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THE FEASIBILITY OF DEVELOPING PAYMENTS FOR CATCHMENT PROTECTION SERVICES AND IMPROVED LIVELIHOODS IN SOUTH AFRICA

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GLOSSARY

Catchment

In South Africa the English term catchment is used to define the boundary of an area that drains into a particular water body or river. A catchment is bounded by watersheds, defined as the highest points from which water drains. However, for the purposes of ensuring continuity in this study with the reporting of other study sites, catchment will be used interchangeably with the American description of watershed defined below.

Conservation

In relation to a water resource, conservation means the efficient use and saving of water, achieved through measures such as water saving devices, water-efficient processes, water demand management and water rationing.

Direct negotiation

Where payments for watershed protection services are agreed directly by buyers and sellers. Payments are often embedded within larger projects that set out detailed conservation activities and which involve a lengthy process of bargaining (for example: integrated conservation and development projects).

Exchange-based trades

Where a commodity has been standardized and can be resold in secondary and, in some cases, derivative markets such as futures or options markets.

General authorisations

Refer to users of larger amounts of water, or a water use that could impact negatively on the water resource, but which is generally authorized to continue without a specific license via a notice in the Gazette.

Gross geographic product

The total production of final goods and services in a certain geographic area over a particular time.

Instream habitat

Includes the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse.

Intermediary-based transactions

Occur where funds are channelled via intermediaries, for example: trust funds, local and international NGOs. Intermediaries help to reduce transaction costs associated with searching, negotiating and completing deals.

Licensed users

All users, other than schedule 1 users or generally authorized users, who use water in terms of a license.

Pooled transactions

Involve the pooling of funds by buyers, or pooling of service supplies. Pooling controls trading risks for buyers by sharing the investment among several buyers and, in some cases, by permitting diversified investments.

Protection

In relation to a water resource, protection means: maintenance of the quality of the water resource to the extent that the water resource may be used in an ecologically sustainable way; prevention of the degradation of the water resource; and the rehabilitation of the water resource.

Market-based instruments

Mechanisms used to generate funds or resources in order to encourage certain behaviour.

Payments

Rewards or incentives paid for certain land use activities. These may be monetary or in kind.

National Water Act

The National Water Act for South Africa (Act No. 36 of 1998).

Water entitlements

All water use authorised according to criteria of equitable allocations, beneficial use in the public interest, and environmental values. This excludes the reserve, international obligations, interbasin transfers, strategic needs and future use.

Water rights

Under the NWA (Act No. 36 of 1998), the only right to water is conferred for the reserve, this includes the reserve for basic human needs and the ecological reserve. This reserve allocation remains a national responsibility.

Schedule 1 users

Users of small amounts of water for household use, watering gardens and animals (not for commercial purposes) or storing and using rainwater from a roof.

Sediment

Any solid particles transported by, suspended in, or deposited by water or air, or accumulated in river beds by other natural agents.

Sediment transportation

The process by which sediments are transported.

Sedimentation

The process by which sediments settle (ie: are deposited) on the river bed.

Soil erosion

The process by which soil particles are detached from the soil surface.

Stream flow reduction activities

"…any activity…[that]…is likely to reduce the availability of water in a watercourse relative to the natural runoff from that area" under section 36(2) of the NWA (Act No. 36 of 1998).

Watershed

A geographic region within which water drains into a particular river, stream, or body of water. The overall health of a watershed comprises the health of the surrounding land and rivers or streams that drain that region. In South Africa a watershed is referred to as a catchment.

Watershed services

Services that facilitate the regulation of water flows, volumes, quality and timing downstream.

ACRONYMS AND ABBREVIATIONS

Act	National Water Act (No. 36 of 1998)
BTP	Bosbokrand Transfer Pipeline
CMA	Catchment Management Agency
CVM	Contingent Valuation Method
DEAT	Department of Environmental Affairs and Tourism
DWAF	Department of Water Affairs and Forestry
ISP	Internal Strategic Perspective
GGP	Gross Geographic Product
GNP	Gross National Product
KL	Kilolitre of water (as part of the daily consumption)
LR	Long run
MAR	Mean annual rainfall
MRTS	Marginal Rate of Technical Substitution
NWRS	National Water Resources Strategy
PES	Payments for environmental services
RSA	Republic of South Africa
SR	Short run
SSA	Statistics South Africa
WC & DM	Water Conservation and Demand Management
WDM	Water demand management
WMA	Water Management Area
WTP	Willingness to pay
WUA	Water User Association

1 DEVELOPING PAYMENTS FOR WATERSHED PROTECTION SERVICES AND IMPROVED LIVELIHOODS IN SOUTH AFRICA: A FEASIBILITY REPORT

1.1 INTRODUCTION

South Africa is currently classified by the International Water Management Institute (IWMI) as approaching a situation of chronic water scarcity. Average annual precipitation is about 500 mm, with significant spatial and temporal variability throughout the country. It is estimated that the country will reach the limits of economically usable, land-based fresh water resources in the first half of this century. Despite the country's extensive infrastructure developments and technological knowledge, supply-side solutions are becoming increasingly costly and less viable. Consequently, new and 'creative' approaches to the provision and management of water are urgently needed (Ashton & Seetal, 2002).

One such approach focuses on payments for environmental services. These payments are considered to be flexible, direct mechanisms that encourage both the suppliers of improved water services and the demanders of these services to engage in active participatory exchanges. By doing so, it is hoped that the availability of water supply or improved water quality will be made available to downstream users (FAO, 2004).

Payments for environmental services (PES) have increasingly been used to finance conservation initiatives as well as rehabilitation initiatives over the past few years (Landell-Mills & Porras, 2002; Pagiola, Landell-Mills & Bishop, 2002). They are broadly defined as incentives that aim to encourage land managers to undertake land management practices that support the development, protection or conservation of environmental services such as landscape beauty, carbon sequestration, biodiversity conservation and watershed protection (Landell-Mills & Poras, 2002; Pagiola & Platais, 2002). Typically, land users / managers receive no compensation for the environmental services generated by their land and hence have no economic incentive to manage it in such a way that ensures the continued provision of environmental services. Due to the failure to generate income from managing land for ecosystem services, land managers/users typically tend towards productive activities such as agriculture and forestry that generate greater economic returns (Pagiola & Platais, 2002). Payments for environmental services aim to address this failure to conserve environmental services by creating incentives for land users/managers to internalise the costs of their land management practices and consequently change them (Pagiola & Platais, 2002).

Typical environmental services are outlined in Table 1.1 below. Payments are made for the associated commodities and land use interventions that support the provision of these services. This particular study examines the potential for developing payments for catchment protection services in South Africa by reviewing the feasibility of this approach at six selected sites. It is anticipated that there is good potential for payments for catchment protection services to address the water scarcity gap and improve livelihoods in South Africa.

Table 1.1: Environmental services, commodities and land use interventions

Service	Commodity	Land use intervention
Carbon sequestration	Trees per hectare	Planting of trees
Biodiversity conservation	Biodiversity protection	Set aside land for conservation
		Maintenance of hedge rows between agricultural fields
	Biodiversity offsets	Protection of alternative biodiversity rich areas
Landscape beauty	Open space	Conservation or parks
	Habitat protection	Conservation
Catchment protection	Water quality	Soil erosion control
		Sediment reduction
		Wetland rehabilitation
		Reduced overgrazing
	Water quantity	Removal of alien invasive plants
		Reduced planting in the riparian zone
		Efficient irrigation practices
	Aquatic ecosystem goods and services protection and maintenance	Environmentally sensitive water releases
		Monitoring of aquatic stocks
		Controlled harvesting
		Protection and rehabilitation of aquatic habitat

The development of payments for catchment protection services require certain necessary conditions to be met. These are:

- Buyers and sellers need to exist and be interested in trading;
- Costs of participating in trading (transaction costs) need to be low;
- A legal or supportive institutional framework that supports trading needs to be evident;
- Property rights must be clearly defined; (this is often particularly difficult when it comes to catchment protection services);
- Goods or services need to be priced correctly where there are direct markets for them, obviously for catchment services many of these do not have explicit values attached;
- Information must be freely available and accessible.

Even where these conditions are met, the economic, social and environmental landscape specific to a country such as South Africa may prove to be less supportive of payment mechanisms. As a result, the following issues and objectives need to be understood:

- The inter-linkages between watersheds and watershed activities;
- Social equity needs within and between watersheds;
- Discrepancies in power bases between demanders and suppliers of watershed services;
- National water use efficiency requirements; and
- Broader national objectives relating to water and land use as well as development.

The following payment instruments are used internationally to develop markets for watershed protection services and improve livelihoods and have the potential to be applied in South Africa. They are generic and have been identified by Landell-Mills and Porras (2002), for all developing countries:

- Tradable licences or rights
- User charges
- Intermediary-based transfers
- Pooled transactions

- Internal trading
- Clearing house mechanisms
- Retail-based market

It is important to note that payments for catchment protection services can be negotiated between any demander or supplier of the service. However, for the purpose of this project, one of the critical elements considered in evaluating the six potential sites was the extent to which poor or marginalised groups could be encouraged or supported to provide the required catchment protection services. And by doing so, would these groups gain access to another form of income and changed livelihoods? Against this background, this component of the project aims specifically to address the question "Is it feasible to development payments for catchment protection services in South Africa?"

1.1.1 Background to the broader project

This project focuses on the use of market-based mechanisms for watershed management globally. It also aims more specifically to understand the implications and opportunities for these mechanisms to improve livelihoods. The project is being conducted in a number of developing countries at different scales, and four countries in particular are being highlighted as action learning sites. These are India, Indonesia, South Africa and the Caribbean. The project is funded by DFID through the International Institute for Environment and Development (IIED) and runs until 2006.

The South Africa component of the overall global project focuses on the potential for using market-based mechanisms, within the framework of a well-defined and highly integrative water legislative environment, to address issues around equity, efficiency and water productivity. The first phase of the South Africa project focussed on the development of a scoping report for catchment protection services in South Africa. It reviewed the bio-physical and the socio-economic status of water and catchment management at the national level. The National Water Act (Act No. 36 of 1998) was briefly reviewed and potential sites for action learning were listed.

The second phase, the basis for this report, reviewed the potential feasibility for developing market-based mechanisms for six selected sites. The key constraints and opportunities for the development of these mechanisms were identified, analysed and documented for the six selected sites. These sites are: the Olifants catchment, the Sabie-Sand catchment, the Upper Vaal catchment, specifically the Klip River, the Mhlathuze catchment, the St Lucia Estuary and the Levuvhu-Letaba catchment. This report captures the learning from this phase.

The third phase is expected to focus on the practicalities of implementing market-based mechanisms. This will include a thorough understanding of the critical success or boundary factors for market based mechanisms in South Africa through site-specific, case-study reviews.

1.1.2 Purpose of this report

This report records the result of investigations into the potential for developing payments for catchment protection services in six selected sites in South Africa. The study aimed to understand whether a number of critical aspects namely: the hydrological environment, land tenure and ownership, the identification of poor and marginalized groups, power imbalances, land use, and economics had the potential to hinder or support the development of payments for catchment protection services in each of the sites.

For each site the following questions were asked:

1. Does the hydrological landscape support or hinder the development of payments for catchment protection services? What services are demanded and can be provided?
2. Do the land tenure and ownership structures support or hinder the development of payments for catchment protection services?
3. Who are the poor and marginalised groups in the catchment, and can they participate in land management activities that will provide catchment protection services?
4. Who holds the power in the catchment and what are the implications of power imbalances for developing payments for catchment protection services?
5. What are the land use activities in the catchment and will they support or hinder the development of payments for catchment protection services?
6. What are the economic activities in the catchment and how will the economics of the catchment support or hinder the development of payments for catchment protection services?

Based on the reviews of each section, recommendations were made for each site and two pilot sites were selected for 'action-learning' implementation in South Africa.

1.1.3 The structure of this report

This report details the feasibility of implementing payments for watershed protection services and improved livelihoods in six catchments in South Africa. After a preliminary recommendation is made on site selection, the report is divided into three main sections, namely:

- **Chapter 1** - The Feasibility Report gives the introduction and background to the broader project, requirements and criteria for site selection, and a summarised discussion of the options and recommendations.
- **Chapter 2** - Contains the detailed site report on each of the six sites.
- **Chapter 3** - Outlines the phase III workshop and plan for the pilot study.

1.2 REQUIREMENTS AND CRITERIA

Specific criteria were developed and used to select from the six proposed sites, and selected from them, two sites for the action-learning pilot programme South Africa. The criteria were developed through consultation with IIED, DFID in South Africa, and the South Africa project advisory committee. They were reported in the Phase 1 scoping report. Based on these criteria and the outcomes of the feasibility studies, two sites were selected for action-learning at a planning workshop held in October 2004.

