RIVER HEALTH PROGRAMME

A BIOMONITORING SURVEY OF THE OLIFANTS RIVER CATCHMENT FALLING WITHIN LIMPOPO PROVINCE.

FIELD SURVEY OF 2004.

Report date: March 2005

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Executive Summary.

Background.

The Olifants River Catchment was one of the first catchments to ever be studied under the auspices of the River Health Programme. The catchment was surveyed over a two year period between 1998 and 1999. The initial survey was conducted across the entire catchment and extended over Gauteng, Mpumalanga, Limpopo povince and the Kruger National Park. Although the data generated through the first survey was used to develop monitoring protocols and the results of the survey were published in the first State of The Rivers Report (SORR), March 2001, the technical reports behind the survey were never completed. The task of writing the first reports fell upon specialists from The Department of Water Affairs and Forestry (DWAF) and although some draft reports of the first survey were partially completed, the formal documents have never been finalised. However, data from the first survey is on hand. A site inventory report for the first survey was published through the Water Research Commission (WRC), (2001) and forms the basis of all subsequent site inventory reports for later river surveys.

A team of scientists, technicians and assorted coworkers worked together to plan and undertake the 2004 survey. A total of 18 sites were surveyed in the Olifants River main stem and tributaries. The major tributaries, which were assessed, include the Mohlapitse, Selati and Makhutswi rivers.

The first survey of the catchment addressed the full compliment of river health programme monitoring protocols. However, due to time and technical constraints, the 2004 survey only addressed *In situ* water quality, fish and invertebrates.

The sites were assessed using the current River Health Programme (RHP) biomonitoring protocols between July and August 2004

- Fish Fish Response Assessment Index (FRAI)
- Invertebrates South African Scoring System Version 5 (SASS5)

It should be noted that the first survey of the catchment was undertaken in a wet rain cycle and high base flows, while the 2004 survey was conducted at the onset of a drought period.

This technical report brings together, all of the results of the above surveys.

The CD version of this report includes the detailed calculations of each monitoring protocol, together with graphics and a detailed photographic library of each site.

Results.

Results depict the present ecological state of each ecoregion of each river of the catchment as based on level 2 eco-region boundaries. (see Figure 1 page 10) Results are non judgemental and merely describe the state of the catchment as it was, during the study period. Due to the extensive amount of data, which has been generated in

earlier SORR surveys, IFR surveys and assorted fish surveys, the results of this survey should be viewed with high confidence, within the existing drought scenario.

Summarized results based on 4 Present Ecological State Classes as utilized in RHP State of River Reports (SORR).

NATURAL	A
GOOD	B/C
FAIR	C/D
POOR	E/F

River	Eoregion	FISH	INVERTEBRATES
Olifants	8	D	C
Olifants	9	D	C
Olifants	10	D	C/D
Olifants	3	D	B/C
Mohlapitse	9	C	A
Blyde	3	C	B
Selati and Makhutswi	10	C	A
Selati	3	C	D

Perhaps the biggest failing of this survey was the lack of buy in to the process from the respective district personnel. Despite numerous communications, both directly to the districts and through senior management channels, no district personnel assisted with the surveys and nobody attended a field day, which was well advertised, under the auspices of the Olifants River Forum.

Conclusions.

As can be seen from the above table, the present ecological state of the Olifants River Catchment varies considerably between ecoregions. Mountain streams within the Lekgalameetse Reserve, reflect the expected high diversity of aquatic invertebrates, and associated good water quality. However, within the reserve, fish populations are no longer in a natural condition. The Blyde River also reflects this pattern, largely because the river is protected by private farms. Impacted fish communities are almost certainly as a result of reduced river flows and fragmentation of the system through the placement of dams and weirs. The remainder of the Olifants Catchment is in a fair or largely modified ecological condition class.

Water quality throughout in the mountain streams of the study area, was considered to be good. However, the main stem of the Olifants River continues to reflect a largely modified water quality due to upstream mining activities. Salt loads are high and the conductivity exceeds 50mS/m. The lower Selati River in Phalaborwa yielded a conductivity in eccess of 200mS/m, above the measurement range of field instruments. Pulsed releases from the Blyde Dam are thought to be harmful in that

they interfere with temperatures within the lower river, along with the obvious impacts associated with unseasonal flow patterns.

While the Olifants Catchment remains in a largely modified state outside of nature reserves, increasing water demands within the catchment are likely to cause a downward trend in the overall status of the system.

Summary of desired management actions.

ISSUE	ACTION	RESPONSIBILITY
In terms of water supply for the environment, there have been two major studies undertaken for the catchment to date. The latest Ecological Reserve determination, conducted in 2000 has yet to be implemented. While it is understood that the DWAF have a difficult task in addressing administrative issues behind the process, the inability to implement the reserve must be seen as a major failing. The process was hugely expensive, given the scale of the catchment and while DWAF are procrastinating, the riverine environment of the catchment is degrading. The implementation of the reserve would go some way towards protecting the existing fauna and flora, while providing some indication of water availability for future licences.	DWAF to be contacted at both National and provincial level, and encouraged to implement the Reserve.	Senior Management Environmental Affairs.
In the absence of an ecological reserve, those mountain catchment areas of the Mohlapitse, Selati and Makhutswi Rivers should be afforded high levels of protection. The upper catchments have been seriously neglected in recent years and there is an urgent need to implement strict veld management.	Limpopo Parks to be contacted and urged to implement strict veld management in the upper catctchment.	Senior Management Environmental Affairs.

ISSUE	ACTION	RESPONSIBILITY
Pulsed releases from Blyde Dam are coordinated for agricultural purposes with little recognition of environmental requirements. From an environmental perspective, releases should mimic the natural hydrological regime of the system. Pulses of flow are considered detrimental to the ecology. Departmental management should liaise with water resource managers in an effort to improve the management of flows for the environment. This issue would once again be addressed, should a reserve be implemented in the lower Blyde Catchment.	DWAF to be contacted at both national and provincial level, and encouraged to implement the Reserve. Pulsed releases to be replaced with reserve flows.	Senior Management Environmental Affairs.
The Selati River is being completely diverted into an irrigation canal and the downstream river environment has been adversely affected, with all fow dependant species now being absent from the river below the diversion. Although a Reserve would address this issue, it is not acceptable that 100 % of river flows be diverted.	DWAF and the Dept. of Agriculture to be contacted at both National and provincial level, and encouraged to implement the Reserve.	Senior Management Environmental Affairs.
Along the Olifants River main stem, there appears to be a proliferation of both sand mining and pebble mining. While these activities are having a limited direct impact on the aquatic habitat, they are adversely affecting the riparian environment, which in turn is causing increased erosion and deposition of sediments within the river channel.	EIM office and the Dept. of minerals and Energy should be contacted to ascertain what mining licences have been issued. District offices should monitor the situation and law enforcement issues should be addressed.	Senior Management Environmental Affairs. EIM office, districts.
The contents of this report should be publicized.	Report should be circulated to DWAF and other relevant Departments and district managers.	Senior Management Environmental Affairs.
	Data from the report to be captured on the National Rivers Data Base.	Biodiversity and Biomonitoring offices.

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1. Introduction.

The Olifants River Catchment was one of the first catchments to ever be studied under the auspices of the River Health Programme. The catchment was surveyed over a two year period between 1998 and 1999. The initial survey was conducted across the entire catchment and extended over Gauteng, Mpumalanga, Limpopo povince and the Kruger National Park. Although the data generated through the first survey was used to develop monitoring protocols and the results of the survey were published in the first State of The Rivers Report (SORR), March 2001, the technical reports behind the survey were never completed. The task of writing the first reports fell upon specialists from The Department of water Affairs and Forestry (DWAF) and although some draft reports of the first surveywere partially completed, the formal documents have never been finalised. However, data from the first survey is on hand. A site inventory report for the first survey was published through the Water Research Commission (WRC), (2001) and forms the basis of all subsequent site inventory reports for later river surveys.

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It should be noted that the first survey of the catchment was undertaken in a wet rain cycle and high base flows, while the 2004 survey was conducted at the onset of a drought period.

