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Olifants River Ecological Water Requirements Assessment:

Ecological Reserve Report

EXECUTIVE SUMMARY

The Olifants River Ecological Water Requirements Assessment was initiated by the Department of Water Affairs and Forestry for planning purposes due to increased water demands in the Olifants River catchment, which was already regarded as being water stressed. A Comprehensive determination of the Reserve was conducted with the aim of quantifying the environmental requirements of the resource in order to protect the aquatic ecosystem and secure ecologically sustainable development and use of the resource. The outcome of this determination was recommended flow and water quality objectives that should be achieved in order that the aquatic ecosystem can be afforded the level of protection as required by the Ecological Class.

The purpose of this report is to provide water resource managers with a concise document of aquatic ecosystem conditions in the catchment and to highlight what needs to be achieved in the short and long-term to protect the aquatic ecosystem in order to provide ecologically sustainable development and use of the resource in the future. The report also looks at whether the ecological requirements can be met and the effect of the Ecological Reserve on the water supply to the current water users.

A summary of the present and future Ecological Classes are given in ***Table 1****.*

Table 1: Summary of PES, EIS and EC

Reach	***PES***	***EIS***	***EC***
Upper Olifants River: Segment 1 - 8	*D*	*Moderate*	*D*
Upper Olifants River: Segment 9 - 13 (Witbank Dam)	*E*	*Moderate*	*D*
Upper Olifants River:Segment 14 (Doringpoort Dam) - 27 (at and excluding Klipspruit confluence)	*D*	*Moderate*	*C*

Reach	**PES**	**EIS**	**EC**
Upper Olifants River: Segment 29 (Wilge confluence) – 37 (upper end of Loskop Dam)	*C*	*High*	*B*
Klein Olifants River: Segment 1 – 4 (Middleburg Dam)	*D*	*Moderate*	*D*
Klein Olifants River: Segment 5 (Middleburg Dam) – 12 (Olifants confluence)	*D*	*Moderate*	*D*
Wilge River: Segment 1 (Bronkhorstspruit Dam) – 7 (Premier Mine Dam)	*C*	*Moderate*	*C*
Wilge River: Segment 7 (Premier Mine Dam) – 20 (Olifants confluence)	*B*	*High*	*B*
Middle Olifants River: Segment 39 (Loskop Dam Wall) – 45	*C*	*High*	*B*
Middle Olifants River: Segment 46 – 57 (Arabie Dam)	*D*	*Moderate*	*D*
Middle Olifants River: Segment 58 (Arabie Dam wall) – 84	*E*	*Moderate*	*D*
Elands River: Segment 1 – 7 (Rust de Winter Dam)	*C*	*Moderate*	*B*
Elands River: Segment 8 (Rust de Winter Dam) – 15 (Rhenosterkop Dam)	*E*	*Moderate*	*C*
Elands River: Segment 16 (Rhenosterkop Dam) – 27 (Arabie Dam – Olifants confluence)	*E*	*Moderate*	*D*
Lower Olifants River: Segment 85 – 99 (Blyde confluence)	*E*	*High*	*D*
Lower Olifants River: Segment 100 (Blyde confluence) – 110 (Selati confluence)	*C*	*High*	*B*
Lower Olifants River: Segment 111 (Selati confluence) – 132 (Mozambique border)	*C*	*High*	*B*
Selati River: Segment 1 – 9	*C*	*Moderate*	*C*
Selati River: Segment 10 – 18	*E*	*Moderate*	*D*
Blyde River: Segment 1 (Blydepoort Dam) – 8 (Olifants River confluence)	*B*	*High*	*B*
Steelpoort River: Segment 1 – 8	*D*	*High*	*D*

The social assessment of the Olifants River did not have any influence on the setting of the Ecological Class. It was recommended, however, that a special project be established to formally integrate the link between human uses and values of river resources, and the quantification of environmental flow requirements, into the IFR process.

From the system analysis results it was evident that the IFR can be fully supplied at most of the sites. It was only sites 13, 15 and 16/17 in the lower Olifants River that were not fully supplied. On average over the analysis period the IFR at sites 13, 15 and 16/17 were supplied respectively at 91%, 88% and 89% of its full requirement. The shortages only occurred during the dry winter months.

Although most of the IFRs were fully supplied, the supply to existing users in the catchment was affected. In the incremental catchments upstream of IFR sites 2,7,9,10 and 14a and 14b the reduction in the supply to current users was relatively small, while significant in other areas.

The scenarios were further evaluated with respect to the ecological consequences. The resulting river state in terms of the impact of the imposed flow regime on the aquatic ecosystem associated with the various scenarios were then compared to the present state and the desired state. The summarised results of the evaluation are as follows:

- *At IFR sites 1, 5, 13 and 17 none of the scenarios could achieve the objectives required to achieve the EC. The 10% drought scenario was the best alternative at IFR 1 and 5. The PES scenario was the best alternative at IFR 13 and 17.*

- *At IFR sites 2, 4, 6 and 8 all the scenarios could achieve the objectives, although a higher risk of not achieving the objectives is coupled to the scenarios.*

It shall be noted, however, that the yield analysis was done for each incremental catchment on its own. For instance, the possibility of the Blyderiverspoort Dam supporting the flow requirements in the Lower Olifants River was not investigated. It is believed that most of the shortages can be overcome, although this will have to be determined by means of a more comprehensive study.

Olifants River Ecological Water Requirements Assessment:

Ecological Reserve Report

1. INTRODUCTION

1.1 BACKGROUND

The Olifants River Ecological Water Requirements Assessment was initiated by the Department of Water Affairs and Forestry for planning purposes due to increased water demands in the Olifants River catchment, which was already regarded as being water stressed. A Comprehensive determination of the Reserve was conducted with the aim of quantifying the environmental requirements of the resource in order to protect the aquatic ecosystem and secure ecologically sustainable development and use of the resource. The outcome of this determination was recommended flow and water quality objectives that should be achieved in order that the aquatic ecosystem can be afforded the level of protection as required by the Ecological Class.

1.2 PURPOSE OF THIS REPORT

The purpose of this report is to provide water resource managers with a concise document of aquatic ecosystem conditions in the catchment. The report aims to present the historical and present conditions in the catchment and to highlight what needs to be achieved in the short and long term to protect the aquatic ecosystem in order to provide ecologically sustainable development and use of the resource in the future. The report also looks at whether the ecological requirements can be met and the effect of the Ecological Reserve on the water supply to the current water users.

This report summarises the recommendations and/or outcomes presented in the Upper, Middle and Lower Olifants Comprehensive Ecological Reserve (Quantity) reports; the Present Ecological State (PES) and the Ecological Class (EC) of the Olifants River report; the Preliminary Ecological Reserve (Water Quality) report; the Scenario Analysis report and the Social Utilisation report. Specialist technical detail can be found in the respective reports.

1.3 STUDY AREA

A Comprehensive determination of the Reserve was conducted for the Olifants Water Management Area. Due to the large size of the catchment and for the purpose of this study the Management Area was divided into the Upper, Middle and Lower Olifants catchments.

The Upper Olifants catchment was delineated as the area upstream of the Loskop Dam, including the Wilge and Klein Olifants Rivers. The Middle Olifants River catchment was delineated as the area between the Loskop Dam and Penge, which included the four main tributaries: the Selons, Moses, Elands and Mohlapitse Rivers. The Lower Olifants River catchment was defined as the area between Penge and the border with Mozambique, encompassing three main tributaries: the Steelpoort, Selati and Blyde Rivers. Refer to **Figure 1.1**.

1.4 PROCESS TO DETERMINE THE ECOLOGICAL WATER REQUIREMENTS

The process followed to determine the ecological water requirements of the Olifants River followed that prescribed by DWAF (DWAF, 1999 **– Volume 3**). The geographical boundaries of the study area were delineated (see **Section 1.3**) and IFR sites selected. The selection of the sites was based on aerial video footage of the study area, an assessment of the instream and riparian habitat integrity for each 5 km segment of the river and a field visit by IFR specialists. Sites were selected on the basis of ease of access, distance from impoundment, suitability for hydraulic modelling, suitability of biological cues, the structure and condition of the riparian vegetation, and river zonation. A map depicting the position of the IFR sites is given in **Figure 1.1**. A table listing the IFR sites with their exact geographic location is given in **Appendix A**. It was not possible to assess the IFR requirements for each site in detail, due to time constraints, therefore the results obtained from a detailed assessment was converted to equivalent values for a matching or similar site. **Appendix A** highlights those sites that were used as matching or similar sites.