The criteria are outlined in Table 1.2.

Table 1.2: Criteria for site-selection in South Africa

Criterion	Explanation	Link to other projects	1	2	3	4	5	6
Administrative capacity	There should be regional capacity in the regional DWAF office to support the process	DFID WFSP criterion						
Strategic area issues	The area should be identified for strategic development needs, either as a Presidential lead project, or Integrated Development Zone (IDZ), or be an ISRDP node. Other agencies should be active in the area to support building the capacity to use water productively (co-operative governance).	DFID WFSP criterion						
Significant RDM requirement	There should be a significant reserve requirement, or special needs for the protection of the environment, i.e. sensitive river systems. The intention of this is to test the balance between the ecological reserve, the need to make water available for rural development, and the curtailment of existing lawful use.	DFID WFSP criterion						
One catchment	There should be an effort made to do the full compulsory licensing process in at least one catchment, and to integrate all the relevant aspects of IWRM (quantity and quality).	DFID WFSP criterion						
Stressed catchments	The catchments selected should experience water stress i.e. the demands for water should exceed the available water, and WC/DM and curtailment of existing use will be necessary to provide water to the rural poor. There should be an existing demand from users for new licences.	DFID WFSP criterion						
Institutional arrangements	There should preferably also be a CMA board established – and the establishment of Water User Associations should have progressed well.	DFID WFSP criterion						
Rural socio-economic development needs	There should be a significant rural population, preferably with clearly articulated plans for development. Other agencies should be focussing on rural development.	DFID WFSP criterion						
Surface and groundwater interactions	There should be groundwater allocation problems. The water allocation plan should require conjunctive use of surface and groundwater resources to support rural development needs.	DFID WFSP criterion						
Water quality constraints	There should be water quality related problems. Watershed services should be able to address the nature of the water quality need and the associated drivers.	IIED-CSIR criterion						
Broad land-use activities	A wide range of land-use activities should be evident. These activities should be cross-cutting from livelihoods dependant use to commercial use.	IIED-CSIR criterion						
Hydrological information available	Well-documented, quantifiable and accessible hydrological information should be available, supported by local beliefs and priorities.	IIED-CSIR criterion						
DWAF priority for compulsory licensing	The area should be prioritised according to DWAFs catchment selection for compulsory licensing	IIED-CSIR criterion						
Project linkages	There should be clear and supportive linkages with other initiatives in the region.	IIED-CSIR criterion						
Demanders and sellers	Demanders and sellers of watershed goods and services should be evident and willing to support the broader initiative.	IIED-CSIR criterion						
Tangible goods and services	The identified watershed services should be tangible within the context of the catchment. Benefits should be clearly evident to all.	IIED-CSIR criterion						
Water trading	Informal markets for water trading should be evident. These trades may be temporary or permanent.	IIED-CSIR criterion						

1.3 DISCUSSION OF THE OPTIONS

A summary of the six sites reviewed is provided in Table 1.3. According to the feasibility criteria's, all six sites had the potential to provide catchment protection services. However, the Levuvhu/Letaba catchment has a greater need for the provision of basic services such as domestic water supply and sanitation, hence it was marked as having limited to no potential. All catchments had hydrological information available and showed the need for interventions for water supply improvements, water quality improvements or rehabilitation of the aquatic ecosystem. Land tenure and ownership were clearly defined for all sites except for the Upper Vaal catchment at the Klip river site. In this area, the poor tended to be organised into informal settlements and did not have any rights of tenure or ownership. Power imbalances were evident in all the catchments, but where communities were well-structured and guided by a respected tribal chief, the potential for participatory bias and competition over shared benefits was reduced. Land use activities in all catchments provided opportunities for improvement and the provision of catchment protection services. However, the demand in the Levuvhu/ Letaba was for water for productive use by poor communities, while in St Lucia these communities were situated downstream from the service demanders making it more difficult for land use changes to improve the water resource through payments for catchment protection services. Finally, the economics of the six sites indicated that there were potential buyers in all catchments, although only the Klip river and the Olifants catchment had economically powerful buyers with clear demands for catchment protection services.

Table 1.3: Summary table of the feasibility of the six reviewed sites for implementing payments for catchment protection services in South Africa

Site	Catchment protection service	Hydrology	Land ownership	Power imbalances	Land use	Economics	Comments
Olifants	√	√	√	√	√	√	Selected
Sabie-Sand	√	√	√	√	√	√	Selected
Klip River	√	√	X	√	√	√	Not selected
Mhlatuze	√	√	√	√	√	X	Not selected
St Lucia Estuary	√	√	√	√	X	X	Not selected
Levhuvu and Letaba	X	√	√	√	X	X	Not selected

Based on these reviews it is evident that opportunities for catchment protection services in South Africa have tended towards issues around water quality management through sedimentation control, wetland rehabilitation and protection, and ground water rehabilitation. Protection of the reserve and the related protection of river biodiversity were also raised. Water supply improvement tended to be less important in terms of the provision of watershed protection services and this may be due to programmes such as the working for water initiative that are already effectively addressing water flow and assurance issues.

The six sites fell into three categories of water classification, namely stressed, developed or in deficit. The Olifants, in particular, showed clear opportunities for the development for watershed protection services as sedimentation appeared to impact both the flow of water in the rivers as well as the storage capacity of the Phalaborwa Barrage. Unfortunately,

opportunities in the Sabie-Sand appear to be limited due to the scale of the sedimentation problem in the Sand River and the classification of the Sabie River as pristine.

As expected, land ownership in all six catchments was very varied and consisted of private land ownership, government owned land and communal land. The implications for property rights and the opportunity for land owners to effect changes to land management practices, varies widely across the sites. Ownership of the problems such as sedimentation, and having the authority to implement different practices, potentially limits the success of opportunities for developing payments for watershed protection services.

Power imbalances are key boundary factors to effecting payments for environmental services. This includes the power to formalise a group or base from which to negotiate prices, activities, timeframes and the nature of payments mechanisms. There are definite power imbalances in each of the six sites; many of these Imbalances are linked to the historical imbalances in South Africa. These need to be carefully addressed for payments for watershed protection services to be successful.

Land use and economic practices are also important as they help to identify the nature of the activity causing environmental damage, and also indicate whether or not there is a strong enough economic agent in the area to make payments for changing land management practices. These are explored in greater detail in the site case studies in section two of this report.

1.4 RECOMMENDATIONS

Catchment protection services are one of the most complicated environmental services to understand, quantify and package for the purposes of payments. This is mainly due to the limited amount of empirical research done on the biophysical relationships between land use activities and their impacts on water flows and water quality. Six potential sites for the implementation of payments for watershed protection services have been reviewed in this feasibility study. Each site presented unique opportunities and limitations for the development of a pilot site. Based on the comparative assessment, the selection criteria and the workshop consensus, two pilot regions were selected; these are the Olifants River Catchment and the Sabie-Sand Catchment.

Further interviews and site visits have confirmed that the Olifants River catchment has excellent opportunities for the development of payments for watershed protection services. Both buyers and sellers of services are well-defined and interested in finding solutions to meeting water quantity and quality demands in the region. There are initiatives already underway in communities that are focussing on improving land management practices through the planting of trees and grasses. These initiatives are only implemented at a very small scale of about 1 hectare plots and there is potential to increase these to 5 hectare plots, or engage with neighbouring communities or farmers. This site will be piloted in Phase 3 of the broader project on payments for watershed services.

In contrast, the Sabie-Sand catchment is however more complex for two important reasons. The first is that the Sand River sub-catchment is very large and the downstream buyers potentially are too small to facilitate payments that will effect meaningful change. Second, the Sabie River is regarded as one of the most pristine rivers in South Africa and effectively does not have any water quality demands, though water supply issues may potentially increase with new developments in the region. At this point, the pursuit of payment opportunities in the catchment are dependent on the needs of the Sabie River Water Forum and the willingness of farmers located upstream of the Kruger National Park to effect

payments. This opportunity will be investigated further as part of Phase 3 of the "Payments for watershed protection services and improved livelihoods in South Africa" project[1].

Some of the issues that need to be addressed for making payments for catchment protection services in South Africa are outlined:

- The nature of the existing communities and selection of participants needs to be addressed very carefully. Different issues are involved in selection based on free-market job creation versus a communal traditional environment. In the case of the latter one cannot just randomly select and pay people, because the method of payment and whom you employ changes the power imbalances within the community. The potential for sabotage by those bordering the project needs to be managed and addressed.
- There are benefits to including an objective and scientific view through the project team, as there are no local political pressures and alliances. However, it is important to establish good project partners on the ground so that these issues can be addressed.
- The opportunity for making payments is definitely stronger within the mining community rather than the tourism sector. Revenue from tourism is relatively insignificant when compared to payments made specifically for water by large industry such as mining, in some of the catchments.
- Sedimentation in some of the catchments is very much part of an ongoing and natural phenomenon based on soil types, this needs to be considered as it is not only a result of poor land use and management. This could potentially complicate the efforts made by communities to manage soil erosion and needs to be addressed especially in times of sudden or heavy rainfall. There is also an extended argument that commercial farmers potentially contribute quite heavily to the sediment load in rivers and not just the vast areas of marginal land housing formally displaced communities.
- The cause-effect relationships between landuse practices and water impacts are not fully understood in all the catchments reviewed.
- Finally it is imperative that an intermediary to facilitate negotiations and payments is identified and established, where an appropriate facilitator is not available.

[1] Progress and reports on this project are available at www.csir.co.za/ere/markets_4_watershed_services

2 DETAILED SPECIALIST REPORTS

This section of the report contains the feasibility studies for the six selected sites. These feasibility studies consider the potential for developing payments for watershed protection services specifically the opportunities and constraints for the hydrological flows of the area, the land tenure and ownership regimes, the identification of poor and marginalized groups with a particular focus on power imbalances, the land use patterns, and the economic activities in the selected areas. The six selected sites selected lie in the central to the eastern regions of South Africa and differ in terms of water supply, water quality, soil types, vegetation cover, industrial activity and cultural groups. Hence, these examples provide unique and diverse opportunities for action-learning around payments for watershed protection services.

South Africa is situated at the southern tip of the African continent and is bordered by six countries namely, Botswana, Lesotho, Mozambique, Namibia, Swaziland, and Zimbabwe. Regarded as the economic powerhouse of the African continent, South Africa exports extensively to many neighbouring countries. The country has a total surface area of 1.2 million km^2 and is drained by a number of perennial rivers, many of which are shared by its bordering countries, for example, the Orange River, shared by Namibia and Lesotho and the Crocodile River shared by Swaziland and Mozambique (King, 2002). Rivers are the main source of water in South Africa and approximately 77 percent of the population of 45.5 million have access to safe water (DBSA, 1998). However, due to large income discrepancies, large sectors of the population have a limited ability to cover the costs of service provision (DBSA, 1998). Figure 2.1 shows the 19 water management areas of the country and the locations of the six selected study sites.

