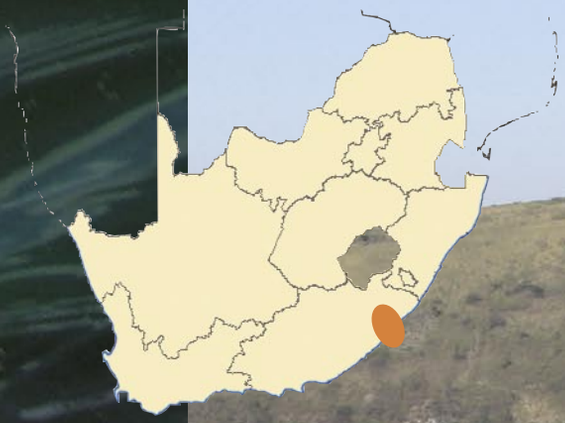
STATE-OF-RIVERS REPORT No. 14



Mthatha River System - 2008

The River Health Programme

Foreword

This document is an initial, yet vitally important stepping stone on the future development, and well-being of the Mthatha River. The sustainable protection of the natural environment is not only enshrined in the constitution, but is again reflected in the National Water Act (Act 36 of 1998), as well as in a myriad of DWAF policies and strategies. To meet these requirements, the DWAF created a River Health Section, and is currently busy further populating this section to deliver a quick, accurate, in-depth and ongoing service. Although only a few prioritized rivers or river sections have been investigated to date, together with the setting up of monitoring points, this will in due course spread across Water Management Agencies 12 and 15, with a wall-to-wall monitoring network. In this way, the DWAF can keep its finger on the pulse of each and every watercourse, and step in when points of concern arise.

The Mthatha River is the latest addition to the growing list of rivers investigated by the River Health Section. The time is indeed ripe for such an intervention, especially as the Mthatha River has been getting a fair amount of negative publicity in both the print and electronic media due to the population incidents. Not only this but the area around Mthatha itself has been included in the so-called Mzimvubu Development Project, which is being spearheaded by ASGISA which is also a Presidential Icon Project. There have been a number of recent enquiries regarding water-related tourism activities on the Mthatha Dam and at the estuary. The Mthatha River is also used for varied purposes, such as hydropower generation, irrigation, domestic and industrial water supplies and stock-watering.

The time is thus ripe for the production of this important document. It is now up to everone involved either directly or indirectly in the water sector to make use of this initial stepping stone as a solid footing for the way forward in ensuring the Ecological Health of the Mthatha River. This way, future generations can enjoy the environment as guaranteed in the Constitution.

Ms. Nomonde Mnukwa
Chief Director: Eastern Cape

Context of this Report

The Mthatha State-of-Rivers report was developed as part of the biomonitoring and reporting capacity building initiative in the Eastern Cape. While this report is mainly based on the Mthatha technical report (RHP web site: www.csir.co.za/rhp/), contributions were also received from many individuals. Main contributors towards the earlier drafts, with their affiliated organisations and contributions in brackets, are listed below:

Pumza Gasa-Lubelwana (DWAF; Project coordination); Ntombokuqala Myeko (WSU; Floods; The Ngqungqu tributary; RHP background; Land cover and land-use); Sizwe Cawe (WSU; Alien vegetation along the Mthatha river; Mangroves; Making mats; Plantations; Indigenous forests); Ndipha Bhengu (WSU; Origin of the water hyacinth in the Mthatha River); Elliot Weni (DWAF; Nature Reserves; Mthatha River upstream of Mthatha Dam); Dumisani Kali (WSU; Ecosystem services; Mthatha estuary; Mthatha Town); Ntsiki Majiza (WSU; Education opportunities for children in environmental sciences; Mthatha River between First Falls and Kwa-Ntsaka location; Indicators); Chief Takata (Mthatha River between First Falls and Kwa-Ntsaka location); Kululwa Mkosana (DWAF; Wetlands and importance; Recommendations and Management actions; River Health Indicators; River Health Categories); Mmabatho Mampane (DWAF; River Health Indicators; Ecosystem services; Recommendations and Management actions); Thulani Guzana (DWAF; Water quality; Mthatha estuary); Tando Ntozakhe (WSU; RHP background; Water quality, sewage pollution); Zanele Sishuba (DWAF; Mthatha Dam; Overview of the Mthatha catchment); Janine Adams (NMMU; Mthatha estuary); Mlondolozi Mbikwana (DWAF; Water supply and sanitation; Ecoregions; Land cover and land-use); Lungile Gaulana (DWAF; wetland map); Charon Swarts (DWAF; Geology and soils); Thembela Bushula (DWAF; Mthatha headwaters; coordination of meetings).

Other contributions by:
Wilma Strydom (Editor); Devlyn Hardwick (CSIR; Gully erosion in the Mthatha catchment; Land-use and ecoregion maps; Water and sanitation statistics; gully photographs); Liesl Hill (CSIR; RHP background); Bettina Genthe and Maronel Steyn (CSIR; Human health and water quality); Peter MacMillan (CSIR; WMA maps; ordering of information); Mike Silberbauer (DWAF, RQS; Editing and review); Peter Ashton (CSIR; Review).

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Content

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Summary

This state-of-river report for the Mthatha is the second for a river system in the Eastern Cape under the River Health Programme (RHP). It is a summary of the findings of studies of the ecological functioning of the Mthatha catchment and provides valuable information for the management of the water resources in the catchment.

Healthy rivers are essential to our well-being and the sustainable development of our country: we rely on rivers for our survival and benefit from the goods and services that rivers yield. However, competing demands of poverty alleviation, industrial development, provision of services and economic growth can all too easily over-ride the basic requirement for protection of the river environment. Without a sustainable environmental base, developmental gains may be short-lived, resulting in irreversible damage to the aquatic environment and causing more hardship than before. Loss of aquatic ecosystem integrity can increase the cost of obtaining safe potable water, impair the quality of life and incur health costs for treatment of acute and chronic diseases related to prolonged exposure to water pollutants.

RHP studies show that the EcoStatus of the Mthatha River is Fair to Poor in the upper river, Poor to Seriously Modified in the Mthatha Town area and immediately downstream, and Fair in the lower river. Deteriorating water quality in the middle and lower reaches of the Mthatha River poses potential health and economic risks to the communities living there. Population growth has outstripped the development of infrastructure and the supply of potable water to all households is a problem. The majority of rural households do not have access to clean potable water and many use untreated river water. Most households also do not have adequate sanitation facilities. Poor sanitation, overloaded systems and malfunctioning sewage treatment works result in untreated human waste discharging into the river, despite the requirements of the National Water Act (Act No.36 of 1998), which requires that all effluent discharges, including runoff from industries, dumping sites, and formal and informal settlements, must comply with the national water quality regulations. The authorities have a duty to deal with offenders and to arrange that affected areas are cleaned up, for example by installing and managing adequate solid and liquid waste disposal

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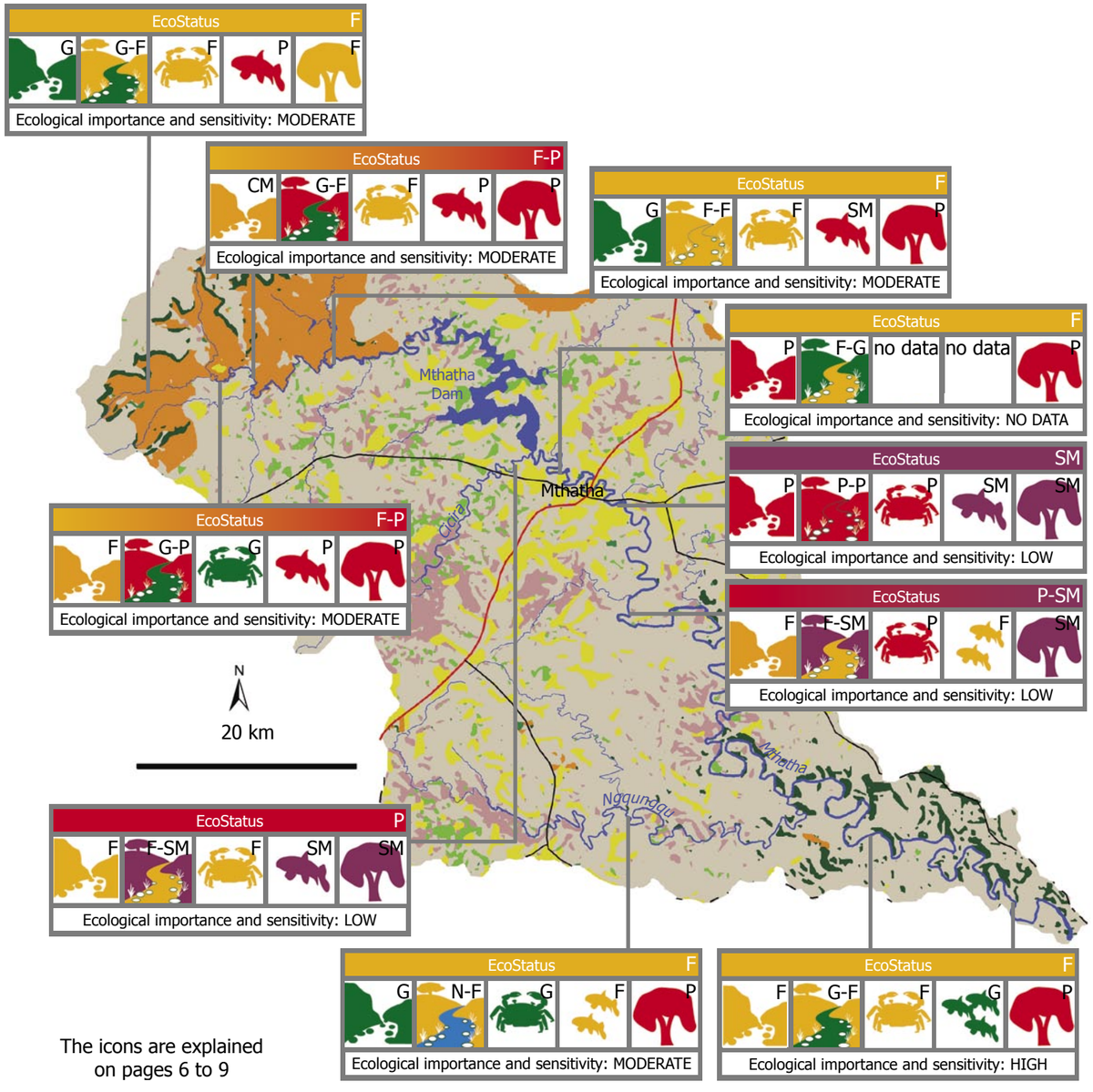


The icons are explained on pages 6 to 9

Isishwankathelo

Ingxelo engobume bomlambo *waseMthatha yeyesibini ukwenziwa yiRiver Health Programme (RHP) apha eMpuma Koloni. Le ngxelo ishwankathela iziphumo zezifundo ezingokusebenza kwendalo yomhlaba waseMthatha. Ezi ziphumo zinika ulwazi olubalulekileyo oluthi luncede ekunonopheleni amanzi kule ngingqi.*

Imilambo ekwisimo esihle inenxaxheba enkulu kwimpilo yethu nasekusebenziseni ngononophelo izinto eziphuhliswa lilizwe lethu: Ukuze siphile, sixhomekeke kwimilambo kwaye siyaxhamla kwizinto eziveliswa ngumlambo. Kodwa ke, ukukhula kwezidingo zokugxotha indlala, uphuhliso lwemizi-mveliso, ukwenziwa kweenkonzo kuluntu kunye nezeqoqosho, zonke ezo zinto zingayigubungela eyona njongo yokukhusela amanzi. Xa singenaso isiseko sendalo esihlala sikho, zingakhawuleza ziphele izinti esizizuza kuphuhliso, ibangele umonakalo ongenako ukulungiseka emanzini, kube nzima kunakuqala. Xa sithe saphulukana nendalo yasemanzini siyakuzifumana sihlawula ixabiso eliphezulu lokuzuza amanzi okusela acocekileyo, ichaphazeleke impilo, siphele sihlawula kakhulu ukuze sinyangwe kwizifo esizifume ngokuthi sidibane nezinto ezingcolisa amanzi.

Izifundo zeRHP zibonisa ukuba isimo sendalo somlambo uMthatha siphakathi kokubaNgcono nokubakwimeko embi kumantla omlambo, umbindi wedolophu uMthatha nasezantsi kwayo zikwimeko embi netshintshileyo kakhulu, ngeli lixa umlambo emazantsi ukwisimo esiNgcono. Imeko yamanzi eqhubeka nkokubambi embindini nasemazantsi omlambo uMthatha ibeka impilo noqoqosho lwabantu abahlala kuloo ngingqi emngciphekweni. Ukwanda kwabantu kubangele ukunqongophala kwezixhobo, nto leyo ibangele ubunzima ekuseni amanzi acocekileyo okusela eluntwini. Uninzi lwezindlu zasezilalini abakwazi kufikelela kumanzi acocekileyo okusela, baphele besebenzisa amanzi omlambo angacocekanga. Izindlu ezininzi azinazo ngokwaneleyo izindlu zangasese. Izindlu zangasese ezingekho mgangathweni uphezulu, ukugcwala kwendawo zokugcina ilindle nokungasebenzi (okanye ukonakala) kweendawo zokucoca ilindle, zonke zibangela ukuba ilindle lomntu elingacocekanga liye kungena emlanjeni linjalo. Le nto ke igqitha ngaphaya kwemimiselo yoMgaqo waManzi, ogxinisisisa ekubeni, isimo samanzi angcolileyo ngokusetyenziswa, oku kubandakanya amanzi asetyenziswayo avela kwimizi-mveliso, iindawo zokulahla inkukuma, izindlu zabantu namatyotyombe kufuneka sibe ngaphantsi komlinganiselo obekiweyo nguzwe-lonke. Abasemagunyeni ke banoxanduva lokujonana nabophuli-mthetho, baqisike ukuba loo ndawo icociwe. Le nto ke ingenziwa ngokuthi kumiselwe izixhobo nezindlu zokugcina amanzi nelindle engcolileyo, nkokwemigaqo kazwe-lonke.

Ukutshintsha indlela umlambo ohamba ngayo kunye notsalombane emanzini zezinye izinto ezixhalabisayo. Isebe lamanzi nezamahlathi, engingqini nakuzwelonke, uzakube usenza uphando olunzulu lwendalo yomlambo uMthatha. Le nto iza kubangela ukumiselwa kohambo lomlambo ngokwendalo nokulondolozwa ngeliso elibanzi kokuvulelwa kwamanzi edamini ukuze umlambo

Qhubeka uye kwiphepha le-4

Isishwankathelo (siyaqhubeka)

ufuze ukuhamba ngokwendalo.

Iingxaki ezinxulumene namanzi azisuki emlanjeni. Amanzi amaninzi esichotho nomhlaba ocukeneyo, ziye zidibane zibangele ukhukuliseko lomhlaba olubonakala kumhlaba waseMthatha wonke. Ukususwa kwemithi yemvelo ngokudlisa imfuyo ngokugqithisileyo, iyenza mbi ngokuthe chatha imeko. Loo nto ibangela ukuba umhlaba obalulekileyo uphela ungena ubemninzi emlanjeni. Bonke ke abachaphazelekayo, kuquka oosomahlathi, abalimi nabafuyi nabo basemasemagunyeni ekuhlaleni, kufuneka bakhusele amanxweme omlambo ngokuthi bavumele umhlaba nezityalo ezaneleyo ezingqonge umlambo ukuzama ukudambisa izikhukula nokubamba umhlaba ungakhukuliseki. Ukuba kunikwenzeka, abahlali bale ndawo kufuneka bayeke ukudlisa imfuyo endaweni enye ngokugqithisileyo nokususwa kwemithi yemvelo eselunxwemeni lomlambo. Abasemagunyeni kufuneka bacebe ukususa izityalo ezingezizo ezemveli ezikhula emanzini, olulukhula lwamanzi.