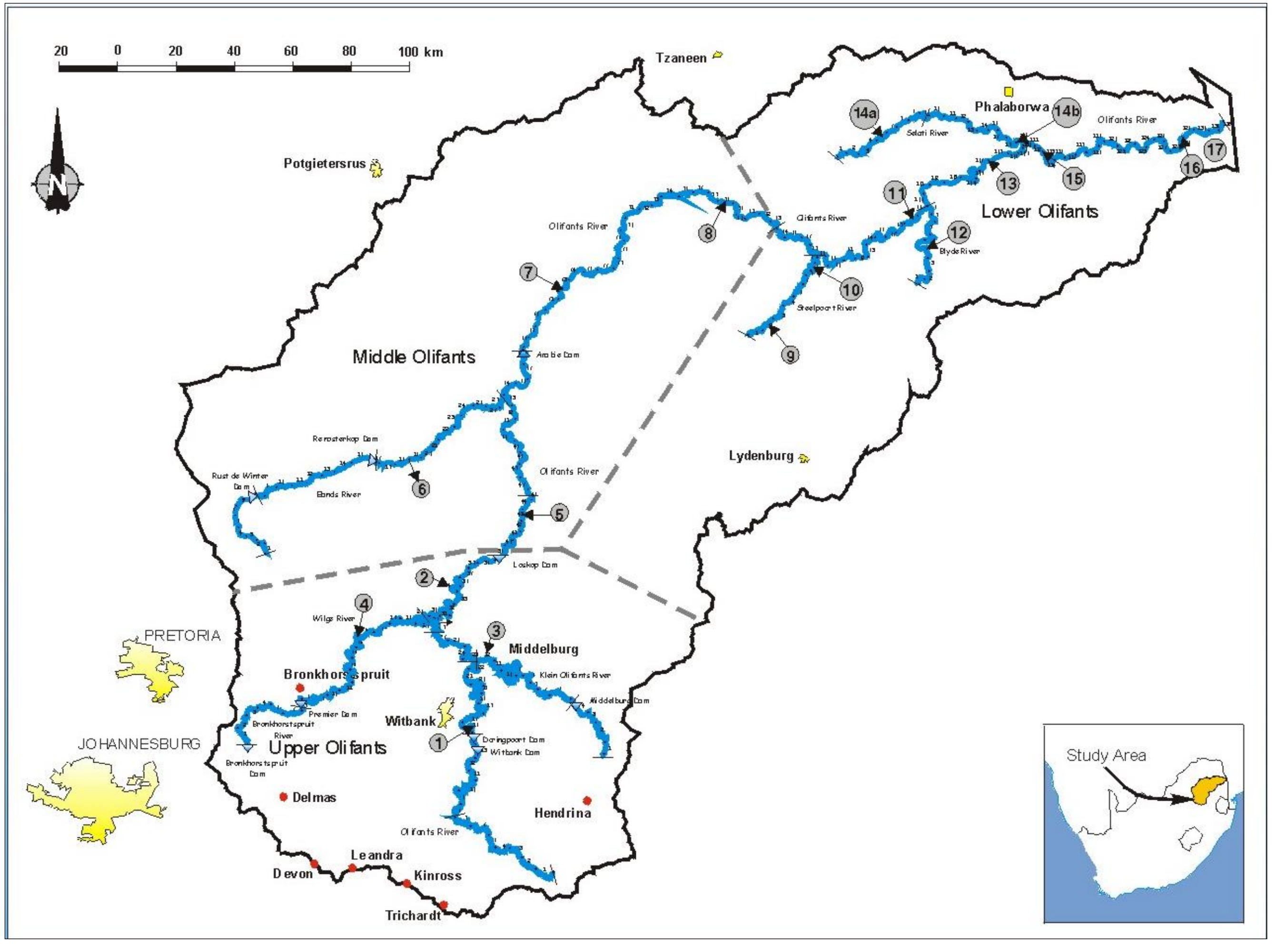


Figure 1.1: Location of IRF Sites

Reference conditions describing the natural unimpacted characteristics of the water resource were then established for each IFR site. Historical information and data, and/or data from reference sites (minimally impacted sites) were used to describe the reference conditions for the channel, hydrology, biota and the water quality. Due to data limitations and/or the absence of any existing class A reaches, the reference condition may not represent a natural state river, but rather the best estimate of a minimally impaired baseline state.

The Present Ecological State (PES) was then derived from, or described as a change for the worse from a described reference condition. The degree of change is described by one of a range of classes (Class A to Class F), where Class A to D is considered to be ecologically sustainable, and classes E to F indicate a current state that is ecologically unsustainable. In the OREWRA project the PES was expressed in the components: habitat (habitat integrity), biophysical (fish, riparian vegetation, aquatic invertebrates and geomorphology) and water quality (chemistry) integrity.

The trajectory of change, which describes the current trend of changes in the river in present conditions, was then described for each component for which the PES was determined. Both short term (less than 5 years) and long term (more than 10 years) changes were described. It was therefore possible to derive whether the PES evaluation reflects a stable state, or whether it was still changing under present conditions.

The Ecological Importance and Sensitivity of the river was then established, taking into consideration both abiotic and biotic components of the system. The social importance of the river was taken into consideration within the context of the ecological importance and sensitivity. The sociological assessment was restricted to the dependence of people and communities on a healthy riverine ecosystem for their basic needs, but did not include their social dependence on the river for commercial or subsistence farming.

Taking into consideration the Ecological Importance and Sensitivity of the river reach and constraints to its restoration potential, the specialists provided Ecological Classes for all components for which PES classes were determined. This specifically related to what could be achieved in the short-term. More importantly, long-term Ecological Classes, which is the end target for the river reach, were also recommended. This Ecological Class, although considered attainable, might only be achieved in the long-term, due to present constraints in the system. This means that in the short-term, an intermediate short-term ecological class might need to be achieved first, and that persistent improvement of the system would be required to achieve the long-term ecological class. This would require a long-term catchment strategy. (*Louw & Palmer, 2001*).

Resource Quality Objectives for each technical component were then derived for each IFR site. The objectives where either numerical (flow and water quality) or narrative (biota, geomorphological).

These IFR sites are to be monitored regularly to assess if the management objectives are being achieved and to establish if the Reserve and resource quality objectives are adequate and appropriate to support the habitat and biota at the level of protection required by the Ecological Class. A monitoring programme report has been produced to assist in the above.

2. UPPER OLIFANTS CATCHMENT

2.1 WILGE RIVER

2.1.1 Ecological Class

(a) The Bronkhorstspruit River upstream of the Bronkhorstspruit Dam is in a Class C, which is mostly due to landuse activities such as agriculture and the presence of exotic vegetation. The EIS is moderate and no motivation therefore exists to improve this section of the river. **The EC is therefore a Class C**.

(b) The Wilge River downstream of the Bronkhorstspruit Dam is in a **Class B** PES with a high EIS. **As it would not be attainable to improve the river to a Class A, the EC is maintained as a Class B.**