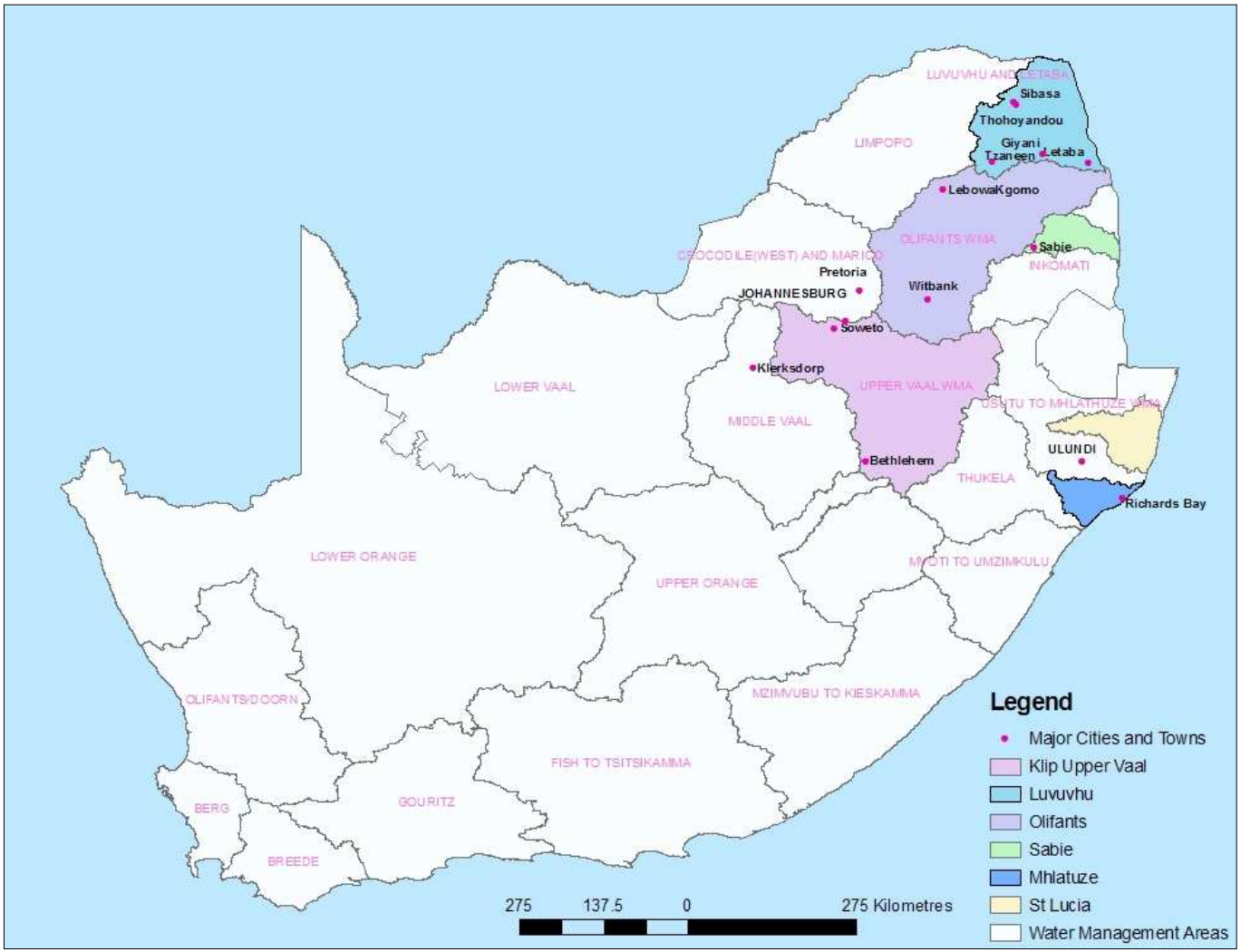

Figure 2.1: Map showing the 19 water management areas in South Africa, highlighting the position and extent of the six selected catchments

2.1 SITE ONE: THE OLIFANTS CATCHMENT

2.1.1 Introduction

The Olifants River originates to the east of Johannesburg and flows in a north-easterly direction, ultimately flowing through the Kruger National Park to Mozambique where it joins the Limpopo River before discharging into the Indian Ocean. The Olifants Water Management Area falls within the Limpopo River Basin; this basin is shared by Botswana, Mozambique, South Africa and Zimbabwe. The Olifants River flows through the Gauteng, Mpumalanga and Limpopo Provinces of South Africa. The Department of Water Affairs and Forestry (DWAF) divides the Olifants catchment into four sub-areas, namely the Upper Olifants, Middle Olifants, the Steelpoort and the Lower Olifants. Before the Olifants River flows into Mozambique it is joined by the Letaba River. The Olifants River is classified as a perennial river but is increasingly experiencing low to seasonal flows in its ower reaches where it flows through the Kruger National Park. The mean annual rainfall for this area ranges broadly between 500 and 800 mm per year with higher annual rainfall of 1000 mm in the mountain areas. A number of mining activities occur in the water management area. These mining activities extract coal, copper, phosphate, platinum, chrome, vanadium and diamonds.

Figure 2.2 shows the land cover for the Olifants River basin. The catchment extends over a distance of approximately 5,455,157.21 hectares. In the Upper Olifants catchment, fair quality water is available and is used by the commercial agriculture, mining, industrial, and residential sectors. As the river flows north it enters the Middle Olifants, a region characterised by poor, highly erodible soils. Limited commercial agriculture occurs here and the landscape is predominantly typical of rural communal land in South Africa, distinguished by high density dwellings, subsistence agriculture, overgrazing and deforestation. Soil erosion is widespread in this sub-catchment, leading to high levels of sediment in the Olifants River and its tributaries. The region is further compromised by low annual rainfall and inadequate water supply. The river then flows eastwards into the Lower Olifants Catchment. This region is characterised by some forestry, but mainly by communal land, mining, urban residential, commercial agriculture and land set aside for nature conservation. The Phalaborwa Barrage is situated just south-east of the town of Phalaborwa. Beyond this point, the Olifants River becomes increasingly stressed in terms of both water supply and water quality, with severe impacts on aquatic life downstream and into the Kruger National Park (State of the Rivers Report, 2001b).

This catchment was selected as one of the feasibility sites due to its complexity at both spatial and temporal scales. It is regarded by the Department of Water Affairs and Forestry (DWAF) as a catchment under water stress, facing pressures related to water resource distribution, efficient use and sustainability (DWAF, 1999). Due to the scale of this catchment, the diverse landscape, vegetation, soils and climatic characteristics, there are potentially many opportunities for payments for watershed protection services. This is especially true to because of the need to find well-designed and creative solutions to resolve the scarcity of water resource availability for development in the region, while as accessibility to water resources and water quality constraints become more urgent.

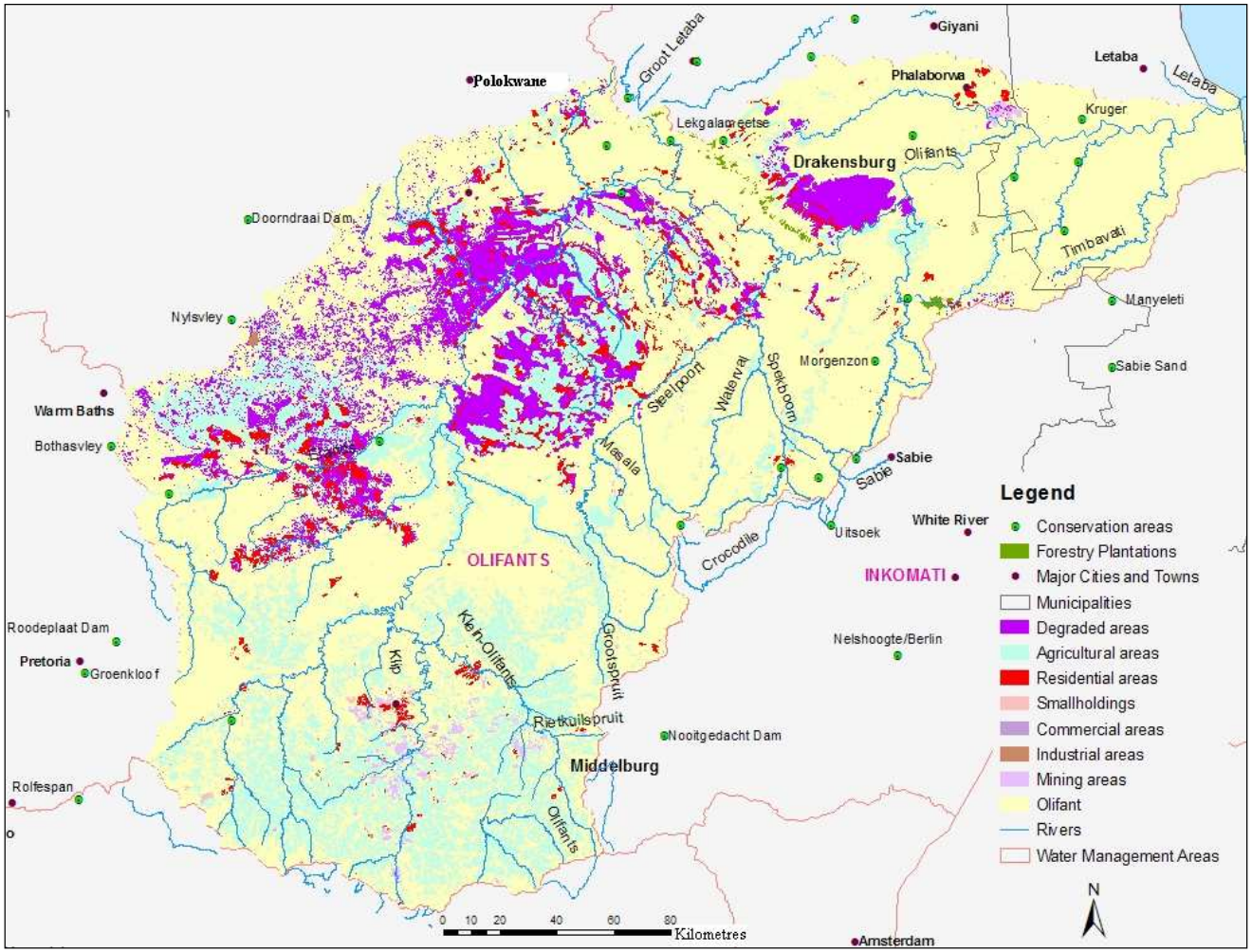

Figure 2.2: Map of the Olifants River catchment showing land cover types

A number of opportunities for payments were identified in this catchment. These ranged from water quality management through improved wetlands, sedimentation management, improved farming practices and mine water discharges, to water supply management through the removal of alien vegetation, improved efficiency in agriculture, mining and industrial activities, reduced uptake or water loss through unmanaged weirs and the protection of 'sponges'. These opportunities are investigated further in this chapter with a specific focus on the hydrology, social dynamics, land use, and the economics of the region.

2.1.2 A Hydrological review of the Olifants Catchment

This section aims to assess whether or not the hydrological landscape of the Olifants catchment would hinder or support the development of payments for catchment protection services. Four hydrological components were examined: water quantity, water quality, groundwater and aquatic ecosystem services. The implications of these four components on the potential development of payments for catchment protection services is discussed.

2.1.2.1 Water quantity

About 57 percent of water requirements in the Olifants catchment are used by the irrigation sector. Power generation represents 19 percent of the total water requirements used for cooling thermal power stations. There are no natural lakes or large wetlands in the Olifants water management area, while vleis and pans occur intermittently. The Olifants River is currently classified as a permanent river from its source through to the Mozambique border. However, the section of the river running through the Kruger National Park is increasingly experiencing only seasonal flows.

The natural Mean Annual Runoff (MAR) for the Olifants Water Management Area (WMA) amounts to 2,040 million m^3 per year, and most of the surface runoff originates from the higher rainfall and mountainous areas of this catchment (DWAF, 2004a). It must be noted that this total volume is based on preliminary estimates only, with the impact on yield being a portion of this (Table 2.1).

Table 2.1: Water requirements for the year 2000 (million m^3/year)

Sector/ sub-area	Irrigation	Urban1	Rural1	Mining and Bulk Industrial2	Power generation3	Afforestation4	Total local requirements
Upper Olifants	44	62	6	20	181	1	314
Middle Olifants	336	15	28	13	0	0	392
Steelpoort	69	3	5	17	0	1	95
Lower Olifants	108	7	5	43	0	1	164
Total for WMA	557	87	44	93	181	3	965

Source: DWAF, 2004a
1) Includes component of Reserve for basic human needs at 25 litres / person / day.
2) Mining and bulk industrial water uses that are not part of urban systems.
3) Includes water for thermal power generation only.
4) Quantities refer to the impact on yield only.

Data for the year 2000 indicate that large quantities of water were used in irrigated agriculture, while 172 million m^3 per year were transferred into the Water Management Area mainly for use as cooling water for power generation (DWAF, 2004a). Furthermore, eight million cubic metres of water per year are transferred out to the neighbouring Limpopo, Crocodile West and Marico WMAs (DWAF, 2004a).

According to the National Water Resource Strategy (DWAF, 2004a), there is a deficit in water along the whole of the Olifants River, except for the most upstream reaches. In addition to the water deficit, water requirements in the area have increased as a result of the current mining developments and the influx of people to work on the new mines (DWAF, 2004c). Other issues of particular concern especially in the communal land areas, include: the availability of water during dry seasons; pollution of water resources as a result of increasing population; pollution of groundwater by seepage from pit latrines; and the impacts of overgrazing and soil erosion on water resources (DWAF, 2004c).