Iqela (Provincial Task Team, PTT) leSebe laseMpuma Koloni leRHP lunoxanduva lokumisela, ukulondoloza nokuphuhlisa iRHP apha esebeni. Eli qela liza kuqhubeka ngokuthi lifumane namanye amaziko anomdla kule nkqubo, bobelane nangezixhobo ukuze icace indima yokudlwalwa liziko ngalinye. Eli qela liza kusasaza umgaqo oza kulandelwa xa kujongwa umlambo ngokubanzi, kulondolozwe ulwazi kwenziwe nengxelo. Eli qela libambisene neSebe lamanzi namahlathi namanye amaziko abandakanyekayo, liphuhlisa labelane nangolwazi ukuze kugcinwe, kulondolozwe, kukhuselwe nokuzama ukubuyisela indalo yamanzi kwisimo sayo sokuqala. Eli qela, iPTT, alinako ukufezekisa lo msebenzi lodwa, kungoko ke amasebe athatha inxaxheba kufuneka abonise ukuzinikela kwawo kwi RHP nePTT ngokuthi afakele kwiincwadi zabo ezibonisa imisebenzi eza kwenziwa, ufundo lwemilambo kusetyenziswa izidalwa zasemanzini nangokuxhasa avumele ukubandakanyeka kwamalungu abo kwiRHP.

Summary (continued)

infrastructure according to national standards.

Flow modification through damming and power generation is another area of concern. The Department of Water Affairs and Forestry's national and regional offices will be determining the ecological Reserve for the Mthatha River, in order to establish environmental flow requirements and manage flow releases to simulate seasonal flows and natural hydrological fluxes as closely as possible.

Water-related problems are not restricted to the river channel itself. Concentrated surface flow during rainstorms and the phenomenon of "soil piping" combine to cause the gully erosion apparent throughout the Mthatha catchment. The removal of natural vegetation, for example through overgrazing, aggravates the situation. The net result is that valuable topsoil ends up as sediment in the river channel. All those concerned, foresters, agriculturalists and local authorities, need to protect riparian zones by allowing sufficient buffer areas to ensure that flood attenuation and sediment trapping occurs. If at all possible, local communities should avoid the adverse effects of overgrazing and the removal of indigenous trees and other vegetation from the riparian zone. Where alien vegetation has invaded the riparian vegetation, land managers need to carefully remove the alien plants while avoiding further damage to the riparian zone. The responsible authorities should also plan to eradicate invasive alien in-stream vegetation such as water hyacinth.

The Eastern Cape RHP Provincial Task Team (PTT) is responsible for implementing, maintaining and developing the RHP in the province. The PTT will continue to identify and align the efforts and resources of collaborating institutions and make roles and responsibilities explicit. The PTT will also develop and distribute a framework and plan of action for the co-ordination of river surveys, information management and reporting. In collaboration with DWAF and other responsible organisations, the PTT is developing and disseminating the knowledge to sustain, manage, protect, and rehabilitate the aquatic ecosystem. The PTT cannot achieve this alone, so participating organisations should show their commitment to the RHP and PTT by including biomonitoring in their business plans and by supporting and endorsing the involvement of their staff members in the RHP.

River Health Programme Background

A river links together many other ecosystems in a catchment and the health of a river is therefore a good reflection of the health of a catchment. Healthy rivers are essential to human well-being and sustainable development. People rely on rivers for their survival and derive benefits from the goods and services that rivers yield. We monitor these ecosystems and the organisms that live in them to enable informed management and protection of our rivers.

The Department of Water Affairs and Forestry (DWAF), as the legal custodian of water resources in South Africa, is responsible for the development, implementation and maintenance of all national water resource quality monitoring programmes, including the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP). The River Health Programme (RHP) is one of four sub-programmes of the NAEHMP (the others are wetlands, estuaries and groundwater dependent ecosystems). The overall purpose of the RHP is to provide information on the state of health or ecological integrity of rivers to support the management of these resources.

The RHP has been in existence since 1994, and various organizations and individuals have taken part in the development and implementation of the Programme. At a national level DWAF, the Department of Environmental Affairs and Tourism (DEAT) and the Water Research Commission (WRC) are custodians of the Programme and provide strategic guidance. At the provincial and local level, provincial task teams (PTT) implement and maintain the RHP under the leadership of provincial champions. Participants in the RHP come from DWAF Regional Offices, provincial DEAT, SANParks, provincial parks boards, academic institutions, conservation agencies, water boards and private sector and industry.

Monitoring programmes such as the RHP are essential for realising the sustainable development of water resources in South Africa. Competing demands for poverty alleviation, industrial development, provision of services and economic growth imperatives can all too easily over-ride the basic requirement for environmental protection. Without a sustainable environmental base, developmental gains could be short-lived, causing irreversible damage to the environment which supplies the water we use for food production, industrial development and agricultural enterprise. The complex integration of ecological, economic and social objectives is crucial to the sustainable development of these water resources. The immediate gain from certain activities might seem financially attractive, but the longer term consequences could be devastating for sustainability and human livelihoods. Loss of aquatic ecosystem integrity can increase the cost of obtaining safe potable water, impair the quality of life and incur health costs for treatment of acute and chronic diseases related to prolonged exposure to water pollutants.

State-of-Rivers (SoR) reporting

Well informed decision-making and changed behaviours are needed to ensure sustainable development. This can only be accomplished if the relevant information is available. State-of-Rivers reporting provides such information in the style of State of Environment reporting, using the Organisation for Economic Co-operation and Development (OECD) Pressure-State-Response (PSR) framework, where:

Pressure describes the social and economic activities that exert pressure on the environment or ecosystems;

State represents the present state or health of an ecosystem and is a direct result of these pressures; and

Responses are the management actions and policies needed to relieve the pressures and impacts through correct management.

Over time, as we record more and more trend data for ecosystem health, the consequences of increasing social and economic activities (pressures) on sustainability and human livelihoods is becoming clear.

In order to convey SoR information to a wider audience, the Mthatha River technical report (intended for water resource managers) is enhanced and supplemented by a suite of products:

SoR Report – (this document) a concise, readable version containing the major findings, aimed at parliamentarians, resource managers and the public;
Poster – an eye catching version that gives the state of a river in a nutshell, for display in public buildings, schools, libraries and clinics;
Non-verbal poster – to accommodate those that have difficulty reading, the non-verbal poster has a dual purpose with guidelines for use in the Junior Primary Phase in schools;
Activity book – based on the OBE curriculum and with teacher supervision, the learner discovers wise water uses as well as the importance of river ecosystems.

Measuring River Health

Ecologically based approaches and methods for determining the state of river ecosystems include Eco-classification and Eco-Status (using Indicators and Indices) and a River Health Categorisation.

To determine the ecological health of South Africa's river systems, the RHP focuses on biological indicators and indices (macro-invertebrates, fish and riparian vegetation), also referred to as biological responses, and in-stream and riparian habitats. The ecological health of a river is also called the Present Ecological State, or PES.

Biological organisms and communities are adapted to live within a certain range of environmental conditions. Because they are closely attuned to disturbances that occur in a river ecosystem over extended periods of time, they are excellent indicators of the ecological health of the river.

The RHP has a range of tools at its disposal for assessing the health or condition of aquatic resources. Each tool summarises the biological response data using an index or model to generate metrics (such as MIRAI, FRAI or EcoStatus) expressed as an Ecological Category.

EcoClassification

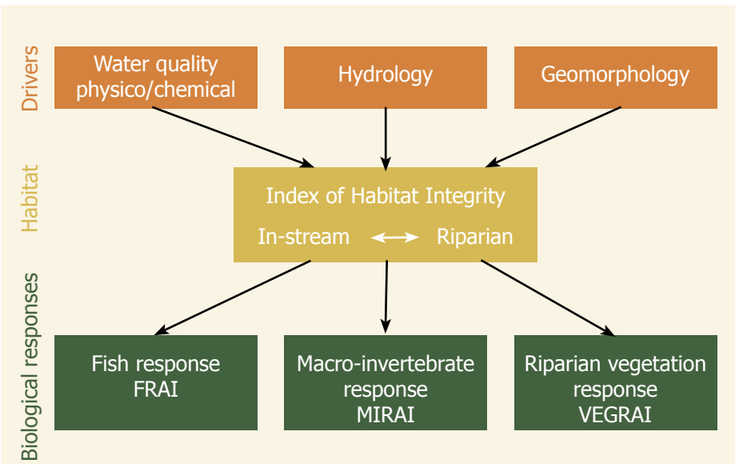
EcoClassification is the term used for the Ecological Classification process, which derives the PES by monitoring a range of biophysical attributes (e.g. macro-invertebrates, fish, and riparian vegetation), and comparing the results with those of the natural reference condition.
The RHP design allows comparison between reference sites or conditions and monitoring sites. Ecoregions, which are characterised by distinct abiotic factors such as climate, soil, geology, physiography and natural vegetation, establish the reference sites or reference conditions for such a comparison. By comparing a selected site to a natural or minimally impacted site in the same ecoregion, it is possible to establish whether changes in the river system are natural or unnatural.

The same EcoClassification process is followed in the RHP as in the determination of the ecological Reserve. Within the RHP context, the focus is on biological responses as indicators of ecosystem health, so biological response data is assessed in terms of the severity of biophysical changes. The RHP includes only a cursory assessment of the cause-and-effect relationships between the drivers (e.g. physico-chemistry, geomorphology, hydrology) and the biological responses.

EcoStatus

The EcoStatus of a river system describes the overall condition or health of the system, in terms of its ability to support an appropriate natural fauna and flora, and its capacity to provide a variety of goods (e.g. timber, food, medicine) and services (e.g. purification, degradation of organic matter). It therefore reflects an ecologically integrated state representing a series of:

- Ecosystem Drivers (hydrological, geomorphological, and physico-chemical); and
- Ecosystem Responses (macro-invertebrates, fish and riparian vegetation).



The relationship between the indices used to determine the ecological health of a river according to the EcoStatus procedure.

River Health Categories

River Health categories are associated with varying levels of present ecosystem health and the potential of an ecosystem to offer particular goods and services (see table below). A section of a river in a natural class may be more suitable for conservation and tourism, while a river in a good class may have recreational potential. A river in a fair class may have lost much of its capacity to be a reliable and good quality source of water while rivers in a poor class have little or no capacity remaining to support any ecological goods or services. River health categories thus represent a combination of human impacts. Resource managers have to take decisions concerning these impacts, in the knowledge that the consequences for the river ecosystem may be irreversible.

River Health Category	Ecological Perspective	Management Perspective
Natural	No or negligible modification of in-stream biota and riparian habitats	The river is relatively untouched, no dams impede flow and no waste discharges enter the river.
Good	The biodiversity is largely intact and the ecosystem is essentially in a good state.	Human related disturbances have a low impact on the river.
Fair	Few sensitive species may be absent and biological populations are less abundant - invasive or opportunistic species may be present.	Multiple disturbances are associated with economic development and include impoundment, water quality degradation and habitat modification.
Poor	River habitat diversity and availability have declined and only tolerant species are present. Those species that survive are often diseased and population dynamics are often disrupted.	High human densities or extensive resource exploitation have greatly altered the river. Management intervention should already be in place to improve the health of the river, restoring flow patterns, water quality and river habitats.

The River Health categories have been revised and aligned with the ecological Reserve categories A to F and will in future be reported on as described in the table below.

Ecological categories, category names and associated meanings with colour codes used to interpret EcoStatus and RHP data.

Ecological (Reserve) categories	River Health category	Description	Colour
A	Natural	Unmodified natural	Blue
B	Good	Largely natural with few modifications	Green
C	Fair	Moderately modified	Yellow
D	Poor	Largely modified	Red
E	Seriously modified	Seriously modified	Purple
F	Critically modified	Critically or extremely modified	Black

Driver and response indicators used in the RHP

EcoStatus is based on the principle that the biological responses reflect the integrated effect of the modification of the drivers and that this results in an ecological endpoint. In the RHP context, biological responses are the primary indicator of ecosystem health while habitat integrity is generally used as a surrogate for driver information. Although a detailed analysis for the physical drivers, i.e. geomorphology, hydrology and water quality is not required for a RHP level EcoStatus assessment, this data is used to compliment and improve the confidence of the habitat integrity assessment, if available.

Driver indicators

Geomorphology and hydrology

Geomorphological processes determine river channel morphology which provides the physical environment which stream biota live in. Changes to channel form can occur naturally or as a result of human activities such as damming, water transfer or irrigation. Hydrological processes control how much water is available and the nature and speed of the flow, which in turn determine the abundance and distribution of biota by creating dynamic habitats and substratum conditions. Geomorphological and hydrological changes are associated with erosion, increased sediment, declining water quality and altered stream hydraulics.

Water Quality

Water quality variables that determine the ability of a river to support aquatic ecosystems include turbidity, suspended solids, temperature, pH, salinity, dissolved ions, nutrients and metals. Pollution associated with human activity in the river basin and natural geomorphic processes can alter the quality of the water to detrimental or lethal levels for aquatic organisms.

Water quality is not a standard RHP indicator.

Habitat

Habitat

The availability and diversity of habitats (in-stream and riparian areas) are important determinants of the biota that are present in a river. Impacts that could influence river habitat include modification of the volume of water, a change in the natural flow patterns, bed and channel modifications, water quality deterioraton, alien water plants and waste disposal. In the RHP, the Index of Habitat Integrity (IHI) is generally used as a surrogate for driver information.

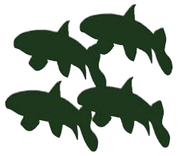
Driver and response indicators used in this report

The Geomorphological Assessment Index (GAI) was the driver index used in the Mthatha River assessment. Fish (FRAI), macro-invertebrates (MIRAI) and riparian vegetation (IRVI) were the biological response indicators used.

Response indicators

Macro-invertebrates

Aquatic invertebrate communities respond relatively quickly to localised conditions in a river, especially water quality and habitat diversity. These communities are common, have a wide range of sensitivities, and have a suitable life-cycle duration that indicates short to medium-term impacts of water quality. The Macro-Invertebrates Response Assessment Index or MIRAI model is the current method for reporting on the macro-invertebrates as it provides a habitat-based cause-and-effect foundation for the interpretation of deviations of the aquatic invertebrates from a reference condition. These results are then integrated into the overall Ecostatus score. Note that previous reports used the South African Scoring System or SASS to express the sensitivity of macro-invertebrates as an index score, also called the average score per taxon (ASPT).



Fish

Fish are relatively long-lived and mobile, so they indicate longer-term changes in the condition of river habitats due to changes in river flow, river structure or the chemical composition of the water. To determine the fish habitat index, a specialist assesses the characteristics of a fish assemblage in a specific river reach, including the number of species, age classes, general health, sensitivity to disturbance and preferences regarding environmental conditions. This report uses the Fish Response Assessment Index (FRAI) model, which is a modification of the Fish Assessment Integrity Index (FAII) used in previous reports. FRAI reflects the presence or absence of a species rather than species abundance and is part of the integrated EcoStatus model.

Riparian Vegetation

Riparian vegetation links the in-stream aquatic ecosystem to the surrounding terrestrial ecosystem, which in turn influences river process and patterns. A healthy riparian zone maintains channel form and serves as an important filter for light, nutrients and sediments. It regulates river flows, improves water quality, provides habitats for fauna and corridors for their movements, controls river temperature and maintains bank stability. Changes in the structure and function of riparian vegetation commonly result from changes in the flow regime of a river, exploitation for firewood, or use of the riparian zone for grazing or ploughing. The results are expressed as a percentage deviation from natural or unmodified riparian conditions. Riparian vegetation is a vital component of an aquatic ecosystem. Points to note include species composition, structure and extent of cover, presence of juvenile indigenous riparian species, cover of invasive alien vegetation and human disturbances such as vegetation removal, sand mining and construction.

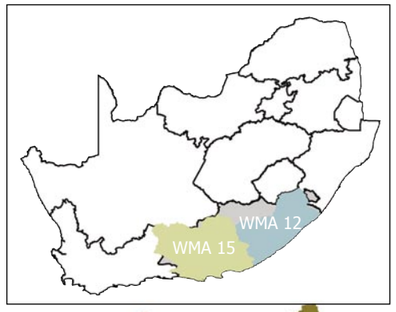
Since the RHP's Riparian Vegetation Index (RVI) was being reviewed and revised when this study commenced, a modified version of the RVI, the Integrated Riparian Vegetation Index (IRVI), was used in the riparian vegetation assessment. The newly developed Riparian Vegetation Response Assessment Index (VEGRAI) which was designed as part of the suite of models used to assess ecological status will be used in future SoR studies.