2.1.2 Summary of Present Ecological State, Trajectory of change, Status Quo scenario and Ecological Class

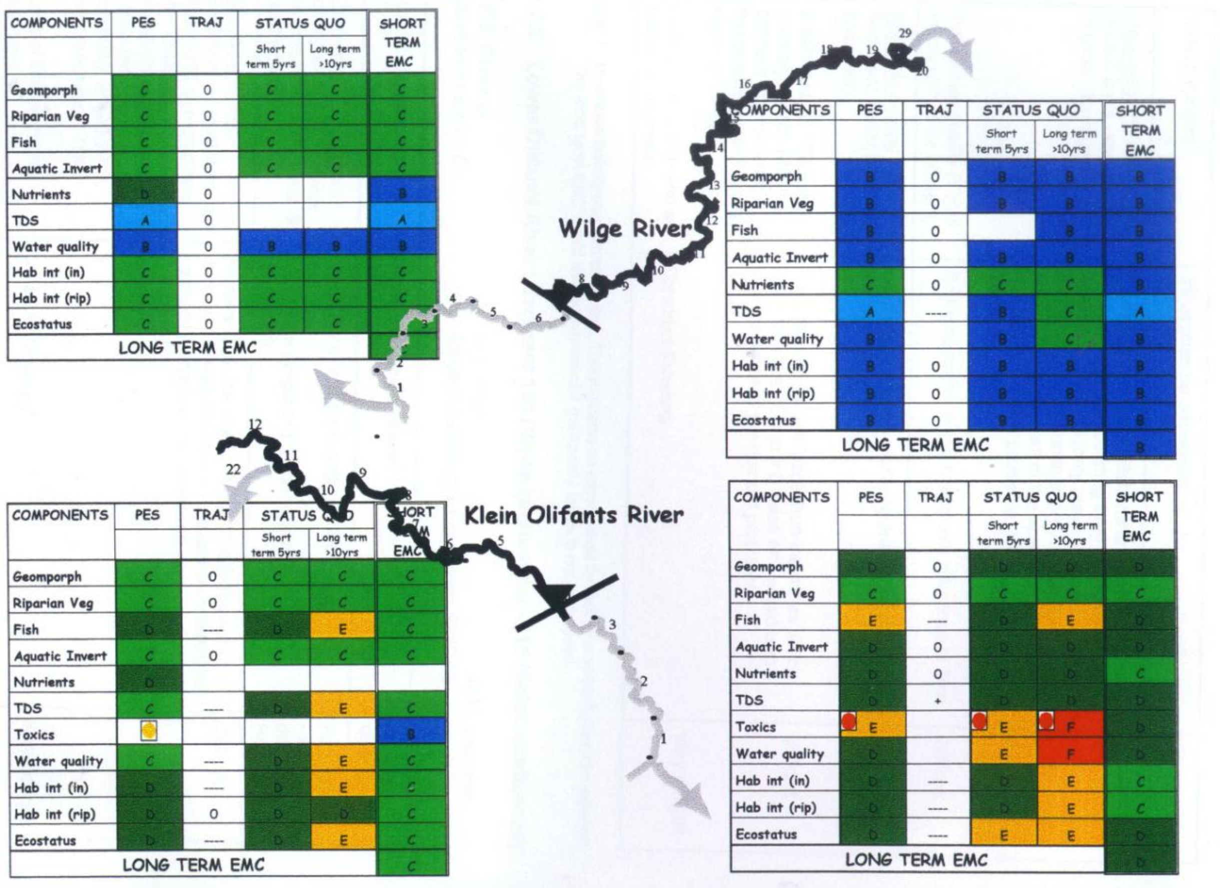
See **Figure 2.1**.

2.2 KLEIN OLIFANTS RIVER

2.2.1 Ecological Class (EC)

The Klein Olifants River is in a class D PES with changes in flow regime upstream of Middleburg Dam the major cause and changes in flow regime and nutrient enrichment from sewage the major causes downstream of Middleburg Dam. The EIS for the section downstream of Middleburg Dam is moderate and improvement is recommended to a Class C. This is because most of the individual components are in a Class C (including geomorphology and water quality – the drivers) and if the problems are addressed, the overall C Class will be easily achieved. **The recommended EC for the section upstream of Middleburg Dam is therefore a Class D and for the section downstream a Class C.**

2.2.2 Summary of Present Ecological State, Trajectory of change, Status Quo scenario and Ecological Class



COMPONENTS	PES	TRAJ	STATUS QUO		SHORT TERM EMC
			Short term 5yrs	Long term >10yrs	
Geomporph	C	0	C	C	C
Riparian Veg	C	0	C	C	C
Fish	C	0	C	C	C
Aquatic Invert	C	0	C	C	C
Nutrients	D	0			B
TDS	A	0			A
Water quality	B	0	B	B	B
Hab int (in)	C	0	C	C	C
Hab int (rip)	C	0	C	C	C
Ecostatus	C	0	C	C	C
LONG TERM EMC					C

COMPONENTS	PES	TRAJ	STATUS QUO		SHORT TERM EMC
			Short term 5yrs	Long term >10yrs	
Geomporph	B	0	B	B	B
Riparian Veg	B	0	B	B	B
Fish	B	0		B	B
Aquatic Invert	B	0	B	B	B
Nutrients	C	0	C	C	B
TDS	A	----	B	C	A
Water quality	B		B	C	B
Hab int (in)	B	0	B	B	B
Hab int (rip)	B	0	B	B	B
Ecostatus	B	0	B	B	B
LONG TERM EMC					B

COMPONENTS	PES	TRAJ	STATUS QUO		SHORT TERM EMC
			Short term 5yrs	Long term >10yrs	
Geomporph	C	0	C	C	C
Riparian Veg	C	0	C	C	C
Fish	D	----	D	E	C
Aquatic Invert	C	0	C	C	C
Nutrients	D				
TDS	C	----	D	E	C
Toxics					B
Water quality	C	----	D	E	C
Hab int (in)	D	----	D	E	C
Hab int (rip)	D	0	D	D	C
Ecostatus	D	----	D	E	C
LONG TERM EMC					C

COMPONENTS	PES	TRAJ	STATUS QUO		SHORT TERM EMC
			Short term 5yrs	Long term >10yrs	
Geomporph	D	0	D	D	D
Riparian Veg	C	0	C	C	C
Fish	E	----	D	E	D
Aquatic Invert	D	0	D	D	D
Nutrients	D	0	D	D	C
TDS	D	+	D	D	D
Toxics	E		E	F	D
Water quality	D		E	F	D
Hab int (in)	D	----	D	E	C
Hab int (rip)	D	----	D	E	C
Ecostatus	D	----	E	E	D
LONG TERM EMC					D

Figure 2.1: Wilge and Klein Olifants Rivers – Summary of PES, trajectory of change, status quo and EC results

2.3 UPPER OLIFANTS RIVER

2.3.1 Ecological Class

(a) Upstream of Witbank Dam

The Upper section of this reach of river is in a Class D with the lower reach in a Class E, which is mostly due to the impacts of mining on water quality and resulting impacts on the biota. The EIS is moderate and no improvement is therefore required in the Class D reach. The reach with a Class E PES is however, deemed to be unsustainable and must be improved to a minimum of a Class D. **The recommended EC for this reach is therefore a Class D**.

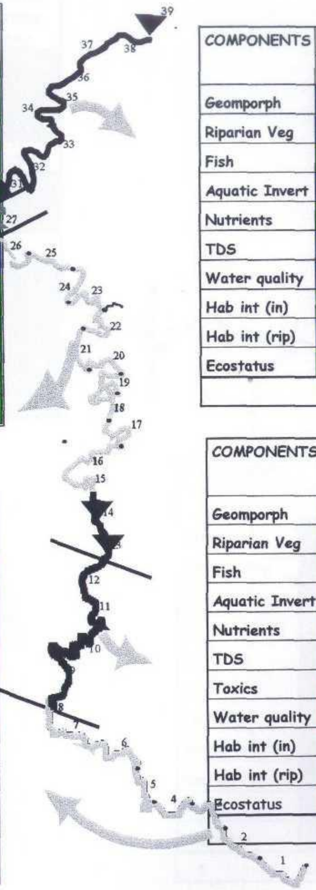
(b) Witbank Dam to Loskop Dam

The Upper section of this reach (to the Klipspruit confluence) is in a Class D mostly due to the impacts of mining on the water quality and the operation of Witbank Dam. The section from the Wilge River confluence to Loskop Dam is in a Class C state. The improvement of the PES is mostly due to the good water quality and flow regime from the Wilge River that attenuates any upstream impacts. Even though the EIS is only moderate for the upper section, improvement is recommended to a Class C as most of the individual components are in a Class C (including geomorphology – one of the drivers), and if the water quality problems are addressed, the overall Class of a C will be easily achieved. The lower section requires improvement, as the EIS is high. **The recommended EC for the upper section is therefore a Class D in the short-term and a Class C in the long-term and for the section downstream of the Wilge River confluence an EC of Class B.**

2.3.2 Summary of Present Ecological State, Trajectory of change, Status Quo scenario and Ecological Class

COMPONENTS	PES	TRAJ	STATUS QUO		SHORT TERM EMC
			Short term 5yrs	Long term >10yrs	
Geomporph	C	0	C	C	C
Riparian Veg	C	----	C	D	C
Fish	D	0	D	D	C
Aquatic Invert	C	0	C	C	C
Nutrients	C				C
TDS	D	----	D	E	C
Toxics					B
Water quality	D		D	E	C
Hab int (in)	D	0	D	D	C
Hab int (rip)	C	0	C	C	C
Ecostatus	D	----	D	D	C
LONG TERM EMC					C

COMPONENTS	PES	TRAJ	STATUS QUO		SHORT TERM EMC
			Short term 5yrs	Long term >10yrs	
Geomporph	B	0	B	B	B
Riparian Veg	B	0	B	B	B
Fish	C	0	C	C	B
Aquatic Invert	B	0	B	B	B
Nutrients	C				B
TDS	B	----	B	C	B
Water quality	B		C	C	B
Hab int (in)	C	0	C	C	B
Hab int (rip)	B	0	B	B	B
Ecostatus	C	----	C	C	B
LONG TERM EMC					B