Since this is a second formal survey of the Olifants Catchment and due to the amount of background data which has already been published, relating to this catchment, this report will focus primarily on presenting the results of the fish and invertebrate surveys.

2. Ecoregions.

Kleynhans *et al* (2002) developed Level 1 ecoregion boundaries for the Limpopo Province and in 2003, a review of the 2002 ecoregion boundaries was undertaken and level 2 boundaries addressed. Figure 1 provides a map of the revised eco region boundaries and sites which were surveyed for this this report.

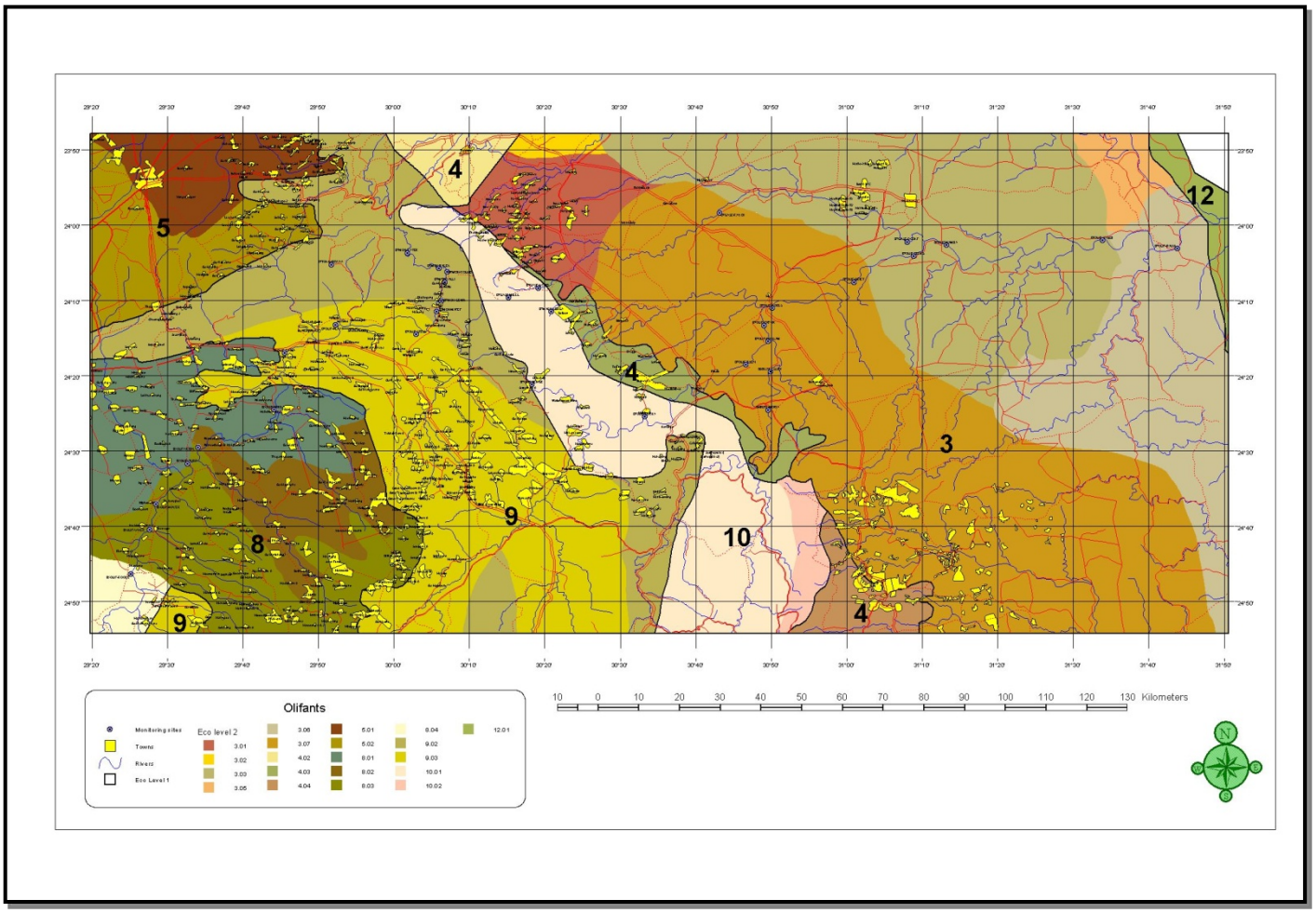
3. Sites surveyed.

Due to time and staffing constraints, 18 sites were selected for this second level survey of the catchment. The sites were selected on the basis of their representivity within each ecoregion. Table 1 provides a list of those historical monitoring sites within the catchment, together with an indication of those sites used for the 2004 survey.

Table 1. Locations of monitoring sites used during the 1998 – 1999 and 2004 biomonitoring surveys.

RHP Site code	Locality	River	Eco region	Lat degrees	Long degrees	1998 - 1999 survey	2004 Survey
B5OLIF-ROODE	Tompie Seleka Bridge	Olifants	8.04	-24.7722	29.4200	X	X
B50LIF-VANDE	Scrapyard	Olifants	8.03	-24.6736	29.4608	X	X
B5OLIF-POWER	Powerline crossing (rapid)	Olifants	8.03	-24.6175	29.4750	X	
B5OLIF-ADRIA	Iron Bridge	Olifants	8.03	-24.5278	29.5458	X	
B5OLIF-VEEPL	Nebo Road Bridge	Olifants	8.03	-24.4925	29.5681	X	X
B5OLIF-MOHLA	Below Mohlaletsi junction	Olifants	8.01	-24.4086	29.7361	X	
B5OLIF-DIAMA	Above Burgersfort Bridge	Olifants	9.03	-24.2830	29.7601	X	X
B7OLIF-PLAAT	Behind Potlake Nat.Res	Olifants	9.03	-24.2206	29.8722	X	
B7OLIF-STELL	Stellenbosch Nat.Res	Olifants	9.03	-24.2417	30.0500	X	X
B7OLIF-PENGE	Penge	Olifants	10.01	-24.3528	30.3058	X	X
B7OLIF-FOCHA	Strydom tunnels (Mametsa)	Olifants	10.01	-24.4240	30.5550	X	X
B7OLIF-BAZAI	Up from Blyde	Olifants	3.07	-24.3092	30.7774	X	
B7OLIF-PHOSAM	Phosa Moya (Blyde confluence)	Olifants	3.07	-24.2571	30.8273		X
B7OLIF-OXFOR	Down from Blyde	Olifants	3.07	-24.2220	30.8183	X	
B7OLIF-HOEDS	Hippo Pools bridge	Olifants	3.07	-24.1842	30.8358		X
B7OLIF-GRIET	Grietjie	Olifants	3.03	-24.1263	31.0166	X	
B7OLIF-ZEEKG	Seekoeigat	Olifants	3.03	-24.0688	31.1490	X	X
B7OLIF MAMBA	Mamba KNP	Olifants	3.03	-24.0445	31.2208	X	
B7OLIF-VYGEB	Vygeb KNP	Olifants	3.03	-24.0344	31.5660	X	
B7OLIF-BALUL	Balule KNP	Olifants	3.06	-24.0517	31.7302	X	
B7TONG-BEWAA	Tongwane Bewaarkloof	Tongwane	9.02	-24.0878	29.8632	X	
B7MOH-WATER	Mohlapitse waterfall	Mohlapitse	9.02	-24.0619	30.0306	X	
B7MOH-BADEN	Mohlapitse Baden	Mohlapitse	9.02	-24.0959	30.1006	X	X
B7MOH-WOLKB	Mohlapitse Wolkberg	Mohlapitse	9.02	-24.1032	30.1185	X	X
B7MOH-VALLI	Mohlapitse Valli	Mohlapitse	9.02	-24.1262	30.1138	X	
B7MOH-GEMIN	Mohlapitse Gemini	Mohlapitse	9.02	-24.1683	30.1056	X	
B7MOH-MAFEF	Mohlapitse Mafef	Mohlapitse	9.02	-24.1910	30.0958	X	
B6BLYD-MORIA	Blyde moria	Blyde	3.07	-24.4090	30.8272	X	
B6BLYD-ESSEX	Blyde Essex	Blyde	3.07	-24.3248	30.8318	X	X
B7MAKH-LEKGA	Makhutswi Lekgalameetse	Makhutswe	10.01	-24.1912	30.3488	X	X
B7GASE-MIDDL	Selati Lekgalameetse	Ga-Selati	10.01	-24.1609	30.2542	X	X
B7GASE-SCHEL	Selati weir	Ga-Selati	10.01	-24.1392	30.3201	X	X
B7GASE-RANCH	Selati Ranch	Ga-Selati	3.07	-23.9726	30.7196	X	X
B7GASE-OCONF	Selati confluence	Ga-Selati	3.03	-24.0374	31.1344	X	X

Figure 1. Eco region boundaries and monitoring sites of the Olifants River Catchment.