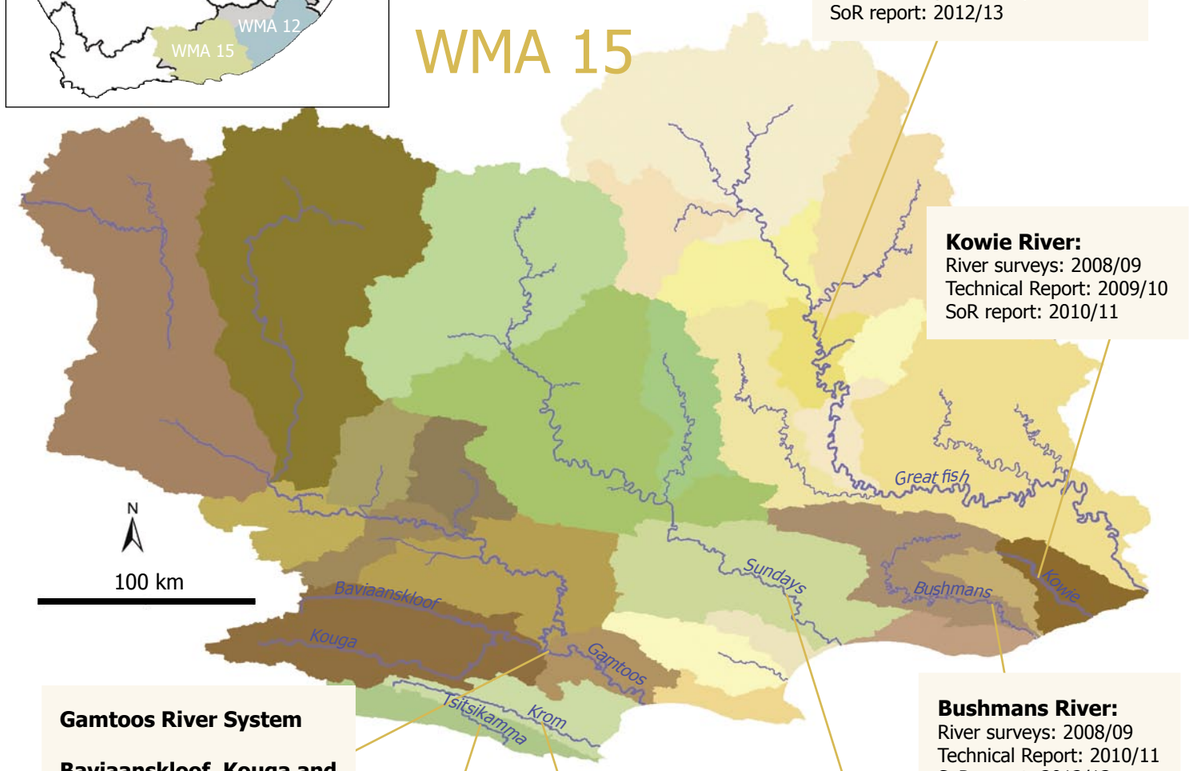
Eastern Cape River Health Programme

The Eastern Cape covers two Water Management Areas (WMAs); WMA 12 (the Mzimvubu to Keiskamma) and WMA 15 (the Great Fish to Tsitsikamma).

The Mthatha River is the second main river system to be monitored under the Eastern Cape RHP. The Mthatha River catchment is situated in the Mzimvubu to Keiskamma Water Management Area in the former Transkei region of the Eastern Cape, between the Mbashe and Mzimvubu River catchments.

The maps below show the rivers within WMAs 15 and 12. The boxes indicate the monitoring and reporting planning for each river.





Great Fish River System
River surveys: 2008/09/10
Technical Report: 2011/12
SoR report: 2012/13

Kowie River:
River surveys: 2008/09
Technical Report: 2009/10
SoR report: 2010/11

Bushmans River:
River surveys: 2008/09
Technical Report: 2010/11
SoR report: 2012/13

Sundays River System
River surveys: 2008/09/10
Reporting: Following on completion of four seasonal surveys

Gamtoos River System

Baviaanskloof, Kouga and Gamtoos rivers
River surveys planned: 2007/08
Technical Report: 2009/10
SoR report: 2010/11

Krom River:
River surveys: 2008/09
Technical Report: 2010/11
SoR report: 2011/12

Tsitsikamma rivers #
River surveys: ongoing
Technical Report: 2009/10

Macro-invertebrate and water quality sampling on the Bloukrans, Elandsbos, Lottering, Grootrivier(East), Elands and Storms rivers.

The River Health Programme in the Eastern Cape

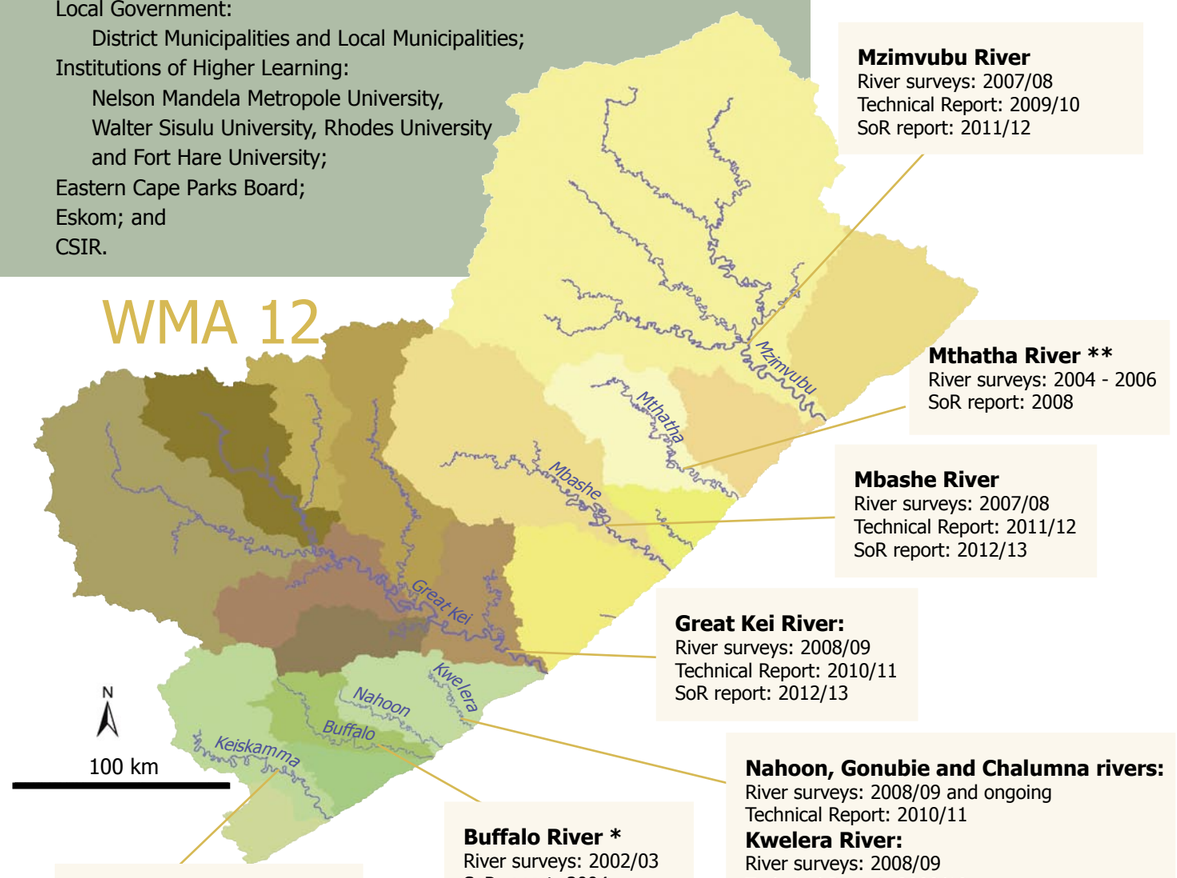
In the Eastern Cape, a number of organisations have been instrumental in the implementation and funding of the RHP in the province. Building on the pioneering work of individuals and organisations that established the RHP in the region, the Department of Water Affairs and Forestry is now leading the programme in the Eastern Cape. Partnerships between government departments, municipalities, water boards, centres of learning, research organizations and local communities ensure a sustainable foundation for the River Health Programme through participation, capacity building, knowledge sharing and knowledge transfer.

Partnerships already in place are:
Government Departments:
- Department of Water Affairs and Forestry and the Department of Education;
- DEDEA – Biodiversity and Marine and
- Coastal Management Directorate;

Local Government:
- District Municipalities and Local Municipalities;

Institutions of Higher Learning:
- Nelson Mandela Metropole University,
- Walter Sisulu University, Rhodes University
- and Fort Hare University;

Eastern Cape Parks Board;
Eskom; and
CSIR.



Mzimvubu River
River surveys: 2007/08
Technical Report: 2009/10
SoR report: 2011/12

Mthatha River **
River surveys: 2004 - 2006
SoR report: 2008

Mbashe River
River surveys: 2007/08
Technical Report: 2011/12
SoR report: 2012/13

Great Kei River:
River surveys: 2008/09
Technical Report: 2010/11
SoR report: 2012/13

Nahoon, Gonubie and Chalumna rivers:
River surveys: 2008/09 and ongoing
Technical Report: 2010/11

Kwelera River:
River surveys: 2008/09
Technical Report: 2009/10

Buffalo River *
River surveys: 2002/03
SoR report: 2004

Keiskamma River
River surveys planned: 2008/09
Technical Report: 2009/10
SoR report: 2010/11

***** The 2004 publication of the Buffalo River System State-of-Rivers report was a first for Eastern Cape.

****** This report, the State-of-Rivers Report: Mthatha River System 2007, is the second in a series of reports and other products that will cover all of the major river systems in the Eastern Cape.

Overview of the Mthatha River catchment

Physical Characteristics and Ecoregions

Terrain

The Mthatha River catchment is roughly 100 km long and 50 km wide and covers an area of just over 5 520 km^2. At an altitude of just over 1 400 metres a steep escarpment in the Drakensberg Mountains forms the north and north-western border of the catchment. From here, the 250 km long Mthatha River with its two large tributaries winds its way to the sea north of Coffee Bay. In the vicinity of Mthatha town, the river flows through a wide plain with a flat gradient. Here the Cicira River joins the Mthatha River between Mthatha Dam and Mthatha town from the west. The topography of the catchment is generally undulating, becoming more hilly and broken towards the coast. The coastal area has a moderate to high relief with the Mthatha River flowing through a deep, meandering gorge. The Ngqungqu River drains the lower western part of the catchment.

Major water storage reservoirs in the Mthatha catchment are the Mthatha Dam on the Mthatha River and Corana Dam upstream of the Mthatha Dam on the Corana tributary of the Mthatha River. The Mthatha Dam has a catchment area of 886 km^2 and can store up to 254 million m^3 of water, while yielding about 14,5 million m^3 of water a year. Mthatha Dam supplies Mthatha town and the surrounding areas with domestic water and acts as balancing water storage, supplying the small dams at First and Second Falls downstream of Mthatha town.

Climate

The climate of the Mthatha catchment is warm to temperate, with rainfall occurring mostly in the summer in the form of heavy thunderstorms. Average rainfall varies according to altitude and topography, ranging from 1 000 to 1 300 mm per annum along the coast, to 700 mm per annum in the interior and up to 1 500 mm per annum along the escarpment. The Mbashe to Msimvubu area in which the Mthatha catchment falls has one of the highest mean annual runoffs in the country and the mean annual runoff of the Mthatha River catchment is approximately 382 million m^3. The area is occasionally affected by tornadoes, a rarity in southern Africa. The temperature is mild along the coastal areas, with a mean annual temperature of 21 °C (ranging from 3 °C to above 30 °C), and a slightly wider range inland with a mean annual temperature of 16 °C (ranging from 3 °C to above 40 °C). Light snowfalls may occur in winter in the Baziya Mountains, melting within a day or two.

Geology and soils

The geology of the catchment comprises sandstones and brownish-red and grey mudstones of the Beaufort Group from the headwaters of the Mthatha River to approximately 30 km from the coast. From this point to the estuary it becomes dark grey shales, mudstones and sandstones of the Ecca Group. Exposures of Karoo dolerite intrusions are found throughout, but mostly in the higher lying areas of the catchment. There are also scattered deposits of alluvium along the river banks in some valleys. In the upper region of the catchment, the soils are mainly shallow, rocky and leached. Towards the coast the soils are more deeply leached, sandy and clay loams with organically rich dark topsoil. The erodibility of the soils is fairly high. Salts leached from the soil by penetrating rain influence the mineral content of the Mthatha River.

Vegetation

The Mthatha River runs through three biomes (grassland, savanna and thicket) and two level 1 ecoregions. Falling within the Eastern Uplands Ecoregion, vegetation, the upper catchment is mainly grassland, dominated by Moist Upland Grassland. Other vegetation types are the Valley Thicket and patches of Afromontane Forest. The lower catchment vegetation within the Eastern Coastal Belt Ecoregion is mainly Coastal Forest, Valley Thicket, Thorn Bushveld and Coastal Grassland. Coastal and riparian forests cover about 10% of the catchment. Alien vegetation associated with forestry plantations can be found in the upper regions of the Mthatha catchment while indigenous vegetation in the form of coastal and riparian forest occurs in the central and coastal regions of the catchment.

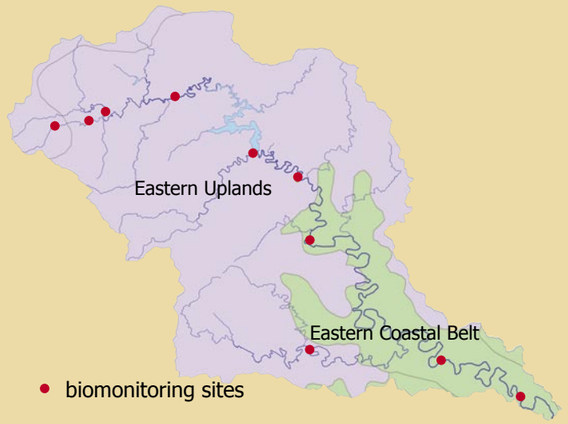
Ecoregions

Ecoregions are areas of broad ecological similarity. Level 1 ecoregions are areas with similar geology, natural vegetation, rainfall, terrain morphology, and climate, while subdivision into level 2 ecoregions requires local specialist knowledge.

The following procedures guided site selection for the biomonitoring of the Mthatha River:

1. Ecoregion Level 2 delineation of the catchment produced by RQS, DWAF;
2. Aerial video of the catchment and major tributaries flown in March 2004 by Dr Anton Bok and Dr Neels Kleynhans;
3. Planning workshop and desktop river health site selection workshop in February 2005.

The biomonitoring sites were selected on the basis of ecoregion and therefore ecological homogeneity, as well as usefulness to resource managers.

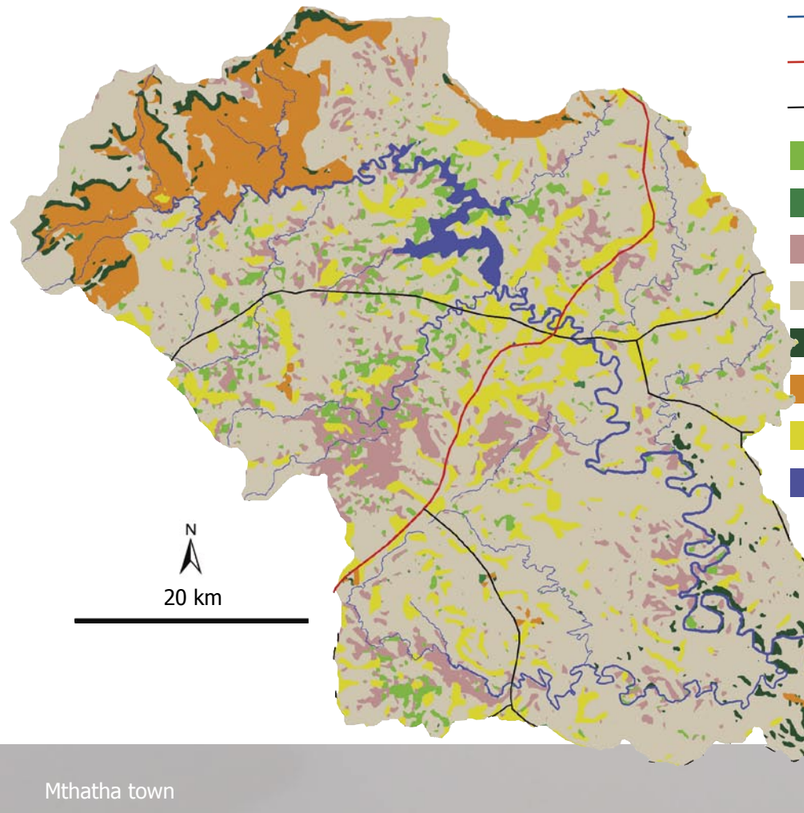


View of forestry and timber related activities in the upper Mthatha catchment

Land cover and land-use

Forestry and subsistence farming are the main land uses in the catchment. A few natural areas exist, mainly around the steep valleys towards the coast. Veld and grazing for subsistence farming with cattle, goats and sheep occupy approximately 70 % of the catchment, with 15 % used for subsistence agriculture (vegetable and grain crops). Approximately 4 % of the Mthatha catchment is covered with commercial forest plantations, mostly in the headwater regions.