2.1.2.2 Water quality

A number of mining activities occur in the Olifants WMA. These include: coal mining in the Upper Olifants, platinum and chrome mining in the Middle Olifants, copper and phosphorus mining in the Lower Olifants. The coal mines in particular have a high potential to degrade the quality of water in associated rivers, especially in the Upper Olifants sub-area (DWAF, 2004c). However, remedial measures have been taken to control the discharge of mine leachate and wash-off to with the assimilative capacity of the natural streams (DWAF, 2004a). In the Middle and Steelpoort areas, water quality problems include: salinity, eutrophication, and sediment (DWAF, 2004c). The salinity and eutrophication problems have been attributable to return flows from irrigation, seepage from mining and discharges from sewage treatment plants. The sediment problem has been attributed to poor agricultural practise in the rural areas, and has caused operational problems at the Phalaborwa Barrage. It has been reported that in the Lower Olifants sub-area return flows from the mining complex around the Phalaborwa area influence the quality of water in the Ga-Selati River, which as a result impacts on the quality of water in the lower Olifants River.

2.1.2.3 Groundwater

The Olifants WMA has a very variable lithology, which controls the occurrence of groundwater at any given area. The lithology ranges from Karoo age siltstone and sandstone, to granite in the Lowveld. The highest groundwater resources are, however, associated with the dolomitic aquifer (DWAF, 2003b), which occupies only about four percent of the total area within the Olifants catchment. Large quantities of groundwater (estimated at 6.19 million m^3/ year, ISP) are used for irrigation purposes especially in the north west of the Olifants WMA (DWAF, 2004a). In addition, large quantities of groundwater are also used for rural water supplies especially in the Middle Olifants sub-area where most of the rural population reside. There is a substantial potential for increased groundwater utilisation on the Nebo Plateau, though, further exploitation of groundwater in areas underlain by dolomitic aquifers may directly impact on surface water flows.

A number of groundwater issues have been identified in the Olifants WMA. These include: the mining and industrial activities that pose risks to the natural groundwater quality and, thus, surface water quality; the dewatering around open pit mines and increased backfilled pits leading to decant of poor quality water; the impact of agricultural activities on water resources due to the use of fertilisers (these contribute to the levels of nitrates and phosphates in groundwater); the heavy utilisation of dolomite in the Delmas area and over-exploitation of

groundwater resources of the basalt in many areas; and the impact of erosion on groundwater recharge (DWAF, 2004c).

2.1.2.4 Aquatic ecosystems

The condition of the riverbeds in the Olifants WMA varies between heavily modified to slightly modified, while the flow and riparian/bank conditions vary between severely modified and slightly modified. Most instream biota is indigenous in the surface water resources of the Olifants WMA. Watershed services to improve the livelihood of aquatic ecosystems in this sub-area would include the rehabilitation of riparian vegetation especially in areas where the riparian/bank conditions are severely modified (DWAF, 2000).

2.1.2.5 Implications of hydrological issues for developing payments for catchment protection services in the Olifants catchment

The Department of Water Affairs and Forestry classifies the Olifants WMA as a water stressed area, with a deficit of 192 million m^3/year. Due to the increased demand for water in the Olifants WMA and the water quality problems mentioned above, there is an opportunity for the development of catchment protection services, especially through sediment management and wetland rehabilitation. Other options include effective management of agricultural activities to mitigate the impacts of return flows on the quality of water, efficient application of remedial measures to control leachate and wash-off from mines. Implementation of these options would help to improve overall water quality. Water Conservation and Demand Management (WCDM) measures could also be used. These include measures such as implementing low-water use technologies in agriculture to allow more raw water to be available in streams, and reusing water where feasible.

2.1.3 Land tenure and ownership arrangements in the Olifants catchment

One of the critical components for developing payments for catchment protection services is clearly defined property rights. This includes property rights associated with land and land-based activities that impact on the water resources in the catchment. This section reviews the land tenure and ownership arrangements in the Olifants catchment and their implications for payments for catchment protection services.

The Upper Olifants Sub-Area is the economic heart of the catchment and also the site of the largest urban areas in the catchment: Witbank and Middelburg. Urban, mining and industrial developments in this sub-area are expected to lead to continued strong population growth. Large-scale commercial irrigation agriculture occupies the lower reaches of the sub-area and parts of the Middle Olifants Sub-Area (downstream from the Loskop Dam). Large tracts of land in the sub-area fall under urban and industrial use and some 80 percent of the population of this sub-area lives in formal urban areas (DWAF 2004a). Land is mostly used for industry, mining, urban residential purposes or commercial agriculture. Land ownership is mostly private. The large irrigation developments downstream of Loskop dam result in irrigated agriculture having the highest water demand in the Middle Olifants Sub-Area, despite 60 percent of the total population of the catchment living in this sub-area. Agriculture contributes 7 percent to the gross geographic product (GGP) of the Olifants WMA, while irrigation agriculture accounts for 57 percent of the total water requirements in the catchment (DWAF 2004c). Power generation represents 19 percent of the total water requirements in the catchment and urban, industrial and mining, together, account for a further 19 percent

(DWAF 2004c). The highest water requirements in the Upper Olifants Sub-Area are represented by the thermal power stations located here.

Moving downstream towards the Middle Olifants Sub-Area, past the commercial agriculture in the vicinity of Loskop Dam, brings one to the so-called "communal areas" of the catchment. The Middle Olifants Sub-Area is the most populous of all the sub-areas. But despite this fact, water use for domestic purposes is very low in comparison with other sectors (such as irrigation agriculture near Loskop Dam, the main water user in the sub-area). Service delivery is very poor in this area, large parts of which used to belong to the former homelands of the Apartheid era (the Lebowa homeland in particular). Rural dwellers practice subsistence agriculture to some degree, but poor quality soils and land degradation coupled with inadequate infrastructure curb the extent of these practices. Government aims to bring most South Africans on a basic standard of service delivery by 2010 (the so-called "RDP standard"). This will increase demand for service delivery (especially water) in the communal areas of the catchment. At present, water use for domestic purposes is low where individuals rely on water from a communal water source from where they have to transport the water to the homestead. When water is freely available from a tap in the yard or house, water use increases.

The agricultural practices of the rural communities in the Middle Olifants- and Steelpoort Sub-Areas of the catchment are the main source of the sediments in the Olifants River (DWAF 2004a). The soils in these areas are highly erodible and are not well suited for agriculture. However, in the Apartheid Era, the BaPedi communities living in the catchment had no choice as to where they could live and were forced to depend on the land and the surrounding natural resources for their livelihoods. The high erodibility of the soils in the Middle Olifants Sub-Area coupled with inadequate land management practices are the major contributing factors to sedimentation in the river. Irrigation schemes originally established as poverty relief initiatives in the homelands are currently in disrepair, though there are plans to revive these irrigation schemes (DWAF 2004a). This will increase water usage and agricultural activity in the Middle Olifants- and Steelpoort Sub-Areas. DWAF (2004a) notes that poverty eradication schemes – such as irrigation schemes – will not be sustainable if the full cost of water is applied (water transferred into the catchment is imported at a high cost and is therefore expensive). DWAF (2004a) is examining opportunities where existing water allocations can be made available for poverty eradication schemes. Land tenure and ownership in the former homelands depend on the authority in the area. Where areas fall under the authority of municipalities, private land ownership is encouraged. In areas still under the authority of tribal leaders, access to land (whether for housing or agriculture) is gained with permission from the tribal authority. The tenure regime in the "communal areas" of the Middle Olifants Sub-Area and parts of the Steelpoort Valley is of a mixed nature. This area is commonly known as Sekhukhuneland.

The Steelpoort Sub-Area is the site of mining- and industrial activity as well as irrigation agriculture – irrigation and mining are the largest water users in the sub-area. The proposed De Hoop Dam will also be situated in the Steelpoort Valley. The dam will be planned in such a way as to release its proportional contribution to the ecological Reserve. The water from the dam will come at a high cost and it is unlikely that irrigation and afforestation developments will be able to afford the water. The water will be largely used to supply the mines and domestic requirements (DWAF 2004a). Parts of Sekhukhuneland fall within this sub-area. Land ownership is therefore private, public and communal. Some conservation areas are found in the Steelpoort Valley such as the Sterkspruit- and Lydenburg Nature Reserves. Further development of chrome and platinum mines has been proposed and it is expected that these developments will result in significant urban growth within the sub-area. Urban growth is also expected in Burgersfort where mine workers will be housed (DWAF 2004a).

The Lower Olifants Sub-Area is the site of large conservation areas, most notably the Kruger National Park in the lower reaches of the Olifants River. The main urban area of this sub-area is Phalaborwa which owes its existence to the mining sector. Land ownership in town is mostly private – land is either owned by individuals or by mining companies. The Ba-Phalaborwa municipality is the main user of water purified by the Lepelle Water Board (situated in close proximity to the Phalaborwa Barrage and mines). Large tracts of land in the Phalaborwa area belong to mining companies – a company such as SASOL even holds land for conservation and recreational purposes apart from the large areas of land utilised specifically for mining activities.

2.1.4 Identification of poor and marginalized groups in the Olifants catchment

Communities in Sekhukhuneland generally have a low quality of life (QoL) due to inadequate service delivery and unemployment. Additional livelihood streams, such as income from the provision of watershed services, will be welcomed by communities in this area.

Quality of life is a difficult concept to define. Westaway (2003) described QoL as a multidimensional concept, with objective and subjective components, that shift with changing social circumstance. Despite a doubling in the national income of the United States, for example, life satisfaction remained the same due to QoL indicators expanding from material terms of income to include more spiritual rewards such as satisfaction with personal development (Westaway, 2003). Indicators of QoL, in this instance, will focus on qualitative and subjective information.

The core components of QoL are health status, well-being and satisfaction in a range of life domains (Westaway, 2003). South African studies have shown that well-being and satisfaction are often directly related to levels of service delivery, the nature of employment and levels of income (Devey & Møller, 2003; O'Leary, 2003; Richards, 2003; Westaway, 2003). Westaway (2003) demonstrates the link between service delivery and QoL in Doornkop, South Africa, indicating that improved QoL is an outcome of service delivery (Doornkop is situated in the City of Johannesburg Metropolitan Area and comprises both formal and informal housing).

High unemployment rates (only 38 percent of the labour force is employed), low income levels (43 percent of household report no annual income) and a low standard of service delivery (see Table 2.1) in Sekhukhuneland contribute to a low QoL in this area. Many households rely on migrant labour for income (RADAR, 2002). Where health status is a core component of QoL, the health status of the communities of Sekhukhuneland can be said to contribute to a low QoL, with a 13.2 percent HIV prevalence rate among women attending antenatal clinics (RADAR, 2002).

The area known as Sekhukhuneland forms part of the former Lebowa homeland. In the 1960s, Sekhukhuneland, together with a number of other so-called "native reserves", was incorporated into a homeland for the BaPedi people. The homeland, known as Lebowa, is now part of the Limpopo Province. The former Lebowa is made up of a number of municipalities, such as the 5 local municipalities that together forms Sekhukhune Cross Boundary District Municipality, that occupies parts of Mpumalanga and Limpopo Provinces. Due to the history of the area, the demographics of the 5 local municipalities are very similar. For the purposes of this study, the demographics of one of these local municipalities was studied in further detail.

The Greater Tubatse Local Municipality

The Greater Tubatse Local Municipality is situated in the north-western section of the Olifants Catchment (north-west of Lydenburg) and mainly in the Middle Olifants Sub-Area. The QoL of the inhabitants of this municipality reflects the overall QoL of the majority of residents in the previous Lebowa homeland, confirmed by demographic data from Statistics South Africa (2001). People mainly engage in subsistence agriculture although poor quality soil, land degradation and poor water delivery infrastructure decreases the actual contribution from agriculture to livelihoods. Many households rely on migrant labour to generate livelihoods (RADAR, 2002).

The population of the Greater Tubatse Municipality is mainly comprised of BaPedi people – African people speaking the Sepedi language. In terms of population groupings, 99 percent of the population of the municipality is comprised of African people (as opposed to White, Coloured and Indian) (Statistics South Africa, 2001). Ninety percent of the population speaks the Sepedi language. The majority of the population of the municipality is under the age of 34; 30 percent of the population falls into the 5 to 14 age group while 34 percent falls into the 15 to 34 age group (Statistics South Africa, 2001). The average age of residents of the municipal area is therefore quite low implying that quite a large proportion of the population is too young to work.

Table 2.2 indicates the status of objective factors that indicate the QoL of the residents of the Greater Tubatse Municipality. In Table 2.2, only the most significant groupings are reflected for every factor (for example, the majority of the population use either electricity or candles for lighting).

Based on these statistics, the majority of the population of Sekhukhuneland live in poverty; 43 percent of the population reports no annual income, while 22 percent of households receive less than R800 per month. The majority of households in Sekhukhuneland have 4 or more household members; R800 per month per household implies that individuals have to live on less than the UNDP standard of $1 a day.