4. *In situ* water quality.

Temperature, pH and conductivity were recorded at each site using hand held meters. See Table 2.

Table 2. In situ water quality measured at each of the monitoring sites.

RHP SITE CODE	RIVER	DATE	TIME	TEMP °C	CONDUCTIVITY mS/m	pH
B5OLIF-ROODE	Olifants	11.08.04	15.00	20	54	8.2
B50LIF-VANDE	Olifants	13.08.04	8.30	17	79	8.0
B5OLIF-VEEPL	Olifants	13.08.04	11.00	19	88	8.7
B5OLIF-DIAMA	Olifants	20.08.04	12.00	25	105	8.9
B7OLIF-STELL	Olifants	20.08.04	10.00	18	66	8.5
B7OLIF-PENGE	Olifants	17.08.04	10.00	19	54	8.8
B7OLIF-FOCHA	Olifants	28.07.04	12.00	16	65	8.7
B7OLIF-PHOSAM	Olifants	28.07.04	15.00	18	64	8.9
B7OLIF-HOEDS	Olifants	27.07.04	13.00	20.5	51	8.9
B7OLIF-ZEEKG	Olifants	27.07.04	13.00	19	49	8.9
B7MOH-BADEN	Mohlapitse	19.08.04	10.30	17	15	8.4
B7MOH-WOLKB	Mohlapitse	19.08.04	14.00	19	12	8.0
B6BLYD-ESSEX	Blyde	29.07.04	15.00	19	25	8.4
B7MAKH-LEKGA	Makhutswe	08.05.03	14.00	19	22	8.4
B7GASE-MIDDL	Ga-Selati	08.05.03	9.00	17	26	8.4
B7GASE-SCHEL	Ga-Selati	28.07.04	9.00	16	21	8.6
B7GASE-RANCH	Ga-Selati	27.07.04	16.00	20	81	8.6
B7GASE-OCONF	Ga-Selati	27.07.04	10.30	19	>200	8.6

5. The fish survey.

5.1 Fish monitoring methods.

Fish were gathered using the following techniques.

- Electro - shocking apparatus: a two to three man operation, whereby fish are stunned using AC electric current. The stunned fish are collected in hand held scoop nets positioned down stream. The method is suited to shallow (< 1m depth) swift flowing water over assorted substrates. Also useful around snags, undercut banks and in heavily vegetated but shallow pools.

- Seine net: a net measuring 15m length by 3.5m deep, with 12mm knotless nylon netting. The net is pulled through the water by 2 - 4 people, and fish are collected in a central bag. Suitable for deep pools that are clear of snags.

- Small seine net: a small piece of seine netting attached to two wooden poles. This two man net measures 2m by 1.5m deep, and again has 10 mm mesh. The net is useful for sampling in small pools, but is

particularly designed for use under and amongst overhanging and marginal vegetation.

- Cast or throw net: a circular nylon net, 1.6m radius, with 12mm mesh size. Cast nets can be used by an individual in any habitat, that is clear of snags and obstructions.

Most fish caught were identified at site and returned to the river alive. (A small number of fish from a few sites were kept for a reference collection. The collection will in due course be lodged with the South African Institute for Aquatic Biodiversity. (SAIAB)

When possible, individual fish were examined for parasite loads.

The habitat at the site was categorized, and where possible individual habitats sampled. The effort used to catch fish in each habitat at each site was recorded. However, in the upper catchment, the narrow channel of the river often resulted in efforts being combined for multiple habitats.

Fish habitat is categorized into four velocity depth classes, and allocated a subjective score based upon their abundance using a five-point scale. (Kleynhans 1997)

Fast Deep (F/D); Fast Shallow (F/S); Slow Deep (S/D); Slow Shallow (S/S)
(0=Absent; 1=Rare; 2=Sparse; 3=Moderate; 4=Extensive)

The same scale is utilized to assess the availability of cover types for each velocity depth class. Four cover types are assessed.
(Overhanging vegetation; Undercut bank and root wads; Substrate; Aquatic macrophytes).

Slow Deep Water = > 0.5 meters. Fast water = > 0.3 m/sec.
Fast Deep Water = > 0.3 meters.

Each site was subjected to exhaustive searches using the most appropriate collecting techniques, given the prevailing flow conditions. At all sites, multiple habitats were sampled. At all sites, habitats of similar velocity depth classes and cover types were sampled at different localities

Table 3 . Scientific, English, Afrikaans and abbreviated names for indigenous fish expected to occur within the Limpopo Province study area of the Olifants Catchment. (Names from Skelton, 1993, 2001 and 2002)

Species	English Common Name	Afrikaans	ABB
Amphilius uranoscopus	Stargazer mountain catfish	Gewone bergbaber	Aura
Anguilla bengalensis labiata	African mottled eel	Afrika-bontpaling	Aben
Anguilla marmorata	Madagascar mottled eel	Madagaskar-bontpaling	Amar

Species	English Common Name	Afrikaans	ABB
Anguilla mossambica	Longfin eel	Geelbek-paling	Amos
Aplocheilichthys katangae	Striped topminnow	Streeplampogie	Akat
Barbus afrohamiltoni	Hamilton's barb	Hamilton se ghieliemientjie	Bafr
Barbus annectens	Broadstriped barb	Breestreep-ghieliemintjie	Bann
Barbus bifrenatus	Hyphen barb	Skakel-ghieliemientjie	Bbif
Barbus eutaenia	Orangefin barb	Oranjevlerk-ghieliemientjie	Beut
Barbus lineomaculatus	Line-spotted barb	Lynkol-ghieliemientjie	
Barbus mattozi	Papermouth	Papierbek	Bmat
Barbus neefi	Sidespot barb	Sykol-ghieliemientjie	
Barbus paludinosus	Straightfin barb	Lynvin of Moeras-ghieliemientjie	Bpau
Barbus radiatus	Beira barb	Beira-ghieliemientjie	Brad
Barbus toppini	East coast barb	Ooskus-ghieliemientjie	Btop
Barbus trimaculatus	Threespot barb	Driekol-ghieliemientjie	Btri
Barbus unitaeniatus	Longbeard barb	Longbaard-ghieliemientjie	Buni
Barbus viviparus	Bowstripe barb	Boogstreep-ghieliemientjie	Bviv
Brycinus imberi	Imberi	Imberi	Bimb
Chiloglanis engiops	Lowveld suckermouth	Laeveldse suierbekkie	Ceng
Chiloglanis paratus	Sawfin rock catlet	Saagvin-suierbekkie	Cpar
Chiloglanis pretoriae	Shortspine suckermouth	Kortstekel-suierbekkie	Cpre
Clarias gariepinus	Sharptooth catfish	Sterkpandbaber	Cgar
Glossogobius callidus	River goby	Rivier-dikkop	Gcal
Glossogobius giuris	Tank goby	Tenk-dikkop	Ggiu
Hydrocynus vittatus	Tigerfish	Tiervis	Hvit
Labeobarbus marequensis	Largescale yellowfish	Grootskub-geelvis	Bmar
Labeobarbus polylepis	Smallscale yellowfish	Kleinskub-geelvis	Lpol
Labeo congoro	Purple labeo	Rooiskub-moddervis	Lcon
Labeo cylindricus	Redeye labeo	Rooioog-moddervis	Lcyl
Labeo molybdinus	Leaden labeo	Loodvis	Lmol
Labeo rosae	Rednose labeo	Rooineus-moddervis	Lros
Labeo ruddi	Silver labeo	Silwer-moddervis	Lrud
Marcusenius macrolepidotus	Bulldog	Snawelvis	Mmac
Mesobola brevianalis	River sardine	Riviersardyn	Mbre
Micralestes acutidens	Silver robber	Silwer-rower	Macu
Opsaridium peringueyi	Southern barred minnow	Balkghieliemientjie	
Oreochromis mossambicus	Mozambique tilapia	Bloukurper	Omos
Petrocephalus wesselsi	Churchill	Stompkoppie	Pwes
Pseudocrenilabrus philander	Southern mouthbrooder	Suidelike mondbroeier	Pphi