Commercial water use is dominated by the forestry-related industries (Langeni and KwaBhaca sawmills), followed by the industrial, urban and rural sectors. The agriculture sector is poorly developed. Small-scale irrigation, particularly in the middle and lower reaches of the catchment, is mainly for subsistence agriculture and uses water pumped directly from the rivers using pumps.



River
National road
Main road
Dryland subsistence cultivation
Irrigated commercial cultivation
Degraded land
Natural vegetation
Forests
Indigenous plantations
Urban and built-up land
Dams

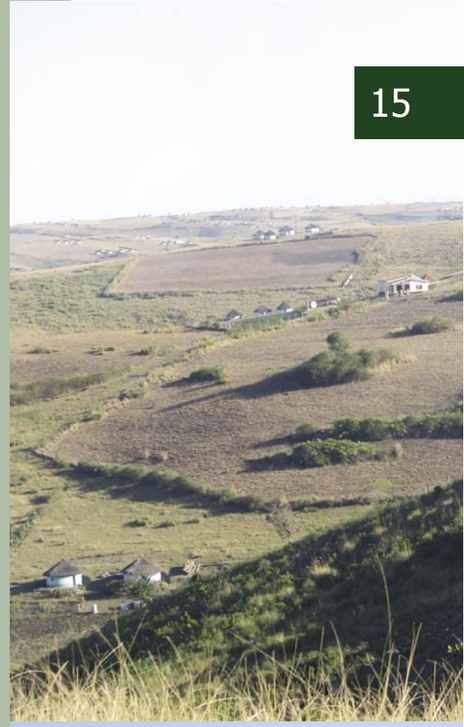
Mthatha town

Hydroelectricity generation in the Mthatha River

Hydroelectric power stations are situated at First and Second Falls* on the Mthatha River downstream of Mthatha town near the small village of Kwa Ntsaka. At First Falls, a small balancing dam fed by the Mthatha Dam supplies water to the turbines to supplement electricity supply during peak periods. The plant produces up to 6 megawatts of electricity during peak periods on weekdays and the turbines generally do not operate on weekends. Electricity generation consumes about 170 million m^3 of water from the Mthatha River every year.

While hydroelectricity is one of the cleanest and cheapest energy sources, it alters hydrological patterns and disrupts the river habitat downstream. The force of the water exiting the turbines leads to scouring of river beds and loss of riverbanks. Changes in water temperature and dissolved oxygen can negatively influence aquatic faunal populations. The unnatural patterns and volumes of water affect the ecological functioning of the river all the way down to the estuary at the Mthatha River mouth, by causing freshwater inflows that are too regular and with sharp variations from low to high and back again.

* http://www.eskom.co.za/about/Annual%20Report%202003/Holdings/htm/2363%20Final-0138.htm




Ngqungqu River catchment

Gully (donga) erosion in the Mthatha catchment

Gully erosion, which occurs throughout South Africa, is particularly visible in the areas of Mjika, Kambi and Nxcise in the Mthatha district. As gullies usually develop on relatively flat land in valley bottoms and low-angled foot slopes that have high agricultural value, it is important to understand how gullying occurs and what the environmental impacts of gullying are.

What are gullies?
A gully is a landform created when running water removes soil from the land surface. Gullies are ditches that can be metres deep and cover tens of metres in surface area. Common processes for gully formation are when surface flow becomes concentrated into furrows called rills, or when surface flow infiltrates into the soil profile causing cavities or soil pipes underground. Surface flow develops when the soil surface is bare of vegetation cover which may be caused by overgrazing, poor land management and changes in land use. Vegetation helps to prevent erosion by reducing rain drop impact, promoting infiltration of water deeper into the soil profile and providing organic material. Plant roots provide stability by binding soil particles together. Gullying that occurs even though there is no concentrated surface flow is due to a combination of geology, soil and climatic conditions.

Gully erosion caused by concentrated surface flow and by soil piping can be seen in the Mthatha district. Soils in the area are acidic and contain dispersive clays which cause the soil to crack after wetting and drying. These cracks provide preferential zones of infiltration for water during rainfall events. Water is able to percolate through the profile and remove material which causes vertical cracks to widen which ultimately leads to collapse and gully extension. Some soils contain high concentrations of iron oxides which harden under water-logged conditions or when exposed at the surface of the profile and these can be seen as rough 'popcorn'-like structures on the sidewalls of the gullies. The iron oxide acts like cement and makes the sidewalls less vulnerable to erosion. With time, the angle of the gully sidewalls flattens out and vegetation becomes established, which stabilises the gully and stops further widening.

Gully size is determined by the availability of readily erodible material and with time, gully length tends to remain constant whereas the number of gullies within an area will increase. Gully growth is non-linear and characterised by periods of rapid growth interspersed with periods of slower development or revegetation and stabilization.

Are they bad for the environment?
Scientists have shown that the rate of soil loss in South Africa exceeds the rate at which soil forms and they often interpret gullying as a major source of sediment loss. Other scientists argue that overland flow results in more soil loss than that which occurs in exposed gully systems because gullying is a natural process that mobilises previous accumulations of sediment. There is strong evidence that an increase in the number of gullies in an area is closely related to periods when droughts are followed by intense flooding. For example, gully extension occurred in some parts of the Eastern Cape and Kwa-Zulu Natal after a major drought in the 1960s, followed by heavy rainfalls and intense flooding in the 1970s.

There is also evidence that the forced removal and confinement of black South Africans to the former homeland areas during the same period also influenced gully development. Population densities increased and land use shifted from cultivation to subsistence farming and grazing. The reasons for this shift are not well established but historians attribute it to a combination of increased migrant labour, drought conditions, a reduced ability to irrigate crops and a reduction in the numbers of draught animals. Abandoned cultivated fields are more likely to experience erosion from surface runoff especially where a combination of drought conditions and vulnerable soils exist.

Gully extension can be stopped by building dam walls or gabion-type structures, which trap sediments within the gully system upstream of the structure. However, this technique is not successful where the soils are erodible or soil piping occurs. It is also possible that the construction of dam walls within a gully can lead to scouring downstream of the structure. This would create a steeper slope and hydraulic gradient and lead to gully incision further downstream.

Examples of erosion gullies in the Kambi area

Social and economic profile of the Mthatha catchment

Mthatha Town is the major urban area in the catchment. The small town of Mqanduli lies on the western border of the catchment near the origin of the Ngqungqu tributary. Rural settlements along riverbanks are common. Corana Dam provides water to a large population east of Mthatha and the Mthatha Dam supplies the Mthatha Municipality Water Supply Scheme and hydroelectricity plant.

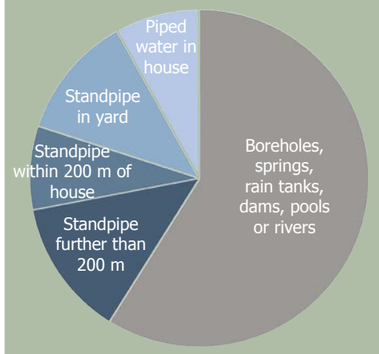
Households in Mthatha Town and the surrounding suburbs have access to potable drinking water and some rural villages have stand pipes. Almost 60 %* of the rural communities have no access to potable drinking water and still depend on untreated river water for their basic domestic needs.

A similar pattern is observed for sanitation (ablution facilities). Households in Mthatha Town and its immediate surrounding suburbs have access to running-water/ flushing toilet systems or flushing toilets with septic tanks, while almost 50 %* of households in the catchment have no toilet facilities.

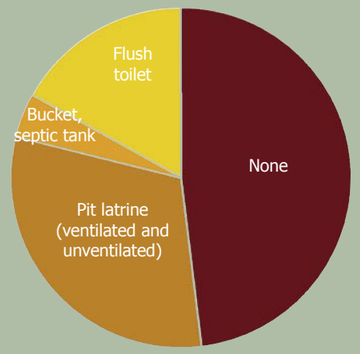
The Mthatha Sewage Treatment Works is long overdue for upgrade and is unable to process all of the town's large amount of raw sewage. The plant is old and the carrying capacity was designed for a small town. Other sewage pump stations cannot cope and some have been completely decommissioned which leads to raw sewage being pumped directly into the Mthatha River.

Deteriorating water quality in the middle and lower reaches of the Mthatha River poses potential health risks to the communities living there. Due to population growth and poor infrastructure, the supply of potable water to all households is a problem.

Type of water supply (proportion of population)*



Type of sanitation (proportion of population)*



* The Mthatha River catchment is shared by the Mhlontlo Municipality (2 704 km^2), King Sabata Dalindyebo Municipality (3 019 km^2) and the Nyandeni Municipality (2 606 km^2). The proportions of the Mthatha catchment covered by each municipality were calculated to determine the relative percentages of the population and households that have access to water and sanitation, as well as their levels of education and employment, as no catchment specific datasets exist. All data was supplied by StatsSA based on the 2000 census at a municipal level. Approximately 16 % of the Mthatha catchment occurs within the Mhlontlo Municipality, 60 % is in the King Sabata Dalindyebo Municipality and 21 % is in the Nyandeni municipality. Mthatha Town is located on the eastern border of the King Sabata Dalindyebo Municipality, and since this municipality contributes to a large proportion of the catchment area, the statistics may be skewed in favour of this dataset. According to the 2007 General Household Survey, the Eastern Cape has the lowest percentage of the population with access to on-site or off-site piped or tap water (72.8 %).

Although the area is heavily populated, it has a low level of economic development. The exception is Mthatha town where the government, commerce and educational institutions provide employment. Mthatha airport is situated to the north west of Mthatha town, close to Mthatha Dam. The Walter Sisulu University, previously known as the University of Transkei, is situated in Mthatha. The Hole in the Wall, Coffee Bay and Mthatha Mouth are some of the well-known holiday resorts along the coast. Subsistence farming occurs throughout the catchment.

Informal settlements naturally cluster near employment opportunities, such as the road works to Ugie, the timber mills and Mthatha town.

Employment sector	Percentage of population
Mining and quarrying	0.2 %
Electricity, gas and water supply	0.1 %
Community, social and personal services	6.3 %
Manufacturing	0.4 %
Trade	2.1 %
Private households	2.7 %
Financial, insurance, real estate and business services	1.1 %
Construction	0.8 %
Transport and communication	0.6 %
Agriculture, forestry and fishing	0.4 %
Other and undefined	2.3 %
Not employed in formal sector **	83.0 %

Level of Education	Percentage of population
Tertiary	6.8 %
Grade 6 to 12	12.5 %
Grade 1 to 5	5.5 %
Some education (primary/secondary)	42.5 %
None	32.7 %

** This is not explicity stated in the StatsSA data, however it is significant that over 80% of the population did not provide a job description.

Mthatha River Headwaters

This study unit represents the upper catchment area and includes the Mthatha River headwaters as well as the Qelana tributary. The natural vegetation of this area is grassland with patches of Afromontane forests. The uppermost regions of the headwaters are still in a natural state as they are relatively inaccessible to humans and cattle. Pockets of indigenous natural forest are still present on the steeper slopes. Forest plantations comprising mainly alien pine species predominate. In some areas commercial plantations occur on one side of the river and communal grazing lands on the other. Large dongas (gullies) scar the grasslands.

Four biomonitoring sites represent the headwaters. Site 1, immediately downstream of the confluence of two mountain streams, is the reference site for the South Eastern Upland ecoregion. Typical of mountain headwater streams, steps, rapids, runs and shallow pools occur. The river banks are not well defined and the adjacent slopes are unstable and sparsely vegetated. Iindigenous vegetation, with a forest canopy of about 18 meters high, grows on the 'island' between the two streams. Sites 2 and 3 lie in the upper foothills. Site 2 which is downstream of confluence between the Mthatha and Qelana rivers is characterised by cobbles, gravel and sand with riffles, rapids and shallow pools alternating with flat sand bed sections with deep pools. Cobbles dominate the river channel at Site 3, but bedrock and gravel and sand sections also occur. Site 4 lies within the lowland river zone and the river channel is characterised by rapids, riffles, runs and shallow and deep pools.

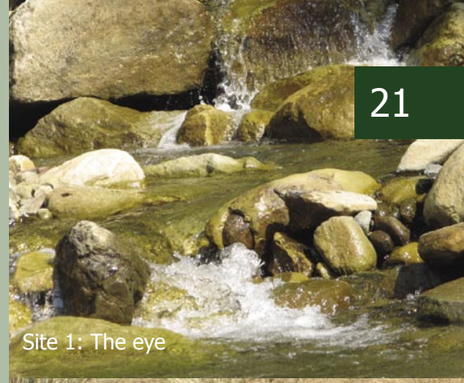
Despite apparently ideal fish habitat, no fish were sampled at Site 1. At sites 2 and 3, with ideal cover and flow rates, only the alien predaceous smallmouth bass and rainbow trout were present.

Shrubs, vines and forbs (herbaceous flowering plants) in this area include the wild pomegranate, wild iris, grape ivy and Plectranthus species. Lianas grow on the forest trees. Indigenous tree species include the Cape ash (*Ekebergia capensis*), forest elder (*Nuxia Floribunda*) and pompon tree (*Dias cotonifolia*). Those on the National list of protected trees are the yellowwood (*Podocarpus*) and Cape lancewood (*Curtisia*). Other protected plants that occur here are lily (*Scadoxus*) and several terrestrial orchid species. Further downstream towards Kambi, buffalo thorn (*Ziziphus mucronata*) and bladdernut (*Diospyros*) trees are also found.

Indigenous Forests

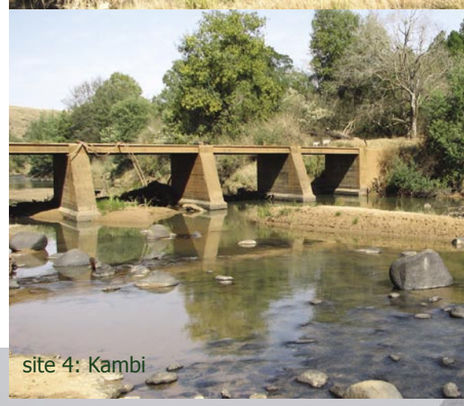
Forty afromontane forest areas, totalling 23 630 ha, are scattered along the Matiwane range to the west of Mthatha. They are home to a variety of fauna including mammals such as bushbuck, red and blue duiker, vervet and Samango monkeys, and lynx. Bird species include raptors and the endangered Cape parrot (*Poicephalus robustus robustus*). Important indigenous timber species include the Outeniqua yellowwoods (*Podocarpus spp.*) and stinkwood (*Ocotea bullata*). In the past, yellowwood timber was much valued for use as railway sleepers, flooring and the manufacture of household furniture. Stinkwood remains the most prized indigenous species for making furniture.

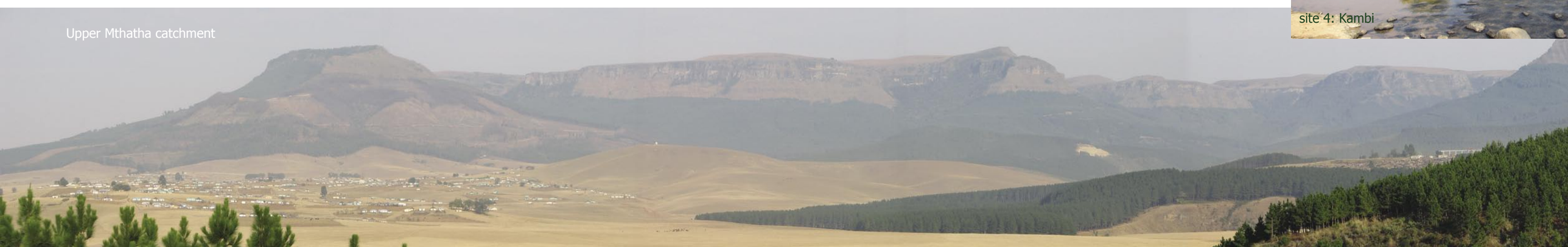
Currently the indigenous forests are under complete protection and no timber harvesting or hunting is allowed. People from local communities do however have access to the forests for collecting wild spinach, also called imifino in isiXhosa, marog, and herbaceous medicinal plants such as *Mentha longifolia, Lycopodium clavatum* and *Cotula nigellifolia*. Debarking of trees (used for traditional medicine) such as the stinkwood is not permitted. Non-consumptive uses are allowed as when diviners go into seclusion in the forest as part of their training.