COMPONENTS	PES	TRAJ	STATUS QUO		SHORT TERM EMC
			Short term 5yrs	Long term >10yrs	
Geomporph	C	----	C	D	C
Riparian Veg	D	0	D	D	D
Fish	E	----	E	E	D
Aquatic Invert	C	0	C	C	C
Nutrients	C	?			
TDS	C	----	C	D	C
Water quality	C	----	C	D	D
Hab int (in)	D	----	D	D	D
Hab int (rip)	D	0	D	D	D
Ecostatus	D	0	D	D	D
LONG TERM EMC					D

COMPONENTS	PES	TRAJ	STATUS QUO		SHORT TERM EMC
			Short term 5yrs	Long term >10yrs	
Geomporph	C	----	C	D	C
Riparian Veg	D	----	D	E	D
Fish	E	----	E	F	D
Aquatic Invert	E	0	E	E	D
Nutrients	C				C
TDS	C	----	D	E	C
Toxics	E		E	E-F	B
Water quality	E		D	E	C
Hab int (in)	D	----	D	E	D
Hab int (rip)	D	----	D	E	D
Ecostatus	E	----	E	F	D
LONG TERM EMC					D

Figure 2.1: Upper Olifants River - Summary of PES, trajectory of change, status quo scenario and EC results

2.4 OVERALL OBJECTIVES FOR THE UPPER OLIFANTS CATCHMENT

It is recommended that water quality management in the Upper Olifants River catchment should focus on the following problems:

- The increasing levels of TDS in the Wilge River
- High TDS and nutrients in the Klein Olifants River
- Low pH and high TDS in the Klip River, and
- All point sources of pollution in the catchment.

Detailed water quality objectives are given in **Appendix C.**

It is recommended that flows within the upper 1 to 4% flow duration percentiles should be maintained. Larger floods in the catchment should be released in order to mobilise the entire bed, maintain the floodplains and the channel structure.
IFR recommendations for each IFR site are given in **Appendix B**.

The IFR recommendations given in the **Appendix B** are unlikely to be met unless the operation of all regulatory structures along the river is co-ordinated. In particular, the management of Premier Mine and Bronkhorstspruit Dams should be co-ordinated with that of Doringpoort and Middleburg Dams.

Direct social dependence on the Upper Olifants River catchment is minimal for most of the time, but should be taken into consideration during drought periods, when boreholes are likely to dry up and people and livestock may become reliant on the river.

Specific, detailed, resource quality objectives that are required to meet the Ecological Classes are described in **Appendices D** to **G**.

3. MIDDLE OLIFANTS RIVER CATCHMENT

3.1 MIDDLE OLIFANTS RIVER

3.1.1 Ecological Class

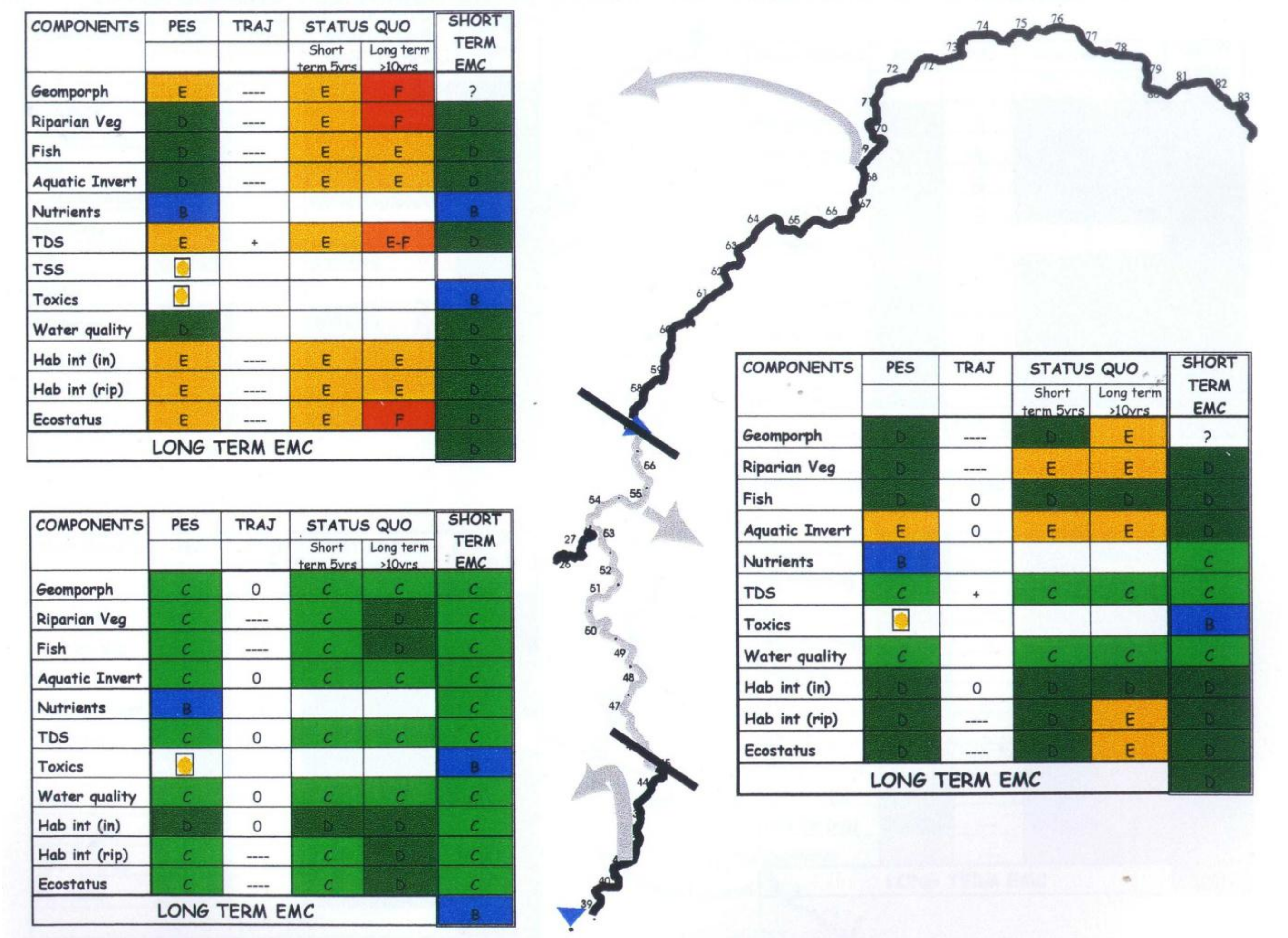
(a) Loskop Dam to Arabie Dam

The section upstream of segment 46 is in a Class C mostly due to agricultural practices. The EIS is high and it will be possible to improve this section to an EC of B in the long term. The section downstream of segment 46 is in a Class D due to agricultural practices and flow manipulation. This section has moderate EIS and no improvement is therefore required. **The EC for the section upstream of segment 46 is a Class B and downstream of segment 46 a Class D.**

(b) Arabie Dam to segment 84

The PES is in an unacceptable Class E mostly due to the excessive sedimentation that is taking place due to informal agricultural activities. **The EC is therefore a Class D**.

3.1.2 Summary of Present Ecological State, Trajectory of change, Status Quo scenario and Ecological Class



COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomorph	E	----	E	F	?
Riparian Veg	D	----	E	F	D
Fish	D	----	E	E	D
Aquatic Invert	D	----	E	E	D
Nutrients	B				B
TDS	E	+	E	E-F	D
TSS					
Toxics					B
Water quality	D				D
Hab int (in)	E	----	E	E	D
Hab int (rip)	E	----	E	E	D
Ecostatus	E	----	E	F	D
LONG TERM EMC					D

COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomorph	C	0	C	C	C
Riparian Veg	C	----	C	D	C
Fish	C	----	C	D	C
Aquatic Invert	C	0	C	C	C
Nutrients	B				C
TDS	C	0	C	C	C
Toxics					B
Water quality	C	0	C	C	C
Hab int (in)	D	0	D	D	C
Hab int (rip)	C	----	C	D	C
Ecostatus	C	----	C	D	C
LONG TERM EMC					B

COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomorph	D	----	D	E	?
Riparian Veg	D	----	E	E	D
Fish	D	0	D	D	D
Aquatic Invert	E	0	E	E	D
Nutrients	B				C
TDS	C	+	C	C	C
Toxics					B
Water quality	C		C	C	C
Hab int (in)	D	0	D	D	D
Hab int (rip)	D	----	D	E	D
Ecostatus	D	----	D	E	D
LONG TERM EMC					D

Figure 3.1: Middle Olifants River – Summary of PES, trajectory of change, status quo scenario and EC results