Species	English Common Name	Afrikaans	ABB
Schilbe intermedius	Silver catfish	Silwerbaber	Sint
Synodontis zambezensis	Brown squeaker	Bruin skreeubaber	Szam
Tilapia rendalli	Redbreast tilapia	Rooiborskurper	Tren
Tilapia sparrmanii	Banded tilapia	Vleikurper	Tspa

Table 4. Scientific, English, Afrikaans and abbreviated names for exotic fish expected to occur within the Limpopo Province study area of the Olifants Catchment. (Names from Skelton, 1993, 2001 and 2002)

Species	English Common Name	Afrikaans	ABB
Ctenopharyngodon idella	Grass carp	Graskarp	Cide
Cyprinus carpio	Carp	Karp	Ccar
Hypophthalmichthys molitrix	Silver carp	Silwerkarp	Hmol
Micropterus dolomieu	Smallmouth bass	Kleinbek baars	Mdol
Micropterus salmoides	Largemouth bass	Grootbek-baars	Msal
Oncorhynchus mykiss	Rainbow trout	Reenboogforel	Omyk
Salmo trutta	Brown trout	Bruinforel	Stru

5.2 Application of the Fish Response Assessment Index (FRAI)

The FRAI is an index which has recently been developed by Dr. Kleynhans of the Resource Directed Measures (RDM) directorate of DWAF. Given our improving knowledge of fish habitat and cover preferences, the FRAI is a logical development of the earlier Fish Assemblage Integrity Index (FAII).

The index once again assess the status of fish populations which are present under existing conditions in relation to those which could be expected under natural conditions. The index follows a dedicated spreadsheet format and rule based model. The expected fish assemblages have beed developed, based upon all historical data sets and by expert judgement. (Angliss 1999, Limpopo Province Environmental Affairs: Fish Distribution Data Base 2005, Engelbrecht 2000)

The methodology has now provided a logical and standardized approach for the interpretation of system health based on fish assemblages. The FRAI has subsequently been adopted for both biomonitoring assessments for river health as well as for the reserve determination process.

The index assesses fish assemblages in terms of the following criteria.

- Flow-depth class metrics.
- Flow modification metrics.

- Cover metrics.
- Health/condition metrics.
- Introduced species metrics.

At each stage in the procedure, motivations for the scores are appended to the spreadsheets by way of comment boxes. Assessments of the fish populations against each of the above are calculated and then, based on expert judgment and prevailing conditions, are weighted and ranked prior to the calculation of an overall index score. The index score is interpreted as a percentage of natural, to provide an interpretation of the Present Ecological State (PES). The results may then also be presented graphically.

Descriptive templates for the PES remain unchanged from the earlier FAII interpretation and for completeness are attached as tables 5 and 6.

Detailed FRAI results are contained in APPENDIX B. (Electronic format)

5.3 Interpretation.

Table 5. FAII assessment classes. (From Kleynhans; 1997)

Class	Description of Generally Expected Conditions	FAII Score (Percent of total)
A	Unmodified, or approximates natural conditions closely.	90 - 100
B	Largely natural with few modifications. A change in community characteristics may have taken place but species richness and presence of intolerant species indicate little modification.	80 - 89
C	Moderately modified. A lower than expected species richness and presence of most intolerant species. Some impairment of health may be evident at the lower end of this scale.	60 - 79
D	Largely modified. A clearly lower than expected species richness and absence or much lowered presence of intolerant and moderately intolerant species. Impairment of health may become more evident at the lower end of this class.	40 - 59
E	Seriously modified. A strikingly lower than expected species richness and general absence of intolerant and moderately intolerant species. Impairment of health may become very evident.	20 - 39
F	Critically modified. An extremely lowered species richness and an absence of intolerant and moderately intolerant species. Only tolerant species may be present with a complete loss of species at the lower end of the class. Impairment of health generally very evident.	0 - 19

Table 6. A descriptive template for the Ecological Management Classes (EMC) of river systems. (From Kleynhans; 1997)

CLASS: MANAGEMENT CLASSES:	MANAGEMENT CLASSES: DESCRIPTION OF PERCEIVED CONDITIONS
WITHIN DESIRED RANGE	
A: UNMODIFIED OR LARGELY NATURAL.	The natural abiotic template should not be modified. The characteristics of the resource should be determined by unmodified natural disturbance regimes. There should be no human induced risks to the abiotic and biotic maintenance of the resource. The supply capacity of the resource will not be used.
B: LARGELY NATURAL WITH FEW MODIFICATIONS	Only a small risk of modifying the natural abiotic template and exceeding the resource base should be allowed. Although the risk to the well being and survival of especially intolerant biota (depending on the nature of the disturbance) at a very limited number of localities may be slightly higher than expected under natural conditions, the resilience and adaptability of the biota must not be compromised. The impact of acute disturbances must be totally mitigated by the presence of sufficient refuge areas.
C: MODERATELY MODIFIED	A moderate risk of modifying the abiotic template and exceeding the resource base may be allowed. Risks to the well-being and survival of intolerant biota (depending on the nature of the disturbance) may generally be increased with some reduction of resilience and adaptability at a small number of localities. However, the impact of local and acute disturbances must at least partly be mitigated by the presence of sufficient refuge areas.
D: LARGELY MODIFIED	A large risk of modifying the abiotic template and exceeding the resource base may be allowed. Risks to the well-being and survival of intolerant biota (depending on the nature of the disturbance) may be allowed to generally increase substantially with resulting low abundances and frequency of occurrence, and a reduction of resilience and adaptability at a large number of localities. However, the associated increase in abundance of tolerant species must not be allowed to assume pest proportions. The impact of local and acute disturbances must at least to some extent be mitigated by refuge areas.
OUTSIDE DESIRED RANGE	
E: SERIOUSLY MODIFIED	The losses of natural habitats and basic ecosystem functions are extensive.
F: CRITICALLY MODIFIED	Modifications have reached a critical level and the system has been modified completely, with an almost complete loss of natural habitats

Table 7. The developed species list for each of the ecoregions of the Olifants Catchment.with species recorded during the 2004 survey

