special features were included as low-impact management zones in the final conservation portfolio. In addition to this, planning unit cost was "discounted" for all those sub-quaternary catchments containing special features. In instances where there are choices between two sub-quaternary catchments, this discounting has the affect of favouring selection of sub-quaternary catchments with special features. | This is an expert-based GIS layer, which is neither exhaustive, nor consistent across the landscape. It merely provides some obvious special features as a starting point for the conservation planning software. Future refinements could improve on this GIS layer by paying better attention to riparian vegetation of special significance and known wetlands. |
| River types (Section **Error! Reference source not found.**) | River types for 1:500 000 rivers, derived using a combination of flow variability (Hannary and Hughes 2003), ecoregions (Kleynhans 2004), and longitudinal zonation (Rowntree and Wadeson 1999). These were used as coarse-filter biodiversity surrogates, and targets were set to conserve a representative sample of all river types. All sub-quaternary catchments contributing towards targets for river types were selected as river conservation zones in the conservation portfolio. Conserving a representative sample of river types is assumed to provide representative habitat for biodiversity to persist and evolve. | River types developed for this assessment are preliminary and based on desktop data. They are still in the process of review and refinement. A potential refinement is to include biogeographical zones, e.g. primary catchments, which reflect evolutionary lineages, and therefore biodiversity. A review of the river types should include aspects such as assessing whether each river type is a true reflection of river biodiversity in the field, as well as testing the effectiveness of river types as coarse filter surrogates of biodiversity. |
| Wetland delineations (Section **Error! Reference source not found.**) | Mapped wetland boundaries for the study area, based on an amalgamation of four GIS layers: sensitive wetlands of the Western Cape Province; perennial and non-perennial pans from 1:50 000 topocadastral maps; beta version of the South African Wetlands Map; and polygons created by applying a 100 m GIS buffer to either side of lowland rivers. | Although this GIS layer includes many known and mapped wetlands from the first two mentioned GIS layers, the vast majority of the delineations are from the beta version of the South African Wetlands Map. This GIS layer is a predictive model which maps where water is most likely to accumulate on the landscape, using remote-sensing and other landscape characteristics. The resultant map therefore represents potential wetlands rather than actual wetlands. Therefore this GIS layer should be verified in the field. A priority point of |

| GIS layer | Description & how it was used in the conservation portfolio design | Limitations |
|---|---|---|
| | | departure would be to verify the sub-quaternary catchments selected in the conservation portfolio as containing important wetlands. |

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|---|---|---|
| Wetland types (Section **Error! Reference source not found.**) | Wetland types derived using the hydro-geomorphological typing framework proposed by the National Wetland Inventory project (Ewart-Smith 2006). This is a hierarchical typing framework that enables wetlands to be characterised according to the functions they perform, and the goods and services they are likely to provide. This GIS layer was applied in the conservation portfolio in two ways. Firstly, targets were set to conserve a representative sample of all wetland types. All sub-quaternary catchments contributing towards targets for wetland types were selected as wetland conservation zones in the conservation portfolio. Conserving a representative sample of wetland types is assumed to provide representative wetland habitat for biodiversity to persist and evolve. The second way in which this GIS layer was applied was to recognise the functional importance of wetlands. All wetland delineations were included in the conservation portfolio as either low- or moderate-impact management zones, the level of management being based on the functional importance and sensitivity of the different wetland types. | Typing wetlands to the level of the Functional Unit provides only a broad-scale list of the diversity of different wetland types in the study area. Finer levels of detail will need to be added using field trips and aerial photography. Wetland typing was undertaken on wetland delineations that are mainly potential wetlands, rather than actual wetlands. Therefore, a priority point of departure would be to verify the sub-quaternary catchments selected as containing important wetland types in the conservation porfolio. |
| Combined fish sanctuaries (Section **Error! Reference source not found.**) | A GIS layer that combines the sub-quaternary catchments designated as fish sanctuaries for the endemic and indigenous freshwater fishes of the study area. This GIS layer was applied in two ways in the conservation portfolio. Firstly, sub-quaternary catchments containing rivers selected as fish sanctuaries were incorporated into the conservation portfolio as river conservation zones. Secondly, any sub-quaternary catchment deemed important for fish migration was selected as a moderate-impact management zone in the conservation portfolio (if it had not already been selected as a river conservation zone). | Designation of spatial areas for fish species alone is not enough to maintain viable populations in the long-term. Attention also needs to be given to controlling alien invasive fish species, and over-abstraction. Fish species in the Olifants/Doorn Water Management Area are highly sensitive to altered water quality and water quantity, and an effort to maintain ecological water requirements throughout the Olifants-Doring and Sandveld primary catchments is essential. |