3.2 ELANDS RIVER

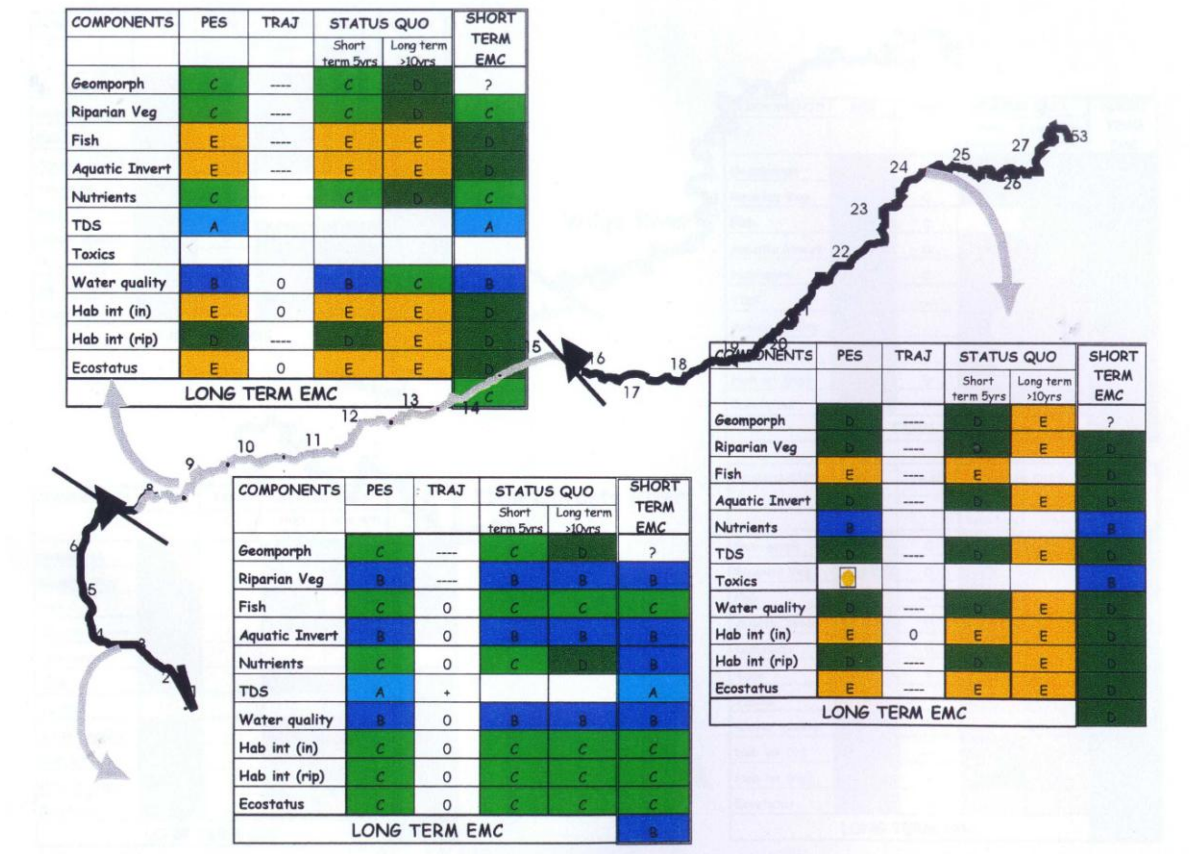
3.2.1 Ecolo gical Class

(a) The Elands River upstream of Rust de Winter Dam is in a Class C mostly due to sand mining and infestation by exotic vegetation. The EIS is moderate and the short-term EC is therefore a Class C. The landuse is however changing to game farming and the associated improvement in the river could result in a Class B. **The long-term EC is therefore recommended as a Class B**.

(b) The Elands River between Rust de Winter Dam and Rhenosterkop Dam is in a Class E PES, mostly due to the lack of releases from the dam resulting in the river drying up. The EIS is moderate and a Class D EC is recommended in the short-term. **Any releases from the Dam could improve the system to such a scale that an EC of Class C is attainable in the long-term.**

(c) The Elands River downstream of Rhenosterkop Dam is in an unacceptable Class E PES. This is mostly due to the operating system of Rhenosterkop Dam to supply water to Syabushwa as well as non-flow related activities such as bush clearing. The EC should be an improvement on the Class E PES and is therefore set as a Class D**.**

3.2.2 Summary of Present Ecological State, Trajectory of change, Status Quo scenario and Ecological Class



COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomporph	C	----	C	D	?
Riparian Veg	C	----	C	D	C
Fish	E	----	E	E	D
Aquatic Invert	E	----	E	E	D
Nutrients	C		C	D	C
TDS	A				A
Toxics					
Water quality	B	0	B	C	B
Hab int (in)	E	0	E	E	D
Hab int (rip)	D	----	D	E	D
Ecostatus	E	0	E	E	D
LONG TERM EMC					C

COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomporph	C	----	C	D	?
Riparian Veg	B	----	B	B	B
Fish	C	0	C	C	C
Aquatic Invert	B	0	B	B	B
Nutrients	C	0	C	D	B
TDS	A	+			A
Water quality	B	0	B	B	B
Hab int (in)	C	0	C	C	C
Hab int (rip)	C	0	C	C	C
Ecostatus	C	0	C	C	C
LONG TERM EMC					B

COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomporph	D	----	D	E	?
Riparian Veg	D	----	D	E	D
Fish	E	----	E		D
Aquatic Invert	D	----	D	E	D
Nutrients	B				B
TDS	D	----	D	E	D
Toxics					B
Water quality	D	----	D	E	D
Hab int (in)	E	0	E	E	D
Hab int (rip)	D	----	D	E	D
Ecostatus	E	----	E	E	D
LONG TERM EMC					D

Figure 3.2: Elands River – Summary of PES, trajectory of change, status quo scenario and EC results

3.3 OVERALL OBJECTIVES FOR THE MIDDLE OLIFANTS CATCHMENT

It is recommended that water quality management should focus on:

- Addressing the impacts of elevated salinity, as a result of irrigation return flows from the Loskop Irrigation Scheme, on water quality in the Olifants, lower Moses and lower Elands Rivers
- Investigating the potential impact of very low winter flows downstream of Arabie (Mokgomo Matlala) Dam and elevated salinities resulting from evaporation.
- Improving land use management in the catchment downstream of Arabie Dam to reduce the impact of soil erosion and high suspended sediment concentrations during high rainfall months.
- Assessing the importance of agricultural toxic substances (e.g. pesticides) in irrigation return flows.

Specific water quality objectives are given in **Appendix C**.

It is recommended that flows within the middle 1 to 4% flow duration percentiles should be maintained in order to mobilise the entire bed from time to time. These large floods maintain the floodplains and channel structure. Although floods of this magnitude cannot at present be controlled, the workshop delegates considered it important that the importance of large floods should be documented for future scenario planning.

The release of freshets and floods should always be in response to climatic triggers in the catchment. This means that although the IFR allocates floods to specific months, it does not mean that these releases should necessarily occur in those months.

IFR recommendations are given in **Appendix B**.

It is recommended that high protection status should be given to the Mohlapitse River when planning developments in the catchment, due to the beneficial impact of this healthy river as a refuge area for aquatic biota.

It is recommended that the results of the Desktop analysis for the upper and middle Elands River should be upgraded to a Rapid determination of the Reserve. This would involve the selection of suitable IFR sites in the Elands River upstream of

Rhenosterkop and Rust de Winter Dams, and selected hydraulic surveys aimed to verify whether the extrapolated IFR results (converted to hydraulic parameters) for this area will achieve the EC.

Specific, detailed, resource quality objectives that are required to meet the Ecological Classes are described in **Appendices D** to **G**.