Olifants 8.0		Olifants 9.0		Olifants 10.0		Olifants 3.0		Mohlapitse 9.0		Blyde 3.0		Selati 10		Selati 3.0	
EXP	REC	EXP	REC	EXP	REC	EXP	REC	EXP	REC	EXP	REC	EXP	REC	EXP	REC
Aben		Aben		Aben		Aben		Aura	3	Aura		Aura	19	Aben	
Amos		Amos		Amos		Amos		Aben		Aben		Aben		Amos	
Bann		Bann		Bpau		Bafr		Amos		Amos		Amos		Bafr	
Bmat		Beut	8	Btri		Bann		Akat	31	Beut	10	Beut	94	Bann	
Bpau		Bmat		Buni		Bmat		Bbif		Blin		Blin		Bmat	
Btop		Bpau	1	Bviv		Bpau		Beut	45	Bnee		Bnee	47	Bpau	2
Btri		Btop		Ceng	3	Brad		Blin		Bpau		Bpau		Brad	
Buni		Btri	3	Cpar	57	Btop	7	Bnee	4	Btri		Cpre		Btop	
Bviv	13	Buni		Cpre	51	Btri	20	Bpau		Buni		Lcyl		Btri	100
Cpar	1	Bviv	7	Cgar	1	Buni	2	Btri		Bviv		Lmar	41	Buni	50
Cpre	33	Ceng		Lcyl		Bviv	6	Buni		Bimb		Mmac		Bviv	20
Cgar	2	Cgar		Lmol	10	Bimb		Bviv		Cpar	1	Oper	1	Bimb	
Lcyl	1	Cpar	146	Lros		Ceng	18	Cpre	25	Cpre	20	Pwes		Cpar	9
Lmol	20	Cpre	20	Lrud		Cpar	51	Cgar	1	Cgar		Pphi	10	Cgar	9
Lros		Lcyl		Lmar	22	Cpre	50	Lcyl		Lcyl	15	Tspa		Gcal	
Lrud		Lmar	45	Mmac		Cgar	9	Lmol	14	Lmol	4	**15**	**6**	Ggiu	
Lmar	50	Lmol	20	Mbre		Gcal		Lmar	6	Lros				Hvit	
Mmac		Lros		Macu	20	Ggiu		Macu	25	Lmar	20			Lcon	
Mbre	100	Lrud		Oper	55	Hvit		Mmac	2	Mmac				Lcyl	
Macu	1	Macu		Omos	3	Lcon		Oper		Mbre				Lmol	20
Omos	184	Mbre		Pwes		Lcyl	2	Pwes		Macu				Lros	
Pwes	62	Mmac		Pphi	1	Lmol	150	Pphi	63	Oper				Lrud	2
Sint		Omos	38	Sint		Lros		Tspa	24	Omos				Lmar	27

Olifants 8.0		Olifants 9.0		Olifants 10.0		Olifants 3.0		Mohlapitse 9.0		Blyde 3.0		Selati 10		Selati 3.0	
EXP	REC	EXP	REC	EXP	REC	EXP	REC	EXP	REC	EXP	REC	EXP	REC	EXP	REC
Szam		Oper	1	Szam		Lrud	4	**23**	**12**	Pwes	2			Mmac	
Tren	65	Pphi	25	Tren		Lmar	158			Pphi				Mbre	1
Tspa	8	Pwes		Tspa		Mmac				Sint				Macu	
26	13	Sint	9	**26**	**10**	Mbre				Szam				Omos	51
		Szam				Macu				Tren				Pwes	
		Tren	4			Oper				Tspa				Pphi	4
		Tspa	6			Omos	3			**29**	**7**			Sint	
		30	**14**			Pwes								Szam	
						Pphi								Tren	11
						Sint								**32**	**13**
						Szam									
						Tren	1								
						35	**14**								

5.4 FRAI Results.

The full FRAI assessments for all ecoregions are presented in APPENDIX B. Results are summarized below.

Olifants 8.0

FISH PES METRIC GROUP		METRIC GROUP: CALCULATED SCORE	FISH PES:BASED ON WEIGHTS OF METRIC GROUPS: CALCULATED WEIGHT	WEIGHTED SCORE FOR GROUP	RANK OF METRIC GROUP	% WEIGHT FOR METRIC GROUP
FLOW-DEPTH METRICS	FD	80.00	0.30	23.88	1.00	100.00
FLOW MODIFICATION METRICS	FM	60.00	0.21	12.54	1.00	70.00
MIGRATION METRICS	MG	33.33	0.09	2.99	4.00	30.00
COVER METRICS	CM	48.00	0.19	9.31	2.00	65.00
HEALTH/CONDITION METRICS	HM	50.00	0.18	8.96	3.00	60.00
IMPACT OF INTRODUCED SPP (NEGATIVE)	IS	-15.00	-0.03	0.45	5.00	10.00
						335.00
FRAI Fish PES				58.12		
FRAI Fish PES Category				D		

Olifants 9.0

FISH PES METRIC GROUP		METRIC GROUP: CALCULATED SCORE	FISH PES:BASED ON WEIGHTS OF METRIC GROUPS: CALCULATED WEIGHT	WEIGHTED SCORE FOR GROUP	RANK OF METRIC GROUP	% WEIGHT FOR METRIC GROUP
FLOW-DEPTH METRICS	FD	55.00	0.34	18.97	1.00	100.00
FLOW MODIFICATION METRICS	FM	60.00	0.21	12.41	2.00	60.00
MIGRATION METRICS	MG	26.67	0.09	2.30	4.00	25.00
COVER METRICS	CM	64.00	0.17	11.03	3.00	50.00
HEALTH/CONDITION METRICS	HM	67.50	0.17	11.64	3.00	50.00
IMPACT OF INTRODUCED SPP (NEGATIVE)	IS	15.00	-0.02	-0.26	5.00	5.00
						290.00
FRAI Fish PES				56.09		
FRAI Fish PES Category				D		

Olifants 10.0

FISH PES METRIC GROUP		METRIC GROUP: CALCULATED SCORE	FISH PES:BASED ON WEIGHTS OF METRIC GROUPS: CALCULATED WEIGHT	WEIGHTED SCORE FOR GROUP	RANK OF METRIC GROUP	% WEIGHT FOR METRIC GROUP
FLOW-DEPTH METRICS	FD	45.00	0.31	14.06	1.00	100.00
FLOW MODIFICATION METRICS	FM	62.50	0.22	13.67	2.00	70.00
MIGRATION METRICS	MG	33.33	0.08	2.60	4.00	25.00
COVER METRICS	CM	48.00	0.19	9.00	3.00	60.00
HEALTH/CONDITION METRICS	HM	62.50	0.19	11.72	3.00	60.00
IMPACT OF INTRODUCED SPP (NEGATIVE)	IS	15.00	-0.02	-0.23	5.00	5.00
						320.00
FRAI Fish PES				50.82		
FRAI Fish PES Category				D		

Olifants 3.0

FISH PES METRIC GROUP		METRIC GROUP: CALCULATED SCORE	FISH PES:BASED ON WEIGHTS OF METRIC GROUPS: CALCULATED WEIGHT	WEIGHTED SCORE FOR GROUP	RANK OF METRIC GROUP	% WEIGHT FOR METRIC GROUP
FLOW-DEPTH METRICS	FD	65.00	0.27	17.81	1.00	100.00
FLOW MODIFICATION METRICS	FM	75.00	0.22	16.44	1.00	80.00
MIGRATION METRICS	MG	26.67	0.22	5.84	2.00	80.00
COVER METRICS	CM	64.00	0.14	8.77	3.00	50.00
HEALTH/CONDITION METRICS	HM	75.00	0.14	10.27	3.00	50.00
IMPACT OF INTRODUCED SPP (NEGATIVE)	IS	15.00	-0.01	-0.21	5.00	5.00
						365.00
FRAI Fish PES				58.93		
FRAI Fish PES Category				D		

Mohlapitse 9.0

FISH PES METRIC GROUP		METRIC GROUP: CALCULATED SCORE	FISH PES:BASED ON WEIGHTS OF METRIC GROUPS: CALCULATED WEIGHT	WEIGHTED SCORE FOR GROUP	RANK OF METRIC GROUP	% WEIGHT FOR METRIC GROUP
FLOW-DEPTH METRICS	FD	75.00	0.25	18.75	2.00	80.00
FLOW MODIFICATION METRICS	FM	72.50	0.31	22.66	1.00	100.00
MIGRATION METRICS	MG	46.67	0.05	2.19	4.00	15.00
COVER METRICS	CM	80.00	0.19	15.00	3.00	60.00
HEALTH/CONDITION METRICS	HM	82.50	0.19	15.47	3.00	60.00
IMPACT OF INTRODUCED SPP (NEGATIVE)	IS	-2.00	-0.02	0.03	5.00	5.00
						320.00
FRAI Fish PES				74.09		
FRAI Fish PES Category				C		