In the Middle Olifants- and Steelpoort Sub-areas, a number of irrigation schemes that fell into disuse are in the process of being revived as poverty eradication initiatives (DWAF, 2004a). DWAF (2004a) includes these irrigation requirements in the water requirements for the sub-areas. The revival of these irrigation schemes can be expected to have a number of impacts on the socio-economic and biophysical environment of the catchment. If sustainable, the irrigation schemes may improve the livelihoods of communities, but this would be at the cost of increased water usage in an already water stressed catchment. A shift from livestock farming to irrigated agriculture may reduce land degradation resulting from overgrazing. In turn, this may decrease soil erosion and reduce the quantity of sediment in the river system. On the other hand, an increase in agricultural activities due to the revived irrigation schemes may increase sedimentation of the river if appropriate measures are not implemented to prevent or reduce soil erosion.

Table 2.2: Status of factors contributing to the quality of life of residents in the Greater Tubatse Municipality

Factors affecting quality of life	% of population
Income	
Households with no annual income (2001)	43
Households that receive between R4801 and R9 600 per annum (less than R800 per month) (2001)	22
Education	
Individuals over 20 years old with no education	40
Individuals over 20 years old with secondary education	28
Employment	
Individuals not economically active in potentially economic active population	65
Individuals unemployed in potentially economic active population	21
Individuals employed in potentially economic active population	13
Individuals in total labour force employed	38
Housing	
Households with formal housing	73
Households with traditional housing	18
Energy	
Households with electricity for lighting	47
Households using candles for lighting	47
Sanitation	
Households with pit latrine (not Ventilated Improved Pit Latrine)	55
Households with no sanitation facilities	26
Access to Water	
Households with access only to water from river / stream	25
Households with a communal standpipe further than 200m away	30
Households with a communal standpipe closer than 200m	15
Waste Removal	
Households with own refuse dump (not municipal service)	65
Households with no form of waste disposal	27

Source: Statistics South Africa 2001

2.1.4.1 Institutional information and the implications of power imbalances for payments for catchment protection services in the Olifants catchment

Stakeholders in the Olifants catchment (specifically with regard to the Phalaborwa Barrage and sedimentation of the river) include: The Lepelle Water Board, the Olifants River Forum, the Ba-Phalaborwa Environmental Forum, DWAF, the provincial departments of environment and water affairs, nature reserves, SANParks (Kruger National Park), mines (Palabora Mining Company, FOSKOR), the relevant municipalities (such as the Sekhukhune Cross Boundary District Municipality), community members, community-based organisations (such as the Sekhukhuneland Ad Hoc Committee on Land), and non-governmental organizations operating in the area.

Confusion regarding institutional structures within the catchment, especially within the communal areas, may hinder the establishment of markets for watershed services. This uncertainty regarding institutional structures is illustrated in a statement submitted by the Sekhukhuneland Ad Hoc Committee on Land to the Portfolio Committee on Agriculture and Land Affairs in November 2003 (PLAAS, 2003). This statement, which covers issues surrounding land tenure and ownership in Sekhukhuneland, was aimed at informing the

Communal Land Rights Bill process of the Department of Land Affairs and reveals tensions between traditional authorities and local government in Sekhukhuneland.

Key issues, related to land ownership and tenure in communal areas, are (PLAAS, 2003):

- Rural people have no access to secure land and property rights;
- Women, and in particular unmarried women, have no access to land rights;
- There is tension between traditional authorities and local government over issues of development;
- There are boundary and land disputes as a result of the "illegitimate" 1993 land transfers to tribal authorities;
- Traditional chiefs still charge levies for land allocations and natural resource utilisation;
- Rural people are still threatened with evictions by traditional chiefs; and
- There is an overlapping of processes – land claims and land disputes have not been settled, yet the Communal Land Rights Bill is imposed.

The establishment of markets for watershed services in the Olifants Catchment may be affected by factors such as tenure security (or insecurity), governance structures, the land reform process (related to tenure security), resolution of disputes, access to natural resources and the power of traditional leaders in certain areas. For example, where there is uncertainty regarding land ownership, markets for watershed services may be compromised due to undefined service providers or suppliers. Where the traditional chief is responsible for decision-making in communal areas, the terms and conditions of a wider market may be affected by a single individual's decisions and perceptions. A person or governance structure that wields the power in areas where markets are established will have the ability to influence the process, and probably the outcome, of establishing markets.

Similarly, coordination between the stakeholders in the wider catchment, such as conservation authorities, mines, the Water Board and communities, will determine whether a market for watershed services can be implemented successfully in the catchment. Disputes regarding the actual causes of high sediment levels in certain stretches of the river may be a constraint to the proposed market for watershed services.

2.1.5 Land use in the Olifants catchment

The various land uses within the Olifants catchment and the potential impacts these land uses have on the water resource influence the potential for payments for catchment protection services in the catchment. Land uses in the Olifants catchment include commercial and subsistence agriculture, forestry, nature reserves, mining, industry, and urban and rural settlements. Table 2.3 presents statistics for the area under each different land use type. The 'other' land use category includes land uses such as rural settlements, mining and industrial land uses (DWAF, 2003b). A significant proportion of land used in this catchment (approximately 85 percent) is highly dependent on the availability of water for productive use in order to continue to be sustainable under the current practices.

Table 2.3: Area under specific land use in the Olifants catchment

Land use	Area (km2)	Area (%)
Agriculture Irrigation Dry land	783.0 8 156.1	1.44 14.95
Forestry	395.0	0.72
Protected nature reserves	6 990.0	12.81
Urban	1 035.7	1.90
Other	37 203.2	68.18

Source: DWAF (2003b)

In the Upper Olifants catchment, there is a concentration of mines, as well as light and heavy industries around the Witbank and Middelburg areas (Ashton et al., 2001). In the middle of the catchment, the main land uses are commercial and subsistence agriculture, forestry and rural settlements. The lower catchment consists of the Phalaborwa Barrage and the Kruger National Park (DWAF, 2003b).

2.1.5.1 Agriculture and Forestry

The major agricultural activities in the catchment are citrus farming and forestry plantations (mainly Pine and Eucalyptus). The citrus and sub-tropical fruit orchards are found in the Middle Olifants catchment, Steelpoort area and Lower Olifants catchment. The heavy abstractions of water required for citrus farming (between Loskop Dam and Marble Hall) reduce the availability of water for ecological functioning downstream in the Lower Olifants catchment. Other commercial crops grown in the catchment include maize, wheat, sorghum, cotton, tobacco, lucerne, potatoes, vegetables, soya bean, cotton, oil seeds and sunflowers. Livestock farming is also prevalent throughout the catchment (Ashton et al., 2001).

Subsistence farming in the area consists of livestock farming (including cattle, goats and donkeys) throughout the Middle and Lower Olifants catchment and rain-fed agriculture particularly in the Lower Olifants catchment (Ashton et al., 2001). Heavy overgrazing and dryland cultivation throughout the Steelpoort River catchment and Middle Olifants catchment has led to soil erosion (Ashton et al., 2001, State of the Rivers, 2001b). The erosion causes high silt levels in rivers and these high levels of silt result in suffocation of in-stream habitats and fish gills leading to loss in fish species. Siltation increases the risk of flooding (DWAF, 2003b and State of the Rivers, 2001b).

The largest forestry plantations occur in the Blyde River area and the main types of trees are Pine and Eucalyptus (DWAF, 2003b). Indigenous forest occupies 1 399 km^2 in the Blyde River area and lower Olifants catchment and the effect of this indigenous forest on runoff is regarded as natural. Plantations close to the river cause increased in-stream sediment loads (State of the Rivers, 2001b).

2.1.5.2 Mining

The products of the mining industry in the Olifants Water Management Area (WMA) include coal, fluorspar, lime, sand, clay, brick, stone, granite, magnesite, mica, copper, emeralds, phosphate, andalusite, tin, gold, iron ore, felsite, asbestos, chrome, vanadium and platinum (DWAF, 2003b). Extensive coal mining takes place in the Upper Olifants area and these coalmines provide fuel to the local power stations and the domestic and international markets.

In addition, the Premier Mine situated outside the Olifants River Basin also receives water from the Wilge River. Mining activities generally have a negative effect on water quality.

Products of mining activity in the Middle Olifants area include andalusite, platinum, asbestos and chrome. There are eight mines in the Steelpoort area producing chrome, vanadium, platinum, granite and coal. The Lower Olifants Area is the area where significant mining activities are taking place. Major mining companies include Palabora Mining Company, Foskor and Pegmin Mine and their products include copper, emeralds, asbestos, magnetite, phosphate, clay, feldspar, slate, fertilizer, gold, mica, crushed stone, platinum, andalusite and chrome (Ashton et al., 2001 and DWAF, 2003b). Appendix 1, lists the mines in the Olifants catchment, their status and relative size, as well as the commodities produced by each mine and the probable scale of environmental impact associated with each mine.

Implications of mines on water quality in the Olifants catchment

The impacts of mining activities on water quality in the Olifants catchment are based on a report written by Ashton, et al. (2001). The effects of mining activities in the Wilge catchment were found to be minor and localised on the water resources in this catchment. These effects on water resources are caused by limited acid mine drainage and increased suspended sediment loads in nearby streams. Extensive mining in the Riet Sub-catchment has high impacts on water resources, particularly the water quality of all streams and rivers. Like the Wilge Sub-catchment, the water quality problems are caused by extensive acid mine drainage. The mining activities in the Middle Olifants catchment leads to increasing levels of trace metals and micro-pollutants such as asbestos fibres being found downstream in the Olifants River.

Mining activities in the Steelpoort Sub-catchment have negative impacts on water in the river systems but there is no clear indication that mines are contributing quantities of either vanadium or chrome to the rivers. The two small mines near Pilgrims Rest in the Blyde Sub-catchment were found to be the likely cause of the increases in suspended sediment concentration but these impacts are localised. The water in the Selati Sub-catchment is contaminated by the effluents from mining activities and is considered to be unsuitable for the protection of aquatic ecosystems and also unfit for human consumption. However, the effluents have increased the quantity of water flowing in the Lower Ga-Selati River and converted this naturally seasonal river into a perennial river.

2.1.5.3 Industries

Industries in the Olifants catchment tend to support the main primary activities in the area where they are located such as agriculture and mining (Ashton et al., 2001). Table 2.4 highlights some of the industries that are situated in the Olifants catchment in the major industrial areas. The main industries in this catchment are steel manufacturing (Highveld Steel in Witbank and Columbus Steel in Middelburg), basic metal industries, manufacturing of machinery and equipment (DWAF, 2003b).

Another important primary industry is electricity generation. There are five Eskom-owned power stations in the Olifants catchment, namely Arnot, Duvha, Hendrina, Kendal and Komati power stations. These power stations are concentrated in the Mpumalanga province near Witbank and Middelburg (Eskom, 2001). According to Ashton et al. (2001), power stations impact on the water resources in the Upper Olifants catchment through the disposal or seepage of their high salinity cooling water; and seepage from ash dumps into the local water resources. However, Eskom (2001) is allowed to dispose of its wastewater in a controlled fashion through its participation in the Saline Release Scheme in the Olifants catchment.

Table 2.4: Some industries in the Olifants catchment

Area	Name of Industries
Witbank	Polifin Samcor Ferrometals Landau Transalloys Vantra Highveld Steel and Vanadium Witbank Abattoir
Middelburg	Colombus Steel Middelburg Ferrochrome Kanhym Feedlot
Delmas	I & J

Source: DWAF (2003b)

Heavy metals and chlorides in effluents from industries and mines originating in the Phalaborwa area may reach unacceptable levels during low flow periods. Upstream abstractions from Ga-selati River cause flow to cease during winter (State of the Rivers, 2001b).

2.1.5.4 Phalaborwa Barrage

The sediment from upstream activities, including overgrazing, industrial and mining activities, accumulates in the Phalaborwa Barrage (State of the Rivers, 2001b). When the Barrage is scoured from time-to-time, large quantities of sediment are released into the Olifants River inside Kruger National Park (KNP) (Ashton et al., 2001). The increased sediment load causes severe fish kills and/or the suffocation of fish by silt clogging their gills, resulting in the loss of invertebrate and fish species. The accumulation of metals in the Phalaborwa Barrage also results in high concentrations of metals in the gills and livers of fish. The accumulation of metals in the bodies of fish reduces their survival and disrupts their development, growth and reproductive potential (Marx and Avenant-Oldewage, 1998, Buermann et al., 1995 and Venter and Deacon, 1995). There are high silt loads in the Olifants River inside the KNP during summer; during dry seasons, silt loads are generally lower (Buermann et al., 1995).