Site 1: The eye


Site 2: downstream of Qelana and Mthatha River confluence


Site 3: Lower Langeni


site 4: Kambi


Upper Mthatha catchment

Mthatha River Headwaters (continued)

Commercial forestry has a large adverse impact on the upper catchment. Alien tree species encroach on the riparian zone. Reduced natural vegetation combined with high river flow events have destabilised the river banks. Activities related to forestry practices have changed the river habitat. Decline in river flows is caused by the increased demand of water by the surrounding pine plantations. Further downstream the natural sourveld grassland is now partially replaced by commercial pine plantations. Invasive alien plants, apart from those commercially forested, include the black and silver wattle, and lantana.

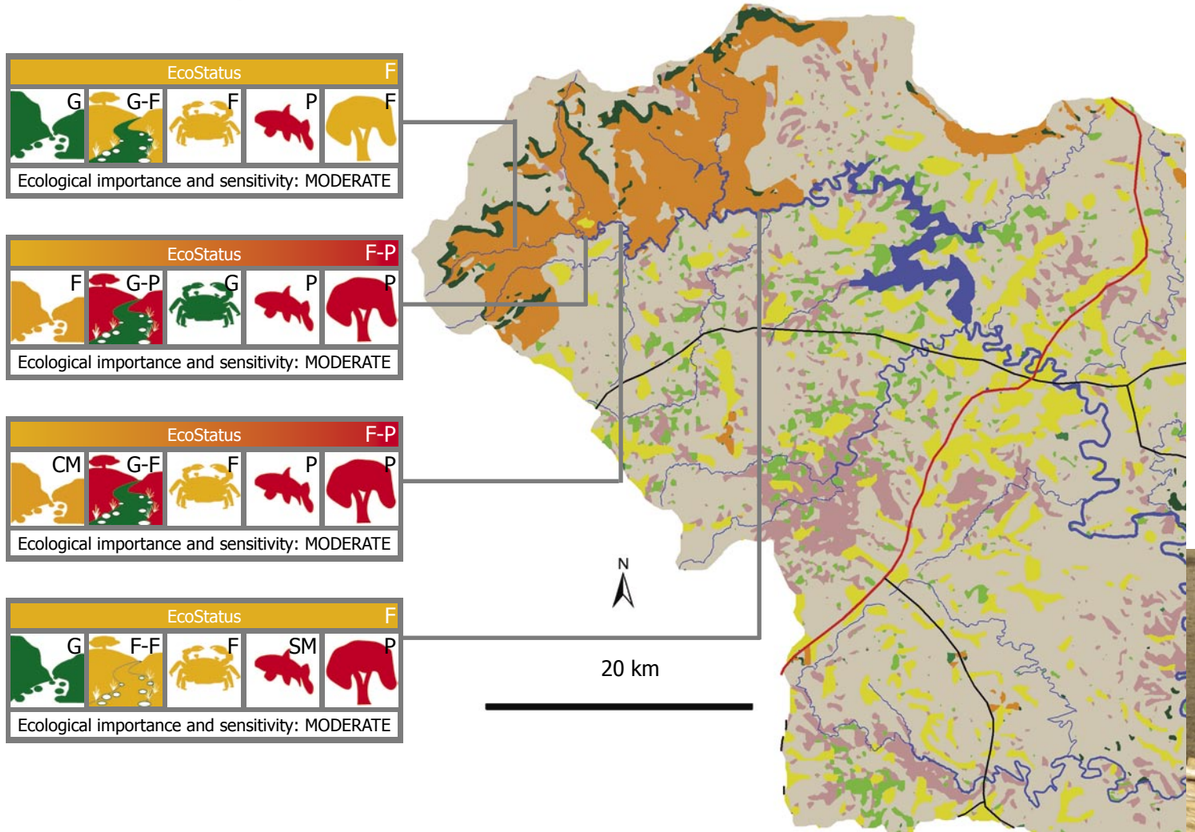
Throughout this area the removal of natural vegetation from the riparian zone is extensive, leading to river bank destabilization and ultimately an unnatural widening of the river. Sand mining in both the river bed and flood zones is evident.

Timber factories (a saw mill and a chipboard factory) draw water from the Qelana tributary for industrial purposes. Any spills from these operations will inevitably flow into the river.

The factory workers live in informal settlements close to the factories and have access to treated Qelana River water for household use. Another informal settlement has developed for people working on the road that will eventually link Ugie with Mthatha and Queenstown. Both the building operations and the people living in the settlement rely on the Qelane River for their water supply. Other recent human impacts in this area include the artificial widening and damming of the river and water abstraction for dust suppression during road construction activities. Longer term impacts are mainly associated with cattle grazing.

Widespread soil erosion in the area closer to the Mthatha Dam results from a combination of natural processes and human factors. Gabions are used to stabilise the soil and to prevent further erosion.

An indigenous fish species that previously occurred in these headwaters, the chubbyhead barb (*Barbus anoplus*), is no longer observed, possibly a victim of predation by alien fish.



Plantations

The plantations in the Matiwane range cover some 80 000 hectares and produce large volumes of timber products every year. Most is used as pine sawlogs, but also includes pine veneer, pine pulp and gum poles. Various pine species are planted in the area, such as *Pinus eliottii, P. patula and P. taeda*. Old plantations of *P. roxbughii* still remain, but are not har-vested for commercial purposes. Gum trees (*Eucalyptus spp.*) are also planted for poles. Mushrooms (*Boletus edulis*) are cultivated in the plantations for the export market.

With 700 full-time employees, the plantations are an important source of employment in the area, where underdevelopment and unemployment are serious problems. Although the plantations are of economic importance, they also have important environmental implications. As the original grasslands were replaced with plantations, far more water is used throughout the year, possibly up to 400 mm per annum or more. For this reason, there is by law a 20 m buffer zone between the riparian vegetation and the plantations.

Impacts on the water resources in the area are:

- Effluent discharges of unacceptable quality cause in-stream water quality to deteriorate.
- An illegal solid waste disposal site where leachate from sawdust dumps enters the river and contributes to the deteriorating in-stream water quality.
- Streamflow reduction where alien plantations alter in-stream habitat.
- Forestry and other alien vegetation encroaching on the riparian zone destabilise river banks causing increased erosion and deposition of sediments that subsequently destroy in-stream habitat.
- Alien fish species may have reduced chubbyhead barb (*Barbus anoplus*) populations in the headwaters.
- Runoff from informal settlements with inadequate water services and sanitation contribute to the poor water quality.

Recommendations for the area are:

- DWAF and local authorities must monitor sewage treatment works and where necessary upgrade them as a matter of urgency.
- DWAF and local authorities need to locate sources of contamination, improve monitoring and take action against those who discharge effluent of unacceptable quality or who are responsible for illegal dumping of waste.
- Local authorities must ensure that alien plantations do not encroach on the riparian zone and must arrange for the removal of invasive alien vegetation where necessary.
- DWAF and local authorities must monitor and manage runoff from towns and informal settlements.
- Local authorities must ensure that proper rehabilitation of the temporary diversion on the Qelane River takes place once the road works have been completed.

Mthatha River upstream of Mthatha town and the Cicira tributary

This study area includes the river reach upstream of Mthatha Town and the Cicira tributary. The Cicira River is represented by one biomonitoring site close to the confluence with the Mthatha River. Video footage was used to assess the river reach between Mthatha Dam and the town.

The Mthatha River in this area consists of a single channel with some vegetated islands, and pools, riffles and runs. Vegetation in the riparian zone of the Mthatha River upstream of Mthatha town is dense, with the woody species reaching heights of up to 8 metres. The indigenous vegetation is interspersed with wattle and eucalyptus species as well as bugweed. The dense vegetation cover ensures stable river banks, despite the high flow releases from Mthatha Dam. Although reed invasion of the river channel is limited, water hyacinth covers large areas of the entire width of the river.

The Cicira River flows through degraded land and grassland and the peri-urban areas of Mthatha town. The river bed material is mainly gravel, with riffles, runs and shallow and deep pools. Steep grassy slopes rise from the fairly narrow and straight river channel. Most of the woody vegetation is over utilized and almost completely absent. After the summer rains, thick grass covers the river banks.

Three perennial springs in the Ncise area, close to the Mtatha Dam provide the local community with water for domestic purposes. Agricultural activities that depend on irrigation are almost non-existent. The land in the immediate vicinity of Mthatha Dam is not cultivated

Instead, agricultural activities are focussed on livestock, such as cattle and sheep, as well as dryland crops such as maize and vegetable gardens close to the houses.

Predatory alien fish, namely smallmouth bass and rainbow trout, occur in this part of the catchment. No indigenous fish species were recorded.

Some of the remaining indigenous trees along the Cicira tributary are the river bushwillow (*Combretum erythrophyllum*) and common hook thorn (*Acacia caffra*).

Water Quality

Water quality refers to microbiological, physical and chemical properties of water that determine its fitness for use. The microbiological quality concerns the presence of organisms such as protozoa, bacteria and viruses that carry the risk of infectious diseases. Physical quality refers to water properties determined by physical measurements such as electrical conductivity (EC), pH, and turbidity. Chemical water quality concerns the nature and concentration of dissolved substances such as salts, metals, and organic chemicals.

Natural water resources that support aquatic life can be significantly degraded by poor sanitation and agricultural runoff. A rapid increase in population density also generates excessive amounts of human waste which reaches surface waters, causing immediate contamination of natural water resources and long-term deterioration of the aquatic environment. Natural water resources are threatened by almost all modern interactions of man with nature.

Water quality results along the Mthatha River show expected trends from upstream to downstream. The concentrations of most parameters downstream are higher than at midstream or upstream. Some seasonal variation is also evident. The concentrations of most parameters (e.g. coliforms, nitrates, conductivity and turbidity) are higher in the summer months than in winter months, because increased washoff from the settlements during summer rains overrides any dilution effect.

Faecal and total coliform bacteria, turbidity, and nutrients are the major problems in the Mthatha River. This means that the water is not fit for domestic use and may pose a serious health risk to communities along the riverbanks who rely on it for primary domestic use.

Different water quality requirements apply to domestic water, recreational water and water to support aquatic life. The Department of Water Affairs and Forestry stipulates the water quality requirements for these different water uses in the 'Water Quality Guide' (http://www.dwaf.gov.za/iwqs/report.htm#Laws%20and%20Guidelines).

Cicira River

Mthatha Dam

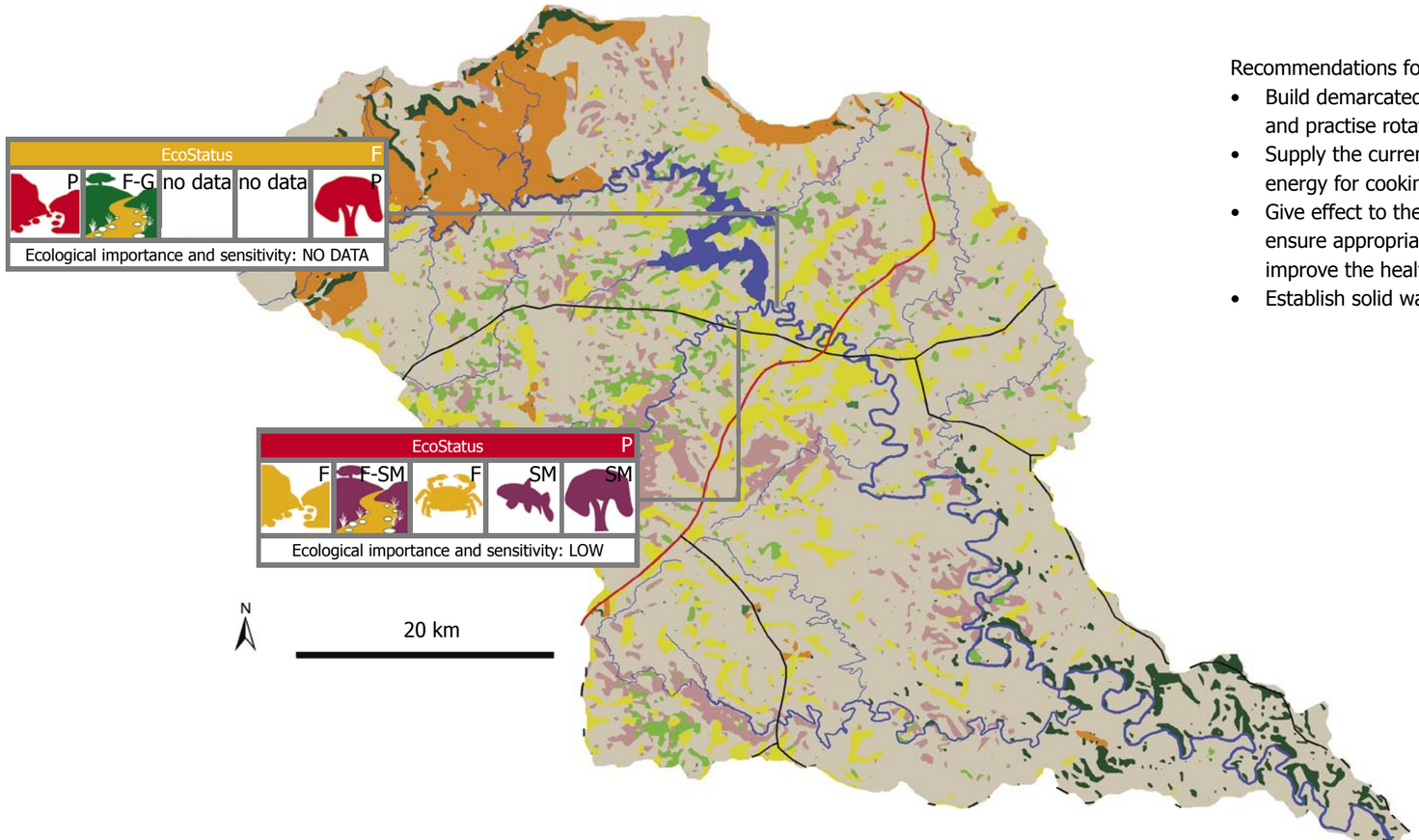
Mthatha River upstream of Mthatha town and the Cicira tributary (continued)

Grazing, water abstraction, vegetation clearing and sand mining have altered the river channel. The Mthatha Dam has also changed the natural river flow. The fairly high erodibility of the soils together with reduced river flows adds to the sediment load in the river. Construction of Mthatha Dam inevitably destroyed the vegetation in what is now the impoundment area. Indigenous trees lost include the river bushwillow (*Combretum erythrophyllum* or uMdubi) and common hook thorn (*Acacia caffra).* The common hook thorn is also known as the cat thorn and uMnyamanzi.

The water quality upstream of the Mthatha Dam is relatively good but it becomes turbid in and downstream of the dam.

The ecological functioning of the Cicira River is severely impaired. The river is highly polluted and inundated with litter and solid waste such as scrap metal, tyres and human waste. Algal growth on the rocks is extensive. Mainly alien vegetation now grows in the riparian zone. Such sparse woody vegetation that remains on the river banks is removed for firewood. The lack of vegetation and the overuse of the river by the community and cattle have combined to cause extensive slumping of both banks.

Three alien fish species were sampled, the banded tilapia, the Mozambique tilapia and the sharptooth catfish.



Mthatha Dam

Mthatha Dam is an earthfill embankment dam on the Mthatha River approximately 6 km north-west of Mthatha town. Its main functions are to supply water to the city of Mthatha and associated peri-urban areas, and to regulate the flow of the Mthatha River for power generation at the two hydro-electric plants situated further downstream at First and Second Falls. The construction of the dam was completed in 1977 and its full supply capacity is 254 million m^3.

Proposals to develop Mthatha Dam are being reviewed by the Department of Water Affairs and Forestry. Suggestions for recreational development include watersports such as boating and canoeing, hiking trails, braai areas, chalets, a hotel, and shops. Since the dam has not been zoned, an encumbrance survey is planned for the near future. A Resource Management Plan will only be done after the encumbrance survey has been completed, and only then will development be considered.

Impacts on the water resources in the area are:

- Agricultural activities and livestock grazing in the riparian zone destroy riparian vegetation, which ultimately results in increased erosion and in-stream sediment deposits and eventual in-stream habitat loss.
- Removal of trees for firewood.
- Runoff from informal settlements with insufficient water services and sanitation contributes to poor water quality.