4. LOWER OLIFANTS RIVER CATCHMENT

4.1 LOWER OLIFANTS RIVER

4.1.1 Ecological Class

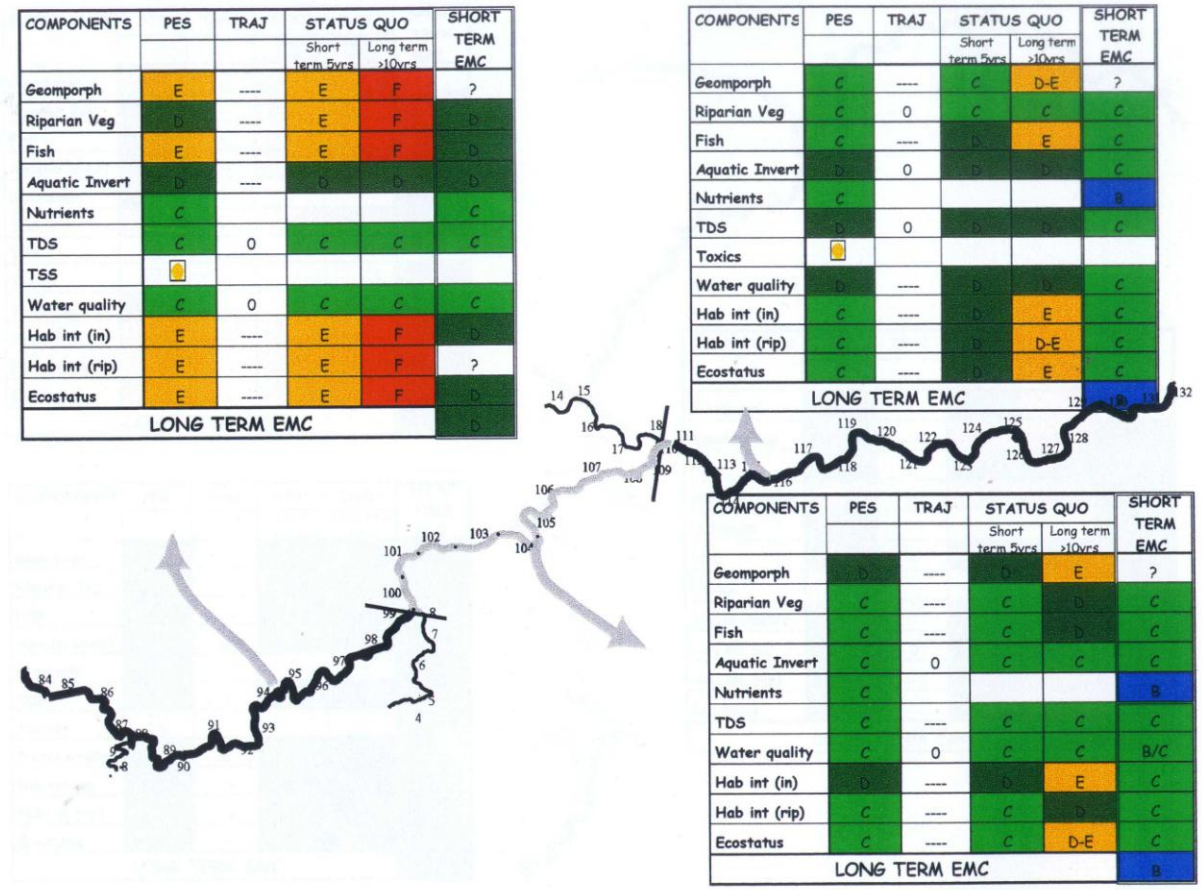
(a) **Segment 85 to the Blyde River confluence**

The reach is in an unacceptable state of a Class E mostly due to the upstream sedimentation problems in the Middle Olifants River. The EC must therefore be improved to a Class D.

(b) **Blyde confluence to the Mozambique border**

The PES is in a Class C mostly due to catchment mismanagement (upstream of the Selati confluence), the water quality problems arising from mining effluent in the Selati River and sedimentation releases from the Phalaborwa Barrage. The EIS is very high and taking into account that the river flows through a National Park, the EC **is set as a Class B**.

4.1.2 Summary of Present Ecological State, Trajectory of change, Status Quo scenario and Ecological Class



COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomporph	E	----	E	F	?
Riparian Veg	D	----	E	F	D
Fish	E	----	E	F	D
Aquatic Invert	D	----	D	D	D
Nutrients	C				C
TDS	C	0	C	C	C
TSS					
Water quality	C	0	C	C	C
Hab int (in)	E	----	E	F	D
Hab int (rip)	E	----	E	F	?
Ecostatus	E	----	E	F	D
LONG TERM EMC					D

COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomporph	C	----	C	D-E	?
Riparian Veg	C	0	C	C	C
Fish	C	----	D	E	C
Aquatic Invert	D	0	D	D	C
Nutrients	C				B
TDS	D	0	D	D	C
Toxics					
Water quality	D	----	D	D	C
Hab int (in)	C	----	D	E	C
Hab int (rip)	C	----	D	D-E	C
Ecostatus	C	----	D	E	C
LONG TERM EMC					B

COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomporph	D	----	D	E	?
Riparian Veg	C	----	C	D	C
Fish	C	----	C	D	C
Aquatic Invert	C	0	C	C	C
Nutrients	C				B
TDS	C	----	C	C	C
Water quality	C	0	C	C	B/C
Hab int (in)	D	----	D	E	C
Hab int (rip)	C	----	C	D	C
Ecostatus	C	----	C	D-E	C
LONG TERM EMC					B

Figure 4.1: Lower Olifants River – Summary of PES, Trajectory of Change, Status Quo scenario and EC results

4.2 STEELPOORT RIVER

4.2.1 Ecological Class

The Steelpoort River is in a PES Class D mostly due to mining related impacts and lack of catchment management. The EIS is high and the trajectory of change is negative. Due to the difficulty in addressing the problems in the catchment, improvement will be unrealistic and the **EC is therefore set at a Class D.**

4.2.2 Summary of Present Ecological State, Trajectory of change, Status Quo scenario and Ecological Class

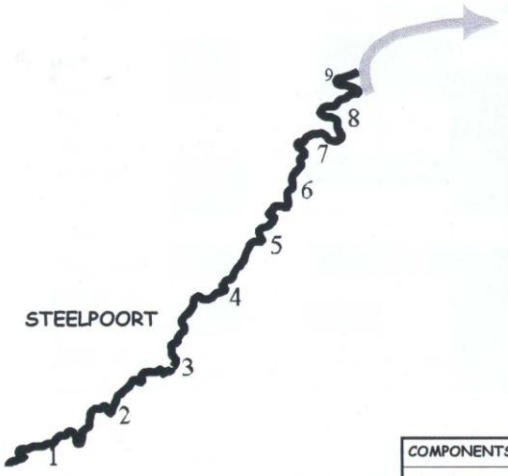
Refer to **Figure 4.2**.

4.3 BLYDE RIVER

4.3.1 Ecological Class

The Blyde River is in a PES Class B. The changes from reference conditions result from the operation of Blydepoort Dam. The EIS is high and the trajectory of change is negative. Some improvement will be necessary to maintain the PES. Further improvement to a Class A is not possible with a large dam situated in the river and its associated impacts. **The EC is therefore a Class B**.

4.3.2 Summary of Present Ecological State, Trajectory of change, Status Quo scenario and Ecological Class



COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomporph	D	----	?	E	?
Riparian Veg	D	----	D	E	D
Fish	D	----	D	E	D
Aquatic Invert	D	----	D	E	D
Nutrients	B				B
TDS	C	----	D	E	C
Toxics					B
pH	E		E	E	D
Water quality	B		C		C
Hab int (in)	D	0	D	E	D
Hab int (rip)	E	0	D	E	D
Ecostatus	D	----	D	E	D
LONG TERM EMC					D

COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomporph	B	0	B	B	B
Riparian Veg	B	0	B	B	B
Fish	B	0	B	B	B
Aquatic Invert	B	0	B	B	B
Nutrients	B	----	B	C	B
TDS	B	0	B	B	B
Water quality	B	0	B	B	B
Hab int (in)	B	0	B	B	B
Hab int (rip)	B	0	B	B	B
Ecostatus	B	----	B	C	B
LONG TERM EMC					B