Blyde 3.0

FISH PES METRIC GROUP		METRIC GROUP: CALCULATED SCORE	FISH PES:BASED ON WEIGHTS OF METRIC GROUPS: CALCULATED WEIGHT	WEIGHTED SCORE FOR GROUP	RANK OF METRIC GROUP	% WEIGHT FOR METRIC GROUP
FLOW-DEPTH METRICS	FD	82.50	0.29	24.26	1.00	100.00
FLOW MODIFICATION METRICS	FM	80.00	0.21	16.47	1.00	70.00
MIGRATION METRICS	MG	53.33	0.09	4.71	4.00	30.00
COVER METRICS	CM	80.00	0.18	14.12	3.00	60.00
HEALTH/CONDITION METRICS	HM	82.50	0.15	12.13	2.00	50.00
IMPACT OF INTRODUCED SPP (NEGATIVE)	IS	-15.00	-0.09	1.32	4.00	30.00
						340.00
FRAI Fish PES				73.01		
FRAI Fish PES Category				C		

Selati 10.0

FISH PES METRIC GROUP		METRIC GROUP: CALCULATED SCORE	FISH PES:BASED ON WEIGHTS OF METRIC GROUPS: CALCULATED WEIGHT	WEIGHTED SCORE FOR GROUP	RANK OF METRIC GROUP	% WEIGHT FOR METRIC GROUP
FLOW-DEPTH METRICS	FD	70.00	0.24	16.72	2.00	80.00
FLOW MODIFICATION METRICS	FM	82.50	0.30	24.63	1.00	100.00
MIGRATION METRICS	MG	53.33	0.15	7.96	3.00	50.00
COVER METRICS	CM	90.00	0.18	16.12	3.00	60.00
HEALTH/CONDITION METRICS	HM	90.00	0.12	10.75	3.00	40.00
IMPACT OF INTRODUCED SPP (NEGATIVE)	IS	0.00	-0.01	0.00	5.00	5.00
						335.00
FRAI Fish PES				76.17		
FRAI Fish PES Category				C		

Selati 3.0

FISH PES METRIC GROUP		METRIC GROUP: CALCULATED SCORE	FISH PES:BASED ON WEIGHTS OF METRIC GROUPS: CALCULATED WEIGHT	WEIGHTED SCORE FOR GROUP	RANK OF METRIC GROUP	% WEIGHT FOR METRIC GROUP
FLOW-DEPTH METRICS	FD	60.00	0.19	11.57	2.00	80.00
FLOW MODIFICATION METRICS	FM	70.00	0.24	16.87	1.00	100.00
MIGRATION METRICS	MG	33.33	0.19	6.43	2.00	80.00
COVER METRICS	CM	68.00	0.17	11.47	3.00	70.00
HEALTH/CONDITION METRICS	HM	75.00	0.19	14.46	2.00	80.00
IMPACT OF INTRODUCED SPP (NEGATIVE)	IS	-5.00	-0.01	0.06	5.00	5.00
						415.00
FRAI Fish PES				60.85		
FRAI Fish PES Category				C		

5.5 Discussion.

The survey reveals that the fish populations within the main stem of the Olifants River, lie within the largely modified condition class (Class D), while the tributaries lie within a moderately modified condition class (Class C).

The following specific points should be noted.

- A total of 27 indigenous fish species were recorded during the survey.
- Although known to be present in the catchment, no exotic fish species were recorded.
- The red data fish species *Opsaridium peringueyi* was recorded in large numbers in the main stem of the Olifants River at site B7OLIF-FOCHA and a single specimen was recorded at site B5OLIF-DIAMA. A single specimen was also recorded in the Selati River at site B7GASE-SCHEL . However, no specimens were recorded in either the Mohlapitse or the Blyde rivers, where the fish have a well documented distribution.
- At the time of the surveys, the Blyde River was flowing strongly and access to the river was difficult. Only marginal areas could be sampled. The results presented for the Blyde River are possibly an underestimation of the true scenario, although the FRAI does take into account historical distribution.
- In the Selati River below Lekgalameetse, at site B7GASE-SCHEL, 100 percent of the rivers flow was being diverted into an irrigation canal. In Phalaborwa, at site B7GASE-OCONF, the water quality of the river indicated that the river was predominantly flowing with effluent, being discharged from the Phalaborwa industrial complex. Between these two sites, the river was standing and only a very limited number of deep pools could be assessed. Clearly, no flow dependent species were recorded in the Selati below the irrigation weir.

6. Invertebrates.

6.1 Invertebrate Monitoring Methods.

The survey for invertebrates was based upon methods developed for Biomonitoring, utilizing the SASS5 protocols (Dickens et al. 2001). (South African Scoring System version 5)

During this survey, the biomonitoring protocols were followed correctly, to obtain valid SASS5 scores. All available habitats were sampled. (Taking cognizance of available habitat both up and down stream a distance of 100 metres)

The SASS5 protocol requires that invertebrate abundances be recorded for each habitat type to family level only. Each family recorded has a predetermined sensitivity rating (score). All scores for the sites are totaled to yield the SASS5 score. The average score of all of the families recorded (ASPT) provides an indication on the number of sensitive, high scoring species represented in the total score.

SASS5 scores must thus be rated in terms of the Average Score Per Taxon (ASPT) and available habitat. In this regard, the Habitat Quality Index (HQI) was applied. The Integrated Habitat Assessment (IHAS) score sheet was also utilized and total scores obtained. However IHAS scores were not manipulated to provide refined SASS5 scores. The IHAS methodology is still under considerable review and there has been little attempt to fine tune the methodology in the lowveld. Scores are thus reflected for future reference only.

Abundances were also recorded and are presented in the tables attached in Appendix C. Invertebrates were recorded to family level only and returned to the river alive.

The method of collecting macro invertebrates utilizes a fine mesh net (1mm nylon) measuring 30 cm x 30 cm. Bottom substrates are disturbed through kicking (kick sampling) and invertebrates collected downstream. Vegetation is sampled by sweeping the net to and fro. Sampling times are indicated on the score sheet.

SASS4 protocols were documented in detail by Thirion et al. (1995). In addition, Chutter (1998) provided a broad framework for river classification for both acidic and alkaline streams based on SASS4 data.

Thirion (1998) produced a template (Table 14) which allows for the interpretation of SASS4 scores with the ASPT, in terms of the Present Ecological State (PES) following the same classification hierarchy as indicated in Table 9. This interpretive framework provides for ranges of scores and ASPT's for each eco-region.

During 2001 a workshop took place to upgrade SASS4 to SASS 5. The results were documented by Dickens et. al. (2001). SASS5 provides for a more detailed and standardized approach to the protocol, leading to improved acceptability of the protocol across the country. However interpretive frameworks have yet to be updated to provide a method for assessing results, based on SASS5 scores.

At this time it is still necessary to convert SASS5 scores back to SASS4 scores for the purposes of assessing the ecological state. In the case of the Limpopo Province, differences in scores between SASS4 and SASS5 are minimal. Significant differences are expected in areas where there are diverse *Trichoptera* (caddis flies). This commonly occurs in streams of the Western and Eastern Cape.

No habitat scores are currently being interpreted for inclusion into this framework.