2.1.5.5 Nature and game reserves

Private land owners in the Gravelotte, Phalaborwa and Mica area have formed and are managing a conservancy known as the Selati Game Reserve. The reserve consists of approximately 30,500 to 33,000 ha of land with 6 different veld types and 22 species of large mammals (Nature Net Properties, 2003 and State of the Rivers, 2001b). This change in land-use from privately owned land to a private conservation area is expected to improve river health conditions in this area and downstream (State of the Rivers, 2001b). Table 2.5 lists the protected natural areas and heritage sites in the Olifants catchment. These protected areas are situated primarily in the Middle and Lower Olifants catchment.

Table 2.5: Protected Natural Areas and Natural Heritage Sites in the Olifants catchment

Area name	Category
Kruger National Park	National Park and Equivalent Reserves
Klaserie	Habitat and Wildlife Management Area
Umbabat	Habitat and Wildlife Management Area
Timbavati	Habitat and Wildlife Management Area
Thorny Bush	Habitat and Wildlife Management Area
Blyderiverspoort	Habitat and Wildlife Management Area
Hebron	Habitat and Wildlife Management Area
Welgevonden	Habitat and Wildlife Management Area
Burgersfort	Habitat and Wildlife Management Area
Lydenburg	Habitat and Wildlife Management Area
Loskop Dam	Habitat and Wildlife Management Area
Enkeldoornspoort	Habitat and Wildlife Management Area
Scuinsdraal	Habitat and Wildlife Management Area
Bewaarkloof	Habitat and Wildlife Management Area
Serala	Habitat and Wildlife Management Area
Lekgalameetse	Habitat and Wildlife Management Area
Mokobulaan	Natural Heritage Site
In-de-Diepte Reserve	Natural Heritage Site
Mount Sheba	Natural Heritage Site
Driekop Caves	Natural Heritage Site
London Nature Reserve	Natural Heritage Site
Doornkop	Natural Heritage Site

Source: DWAF (2003b)

Most tourist activities in the KNP are concentrated along the rivers dues to their aesthetic appeal and their attraction to wildlife. It is therefore inevitable that any deterioration of these aquatic ecosystem will have an adverse effect on tourism in the KNP (Venter and Deacon, 1995).

2.1.5.6 Human settlements

The large urban settlements in the Olifants catchment include Witbank, Middleburg, Bronkhorstspruit, Groblersdal, Lydenburg, Belfast, Phalaborwa and Lebowakgomo. Most of these settlements were developed after the discovery of minerals in these areas. The major rural settlement area in the Olifants catchment is the Sekhukhune area (DWAF, 2003b). Housing developments require the clearing of vegetation and this increases the risk of erosion (State of the Rivers, 2001b). According to Ashton et al. (2001), other impacts of human settlements on water resources in the catchment result from the disposal of domestic effluent, litter and domestic solid waste that are found alongside the roads and across the catchment, and landfill and other solid waste disposal sites in towns.

2.1.5.7 Alien vegetation

According to DWAF (2003b), commercial afforestation has been one of the major sources of alien vegetation in South Africa, largely because of poor forestry management practices in the past. However, new commercial afforestation plantations were found to be generally well managed, maximizing benefits of forestry and minimizing environmental impacts. There is total area of 1,988.3 km^2 that is invaded by alien vegetation. Table 2.6 below shows the area invaded by alien vegetation in the Olifants catchment. The Middle Olifants is the catchment

most affected by alien vegetation followed by the Blyde Sub-catchment. The part of the catchment least affected by alien species is the Upper Olifants catchment.

Table 2.6: Alien vegetation invasion in the Olifants catchment

Secondary catchment	Area (km2)
Upper Olifants	1.8
Wilge	23.2
Elands and Olifants Loskop Reach	270.1
Steelpoort	293.8
Middle Olifants	871.9
Blyde	309.3
Lower Olifants	218.2
Total	1988.3

Source: DWAF (2003b)

2.1.5.8 Implications for land use on the development of catchment protection services in the Olifants Catchment

The major sources of pollution in the catchment are from: subsistence livestock farming and dryland agriculture, in the form of increased sediment loads, and from mining and industry in the form of acid mine drainage and industrial waste. The ecological functioning of the lower catchment inside the Kruger National Park (KNP) is impacted negatively by sediment loads with an associated deterioration in water quality. Other negative impacts on water resources are the reduction of water availability by alien vegetation. Environmentally degraded areas are particularly prone to invasion by invasive species of alien plants.

2.1.6 An economic review of the Olifants catchment

This economic review examines the general economic state of the catchment and identifies possible economic players for payments of catchment protection services. Particular attention was paid to potential buyers of these services.

The GGP of the Olifants catchment was R28.7 billion in 1997, which represented a 4.9 percent contribution to the Gross National Product. The largest contributing economic sectors within this catchment are the mining and manufacturing sectors. Relatively high levels of unemployment are experienced in this catchment. Employment is concentrated within the government (community, social and personal services sector), wholesale and retail trade and agricultural sectors (when the private household sector is excluded). Agriculture is the largest water user and will be sensitive to changes in the availability and cost of water.

2.1.6.1 Gross Geographic Product

The Olifants WMA generates an average of approximately R526 per km^2. The magisterial districts that contributed the most to GGP were Middelburg (25.7 percent), Witbank (20.6 percent), Moretele 2 (14.5 percent), Highveld Ridge (7.5 percent) and Phalaborwa (5.3 percent). The four main economic sectors are mining (22.1 percent), manufacturing (18.2 percent), electricity generation (15.9 percent) and the government sector (15.6 percent) (DWAF, 2003b).

The estimated value of KNP tourism in the 1999/2000 financial year was R136 million in terms of on-site expenditure, R267 million in terms of economic impact, or all expenditure related to visiting the park, and R1 Billion in terms of consumer surplus (Turpie and Joubert, 2001).

2.1.6.2 Employment

Forty-five percent of economically active people in the Olifants WMA were unemployed according to the strict definition of unemployment in 1994. The largest employers were the government sector (48.3 percent), the mining sector (21.3 percent) and the agricultural sector (19.1 percent) (DWAF, 2003b).

Employment figures for 2001 were calculated using the employment data available for the following municipalities that constitute the Olifants catchment: Lepelle-Nkumpi (NP355), Fetakgomo (NP03A3), Maruleng (NP04A1), Greater Tubatse (CBLC5), Makhudutamagu (NP03A2), Mookgopong (NP364), Bela-Bela (NP366), Greater Marble Hall (CBLC3), Greater Groblersdal (CBLC4), Delmas (MP311), Emalahleni (MP312), Middelburg (MP313), Highlands (MP314), Thembisile (MP315), Dr JS Moroka (MP316), Kungwini (CBLC2) and Nokeng tsa Taemane (GT02b1). It was found that 48.6 percent of the economically active people in the catchment were unemployed according to the strict definition of unemployment (Statistics SA, 2003).

Figure 2.3 shows how each economic sector contributed to formal employment levels in the Olifants catchment by economic sectors in 2001. The main employer is the community, social and personal sector (19.3 percent of total employment) which includes the government sector. Other major employers are the wholesale and retail trade (13.1 percent), private household (12.3 percent) and agricultural sectors (12 percent).

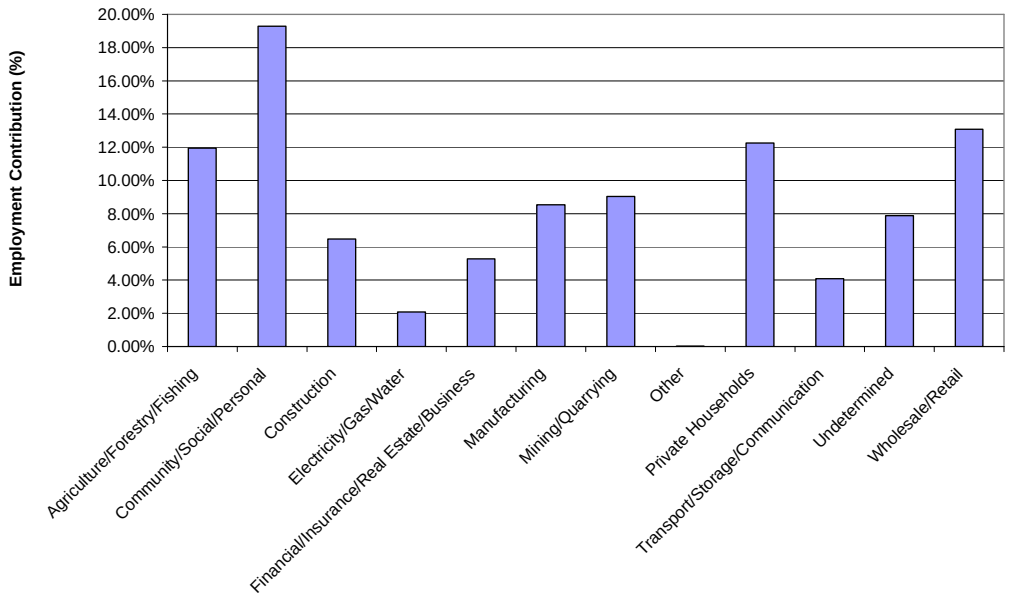

Figure 2.3: The contribution to employment by economic sectors in the Olifants catchment in 2001. Source: (Statistics SA 2003)

2.1.6.3 Resource use

Table 2.7 shows that irrigated agriculture and the ecological reserve are estimated to need almost 60 percent of the total water required in the Olifants catchment (DWAF, 2003b). The ecological reserve is relatively sensitive to the availability of water but will not be sensitive to the price of water as this is theoretically set aside by DWAF as part of the Reserve. Agriculture, on the other hand, will be very sensitive to the availability and price of water over specific seasons. This sector employs a large proportion of people but also makes one of the smallest contributions to the local economy; thus the effect of watershed services should be monitored carefully within the sector. The mining and industrial sectors use the third largest proportion of water in the catchment. These sectors could afford payments for watershed services but may not necessarily demand these services, as they are concentrated upstream.

Table 2.7: Estimated water requirements in the Olifants catchment

Economic activities	Water requirements (million m^3)
Agriculture Irrigation	 600
Domestic Urban Rural	124 80 44
Bulk users Mining Industry	258
Afforestation	54
Power generation	181
Alien vegetation	122
Ecological reserve	480

Source: DWAF (2003b)

2.1.6.4 Implications of land use practices and economic power imbalances on payments for catchment protection services in the Olifants catchment

According to the available land use and economic data, the Olifants River catchment depends highly on the mining and the community and social services sectors as the largest generators of income and providers of employment for the catchment, respectively. The majority of productive land is used for agriculture, protected reserves and other land uses (which include rural settlements, mining and industrial land). Agriculture, industry and mining are based in both the upper and the lower parts of the catchment with poor and marginalized groups of communities situated in the middle of the catchment. This allows for the transfer of payments from downstream users to upstream users for the provision of watershed protection services.

The highest demand for water in the catchment comes from irrigated agriculture, the ecological reserve and bulk water users. The ecological reserve in this case refers to the water required for the ecological functioning of the catchment as the ecological reserve has not yet been established. KNP could be a potential buyer of watershed services (improved water quality and quantity), however the limited net income of the KNP would likely constrain this option.

Other potential buyers are the mining and industrial sectors. Two industries in particular have been identified at this stage, namely FOSKOR and the Palabora Mining Company, although all of their water dependent activities are linked to agreements with the Lepelle Water Board

resulting in payments being directed or approved by the water board unless they form part of social corporate responsibility initiatives around community upliftment.

Another potential buyer is the Lepelle Water Board as it is responsible for managing the Phalaborwa Barrage and is seeking creative solutions to reduce the sediment inflows that currently reduces the storage capacity of the barrage to a mere 10 percent of its total capacity. If sediment loads are decreased, the Lepelle Water Boards will benefit through lower scouring costs. Opportunities are evident within this catchment and the potential buyers that have been approached through site visits are open to the ideas and concepts around payments for watershed services and improved livelihoods. However, the actual payments need to be quantified before these buyers can begin to make decisions around participation from an economic and financial perspective.

2.1.7 Catchment protection services identified in the Olifants catchment

Based on the hydrological landscape outlined in section 2.1.2 and the increasing demand for water of an appropriate quality in the Olifants catchment, there are numerous opportunities for the identification of catchment protection services and the development of payments for these services. The identified services can be classified into 3 core themes, namely; ecosystem goods and services protection and maintenance; water quantity; and water quality.