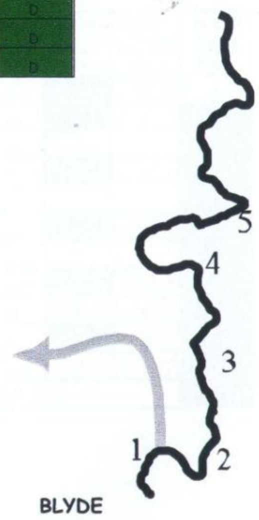


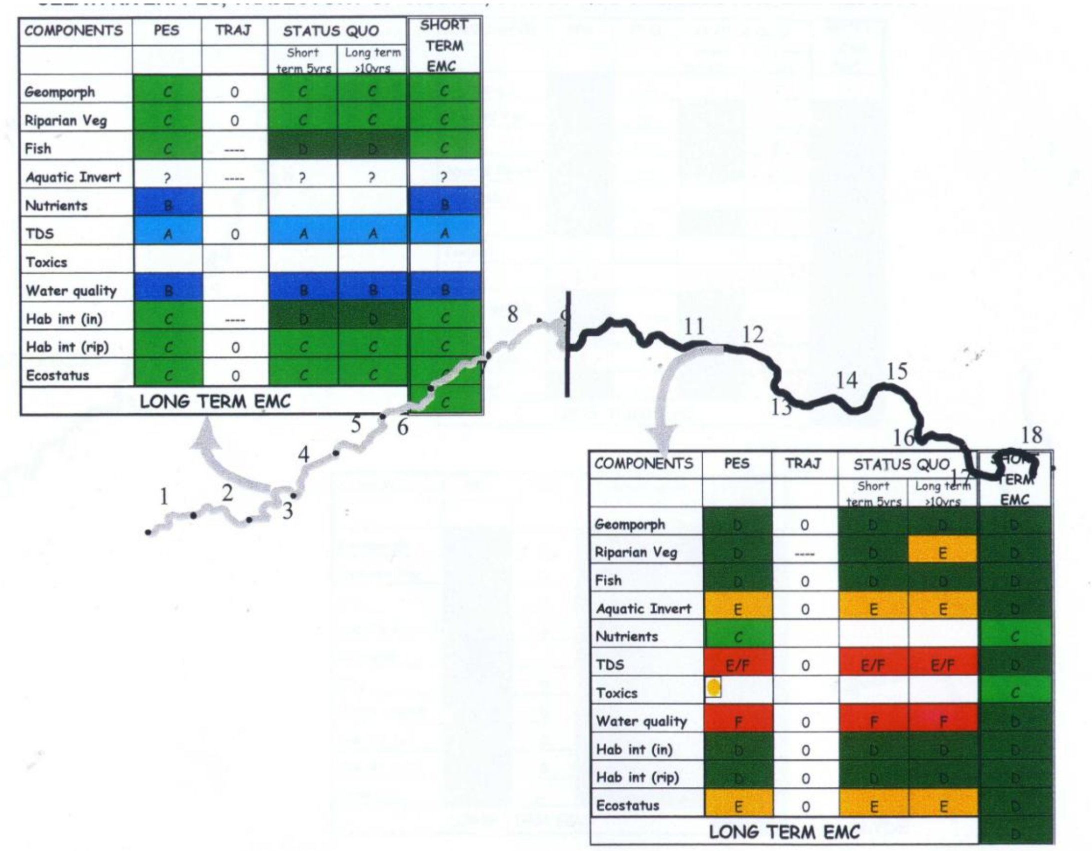
Figure 4.2: Blyde and Steelpoort Rivers – summary of PES, trajectory of change, status quo scenario and EC results

4.4 SELATI RIVER

4.4.1 Ecological Class

The Selati River upstream of segment 10 is in a PES class C mostly due to the impacts from agriculture and villages. The reach downstream of segment 10 is in an unacceptable class E due to the numerous weirs and the water quality problems arising from the mining activities. The EIS is moderate and the **EC is therefore a Class C upstream of segment 10 and an EC of Class D downstream of segment 10**.

4.4.2 Summary of Present Ecological State, Trajectory of change, Status Quo scenario and Ecological Class



COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomorph	C	0	C	C	C
Riparian Veg	C	0	C	C	C
Fish	C	----	D	D	C
Aquatic Invert	?	----	?	?	?
Nutrients	B				B
TDS	A	0	A	A	A
Toxics					
Water quality	B		B	B	B
Hab int (in)	C	----	D	D	C
Hab int (rip)	C	0	C	C	C
Ecostatus	C	0	C	C	C
LONG TERM EMC					C

COMPONENTS	PES	TRAJ	STATUS QUO Short term 5yrs	STATUS QUO Long term >10yrs	SHORT TERM EMC
Geomorph	D	0	D	D	D
Riparian Veg	D	----	D	E	D
Fish	D	0	D	D	D
Aquatic Invert	E	0	E	E	D
Nutrients	C				C
TDS	E/F	0	E/F	E/F	D
Toxics					C
Water quality	F	0	F	F	D
Hab int (in)	D	0	D	D	D
Hab int (rip)	D	0	D	D	D
Ecostatus	E	0	E	E	D
LONG TERM EMC					D

Figure 4.3: Selati River – summary of PES, trajectory of change, status quo scenario and EC results

4.5 OVERALL OBJECTIVES OF THE LOWER OLIFANTS CATCHMENT

It is recommended that water quality management in the lower Olifants River catchment should focus on:

- High silt levels released from the Phalaborwa Barrage
- High fluoride, TDS and sulphate levels in the Selati River
- High levels of particulate chromite in the Steelpoort River
- The distribution and concentration of chromium VI in the Steelpoort River Basin.

Detailed water quality objectives are given in **Appendix C**.

It is recommended that flows within the lower 1 to 4% flow duration percentiles should be maintained in order to mobilise the entire river bed from time to time. These large floods are important in maintaining the channel structure and riparian floodplains. Although floods of this magnitude cannot at present be controlled, the workshop delegates considered it important that the importance of large floods should be documented for future scenario planning.

IFR recommendations are given in **Appendix B**.

Olifants River:

One of the main concerns in the lower Olifants River is erosion and the associated high levels of sediment. This concern cannot be addressed through flow manipulation alone, and an Integrated Land Care Programme is clearly needed.

Furthermore, the IFR recommendations given in **Appendice B** are unlikely to be met unless releases from all the dams and weirs in the catchment are co-ordinated. Related to this is the need for all regulatory structures, large and small, to have outlet facilities capable of providing the downstream ecological requirements, particularly during low-flow periods.

Blyde River:

The recommended ecological flows for the Blyde River are intended to address some of the ecological problems in the river downstream of the Blyderivierpoort Dam. However, it is recommended that further steps are taken to restore this river and prevent the current "negative trajectory of change" in this ecologically important and sensitive river. Particular attention should be given to creating suitable conditions for the recruitment of *Breonardia* trees.

Steelpoort River:
The current velocities needed to mobilise the unusually heavy and highly embedded sediments that characterise the Steelpoort River are not known. This highlights the need to monitor the flows and river conditions in the Steelpoort River, and adjust the recommended IFRs accordingly, either up or down.

Selati River:
A comprehensive rehabilitation programme for the middle Selati River is recommended. The programme should focus on rehabilitating the riparian zone through medium size floods that deposit sediments on top of the calcrete, and in doing so, create habitats for recolonisation of riparian vegetation.

In the lower Selati River, poor water quality should be addressed by management of point and diffuse sources, and not by dilution.

Specific, detailed, resource quality objectives that are required to meet the Ecological Classes are described in **Appendices D** to **G**.

5. ASSESSMENT OF THE SOCIAL UTILISATION OF THE OLIFANTS RIVER

A social assessment of the Olifants River was conducted to ascertain the dependence of communities and stakeholders on a healthy riverine ecosystem. This involved an understanding of the importance of people's reliance on water in the river and the use of riparian plants and animals for food, thatching, medical and other purposes as well as the use of floodplains and pools.

Social use of the river is incidental in the Upper Olifants catchment, but should be taken into consideration during drought periods, when boreholes are likely to dry up and people and livestock may become reliant on the river. Cultural use can be accommodated, irrespective of the quality or flow characteristics of the river.

In the Middle and Lower Olifants catchment, communities in certain sections rely more heavily on the river than in other sections, with the most significant problem being the absence of water supply schemes in the area, which causes the communities to rely exclusively on the river. Cultural use of the river can be accommodated, irrespective of the quality or flow characteristics of the river, as communities indicated that they would adapt the timing of cultural ceremonies to coincide with suitable flow conditions of the river. Communities also use certain riparian vegetation species for medicinal purposes.

The inclusion of social needs and values was a new addition to the IFR process, and as such, had not been formally integrated into the method. It had been concluded during the specialist meeting that the link between human uses and values of the river resources, and the quantification of environmental flow requirements, was tenuous. For example, the vegetation study focussed on woody plants associated with the river, and did not consider in any detail the riverine plants that were identified as socially important, such as various medicinal plants and thatching reeds. It was recommended that a special project be established to formally integrate the link between human uses and values of river resources and the quantification of environmental flow requirements, into the IFR processes.

For the OREWRA study the social importance was only taken into consideration where it had a higher evaluation than the ecological importance. This situation did not arise at any of the sites in the Olifants catchment.

6. SYSTEM ANALYSIS

A system analysis was carried out for the OREWRA study to determine the extent to which the ecological requirements can be met and to determine the effect of the Ecological Reserve on the water supply to the current users. Alternative Instream Flow Requirement (IFR) scenarios, that could potentially still maintain the river in an acceptable state, as well as minimise the impact on supply to the current users, were devised, depending on the impacts of the Ecological Reserve on the existing users.

Four scenarios were analysed in addition to the No IFR scenario and the Required IFR scenario. These additional scenarios were:

- **Scenario 1:** No large floods – The Required IFR scenario was used as base and the large floods with a recurrence interval of more than 1 year were excluded from the IFR rule table. This was done as large floods generally can not be controlled and will occur naturally.