| GIS layer | Description & how it was used in the conservation portfolio design | Limitations |
|---|---|---|
| River ecological integrity (Section **Error! Reference source not found.**) | Ecological integrity of quaternary catchment main rivers used a combination of<br>• Present ecological status (Water Situation Assessment Model data; Kleynhans 2000);<br>• River Health Programme monitoring sites; and<br>• Habitat integrity data at 5 km stretches along the Doring, Groot, Olifants and Rondegat rivers.<br>Ecological integrity of the remaining 1:500 000 rivers (termed "tributaries') was modelled using National Land Cover 2000 GIS data. Modelled tributary integrity was based on a threshold of minimum percentage natural vegetation, and erosion, within the sub-quaternary catchment and riparian buffer. Only rivers that were currently of high ecological integrity were able to contribute toward achieving targets in the conservation portfolio. Selecting rivers of high integrity incorporates many small-scale biodiversity processes and maximizes conservation benefits from functioning ecosystem components that are already in place. Where targets for river types could not be achieved in rivers of high ecological integrity, an assessment of rehabilitation potential was undertaken. | The modelled tributary ecological integrity data are preliminary and need to be refined to consider the cumulative upstream impacts of dams. These refinements should then be field verified. |
| Wetland ecological integrity (Section **Error! Reference source not found.**) | Modelled ecological integrity of wetlands based on National Land Cover 2000 GIS data. The integrity was derived using a threshold of minimum percentage natural vegetation within the sub-quaternary catchment, as well as within a radius of 50 and 100 m of a wetland. Only wetlands that were deemed of high ecological integrity were able to contribute toward achieving targets in the conservation portfolio. Selecting wetlands of high integrity incorporates many small-scale biodiversity processes and maximizes conservation benefits from functioning ecosystem components that are already in place. | This GIS layer is likely to be an under-estimation of the extent to which wetlands have been impacted. The wetland integrity data therefore need to be field verified. Results are likely to be over-optimistic regarding the state of wetlands, due to several limitations:<br>• Differences in scale may under-estimate intense and highly localised impacts that are smaller than the minimum mapping unit of the National Land Cover 2000 GIS layer.<br>• Extent of land degradation under-estimated by National Land Cover 2000 leads to under-estimation of impacts, since wetlands are particularly sensitive to trampling and grazing.<br>• Deleterious land use practices are not always mapped. |

| GIS layer | Description & how it was used in the conservation portfolio design | Limitations |
|---|---|---|
| Significant groundwater discharge areas (Section **Error! Reference source not found.**) | Areas where there is a medium to high prediction of groundwater to surface water interaction. These were modelled using a combination of six GIS layers (groundwater response units, groundwater levels, springs, geological faults, aquifer dependent ecosystems and groundwater contribution to baseflow). In areas of significant groundwater discharge, groundwater is thought to play a particularly important role in the ecological functioning of surface waters, maintaining river pools that serve as crucial refugia in the summer low flow months, sustaining river baseflows, and maintaining wetlands and riparian vegetation. These areas were thus included in the conservation portfolio as moderate-impact management zones. | The resulting map of groundwater-surface water interaction is a predictive model based on relatively coarse-scale desktop GIS data and expert interpretation. These data should therefore be confirmed in the field. |
| Significant groundwater recharge areas (Section **Error! Reference source not found.**) | Areas that have significant groundwater recharge (> 30 mm/yr), based on the Chloride Mass Balance (Lerner *et al.* 1990; DWAF 2005b). Deleterious activities in areas that have significant recharge can have a keystone effect on the functioning of groundwater dependent ecosystems, which can be in the immediate vicinity, or far removed from the recharge area. Identifying areas of significant groundwater recharge allows for pro-active management of activities that may lower the groundwater quantity or quality in their vicinity. Areas that have significant recharge were included in the conservation portfolio as moderate-impact management zones. | Groundwater recharge is based on a national assessment, and is an interpolated surface of 1 x 1 km cells. The scale is quite coarse, although expert knowledge of the area confirms the areas that have been highlighted as significant are a true reflection of reality. |
| Significant water yield areas (Section **Error! Reference source not found.**) | Areas that contribute significantly to the water supply of the Olifants/Doorn Water Management Area are delineated by proclaimed Mountain Catchment Areas. These areas were included in the conservation portfolio as moderate-impact management zones to ensure that land and water use activities do not have a major impact on water quality and quantity, which in turn would have a domino effect on the functioning of many dependent ecosystems. | Future refinements should examine improved methods to measure high water yield areas, such as using mean annual precipitation in combination with evapotranspiration. |
| Rehabilitation potential (Section **Error! Reference source not found.**) | Sub-quaternary catchments that are feasible to rehabilitate to help conserve examples of river types that currently cannot achieve conservation targets in intact rivers. Sub-quaternary catchments deemed feasible for rehabilitation were incorporated explicitly into the conservation portfolio as river rehabilitation zones. | Trade-offs between ecological, economic and social impacts have not been fully taken into account in this assessment of rehabilitation potential. |