Table 2.8 lists the catchment protection services identified in the Olifants catchment and describes the associated activity required to achieve the provision of this service. The table also states whether or not there is an opportunity for the development of these services in the catchment. It is important to note at this point that almost all of these services can potentially be developed and that users have expressed a real demand for them. However, the following criteria have been used as the foundation for this feasibility review and all components need to be at least partially accounted for if payments are to be developed for the provision of the identified services:

- Is there a need for these services from a hydrological perspective?
- Do the land tenure and ownership practices in the catchment support property rights and hence the provision of these services?
- Can these services be provided by poor and marginalised groups in order to allow for the improvement of livelihoods?
- Will the power imbalances in the catchment support or hinder the development and provision of these services?
- Will the land use patterns and practices support the provision of these services?
- Based on the economic returns to the catchment and the identification of key stakeholders, can willing buyers and sellers of these services be identified?

It is not necessarily possible to pursue the development of all the identified services within the scope of this project. The final column in Table 2.8 provides a broad statement related to whether or not it is possible to develop these services in the Olifants catchment through payments based on the criteria above.

In the Olifants catchment there are few distinct opportunities for the development of payments for catchment protection services. These include payments for the maintenance and protection of ecosystem goods and services in particular through the protection of wetlands and ‘sponges’ in the watersheds of the Olifants river and its tributaries; improved water quantity through the removal of alien invasive vegetation species in the middle and lower parts of the catchment along the riparian zone and eucalyptus in the upper catchment linked to

commercial forestry; and water quality improvement through soil erosion management, reduced sedimentation, wetland rehabilitation and improved farming practices.

Table 2.8: Identified catchment protection services for the Olifants River catchment

Watershed service	Commodity/ Land use intervention	Opportunities for payments
Ecosystem goods and services maintenance and protection	Restoration of wetlands and 'sponges' in the watersheds of the Olifants river and its tributaries	Yes
Water quantity	Better utilisation of groundwater	No
	Efficient use of surface water	No
	Alien invasive species removal in the middle and lower parts of the catchment along the riparian zone and eucalyptus in the upper linked to commercial forestry	Yes
Water quality	Soil erosion management	Yes
	Sedimentation reduction	Yes
	Wetland rehabilitation	Yes
	Treatment of acid mine drainage and industrial waste water	No
	Better management of water originating from mines	No
	Better farming practices and reduced pesticide or fertiliser dependency to reduce the impacts of agricultural return flows	Yes

2.1.8 Opportunities and risks for providing catchment protection services in the Olifants catchment

Catchment protection services are one of the most complicated environmental services to understand and quantity. This is due to the limited empirical understanding of the relationships between land use activities and catchment services in many parts of the world (Rojas and Aylward, 2003). South Africa on the whole has a relatively strong scientific base from which to assess catchment protection services but this has been typically focussed on the linkages between vegetation types and water use. Fundamental to identifying catchment protection services is the understanding of these linkages and broader linkages related to other activities, for example: the building of gabions and their impact on sediment control; contouring and the impact on soil erosion; and the impacts of wetland rehabilitation on water quality improvement or flow. Many of the opportunities and risks for developing catchment protection services in the Olifants River catchment relate to the fundamentals of the science but also include issues related to the land use and tenure systems as well as the types of land use activities taking place. This section of the report assesses these opportunities and risks in relation to these three activities.

2.1.8.1 Hydrological arrangements in the Olifants catchment

Based on the above findings, catchment protection service opportunities exist for the protection of 'sponges', the removal of alien invasive species and the control of soil erosion and sediment reduction in the Olifants catchment. Both the Department of Water Affairs and the Olifants River Water Forum support the need to address the water quality and sedimentation issues in this catchment and are willing to consider innovative approaches like the use of payments for catchment protection services. Table 2.9 below lists the opportunities

and risks for the development of catchment protection services in the Olifants catchment based on the hydrological landscape.

Table 2.9: Opportunities and risks for catchment protection services in the Olifants catchment based on the hydrological landscape

Opportunities	Risks
• Need greater removal of **alien invasive vegetation** from the riparian zones and the upper watershed in order to improve water supply. • Water scarcity is a constraint to development in the catchment. • The concepts and methods for removing alien invasive species are already widely understood and adopted as appropriate solutions. • The removal of alien invasive vegetation is ongoing and follow up actions provide the opportunity for long term planning and payment systems.	• The national government is already responsible for removing alien invasive vegetation through the working for water programme and hence there is little incentive for demanders of the service to pay for it.
• Soil erosion is pervasive in the catchment and hence sediment in the rivers and dams is problematic. There is a need to have good **soil erosion control** and **sediment management** programmes. • Many dams have poor storage capacity due to accumullated silt; for example, the Phalaborwa barrage only has a 10 percent storage capacity due to siltation. • The water quality is also poor in parts of the river due to sediment concentrations and is not suitable for users. • There are several solutions for managing soil erosion and sediment that can be provided by the poor.	• The quantified cause-effect relationship between land use activities, soil erosion and sediment accumulation is not well known. • The assigning of responsibility for soil erosion and sediment is unclear. In some parts, the soils are naturally highly erodible and unstable; in other parts of the catchment, practices such as overgrazing, deforestation and poor farming practices compound the situation. • The scale of the impact area is enormous and the costs associated with effecting change are expected to be high. • Evidence of improvement downstream takes a long time. • Monitoring change is difficult.
• Need for **wetland rehabilitation** in the catchment in order to improve water quality and supply. • There are examples of successful projects where wetlands have been rehabilitated on communal lands through conservation initiatives.	• Communities are dependent on harvesting goods from wetlands for their livelihoods and the impacts of converting to conservation need to be understood. • Subsistence agriculture also occurs in wetlands.
• **Technology transfer** for water quality improvement and efficient water use.	• Technology is costly and there is a need for skills transfer associated with the use of the technology.

2.1.8.2 Land tenure and ownership in the Olifants catchment

Based on the findings in section 2.1.3, the Olifants catchment is defined by many different land ownership and management regimes; each with different implications for the provision of catchment protection services. Table 2.10 lists the opportunities and risks for the development of catchment protection services based on land ownership and tenure in the Olifants catchment.

Table 2.10: Opportunities and risks for catchment protection services in the Olifants catchment based on the land tenure and ownership arrangements

Opportunities	Risks
• Land tenure and ownership is well defined and land use activities can be implemented. • Land ownership is mixed between private, government owned and communally owned. • Communal land falls under the authority in the area, typically a tribal leader or tribal chief. • Where land falls under the auspices of a municipality, private ownership is encouraged.	• Where communal land lies under the authority of the tribal leader, this leader needs to support and grant permission for any land use activities to be undertaken. This includes visitation rights and traversing rights in the communal areas. • Collusive behaviour may become evident in areas that compete for projects. • Excluded households may be motivated to act 'destructively' in order to qualify for land rehabilitation projects.

2.1.8.3 Land use patterns in the Olifants catchment

Based on the findings described in section 2.1.4, the major forms of catchment pollution are from sediment loads, acid mine drainage and industrial effluent. There is also a reduction in water availability due to the water use by alien invasive plants. Table 2.11 lists the opportunities and risks for the development of catchment protection services in the Olifants catchment through changing land use practices by land owners.

The major sources of catchment pollution are from: subsistence livestock farming and dryland agriculture, in the form of increased sediment loads, and mining and industry in the form of acid mine drainage and industrial waste. The ecological functioning of the lower catchment inside the Kruger National Park (KNP) is impacted negatively by sediment loads, which lead to deterioration in water quality. Other negative impacts on water resources are the reduction of water availability by alien vegetation. The spread of these plants is promoted by commercial forestry and environmentally degraded areas are particularly prone to invasion

Table 2.11: Opportunities and risks for catchment protection services in the Olifants catchment based on the land use patterns

Opportunities	Risks
• **Industrial effluent** impacts on the water quality; various industries can potentially rehabilitate wetlands or change technology in order to support the provision of certain catchment protection services.	• Participation in these initiatives is not mandatory and relies on the needs of the respective sectors as well as their corporate social responsibility initiatives. • Where there is a high demand for services and improved water quality or quantity, industries may be willing to become involved, however this will require a clear understanding of the links between the services and the provision of water (quality or quantity).
• The **mining sector** also demands water of a certain quality and volume; activities linked to mining impact on the catchment and there are opportunities for this industry to support wetland rehabilitation and community development programmes. This is also supported by the requirements of the mining charter.	
• **Communal land activities** have a large impact on the extent of soil erosion and sediment loss in the catchment. Opportunities exist for communities to improve their farming, grazing and harvesting activities.	• Communities are often dependent on marginal land to meet their basic livelihood needs. Any land use changes must take cognisance of this and make provision for basic livelihoods needs as well as, compensation for changing current patterns of land use.

2.1.9 Opportunities and risks for using payments in the Olifants catchment

The development of payments from a market perspective, considers transaction costs, imperfect information, power imbalances, recognition of buyers and sellers, definition of property rights, the role of the institutional and legal frameworks, and the nature of prices for the identified services.

Within the Olifants catchment many of these market elements are tentative, and efforts are required to address these clearly and effectively prior to engaging in actual payments. The first area of potential concern is the lack of clearly defined buyers and sellers. In a broader sense, buyers and sellers are evident but the challenge in setting up payments is to get them committed to the idea and to clearly identify and measure the catchment protection services for which they will potentially make payments. The institutional arrangements, the economic potential, the value of the catchment service, and the associated transaction costs, are all discussed further in Table 2.12.

Table 2.12: Opportunities and risks for catchment protection services in the Olifants catchment based on the land use patterns

Opportunities	Risks
Willing buyers • In the upper and the lower Olifants there are strong economic actors in the form of mining companies, industry and commercial farming • Specifically identified buyers include: Lepelle Water Board, Palaborwa Mining Company, Foskor, Commercial farmers, Phalaborwa Municipality, Kruger National Park.	**Willing buyers** • The buyers are unable to make payments for the required catchment service for certain reasons. For example it may be legislated that the service be provided, or the buyer may be unable to make a payment. • The number of buyers or amount available for 'payments' may not be large enough to effect measurable improvement in the water supply or quantity.
Willing sellers • In the middle and lower Olifants large numbers of people dependent on subsistence livelihoods with the potential to provide land management options for catchment protection services. • Communities are willing to participate in activities that can potentially reduce their dependency on subsistence agriculture.	**Willing sellers** • The sellers are numerous but identifying a specific community may be difficult. • Language and cultural diversity may make it difficult to communicate the complex ideas behind payments for catchment protection services. • Literacy rates vary across communities and regions. • Traditional leaders need to support initiatives if they are to be adopted by communities.
Institutional arrangements • There are a number of forums established such as the farmers associations, the Olifants River forum, and well-established communities with clearly defined tribal authorities.	**Institutional arrangements** • The institutional arrangements required for payments for watershed services do not exist. • For payments to be made between multiple buyers and sellers, an intermediary or community-based organisation or forum needs to be established to assist with facilitating payments and monitoring progress.

Table 2.12 continued.

Opportunities	Risks
Economic potential for payments • There are identified buyers in the Olifants catchment and these buyers have the potential to effect change through bundled payments.	**Economic potential for payments** • The buyers may not be able to effect change as individuals due to the scale of the catchment. • Buyers may not regard payments for catchment protection services as something they should be paying for but rather services that the government should provide.
Value/price of identified service	**Value/price of identified service** • The value or price of the identified catchment protection services is not known.
Transaction costs	**Transaction costs** • The scale of the catchment is very large and the transaction costs associated with payments may be large enough to hinder progress. • Part of these costs may also relate to lack of information of catchment protection services and the science underlying their provision.

2.1.10 Conclusions and recommendations

Based on the criteria identified in section 1, the Olifants catchment was selected as one of two implementation sites for phase 3 of this project. A number of potential pilot case studies were also identified based on the issues, risks and opportunities identified in the previous section (section 2.1). Two of these case study sites are recommended and discussed in greater detail below:

2.1.10.1 Potential case study A

One opportunity for payments was identified in the Lower Olifants catchment where water quality is affected by upstream sedimentation. This adversely impacts the storage capacity of the Phalaborwa Barrage and the aquatic habitats in the Kruger National Park.

The Phalaborwa Barrage is located in the Lower Olifants sub-area and is managed by the Lepelle Water Board. Palabora Mining Company, FOSKOR and the Ba-Phalaborwa Municipality draw water from the Phalaborwa Barrage. Beyond the Kruger National Park, the Olifants River crosses the South African border and flows into Mozambique.