Recommendations for the area are:

- Build demarcated grazing camps that limit stock size per camp and practise rotational grazing.
- Supply the current users of firewood with alternative forms of energy for cooking and heating.
- Give effect to the requirements of the ecological Reserve and ensure appropriate operating rules for dam water releases to improve the health of the downstream river.
- Establish solid waste disposal infrastructure in the informal areas.

Illegal dumping near Cicira River

Mthatha Town

The town of Mthatha (previously spelt Umtata), is situated along the Mthatha River and was founded in 1879. There are two different explanations for the origin of the name "Mthatha". The first is that it is named after the Sneezewood (Thathe) trees which flourish on the Mthatha River banks and a second explanation is that the name "Mthatha" is attributed to the treacherous nature of the river when it is in flood. The isiXhosa word "thatha", meaning "taker", may therefore have been given as name for the river. The sneezewood tree is known for its wood and medicinal properties.

The Mthatha River downstream of Mthatha town with an altitude of about 650 metres is classified as a lowland river. This reach of the river is characterised by a fairly wide but shallow channel, with boulders, rapids and long stretches of deep pool. A road to an informal settlement runs along the right hand bank confining the riparian vegetation to a narrow strip about 2 to 4 meters wide. From the road the river bank rises almost vertically up a partial cliff slope.

Water quality is poor with very few refuge areas for fish. Two alien fish species were present, the banded tilapia and the sharptooth catfish. Downstream of Mthatha Town, the poor macro-invertebrate assemblages are associated with poor water quality and the presence of fine silty sediments. This confirms the sensitivities of macro-invertebrates to water quality conditions. These sensitivities are reflected in the ASPT and SASS scores but not so much in the MIRAI. The latter focuses more on physical habitat and flow modifications.

Invasive alien species such as lantana (*Lantana camara*), bugweed (*Solanum mauritianum*) and castor-oil plant (*Ricinus communis*) are abundant. Indigenous trees growing to about 5 metres high include the buffalo thorn (*Ziziphus mucronata*), the common hook thorn (*Acacia caffra*) and the river bushwillow (*Combretum erythrophyllum*).

Educational opportunities provided by your local river or stream

The river is an ideal outdoor classroom where teachers can demonstrate many fundamental ecological principles in and of aquatic systems such as the Mthatha River. Knowledge of the distribution of the riverine fauna and flora is scant and patchy, so the river has a scientific value in that it offers an opportunity to university researchers and students to gain an understanding of biota, water chemistry and other aspects of water quality. In urban areas, the river may provide a sad example of environmental degradation. For better management and sustainable utilization of water as a resource, communities need to learn about the present state of a river and understand the potential for improvement embodied in the concept of a desired ecological state; they need to know what biological indicators are and the potential for contamination of rivers by indirect faecal and detergent pollution through nearby groundwater sources.

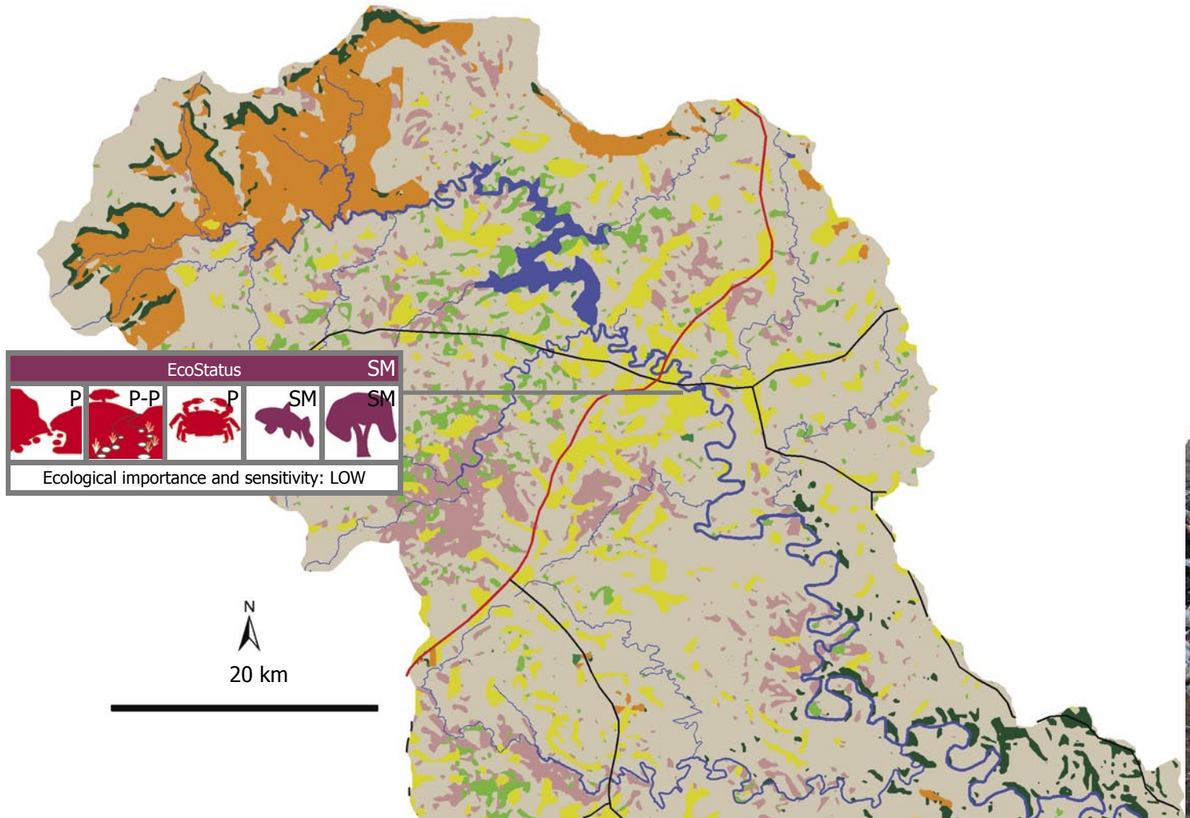
Mthatha town

Mthatha Town (continued)

Water quality downstream of Mthatha town is poor due to the discharge of untreated or inadequately treated sewage. The problem is compounded by other human impacts such as littering and using the river bank as an ablution facility, with foraging dogs and pigs roaming about.

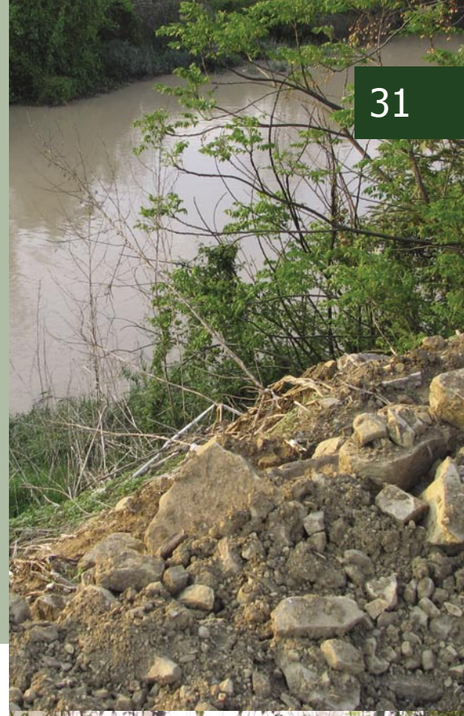
Cholera outbreaks in the area may be linked to these poor water quality conditions. Where densely populated settlements with no access to sanitation occur (as in this area), the water quality of downstream users will be affected by increased levels of nitrates and ammonia, high faecal coliform bacteria counts and the presence of pathogenic bacteria which cause water-borne diseases.

The presence of silty sediments are likely to be related to flow modification from regulated releases of water from Mthatha Dam, which has also led to the smothering of suitable habitat, particularly cobbles and boulders and to a lesser extent sand, gravel and mud for macro-invertebrates, fish and riparian vegetation.



Sewage Pollution

The water that goes down our sinks, toilets and bathrooms ends up as sewage in the sewerage system. In the sewage treatment plant the solids are removed and the water is cleaned and sanitized before it is discharged into the river. In some areas the sewer collection systems are old, poorly-maintained and inefficient. Consequently, many of these systems experience blockages or structural, mechanical and electrical failures. This results in sewage pollution, where raw or partially-treated sewage enters the river. Some sewer systems carry sanitary waste water together with storm water in the same pipe to a sewage treatment plant. In other cases, residents illegally divert stormwater into the sewers. In such cases a heavy downpour can cause the volume of waste water to exceed the capacity of the sewerage system or treatment plant. When this happens the overflow goes directly into the river system.



Impacts on the water resources in the area are:

- Untreated or inadequately treated sewage from sewage treatment works and runoff from settlements contribute to the declining water quality.
- Regulated releases from Mthatha Dam have modified the flow regime and severely altered the instream habitat.
- Predatory alien fish species have had a severe impact on the presence and distribution of indigenous fish species.

Recommendations for the area are:

- DWAF and local authorities must monitor sewage treatment works and where necessary upgrade them as a matter of urgency.
- Local authorities need to publish and enforce the laws governing proper waste disposal. Non-compliance with these laws should have serious consequences.
- DWAF and local authorities must monitor and manage runoff from formal and informal settlements and provide proper water services and sanitation.
- Local authorities must run intensive awareness campaigns regarding the environment and health, involving businesses, educators, learners, and the community at large.
- DWAF must give effect to the ecological Reserve requirements

Mthatha Falls to Kwa-Ntsaka

This reach of the Mthatha River is characterised by a single channel and floodplain within a confined valley. In this lower foothill zone, the bed material mainly consist of mixed bedrock, gravel and cobbles. The river consists of steps, rapids, riffles, runs and shallow and deep pools.

Isolated small-scale sand mining takes place at various points along the river. Some fishing takes place, especially after heavy rains. The inhabitants of Takata village also use the water for irrigation and they grow vegetables in a community garden for subsistence and for sale. The river serves as a major source of water for the local people and their livestock. They use the river for drinking, washing and recreational purposes and it is frequently crossed by people and livestock. The river is also of great socio-cultural value to the community as 'amagqirha' (diviners) from various places come to the river to perform their training or apprenticeship ('ukuthwasa') rituals. During their initiation 'ukwaluka' process, the local initiates ('abakhwetha') cleanse themselves in the river.

The poor water quality of the Mthatha town area extends into this river reach, stimulating escessive algal growth. Algal mats ('ingubo yesele') cover stones in the river making them slippery and dangerous to walk across.

Natural floods that overtop the river channel occur regularly after heavy rainfalls upstream. According to the people living next to the river, the water in the river used to be clean until the construction of the Mthatha Dam. Eskom releases large volumes of water from the dam at First Falls for a few hours every day during peak hydro-electric power generation.

An indigenous fish species, the chubbyhead barb (*Barbus anoplus*) and two species alien to the region, the banded tilapia and the sharp-tooth catfish, occur here. Sharptooth catfish (*Clarius gariepinus*) were introduced into the river around the late 1950s.

Indigenous trees are sparse and include the kei apple (*Dovyalis caffra*) and the river bushwillow (*Combretum erythrophyllum*). Alien invasive species on the river banks include sesbania, lantana and *Solanum mauritianum*. The water hyacinth (*Eichhornia crassipes*) has become a strong, perennial weed that survives even under dry conditions.

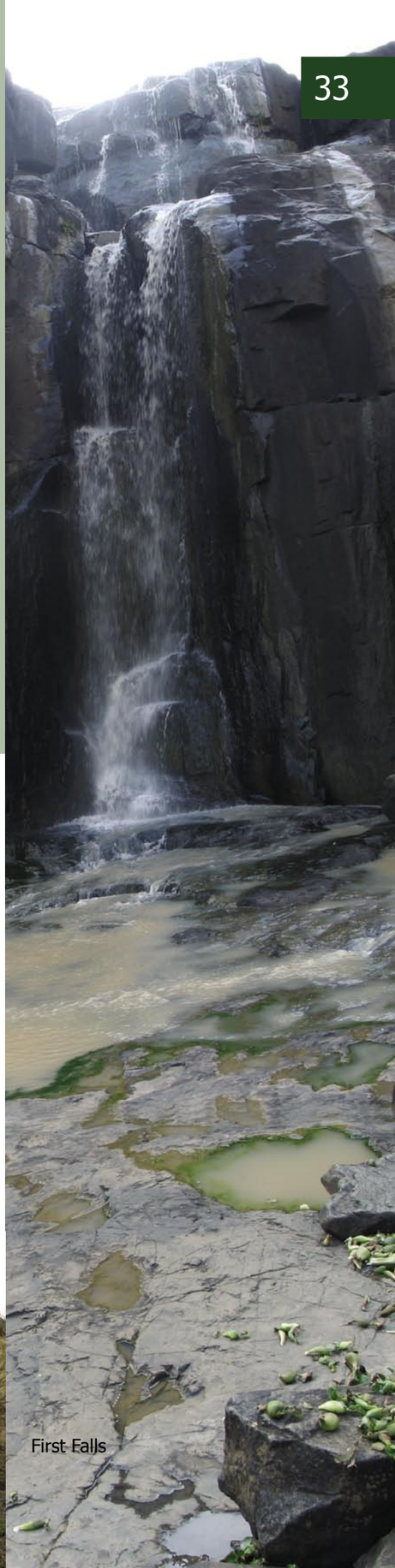
Mthatha River near Kwa-Ntsaka

Floods

A flood is a natural event that can have far reaching effects on people and the environment.

Floods are caused by heavy rainfall, and influenced by vegetation change, urbanisation, and dams. Most floods are caused by heavy rainfall from storms that generate unusually high runoff. Reduced vegetation (caused by factors such as deforestation, veld fires and overgrazing) increases the runoff and associated silt load. If the eroded material enters the river system, it can affect the quality of water, cause turbidity, and release bound nutrients from agricultural fertilizers. Solid items carried by the river in spate, such as branches, stones and logs, can erode or collapse river banks.

Areas below dams are affected when floodwater is released from the dam. In extreme cases, floods can also disrupt the provision of water by damaging weirs, water and sewage treatment works and water supply systems, with consequences for human health. Severe floods damage roads, railways and bridges, electricity and telecommunications infrastructure, inundate valuable agricultural land and destroy crops.



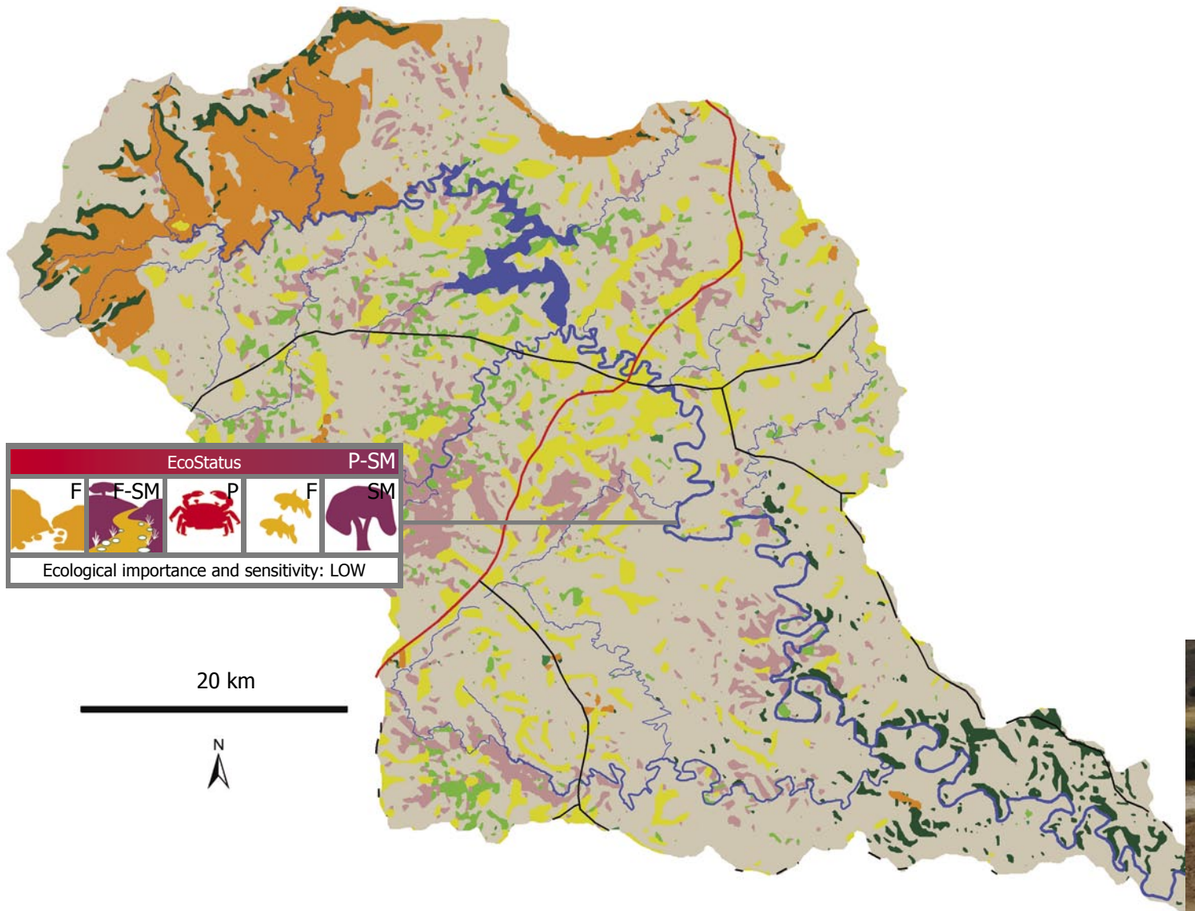
First Falls

Mthatha Falls to Kwa-Ntsaka (continued)

The sediment load in this part of the river is high. Most of the sediment has been generated upstream and trapped by the First Falls Dam. The daily flushing flows of water released for hydropower generation from the First Falls Dam contribute to the reduced vegetation cover. River bank erosion is visible in many places. The release of large volumes of water upstream causes sediment to be taken up by the water which makes it unsuitable for drinking. It has also been reported that the erratic release of water from the First Falls Dam is a problem as it may drown livestock and people crossing the river at the time.