Table 8. Description of SASS4 condition classes. (From Thirion 2000)

CLASS	BIOTIC MODIFICATION RELATIVE TO CURRENT BEST ATTAINABLE CONDITION	DESCRIPTION	SASS5 SCORE (%OF REFERENCE CONDITION)	ASPT VALUE (% OF REFERENCE CONDITION
A	Unimpaired	Community structures and functions comparable to the best situation to be expected. Optimum community structure (composition and dominance) for stream size and habitat quality.	90 – 100 80 - 89	Variable >90
B	Minimally impaired	Largely natural with few modifications. A small change in community structure may have taken place but ecosystem functions are essentially unchanged	80 – 89 70 – 79 70 - 89	<75 >90 75 – 90
C	Moderately impaired	Community structure and function less than the reference condition. Community composition lower than expected due to loss of some sensitive forms. Basic ecosystem functions are still predominantly unchanged.	60 – 79 50 – 69 50 – 79	>75 60 - 75
D	Largely impaired	Fewer families present than expected, due to loss of most intolerant forms. Basic ecosystem functions have changed.	50 – 59 40 – 49	<60 Variable
E	Seriously impaired	Few aquatic families present, due to loss of most intolerant forms. An extensive loss of basic ecosystem functions has occurred.	20 – 39	Variable
F	Critically impaired	Few aquatic families present, with high densities of organisms, then dominated by a few taxa. Only tolerant organisms present.	0 - 19	Variable

Table 9. SASS4 and ASPT values per Ecoregion as an indication of biotic condition. (Adapted from Thirion 2000) (Limpopo eco-regions)

REGION	SASS4	ASPT	CONDITION
HIGHVELD	>120	>6	EXCELLENT
	91-120	5-6	VERY GOOD
	71-90	4.5-5.5	GOOD
	56-70	4.5-5.5	FAIR
	30-35	VARIABLE	POOR
	<30	VARIABLE	VERY POOR
CENTRAL HIGHLANDS	161-170;>170	>7;>6	EXCELLENT
	121-160;141-170	>7; >6	VERY GOOD
	91-120; 121-140	<7.5;<7	GOOD
	61-90	<6	FAIR
	30-60	VARIABLE	POOR
	<30	VARIABLE	VERY POOR
BUSHVELD BASIN	>180	>6	EXCELLENT
	141-180	6-7	VERY GOOD
	91-140	5-6.5	GOOD
	61-90	<6	FAIR
	30-60	VARIABLE	POOR
	<30	VARIABLE	VERY POOR
GREAT ESCARPMENT MOUNTAINS	161-180;>180	>7;>6	EXCELLENT
	141-160; 161-180	>6; 6-7	VERY GOOD
	91-140	>5.5	GOOD
	61-90	<6	FAIR
	30-60	VARIABLE	POOR
	<30	VARIABLE	VERY POOR
LOWVELD AND LEBOMBO MOUNTAINS	141-160; >160	>7; >6	EXCELLENT
	106-140; 106-160; 131-160	>7; 6-7; 5-6	VERY GOOD
	76-105; 106-130	>5; 5-6	GOOD
	61-75	4-6	FAIR
	30-60	VARIABLE	POOR
	<30	VARIABLE	VERY POOR

Table 10. Guidelines for the interpretation of SASS4 scores for southern African waters which are not naturally acidic (pH>6) from Chutter (1998)

SASS4 Score	ASPT	Condition
>100	>6	Water quality natural, habitat diversity high.
<100	>6	Water quality natural, habitat diversity reduced.
>100	<6	Borderline case between water quality natural and some deterioration in water quality. Interpretation should be based on the extent by which SASS4 exceeds 100 and ASPT is <6.
50 – 100	<6	Some deterioration in water quality.
<50	Variable	Major deterioration in water quality.

6.2 Results.

For the purposes of this study, results are presented for individual sites within the eco regions of each river tributary. Both SASS5 and SASS4 scores are indicated. Detailed results are attached as Appendix C.

Olifants River main stem. Ecoregion 8.0

Survey date	11.08.04	13.08.04	13.08.04
Site	B5OLIF-ROODE	B50LIF-VANDE	B5OLIF-VEEPL
Ecoregion	8.04	8.03	8.03
SASS5 Score	81	116	101
No. of families	17	22	21
Score/taxon (ASPT)	4.76	5.27	4.81
IHAS	73	73	74
HQI	99	85	84
SASS4 Conversion	81	116	101
No. of families	17	22	21
Score/taxon (ASPT)	4.76	5.27	4.81
Class	D	C	C

Olifants River main stem. Ecoregion 9.0

Survey date	20.08.04	20.08.04
Site	B5OLIF-DIAMA	B7OLIF-STELL
Ecoregion	**9.03**	**9.03**
SASS5 Score	127	104
No. of families	24	20
Score/taxon (ASPT)	5.29	5.20
IHAS	70	77
HQI	97	116
SASS4 Conversion	125	108
No. of families	23	20
Score/taxon (ASPT)	5.43	5.40
Class	**C**	**C**

Olifants River main stem. Ecoregion 10.0

Survey date	17.08.04	28.07.04
Site	B7OLIF-PENGE	B7OLIF-FOCHA
Ecoregion	**10.01**	**10.01**
SASS5 Score	120	66
No. of families	21	12
Score/taxon (ASPT)	5.71	5.50
IHAS	69	62
HQI	96	89

SASS4 Conversion	126	70
No. of families	21	12
Score/taxon (ASPT)	6.00	5.83
Class	**C**	**D**

Olifants River main stem. Ecoregion 3.0

Survey date	28.07.04	27.07.04	27.07.04
Site	B7OLIF-PHOSAM	B7OLIF-HOEDS	B7OLIF-ZEEKG
Ecoregion	**3.07**	**3.07**	**3.03**
SASS5 Score	131	133	99
No. of families	23	23	18
Score/taxon (ASPT)	5.70	5.78	5.5
IHAS	87	81	71
HQI	121	81	107
SASS4 Conversion	132	143	103
No. of families	23	23	18
Score/taxon (ASPT)	5.74	6.22	5.72
Class	**B**	**B**	**C**

Mohlapitse River. Ecoregion 9.0

Survey date	19.08.04	19.08.04
Site	B7MOH-BADEN	B7MOH-WOLKB
Ecoregion	**9.02**	**9.02**
SASS5 Score	194	196
No. of families	28	27
Score/taxon (ASPT)	6.93	7.26
IHAS	82	86
HQI	108	109
SASS4 Conversion	204	199
No. of families	28	27
Score/taxon (ASPT)	7.29	7.37
Class	**A**	**A**

Blyde River. Ecoregion 3.0

Survey date	29.07.04
Site	B6BLYD-ESSEX
Ecoregion	**3.07**
SASS5 Score	142
No. of families	23
Score/taxon (ASPT)	6.17
IHAS	83
HQI	121

SASS4 Conversion	157
No. of families	23
Score/taxon (ASPT)	6.83
Class	**B**

Selati and Makhutswi rivers. Ecoregion 10.0

Survey date	08.05.03	08.05.03	28.07.04
Site	B7MAKH-LEKGA	B7GASE-MIDDL	B7GASE-SCHEL
Ecoregion	**10.01**	**10.01**	**10.01**
SASS5 Score	166	194	92
No. of families	24	29	16
Score/taxon (ASPT)	6.92	6.69	5.75
IHAS	94	97	61
HQI	120	120	100
SASS4 Conversion	168	197	96
No. of families	23	29	16
Score/taxon (ASPT)	7.30	6.79	6.00
Class	**A**	**A**	**C**

Selati River. Ecoregion 3.0

Survey date	22.07.04	27.07.04
Site	B7GASE-RANCH	B7GASE-OCONF
Ecoregion	**3.07**	**3.03**
SASS5 Score	No SASS	84
No. of families	No flow	20
Score/taxon (ASPT)		4.20
IHAS		84
HQI		88
SASS4 Conversion		84
No. of families		20
Score/taxon (ASPT)		4.20
Class		**D**

6.3 Discussion.

- From table 18, it can be seen that a total of 56 invertebrate families representing 14 orders were recorded during the survey.
- The Mohlapitse and the Selati rivers occurring within the protected areas of the Drakensburg, both hold diverse invertebrate communities, which have many of the more sensitive families present. These rivers are both considered to be in an excellent or unimpaired Class A condition class.

- The lower Selati River did not hold any sensitive families and the river reflected a largely impaired condition class (Class D) Given the poor water quality at the Phalaborwa site, this low class is not surprising.
- The Blyde River produced results, which suggest that the river is in a very good or minimally impaired condition class. (Class B) Once again, the results for the Blyde River may be an underestimation of the status. High flows caused sampling to be very difficult.
- In ecoregions 8, 9 and 10, the Olifants River lies in a good or moderately impaired condition class (Class C). However, in the Lowveld (ecoregion 3), the river is in a slightly better condition. From the above results tables, it can be seen that the habitat condition improves as one moves down the river from the Sekhukhune area to the lowveld and this improved habitat reflects an improved invertebrate assemblage.
- Given the high conductivities, which were recorded along the Olifants River main stem, which are an indication of salt loads, the SASS scores for the river were surprisingly high. It is however noticeable that the invertebrate communities in the Olifants River are dominated by relatively tolerant organisms. The ASPT range is from 4.7 to 6.2.