| **GIS layer** | **Description & how it was used in the conservation portfolio design** | **Limitations** |
|---|---|---|
| Conservation portfolio (Section **Error! Reference source not found.**) | Selected areas for conservation, highlighting river and wetland conservation zones, low- and moderate-impact management zones, and river rehabilitation zones (see below this table for broad management implications of each of these zones). The purpose of this conservation portfolio is to:<br>• Propose areas that will conserve and maintain a sample of the freshwater biodiversity and associated ecosystem processes;<br>• Provide systematic and strategic guidance regarding the trade-offs between conservation and development;<br>• Direct future conservations and development opportunities; and<br>• Provide strategic perspective to decision-makers at the scale of a Water Management Area. | The spatial scale of the portfolio is detailed enough to provide a strategic perspective to sub-national decision-makers on what should be done to conserve biodiversity of freshwater systems. The outputs, however, are not fine enough to provide management guidelines at a local scale, e.g. detailed management objectives of a specific river reach habitat, or of a particular wetland. This finer level of detail will need to be addressed through the development of management plans for each selected *AND field verified* area in the conservation portfolio. These management plans should outline the most appropriate strategies to employ for each selected area, depending on criteria such as the characteristics of the biodiversity features requiring conservation, the main land use pressures and threats in the area, the socio-economic opportunities and constraints, and specific financial and institutional arrangements. The biodiversity features in each selected area, as well as some key management interventions, are provided in Appendix 6 to guide the development of these management plans. |
| "Targets + REC Configuration" (Section **Error! Reference source not found.**) | Desired ecological integrity class for rivers, to serve as a catchment configuration scenario in the development and testing of the National Water Resources Classification System. | The National Water Resources Classification System was only able to apply the "Targets + REC Configuration" to *main rivers of quaternary catchments*. Moreover, the desired class of all rivers within a quaternary catchment was generalised to the condition required at the *outlet* of that catchment. This implies that any tributary selected as a river conservation zone within a quaternary catchment that has a C-category desired at its outlet will also be classified as a category C, rather than A or B, within the National Water Resources Classification System. Using only main river recommendations to classify water resources has profound implications from a biodiversity perspective. Main rivers in South Africa are heavily utilised and regulated to provide water security for socio-economic demands. Tributaries are often less impacted than main rivers and therefore play a critical role in conserving the freshwater biodiversity of South Africa. |

Using these layers along with explicit conservation targets produced a conservation portfolio containing the following zones:

1. *River and wetland conservation zone*: These are sub-quaternary catchments required for achievement of wetland and/or river targets. Any intact wetland or river selected should maintain a present ecological integrity class of A or B.

2. *River rehabilitation zone*: These are sub-quaternary catchments that require rehabilitation of their rivers to an A or B ecological integrity class to help achieve conservation targets.

3. *Low-impact management zone*: Only low impact activities should be allowed in these areas, to maintain the integrity of one or more of the following biodiversity features: special feature and/or wetland function.

4. *Moderate-impact management zone*: Only moderate impact activities should be allowed in these areas, to maintain the integrity one or more of the following biodiversity features: wetland function, fish migratory corridor, upstream management area, significant water yield area, significant groundwater recharge area, and/or significant groundwater discharge area.

Generic management actions within these zones include:

- Retaining natural flow regime (both in terms of magnitude and variability). Flow is one of the most effective management tools available to flush out invasive alien fish and plants, as well as accumulated sediment in rivers, thereby increasing the quantity and quality of spawning habitat for fish, and providing cues for migration and spawning. Management actions to maintain natural flow regime should include:
  - Existing abstractions should be more focussed towards winter (May to September on the Olifants River system; June to September on the Sandveld, Doring and Knervlakte systems).
  - Water release from the Clanwilliam Dam should take note of the ecological requirements of the Olifants-Doring River system (Brown et al. 2004). This includes at least one winter release (preferably August), even if the dam is not full.
  - Optimal use should be made of existing abstractions through demand-management measures.
  - Controlling groundwater abstractions, particularly in the Sandveld and Koue Bokkeveld sub-areas.
  - No further building of instream dams and weirs (not only do these restrict movement, but it has also become common practise in the area to ignore the requirement of allowing summer water releases).
- Prohibiting the stocking of farm dams (even off-stream dams) with alien fish.
- Regular spear-fishing and netting of alien fish as a rehabilitation or control measure.
- No further granting of licenses for extensive agriculture. The catchment as a whole is only just in water balance (water demand equals water availability).
- Enforcing the 35 m riparian buffer zone. This applies to crops, since rivers and their associated biota are highly susceptible to crop pesticides. It also applies to excluding livestock, which cause considerable bank erosion, with subsequent degradation of water quality.

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