The riparian vegetation is heavily impacted by grazing and firewood gathering. Removal of vegetation from the riparian zone has resulted in destabilization of the banks and subsequent widening of the channel. Small scale sand mining occurs along the river banks.

The effect of the poor water quality in the Mthatha town area upstream extends down to this river reach.



Alien fish species in the Mthatha River

Several fish species in the Mthatha River is regarded as introduced alien species. Rainbow trout (Oncorhychus mykiss) and smallmouth bass (Micropterus dolomieu) are introduced species from North America. Species such as the banded tilapia (Tilapia sparmanii), Mozambique tilapia (Oreochromis mossambicus) and sharptooth catfish (Clarias gariepinus) are indigenous to Southern Africa, but are not naturally found in the Mthatha River.

The Feeding habits, behaviour and habitat preferences of alien fish species often have a detrimental affect on native populations of aquatic organisms and may disturb the natural dynamic ecological relationships which are important for sustained ecosystem functioning. The rainbow trout, which is often introduced into rivers to attract recreational anglers, feeds on insects, fish eggs and small fish. The banded tilapia feeds mainly on algae and plant matter. The sharptooth catfish feeds on plankton, invertebrates, insects and fish. The omnivorous Mozambique tilapia is flexible in its feeding habits, feeding mainly on phytoplankton and algae, but also zooplankton, shrimps, small insects and their larvae. Large specimens sometimes prey on other fish as well as their own young.

Impacts on the water resources in the area are:

- The cumulative effect of small scale sand mining is potentially significant if not regulated. Impacts of sand mining include the destruction of in-stream and riparian habitat, in-stream silt deposits and increased turbidity.
- Erratic releases from the First Falls Dam modify flows which in turn result in in-stream habitat destruction due to siltation.
- Predatory alien fish species reduce or eliminate indigenous species.
- Alien vegetation species such as water hyacinth can reduce river flow, which causes incised channels and destabilised river banks.
- Untreated or poorly treated sewage discharges contribute to the poor water quality. Nutrient enrichment causes eutrophication and algal blooms. When the algae die and decay, they further deplete the oxygen in the water which can result in fish kills.

Recommendations for the area are:

- Local authorities must monitor and regulate sand mining activities.
- DWAF must determine the ecological Reserve and give effect to it.
- The relevant authorities and organisations need to stop the introduction of alien fish species.
- Local authorities, in consultation with DWAF, need to monitor and upgrade sewage treatment works, develop and implement waste management plans, and provide proper sanitation and water services to settlements in the area.

The Ngqungqu Tributary

The Ngqungqu River has a mitigating effect on the Mthatha River because it introduces good quality water. Thus in-stream habitats, riparian habitats and the aquatic life of the Mthatha River improve downstream of the confluence with the Ngqungqu River. The biomonitoring site in the Ngqungqu River is also one of the few sites within the catchment where the chubbyhead barb (*Barbus anoplus*) has been recorded. This indigenous cool water minnow has been displaced in many streams due to the invasion of alien trout and bass fish species. The banded tilapia and longfin eel have also been recorded.

At biomonitoring Site no. 10 on the Ngqungqu tributary the one river bank is a steep cliff. Further downstream the river forms wide floodplains on both sides of the river. The river is characterised by rapids, riffles, runs and shallow and deep pools. Boulders, cobbles and sand form the river bed.

In this study area, subsistence farming is the main land-use activity. Some small-scale farmers in the upper reaches of the Ngqungqu catchment use water for irrigation. Livestock, mainly sheep, cattle and goats, graze along the river and use it for drinking water.

Indigenous trees include the river bushwillow (*Combretum erythrophyllum*) and the common hook thorn (*Acacia caffra*). The wild fig (*Ficus sp.*), pompon tree (*Dias cotonifolia*) and bladder-nut (*Diospyros whyteana*) are also present. The average tree canopy height is about 4 m.

Wetlands and their importance

Wetlands are areas transitional between terrestrial and aquatic systems, where the water table is usually at or near the surface (saturated soil). They help prevent soil erosion, reduce flood damage, recharge ground water resources, and regulate runoff. They also help to purify water by trapping many pollutants, including sediment, heavy metals and disease causing organisms.

Farmers can sustainably use many valley-bottom and flood-plain wetlands for grazing. Wetlands also provide reeds that weavers use to make mats and baskets. A few wetlands are used by Sangomas for spiritual ceremonies.

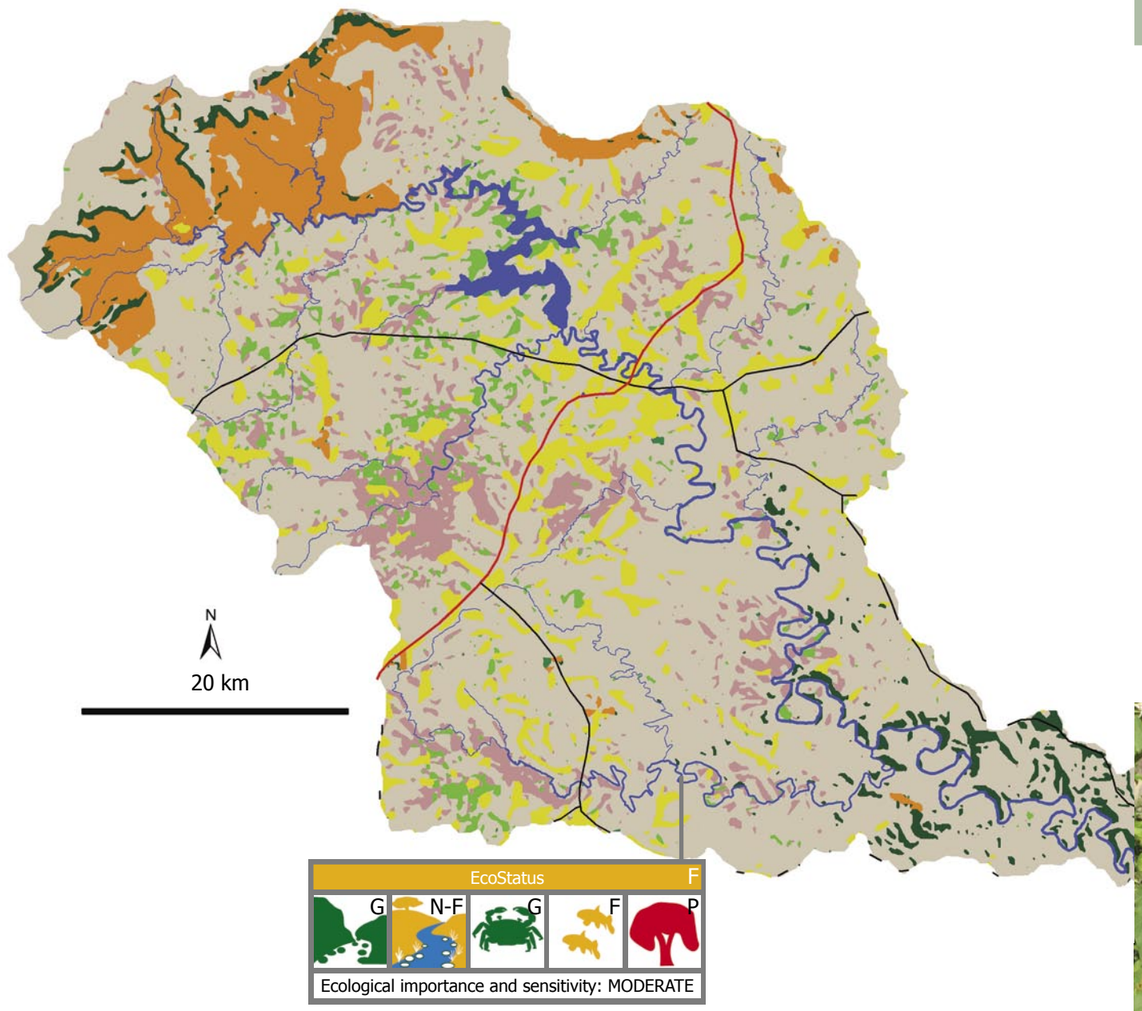
Road construction, urban development and over grazing are gradually destroying wetlands in the Mthatha River catchment.

Site 10: Ngqungqu River

The Ngqungqu Tributary (continued)

Erosion and adverse impacts from cultivation and livestock are the biggest concerns in this area. Erosion has added fine sediment to the river system, forming various types of depositional bars in the river channel. No significant changes to the flow regime have occurred in this tributary. Localized and relatively minor impacts include an old road which crosses the river and a bridge with in-channel supports which affects bank stability and widens the river channel in the immediate vicinity. Overall, the banks of the Ngqungqu River are relatively stable.

Infrastructure development, grazing activities and alien plant encroachment impact upon riparian vegetation. Invasive alien species such as sesbania and lantana form dense stands which have displaced much of the natural vegetation.



Alien vegetation along the Mthatha River

Alien vegetation, both riparian and aquatic, has a large and negative impact on the Mthatha River. Aquatic weeds such as water hyacinth (*Eichhornia crassipes*), grows quickly, and can completely cover water bodies in a relatively short time if left unchecked. If this happens, the plant mats can impede water flow, block sunlight from reaching indigenous aquatic plants, and starve the water of oxygen, which in turn affects fish and aquatic invertebrates. The plants also create a good habitat for insect disease vectors such as mosquitoes. Water hyacinth is present from below the Mthatha Dam to downstream of First Falls.

Examples of encroaching terrestrial alien vegetation along the Mthatha River include the red sesbania (*Sesbania punicia*), and lantana (*Lantana camara*). Black wattle (*Acacia mearnsii*) and pines (*Pinus spp.*) are present in the headwaters and upper reaches of the river; while gum trees (*Eucalyptus spp.*) are present along the banks of the lower Mthatha River. They compete with indigenous vegetation for space, water, and nutrients.

Impacts on the water resources in the area are:

- Trampling of riparian zone by livestock causes erosion.
- Predatory alien fish species have had a severe impact on the presence and distribution of indigenous fish species such as the chubbyhead barb (*Barbus anoplus*).

Recommendations for the area are:

- Local authorities, landowners and agricultural extension officers must develop a grazing management system and soil conservation measures to reduce soil erosion. Where possible, farmers must not allow livestock to graze in the riparian zone.
- Local authorities must ensure that communities are involved in decision-making regarding the use of natural resources.
- The relevant authorities and organisations need to stop the spread of alien fish species.


Lantana camara


Solanum chrysotrichum

Lower Mthatha River

This section of the Mthatha River, between the confluence with the Ngqungqu tributary and the Mthatha River estuary, is classified as a lower foothill zone. The river is characterised by rapids, riffles, runs, and shallow and deep pools, with a boulder and sand bed. Some vegetated islands exist. The cleaner water entering from the Ngqungqu tributary improves the water quality in this section.

Mpindweni Village is located downstream of the confluence with the Ngqungqu River. Although this area has good vegetation cover, sesbania, lantana, inkberry (*Cestrum laevigatum)* and balloonvine (*Cardiospermum grandiflorum*) are amongst the invasive alien species that outcompete the indigenous vegetation. Natural vegetation in the lower reaches of the Mthatha River include valley thicket and forested areas in the riparian zone. Indigenous trees include river bushwillow (*Combretum erythrophyllum*), wild date palm (*Phoenix reclinata*), and broom custer fig (*Ficus sur)*. Grass, shrub and forb species occur on the river banks.

At Mdumbi the one river bank rises steeply up a scarp slope and the other widens out into a floodplain. The vegetation cover is high, but similar to the Mpindweni area, it mainly consists of alien invasive species such as lantana, sesbania, inkberry (*Cestrum laevigatum*) and balloonvine (*Cardiospermum grandiflorum*).

Grazing and subsistence agriculture occur along the river, but have had minimal impact so far.

A number of alien fish species occur in this stretch of river, including a number of species which show a marine origin. The baldy and the pipefish as well as several fish species of estuarine and marine origin were sampled, including some alien species. Due to its preference for cooler water, the indigenous chubbyhead barb (*Barbus anoplus*) - the system's only indigenous species - which was found upstream, did not occur here.

Mthatha River at Mdumbi

Human health and water quality

National monitoring programs have unequivocally shown that surface waters are more often than not polluted by various physical, chemical and biological substances, rendering the water unsafe for use (e.g., recreation, livelihood fishing, bathing, laundry washing, drinking and agriculture). A human health risk assessment of cadmium in the Mthatha River (Fatoki et al., 2004) for example showed an unacceptably high risk of adverse human health effects if they were to use the water for domestic purposes such as drinking and bathing. This demonstrates that when we pollute rivers such as the Mthatha, not only do we affect the ecosystem health, but also put humans' health at risk.

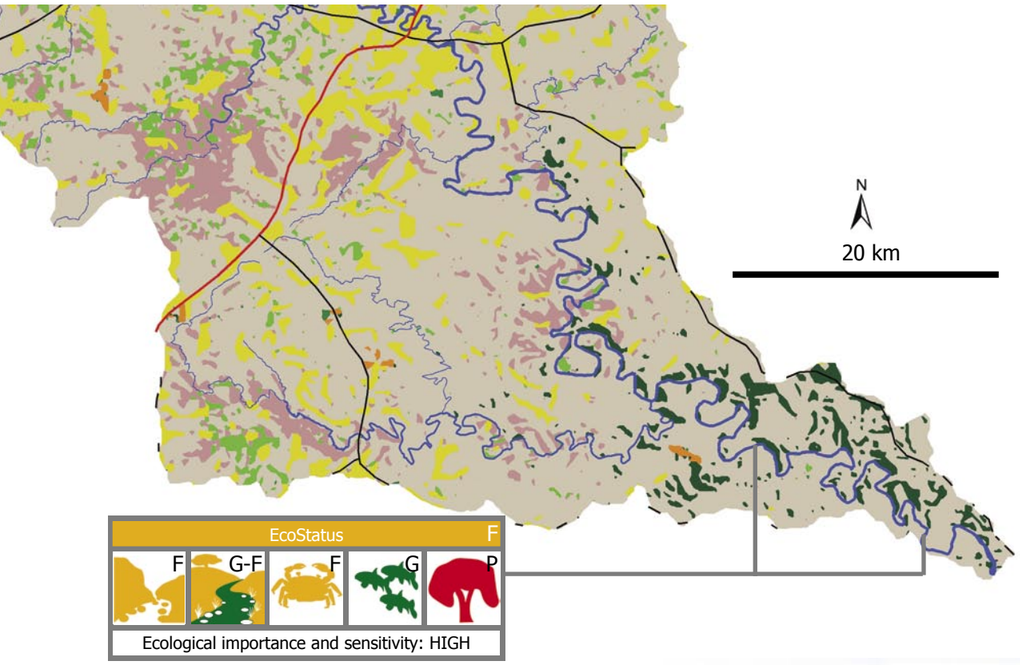
Microorganisms and diseases such as cholera and typhoid occur regularly in South Africa, with rivers and streams often the source of infection due to a lack of sanitation services and provision. These problems will increase until we implement integrated catchment management and protection of the resource for drinking and other domestic purposes.