Table 11. Invertebrate Taxon recorded at each of the 2004 survey sites. (X = Present)

SITE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
TAXON																		
Turbellaria															X			
Annelida																		
Oligochaeta			X				X		X	X			X					X
Leeches	X	X								X					X			X
Crustacea																		
Potamonautidae					X			X			X	X	X	X	X	X		
Aytidae	X	X			X	X			X		X	X						
Hydracarina											X	X	X		X			
Plecoptera																		
Perlidae												X			X			
Ephemoptera																		
Baetidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Caenidae	X	X	X	X	X	X	X	X	X		X	X	X					X
Heptageniidae								X	X		X	X	X		X			
Leptophlebiidae				X	X	X	X	X	X	X	X	X	X	X	X	X		
Polymitarcyidae										X				X				
Tricorythidae		X	X								X	X		X	X			
Odonata																		
Chlorocyphidae								X			X	X	X			X		
Coenagriidae	X	X	X	X	X	X		X	X	X	X	X	X		X			X
Aeshnidae				X		X					X	X			X			
Corduliidae									X	X			X	X	X			X
Gomphidae		X	X	X	X	X	X	X	X	X		X	X	X	X	X		X
Libellulidae	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X
Hemiptera																		
Belostomatidae	X		X	X	X	X		X	X	X	X							X

SITE NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Corixidae				X				X	X	X				X	X			X
Gerridae	X	X	X	X		X		X	X		X	X		X	X			X
Hydrometridae				X														
Naucoridae		X	X	X	X	X		X	X									
Nepidae		X		X	X						X							
Notonectidae		X		X				X							X			X
Veliidae	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Trichoptera																		
Hydropsychidae	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Philopotamidae											X	X		X	X			
Polycentrapodidae												X						
Psychomyiidae											X							
Cased caddis																		
Calamoceratidae														X				
Hydroptilidae														X				
Leptoceridae						X			X		X	X	X	X	X			
Coleoptera																		
Dytiscidae		X		X	X	X		X	X	X		X	X	X	X	X		X
Elmidae	X					X				X			X					
Gyrinidae	X	X	X		X		X	X	X		X	X	X	X	X			
Haliplidae																X		
Helodidae											X	X						
Hydrophilidae				X					X									X
Psephenidae				X							X	X		X	X			
Diptera																		
Athericidae											X			X	X	X		
Ceratopogonidae		X	X	X		X					X							
Chironomidae	X	X	X		X	X	X	X	X	X	X	X	X		X	X		X
Culicidae														X				

SITE NUMBER	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Muscidae				**X**		**X**												**X**
Simuliidae	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**
Tabanidae	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**		**X**
Tipulidae								**X**								**X**		
Gastropoda																		
Ancylidae													**X**	**X**	**X**	**X**		
Lymnaeidae	**X**		**X**	**X**														
Physidae			**X**															
Planorbidae			**X**		**X**							**X**						
Thiaridae		**X**	**X**		**X**													
Pelecypoda																		
Corbiculidae	**X**	**X**	**X**					**X**					**X**					
Unionidae		**X**																
No. of families	17	22	21	24	20	21	12	23	23	18	28	27	23	24	29	16		20

7. Summarized results.

Table 12. Summarized results based on 4 Present Ecological State Classes as utilized in RHP State of River Reports (SORR).

NATURAL	A
GOOD	B/C
FAIR	C/D
POOR	E/F

River	Eoregion	FISH	INVERTEBRATES
Olifants	8	D	C
Olifants	9	D	C
Olifants	10	D	C/D
Olifants	3	D	B/C
Mohlapitse	9	C	A
Blyde	3	C	B
Selati and Makhutswi	10	C	A
Selati	3	C	D

8. Comparisons with the 1998 – 1999 Biomonitoring survey.

Table 20 provides an interpretation of the present ecological state (PES) of the catchment based upon the 1998 –1999 survey.

Table 13. Summarized results of the 1998 – 1999 survey, based on 4 Present Ecological State Classes as utilized in RHP State of River Reports (SORR). Adapted from the 2001 SORR.

River	Eoregion	FISH	INVERTEBRATES
Olifants	8	C/D	C/D
Olifants	9	C/D	C/D
Olifants	10	D	D
Olifants	3	C/D	C/D
Mohlapitse	9	B/C	A
Blyde	3	B/C	B/C
Selati and Makhutswi	10	B/C	A
Selati	3	D	C

From tables 19 and 20, it can clearly be seen that there is a recognizable deterioration in the PES of most ecoregions.

Of particular concern is the apparent decline in the status of the tributaries emanating from the Drakensburg Range. It is well known, that poor management of the upper catchment area has resulted in uncontrolled veld fires and loss of wetland sponge areas. This loss, has in turn resulted in an apparent reduction in river flows, which in turn has caused a decline in the status of instream habitats.

9. Conclusions.

As can be seen from the above table, the present ecological state of the Olifants River Catchment varies considerably between ecoregions. Mountain streams within the Lekgalameetse Reserve, reflect the expected high diversity of aquatic invertebrates, and associated good water quality. However, within the reserve, fish populations are no longer in a natural condition. The Blyde River also reflects this pattern, largely because the river is protected by private farms. Impacted fish communities are almost certainly as a result of reduced river flows and fragmentation of the system through the placement of dams and weirs. The remainder of the Olifants Catchment is in a fair or largely modified ecological condition class.

Water quality in the mountain streams of the study area, was considered to be good. However, the main stem of the Olifants River continues to reflect a largely modified water quality due to upstream mining activities. Salt loads are high and conductivity exceeds 50mS/m. The lower Selati River in Phalaborwa yielded a conductivity in eccess of 200mS/m, above the measurement range of field instruments. Pulsed releases from the Blyde Dam are thought to be harmful in that they interfere with temperatures within the lower river, along with the obvious impacts associated with unseasonal flow patterns.

While the Olifants Catchment remains in a largely modified state outside of nature reserves, increasing water demands within the catchment are likely to cause a downward trend in the overall status of the system.

10. Recommendations.

In terms of water supply for the environment, there have been two major studies undertaken for the catchment to date. The latest Ecological Reserve determination, conducted in 2000 has yet to be implemented. While it is understood that the DWAF have a difficult task in addressing administrative issues behind the process, the failure to implement the reserve must be seen as a major failing. The process was hugely expensive, given the scale of the catchment and while DWAF are procrastinating, the riverine environment of the catchment is degrading. The implementation of the reserve would go some way towards protecting the existing fauna and flora, while providing some indication of water availability for future licences.

In the absence of an ecological reserve, those mountain catchment areas of the Selati and Makhutswi Rivers should be afforded high levels of protection. The upper catchments have been seriously neglected in recent years and there is an urgent need to implement strict veld management.

The Selati River is being completely diverted into an irrigation canal and the downstream river environment has been adversely affected, with all fow dependant species now being absent from the river below the diversion. Although a Reserve would address this issue, it is not acceptable that 100 % of river flows be diverted.

Along the Olifants River main stem, there appears to be a proliferation of both sand mining and pebble mining. While these activities are having a limited direct impact

on the aquatic habitat, they are adversely affecting the riparian environment, which in turn is causing increased erosion and deposition of sediments within the river channel.

Pulsed releases from Blyde Dam are coordinated for agricultural purposes with little recognition of environmental requirements. From an environmental perspective, releases should mimic the natural hydrological regime of the system. Pulses of flow are considered detrimental to the ecology. Departmental management should liaise with water resource managers in an effort to improve the management of flows for the environment. This issue would once again be addressed, should a reserve be implemented in the lower Blyde Ctachment.

Perhaps the biggest failing of this survey was the lack of buy in to the process from the respective district personnel. Despite numerous communications, both directly to the districts and through senior management channels, no district personnel participated in the surveys and nobody attended a field day, which was well advertised, under the auspices of the Olifants River Forum.

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