- **Scenario 2 :** No large floods and drought extended to the 10% exceedance level – The No Large Flood scenario was used as base and the occurrence of drought flows were extended from 3 % or 5 % of the time to 10 % of the time.

- **Scenario 3 :** No large floods and drought extended to the 20 % exceedance level – The No Large Flood scenario was used as base and the occurrence of drought flows were extended from 3 % or 5 % of the time to 20 % of the time .

- **Scenario 4:** Adjusted PES - The only difference between scenario 1 and scenario 4 is that at the sites where the recommended IFRs represented an improved ecological state, the flows that will maintain the Present Ecological State (PES) (also with large floods excluded) was modeled at the IFR sites.

From the system analysis results it was evident that the IFR can be fully supplied at most of the sites. It was only sites 13, 15 and 16/17 in the lower Olifants River that were not fully supplied. On average over the analysis period the IFR at sites 13, 15 and 16/17 were supplied respectively at 91%, 88% and 89% of its full requirement. The shortages only occurred during the dry winter months.

Although most of the IFRs were fully supplied, the supply to existing users in the catchment was affected. In the incremental catchments upstream of IFR sites 2,7,9,10 and 14a and 14b the reduction in the supply to current users was relatively small, while significant in other areas.

There was a significant improvement in the availability of water at the Arabie Dam when the IFRs were imposed on the system. This is as a result of an EC of Class B recommended for the Olifants River downstream of the Loskop Dam, while downstream of Arabie Dam a Class D is recommended.

The effect of the IFRs on the water supply to diffuse users as well as those supplied from major dams was quite significant in the incremental catchments of IFR 1, 3, 4, 5, 6, 8, 11, 12 and 13. Scenarios 3 and 4, provided the best improvement in the water supply situation with the IFRs imposed on the system.

The scenarios were further evaluated with respect to the ecological consequences. The resulting river state in terms of the impact of the imposed flow regime on the aquatic ecosystem associated with the various scenarios were then compared to the present state and the desired state. The summarised results of the evaluation are as follows:

At IFR sites 1, 5, 13 and 17 none of the scenarios could achieve the objectives required to achieve the EC. The 10% scenario was the best alternative at IFR 1 and 5. The PES scenario was the best alternative at IFR 13 and 17.

At IFR sites 2, 4, 6 and 8 all the scenarios could achieve the objectives, although a higher risk of not achieving the objectives is coupled to the scenarios.

It should be noted that the yield analysis was done for each incremental catchment on its own. For instance, the possibility of the Blyderiverspoort Dam supporting flow requirements in the Lower Olifants catchment was not investigated. It is believed that most of the shortages can be overcome, although this will have to be determined by means of a comprehensive study.

7. RECOMMENDATIONS

7.1 WATER QUALITY

(a) It is recommended that water quality management in the Upper Olifants River catchment focus on the following problems:

- Increasing levels of TDS in the Wilge River
- High TDS and nutrients in the Klein Olifants River
- Low pH and high TDS in the Klip River, and
- All point sources of pollution in the catchment.

(b) Water quality management in the Middle Olifants catchment should focus on:

- Addressing the impacts of elevated salinity, as a result of irrigation return flows from the Loskop Irrigation Scheme, on water quality in the Olifants, lower Moses and lower Elands Rivers
- Investigating the potential impact of very low winter flows downstream of Arabie (Mokgomo Matlala) Dam and elevated salinities resulting from evaporation.
- Improving land use management in the catchment downstream of Arabie Dam to reduce the impact of soil erosion and high suspended sediment concentrations during high rainfall months.
- Assessing the importance of agricultural toxic substances (e.g. pesticides) in irrigation return flows.

(c) Water quality management in the lower Olifants River catchment should focus on:

- High silt levels released from the Phalaborwa Barrage
- High fluoride, TDS and sulphate levels in the Selati River
- High levels of particulate chromite in the Steelpoort River
- The distribution and concentration of chromium VI in the Steelpoort River Basin.

In the lower Selati River, poor water quality should be addressed by management of point and diffuse sources, and not by dilution.

7.2 FLOW

(a) Upper Olifants catchment

It is recommended:

- That flows within the upper 1 to 4% flow duration percentiles should be maintained. Larger floods in the catchment should be released in order to mobilise the entire bed, maintain the floodplains and the channel structure.
- That for the IFR recommendations to be met, the operation of all regulatory structures along the river must be co-ordinated. In particular, the management of Premier Mine and Bronkhorstspruit Dams should be co-ordinated with that of Doringpoort and Middleburg Dams.
- That direct social dependence on the river be taken into consideration during drought periods when the boreholes are likely to dry up and people and livestock become reliant on the river.

(b) Middle Olifants catchment

It is recommended:

- That flows within the middle 1 to 4% flow duration percentiles should be maintained in order to mobilise the entire bed from time to time, maintain the floodplains and channel structure.
- That a high protection status should be given to the Mohlapitse River when planning developments in the catchment, due to the beneficial impact of this healthy river as a refuge area for aquatic biota.
- That the results of the Desktop analysis for the upper and middle Elands River should be upgraded to a Rapid determination of the Reserve.

(c) Lower Olifants catchment

It is recommended:

- That flows within the lower 1 to 4% flow duration percentiles should be maintained in order to mobilise the entire river bed from time to time, maintain the channel structure and riparian floodplains.
- That an Integrated Land Care Programme be established in the lower Olifants River as the erosion and the associated high levels of sediment cannot be addressed through flow manipulation alone.

- That a comprehensive rehabilitation programme for the middle Selati River be established and implemented. The programme should focus on rehabilitating the riparian zone through medium size floods that deposit sediments on top of the calcrete, and in doing so, create habitats for recolonisation of riparian vegetation.
- That further steps are taken to restore the Blyde RIver and prevent the current "negative trajectory of change" in this ecologically important and sensitive river. Particular attention should be given to creating suitable conditions for the recruitment of *Breonardia* trees.
- That the flows and river conditions in the Steelpoort River be monitored and the recommended IFRs adjusted either up or down in order to mobilise the unusually heavy and highly embedded sediments.
- That releases from all the dams and weirs in the catchment are co-ordinated, and all regulatory structures, large and small, should have outlet facilities capable of providing the downstream ecological requirements, particularly during low-flow periods.

7.3 SOCIAL ASSESSMENT

It is recommended that a special project be established to formally integrate the link between human uses and values of river resources, and the quantification of environmental flow requirements, into the IFR process.

7.4 SCENARIO ANALYSIS

It is recommended that:

- Further work be conducted to adjust the IFRs of sites 1, 3, 5, 11, 12, 13, 15, 16/17 to find an IFR scenario that will minimise the impact on the users but still maintain the river in an acceptable state.
- The use of the surplus water in the Arabie Dam to satisfy downstream IFRs during the dry winter months, be considered.
- The use of additional storage such as the proposed Rooipoort Dam should be considered and analysed to support the IFR in the lower Olifants River.
- In future analyses it should be considered to reduce the total demand of the diffuse users to a specific selected level based on the experience gained from this study. This will enable the system to obtain a more balanced reduction in supply between diffuse users and those supplied from major dams.

- Before a detailed stochastic planning analysis is performed, it is recommended to first update the hydrology and water requirement and returns flows for the Olifants River catchment.
- A detailed yield analysis for all the major dams with and without the IFRs, using historic and stochastic analysis be performed. This is the only way to know what the shortage or surplus in the system is at various risk levels and to identify the best options to overcome the shortages.
- With the yield characteristics available, a planning model for the total system should be set up, so that water can be allocated at the correct risk levels to various users. The model can then be used to evaluate the supply to the various users and observe if the curtailment criteria are not violated. It is also recommended that the inclusion of the water quality component of the WRPM should be considered as water quality imposes a serious threat in certain parts of the catchment.

7.5 INTEGRATING IFR STUDIES

An assessment of groundwater and wetland ecological flow and water quality requirements is considered necessary for a comprehensive assessment of the Reserve. The results of these assessments need to be integrated into a single set of IFR recommendations, as required in term of the Resource Directed Measures for the protection of aquatic ecosystems.

8. REFERENCES

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Appendix A

Geographic location and description of IFR sites

Appendix B

Instream Flow Requirements

Appendix C

Resource Quality Objectives: Water Quality

Appendix D

Resource Quality Objectives: Invertebrates

Appendix E

Resource Quality Objectives:

Fish

Appendix F

Resource Quality Objectives:

Riparian Vegetation

Appendix G

Resource Quality Objectives: Geomorphology