This is especially the case where people rely on the river for their domestic water. If the river is polluted with toxic chemicals such as arsenic or cadmium, people using it for domestic purposes (e.g., drinking, cooking, bathing, and laundry) will experience short-term and long-term health effects. Pesticides and their residues can also cause adverse effects on users of treated water if removal procedures are inefficient. In addition, some local authorities expect treatment facilities to continue to perform to the same standard without system maintenance, upgrades or technology reviews. Problems such as overloading, power failures and sewer or pump-station overflows can also place strain on wastewater treatment facilities. Many treatment facilities were designed and built long before aquatic scientists were aware of contaminants such as estrogens and anti-retroviral substances.

Some organic chemicals and pesticides adversely affect the health of the ecosystem through bio-accumulation. Chemicals that bio-accumulate in, for example, fish, will increase in concentrations in organisms higher up the food chain, eventually becoming hazardous to human health. Irrigation of crops with polluted water can also put consumers at risk, since chemicals and micro-organisms can adsorb to the surface of the crops or be absorbed by crops. This is especially a problem with crops that are eaten raw.

Lower Mthatha River (continued)

Although still visible, the effects of the upstream dams are less evident in this reach of the Mthatha River. The water quality impact on this section of the river is mainly from stormwater runoff from nearby settlements that do not have formal sanitation. Grazing and subsistence agriculture has resulted in some soil erosion but it is not as severe as in the rest of the catchment. The collection of firewood in the riparian zone and vegetation destruction during bridge building activities disrupts the natural growth of indigenous vegetation which, in turn, gives alien plants the opportunity to invade the riparian zone. Water is abstracted from the Mthatha River for the local rural villages and Coffee Bay.




Senna didymobotrya

Impacts on the water resources in the area are:

- Stormwater runoff from settlements without formal sanitation contributes to the poor water quality.
- Erosion caused by uncontrolled land use practices results in river bank destabilisation, which in turn encourages increased alien plant infestation, in-stream sedimentation and eventually the destruction of riparian and in-stream habitat.
- Predatory alien fish species have reduced or virtually eliminated indigenous freshwater fish populations.

Recommendations for the area are:

- Local authorities and DWAF need to provide sanitation and water services infrastructure to surrounding settlements, in order to improve the water quality situation in the lower Mthatha River.
- Local authorities and agricultural extension officers need to encourage subsistence farmers to improve current land use practices to ensure their future livelihoods.
- The relevant authorities and organisations need to stop the introduction and spread of alien fish species.

The Mthatha Estuary

The Mthatha estuary is on the eastern coast of South Africa approximately 70 km downstream of Mthatha Dam. It is a medium to large estuary, and its mouth is permanently open to the sea. A steep rocky headland prevents the river mouth from migrating in a southwesterly direction. To the northeast of the river mouth there is a well developed sand spit and stabilized sand dunes. The estuary ends 8.5 km upstream of the mouth, where a series of rapids acts as a barrier to sea water. The bed of the estuary is normally 1 to 1.5 metres below mean sea level. The Mthatha estuary has a diversity of habitats. The upper reaches are narrow with beds of common reeds (*Phragmites australis*). Further downstream extensive salt marshes are present and a narrow strip of white mangrove (*Avicennia marina*) extends along the banks. The lower reaches of the estuary consist of shallow mudflats surrounded by mangroves such as the red mangrove (*Rhizopora mucronata*).

The estuary is important for resident breeding fish species and is a nursery area for certain marine juveniles. Twelve of the fish species found here also breed within the estuary. A further 35 fish species have varying degrees of dependency on the estuary. The estuary also provides a movement corridor for river invertebrates that breed in the marine environment and eels that migrate between the sea and the river.

The Mthatha Dam and the hydro-electric scheme affect the amount of water reaching the river mouth. The estuary now receives a higher flow in winter than summer because of dam releases associated with power generation in the winter. Under natural conditions, high flow occurs during the summer months and low flow during winter. The altered flow patterns have changed the salinity in the estuary. Marine influences formerly extended further upstream than is presently the case in winter and this would have resulted in a strong salinity gradient and reduced turbidity. Soil erosion in the catchment has resulted in increased suspended sediment loads over the past 10 years and the Mthatha estuary is now turbid, particularly in the upper reaches.

The estuary is used for both recreational and subsistence fishing and bait collecting. Some subsistence agriculture and livestock grazing take place higher on the banks of the estuary in the upper reaches. Floodplain areas have been cleared to make way for crop cultivation. Mangroves are harvested for firewood and poles for the construction of animal shelters and houses. Between 1961 and 1998, there was a 14 % reduction in the area covered by estuarine plants (70.5 ha to 60.8 ha).

The benthic invertebrate community is currently absent from the middle and upper reaches of the estuary, probably as a result of the high silt load and smothering. This will negatively affect the food chain which depends on the invertebrates as a source of food. The estuary has an estimated 44 fish species, though some changes in fish abundance and composition are expected as a result of the changes in the benthic invertebrate community. Of the 44 fish species, 9 account for 93 % of the total number of fish and 2 species are alien. The adjacent wetlands serve as important spawning grounds for many species of marine life.

Mangroves

Mangroves are trees or shrubs that grow in tropical and sub-tropical coastal regions such as estuaries and tidal areas. They create their own little ecosystems as they provide shelter for a wide variety of fish and other aquatic life, which in turn attract predator species. They stabilise coastal habitats as their extensive root systems protect fine sediments and organic matter from being washed away in the tides and storms.

The three species of mangrove found in the Mthatha River estuary are the white mangrove (*Avicennia marina*), the black mangrove (*Bruguiera gymnorhiza*) and the red mangrove (*Rhizophora mucronata*).

Mangroves, especially the black and red mangroves, are highly sought after for roofing because they provide straight, rot-resistant slats. This has led to significant reduction in the area of mangroves over the years.

White mangroves

Mangrove forests line both the western (on the photograph) and eastern banks of the Mthatha estuary.

The Mthatha Estuary (continued)

Impacts on the water resources in the area are:

- Regulated flows from Mthatha Dam and the hydroelectric scheme have a severe impact on seasonal flows and hence the salinity of the estuary.
- Subsistence agriculture, grazing on the upper banks of the estuary, clearance of floodplain areas for subsistence agriculture and the harvesting of mangroves for firewood and poles are all activities that increase soil erosion, and destroy in-stream habitat.
- Soil erosion in the upper catchment causes the suspended sediment load in the estuary to be very high. Unacceptably high sediment loads destroy habitat, clog fish gills and smother the smaller benthic invertebrate species.

Recommendations for the area are:

- Improve land-use practices, for example by providing environmental education to local communities and involving them in management decisions and actions.
- Determine and implement appropriate operating rules for the release of water for the ecological Reserve and to improve the health of downstream river and estuary.

What is an estuary?

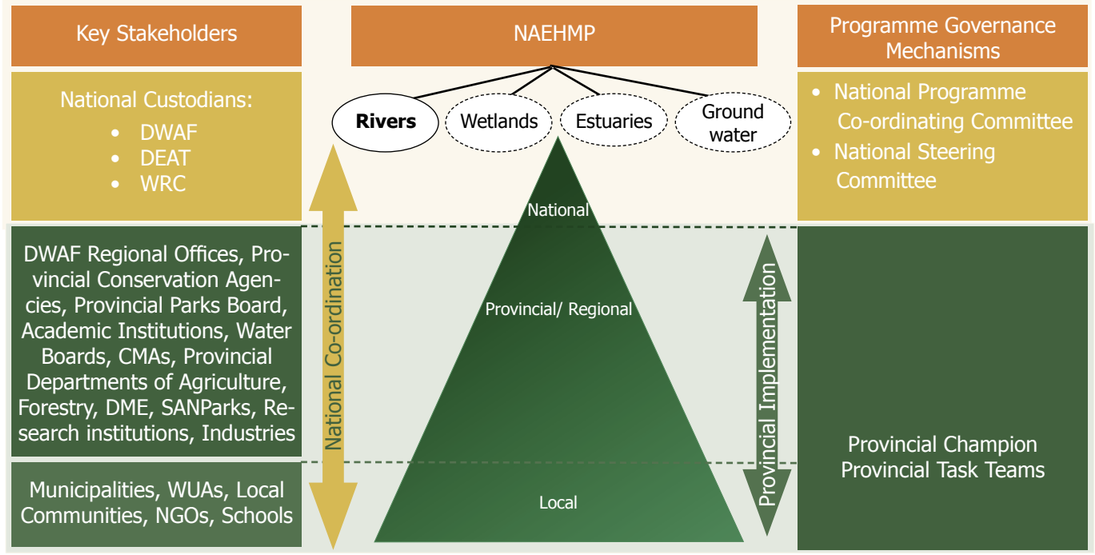
The lower reach of a river, where the sea interacts with the river, is known as an estuary. The amount of river flow determines whether an estuary mouth is open or closed and the extent to which sea water penetrates upstream. The salinity gradients caused by the tidal interactions between the sea and the river define the specific habitats for estuarine life forms which, in turn, form important links in the food chain.

Governance of the RHP

Governance is the process whereby a group of institutions or people manage their common concerns. Within the river management context, a governance framework defines how to address common river health concerns. It also defines who the responsible organisations or entities will be and the relationships between them.

The design, development, and standardisation (concepts, methods, processes) of the RHP are coordinated at a national level, while implementation of the RHP is a provincial responsibility, performed by the Provincial Champion and the Provincial Task Team (PTT).

The figure below explains the RHP governance model as described in the RHP implementation manual.



All participating organisations need to incorporate the RHP into their internal business processes. Apart from generic guidelines for successful RHP governance, a few critical success factors for the RHP include:

- DWAF ensures and visibly demonstrates support for the RHP on all levels;
- DWAF shows a certain level of competence regarding RHP monitoring and reporting, and is able to effectively co-ordinate, integrate and evaluate various technical inputs from participating organisations and various other sources; and
- DWAF has a clear plan for capacity building. The latter includes a thorough assessment of current and desired competencies within participating organisations and an action plan to close the gaps.

Apart from the traditional approach of enhancing skills and knowledge through training, DWAF should explore and develop other options such as coaching and mentoring during field work.

The Eastern Cape RHP PTT has the responsibility for implementing, improving and maintaining the RHP in the province. To achieve this, participating organisations should show their commitment to the RHP and PTT by including biomonitoring in their business plans; and by supporting and endorsing the involvement of their staff members.

For the management of the Mthatha catchment to be successful, the responsible organisations need to follow an adaptive management approach with clear strategies and logistics. To enable this, the PTT needs to identify and align the efforts and resources of collaborating institutions (e.g. Dept of Water Affairs and Forestry, Dept of Environmental Affairs and Tourism, and Local Government), and make roles and responsibilities explicit. The PTT also develops and distributes a framework and plan of action for the co-ordination of river surveys, information management and reporting. In collaboration with DWAF and other responsible organisations, the PTT also needs to develop the knowledge to sustain, manage, protect, and rehabilitate the aquatic ecosystem. A clear understanding of the ecological processes that underlie the delivery of goods and services of river and other aquatic ecosystems is essential.

Legislation

The RHP is supported by legislation such as the Constitution of SA (Act No. 108 of 1996) which states that all citizens, and future generations, have the right to a clean and healthy environment; that pollution and ecological degradation should be prevented; and conservation promoted. The role of public trustee of South Africa's water resources lies with DWAF under The National Water Act (Act No. 36 of 1998). The National Environmental Management Act, NEMA (Act No. 107 of 1998), governs the sustainable use of the environment and the protection of ecosystems. The NEMA also emphasises the importance of integrated environmental management through co-operative environmental governance. The Protected Areas Act (Act No. 57 of 2003) provides a mandate to the managers of the protected areas on aspects of nature protection and conservation within the protected areas, including aquatic ecosystems. The Biodiversity Act (Act No. 10 of 2004), focuses on the management and conservation of South Africa's biodiversity, including freshwater biodiversity. Within the co-operative governance context, the Intergovernmental Relations Framework Act (Act No 13 of 2005) formalises relations between and within the national, provincial and local government.
All the above legislation is only effective when the relevant authorities implement and enforce them. The steps required to ensure implementation, and enforcement where needed, of the recommended management actions are described below.

Impacts on the Mthatha River and recommended management actions

Sources of river contamination
All effluent discharges should comply with the national water quality regulations. To achieve this goal, all sewage works must adhere to operating standards and only discharge treated sewage of acceptable quality into the river. DWAF and local authorities need to monitor sewage treatment works and upgrade them where necessary to deal with increasing sewage loads (or construct new treatment plants).

DWAF and local authorities need to monitor runoff from formal and informal urban areas, industries and dumping sites and take appropriate management action. Where the authorities have identified illegal dumping sites they need to prosecute the offenders and ensure that they clean up the area and mitigate any pollution effects. All residential areas, including informal settlements, must have solid waste disposal infrastructure.

Implementation of the Reserve
DWAF will determine the ecological Reserve for the Mthatha River, establish environmental flow requirements and manage flow releases to simulate seasonal flows and natural hydrological fluxes as closely as possible. DWAF will also award water use licences in line with the in-stream quality and quantity objectives.

Habitat destruction
Inhabitants need to comply with livestock carrying capacities to minimise overgrazing and the resultant sediment input into the river. With the help of local authorities, they should also stabilise localised erosion points.
All those living in the catchment must protect riparian zones and habitats, and their functionality. They need to control and remove aquatic and terrestrial alien vegetation and rehabilitate the riparian habitat to help restore ecosystem services such as flood attenuation and sediment trapping.
Local communities should be aware of the adverse effects of the removal of indigenous trees and other vegetation from the riparian zone.
Local authorities need to evaluate the effects of sand-mining on riparian and in-stream habitat and regulate those operations where the scale of mining is detrimental.

Alien species
Government departments and private organisations involved in agriculture and forestry must ensure sufficient buffer zones along the river banks to protect the riparian vegetation. Where alien plantations have invaded the riparian vegetation, the alien plants should be removed without further damage to the riparian zone.
The responsible authorities should eradicate invasive alien in-stream vegetation such as water hyacinth (*Eichhornia crassipes*).
River users must cooperate with the authorities to prevent the introduction of alien fish, especially predatory species.

Ecosystem goods and services of the Mthatha River

Domestic use: Urban domestic users have treated water for drinking, food preparation, bathing, washing clothes and dishes, watering gardens, washing cars etc., and consequently use more water than rural users.
Rural domestic users generally make use of untreated river water or groundwater for all needs. This is a potential health risk for water-borne diseases such as cholera, typhoid, and diarrhoea.

Irrigation: Small scale, mostly subsistence farmers for watering their vegetables and crops.

Traditional: Traditional healers (sangomas) use river water, and the Zionist Church uses the river for baptisms.

Brickmaking: Some sand and clay mining takes place along the lower reaches of the river to make bricks for building huts or houses. This can result in river bank instability impacts and sediment disturbance.

Fishing: Some small-scale fishing occurs, mostly around the estuary.

Hydroelectricity: Hydro-electric schemes at 1st Falls (22km downstream of Mthatha dam), and 2nd Falls (30km downstream of 1st Falls) provide electricity when needed. The schemes operate sporadically, mostly during peak demand on weekdays), which can cause some distress to the downstream community. Depending on the volume of water used by the hydroelectric scheme, river flow can become altered and uneven.

Recreation: There is some swimming and recreational fishing by the local communities and visitors in the river.
The Lutshaba Nature Reserve has about 10 visitors per day in the low season and 100 visitors per day in the high season.
The Ndulu Nature Reserve in Mthatha has about 10 visitors per day in the low season and 200 per day in the high season.

Waste disposal: Road construction and forestry infrastructure (sawmills, etc.) in the upper reaches of the catchment generate solid waste. In Mthatha town and other urban areas, partially treated or untreated overflow from sewage treatment plants enters the river system. This causes high nutrient concentrations that leads to eutrophication, excessive growth of aquatic plants (including water hyacinth, *Eichhornia crassipes*) and algal blooms, which constitute a health hazard to other water users in the area. Microbial contamination is also a health hazard to water users.

Making mats: Local weavers make mats principally from two species of rushes, *Cyperus textilis* (imizi) and *Juncus kraussii* (incema). The former occurs on the river banks in the inland areas where the water does not flow rapidly, while the latter is an estuarine species. They are collected in late summer and autumn, and laid out to dry for two weeks. After drying, weavers use them to make sleeping mats (amakhuko), meat mats (izithebe), baskets (iingobozi), and beer strainers (iintluzo).
Sometimes cattle graze the rushes, making them too short for weaving. To avoid this problem, some women have started domesticating imizi, planting them in their homestead gardens.

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