The South African National Parks (SANParks) are concerned about the quality of the water flowing in the river from the Phalaborwa Barrage onwards. Water quality deteriorates especially when accumulated sediment is scoured from the Barrage to increase its capacity. SANParks reports ecological damage in the Kruger section of the Olifants due to this activity. The Lepelle Water Board reports extreme problems due to the siltation of the Barrage. At present, the Barrage has a water holding capacity of only 10 percent due to siltation[2]. The only truly effective way of increasing the capacity of the Barrage seems to be a large-scale natural flood, such as the flood of 2001. After this flood, the water holding capacity increased to 60 percent but, due to further inflows of sediment from upstream areas, this capacity again

[2] Interview with Mr Piet Grobler; Lepelle Water Board – Phalaborwa; 27 October 2004.

dwindled to where it is at present (10 percent). Activities determined by land tenure and ownership regimes in the catchment, the livelihoods of poor and marginalized groups in the Olifants catchment, and historical factors (such as the relocation of certain population groupings to homelands) contribute to the current sedimentation problems experienced in the Lower Olifants Sub-Area.

The Lepelle Water Board has funds available to support upstream land management initiatives but it is unlikely that they will be willing to do so. It is more likely that the industries through payments to the Lepelle Water Board support such upstream initiatives. All actors are however willing to engage in discussions and consider beneficial solutions. Within the Sekhukhuneland area, there are large numbers of people living within limited means who would be willing and able to provide the services required to address the problem of sedimentation. The question here needs to be addressed as to how many people would need to be involved, which areas would be targeted and what form their involvement would take. There is also potential for the more efficient use of water within this broader catchment. Essentially, the Department of Water Affairs has decentralised power to the water boards and the Lepelle Water Board is only formally required to release a minimum of 0.54 kl per second downstream, during low flows for the Kruger National Park. The waterboards primary objectives are to supply water to its key clients, the industrial and mining sectors, with little recognition or responsibility of the impacts downstream in the Kruger National Park (KNP). Studies of the impacts of siltation and the flushing of the Barrage on acquatic ecology within the KNP have been conducted, remedial actions have been proposed, to date, these have not been implemented. The Lepelle Water Board is however currently sourcing specialist inputs in order to address this complex problem.

At this time, relatively little information is available on the impact of changing land practices on the reduction of sedimentation and the time taken for the sediment load to travel along the river from the middle Olifants to the lower Olifants reaches. An implementation phase at this site will require that measuring points are set up along the river, before and after the intervention to measure and confirm the changes in sediment loads.

2.1.10.2 Potential case study B

Another potential site lies in the Ga-Selati River, a tributary of the Olifants River. This river provides an opportunity to implement a pilot scheme from the perspective of the typical model for payments for catchment protection services, where the poor reside in the upper reaches of the catchment and can potentially provide catchment protection services for water users downstream, and improve base water flow and supply.

2.1.10.3 Conclusions and recommendations

Power imbalances within the Olifants catchment are fairly clearly defined and well established. Generally, the water board, manages the water agreements, sets prices and manages the Phalaborwa Barrage. It is clear that any form of payments that impact the barrage will need to be negotiated and supported by the Lepelle Water Board. Further, the benefits of the watershed services and the use of a particular market-based mechanism will need to be clearly communicated and supported by the Olifants Water Forum, the respective Water Boards, industry and by the selected communities.

The National Water Act (Act No.36 of 1998) is very comprehensive and the implications for payments for watershed protection services need to be clearly understood before payments can be made. A review of the legislative implications for payments based on the existing

policies for land, water and the environment should form the basis for decision-making for payments for catchment protection services.

Overall, the Olifants catchment provides a good opportunity to test the validity (success or failure) for payments for watershed protection services as it is such a diverse and complex catchment. It is also a catchment that is grappling with water quality and quantity issues driven by rapidly increasing user demands. However, the complexity and the scale of the catchment could prove to be risks for implementation and a carefully chosen site, at a scale that can be managed while encompassing all the 'typical' issues for the catchment, will be critical to the success or failure of implementation.

2.2 SITE TWO: SABIE SAND CATCHMENT

2.2.1 Introduction

The Sabie-sand sub-area is part of the Inkomati water management area, which is situated in the north-eastern part of South Africa. The Sabie River, of which the Sand River is a tributary, is the main river in the Sabie sub-area. It flows through the Kruger National Park into the Corumana Dam in Mozambique, just downstream of the border with South Africa. The Sabie River in this sub-area is regarded as one of the most ecologically important rivers in South Africa. Two dams exist in this sub-area, these are: the Inyaka Dam and the Da Gama Dam. The Inyaka Dam, in particular, was constructed to ensure adequate river flows through the Kruger National Park and to supply water for domestic use, both in the Sabie and the neighbouring Sand River catchment via the Boksbokrand Transfer Pipeline (BTP).

The Sabie-Sand catchment extends over a distance of approximately 632,152.68 hectares and is characterised by forestry, agriculture, degraded land, urban areas and conservation. The two main rivers are the Sabie River and its tributary, the Sand River. Despite the proximity of their location, these two rivers are fundamentally different. The reasons for this include: the soil types in the surrounding environment, the bedrock of the rivers, the historical land zoning and use patterns along the rivers and the consequential social and economic pressures placed on the water resources of both rivers.

The Sabie River is classified as one of South Africa's most pristine rivers and the need for the development of watershed protection services is limited. Although water quality issues in the Sabie catchment are not a priority, water supply issues are of greater concern. Hence catchment protection services related to improving supply are expected to be required.

However, the Sand River has serious sedimentation problems and water supply constraints. There are also a large number of communities in the Bushbuckridge area that depend on the river for subsistence living (water for agriculture, basic needs and sanitation). It is expected that there will be opportunities around erosion control, sediment management and solutions to opportunities for communities to engage in the use of water for productive gains. Figure 2.4 below shows the details of this catchment.

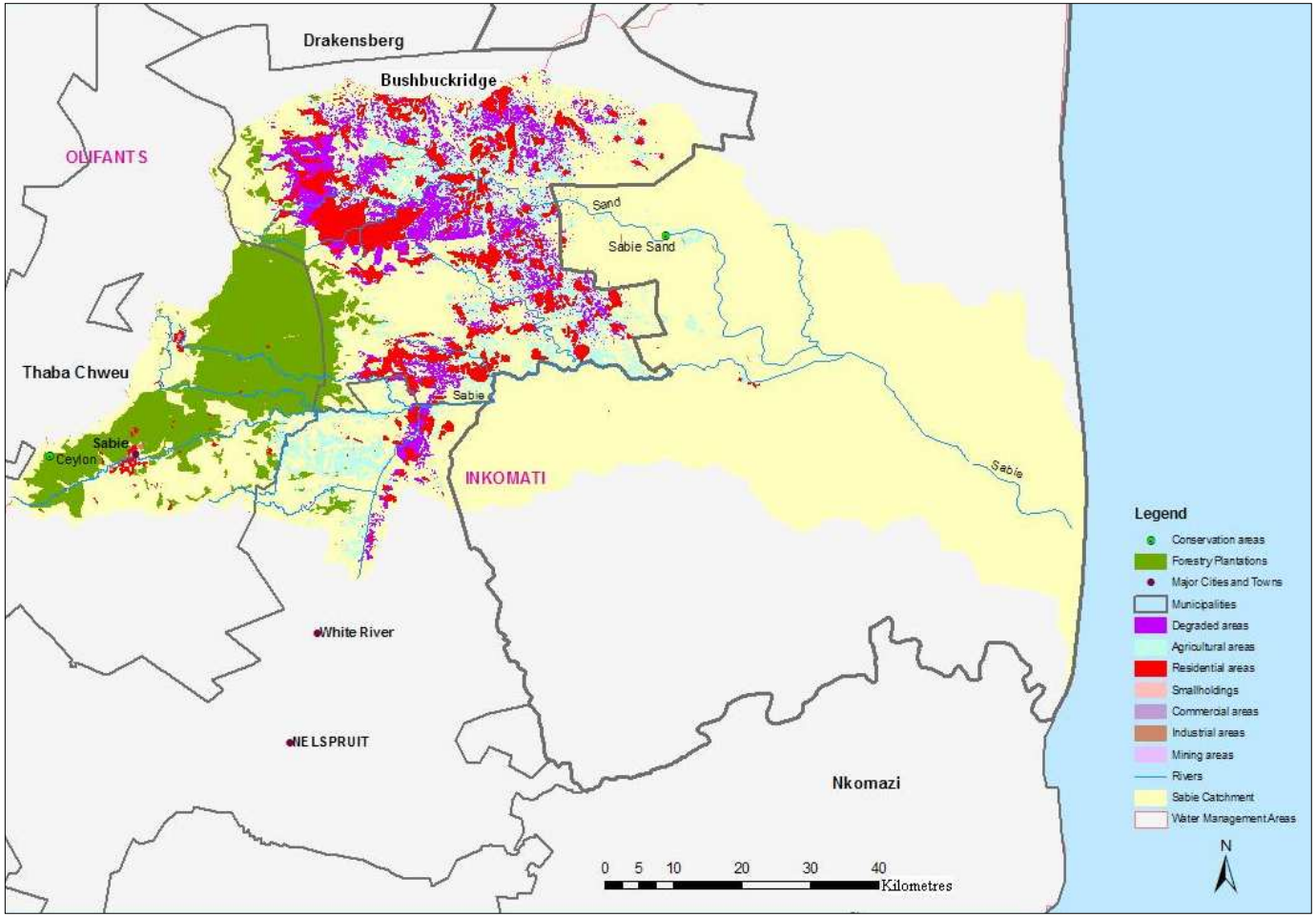

Figure 2.4: Map showing the extent of different land uses in the Sabie-Sand catchment

2.2.2 A hydrological review of the Sabie-Sand sub-catchment

An examination of the hydrological landscape of the Sabie-Sand sub-catchment is needed so that an assessment can be made as to whether or not these features would hinder or support the development of payments for catchment protection services. Four hydrological components were examined namely: water quantity, water quality, groundwater and aquatic ecosystem services. The implications of these four components on the potential development of payments for watershed protection services are discussed below.

2.2.2.1 Water quantity

The natural Mean Annual Runoff (MAR) for the Olifants Water Management Area (WMA) amounts to 866 million m^3/year (25 percent of the natural MAR for the whole Inkomati WMA) (DWAF, 2004a). Table 2.13 below shows the water requirements for the Sabie/Sand catchment in 2003. From the table, irrigation has been identified as the highest water use sector in both sub-areas, followed by the urban water use sector. Water is only transferred within the catchment, and no water was transferred from the nearby Water Management Areas in 2003. However, there is a possibility to transfer 25 million m^3/year from the Inyaka Dam to the Sand River sub-catchment following the completion of the Bosbokrand Transfer Pipeline (BTP) (DWAF, 2004f). This pipeline was constructed to ensure adequate river flow through the Kruger National Park and to supply water to the Sand sub-area to meet the increasing demand for water for domestic use in this sub-area.

Table 2.13: Water requirements/Impact on yield (million m^3/year) for the year 2003 (at 1:50 assurance)

Sub-catchment	Irrigation	Urban	Rural	Mining and Industrial	Afforestation	Total local requirements	Transfers out	Total
Sabie River	54	13	2	Negligible	34	103	8	111
Sand River	11	9	2	0	3	25	0	25
Total for Sabie/Sand	65	22	4	0	37	158	0	128

Source: (DWAF, 2004f)

Key challenges in the Sand sub-area in particular include the lack of method(s) to quantify water used for irrigation purposes, and over-abstraction of surface water. Farmers divert water via small weirs to canals, and in many cases this leaves no water for the Reserve (DWAF, 2004f). Other activities that impact on total surface runoff include streamflow reduction activities. In the Sabie sub-catchment, invasive alien vegetation is regarded as one of the most important activities that reduce surface water yield. An estimated 24 million m^3/year is reportedly lost by this vegetion, however, accurate information was not available prior to the release of the latest ISP report (DWAF, 2004f). Afforestation has adverse impacts on the yield in both the Sabie and Sand sub-areas, and it has been reported to increase from 26 million m^3/year to 37 million m^3/year with the Inyaka Dam in place (DWAF, 2004f). Of this 37 million m^3/year, 34 million m^3/year is in the Sabie sub-area.

2.2.2.2 Water quality

The construction of the Inyaka Dam has provided sufficient assimilative capacity to maintain the quality of water in the Sabie sub-area in its present state (DWAF, 2004f). Industrial water use in the Sabie sub-area is negligible, while in the Sand sub-area it is zero. There are therefore little (if any) incidents of surface water quality degradation associated with industrial water use in these two sub-areas. In addition, chemical pollutants associated with irrigation have not been reported. Return flows are limited in these two sub-areas. Some incidences of elevated nutrients in the Sand sub-area are reported occasionally, but these are associated with the development of informal settlements (DWAF, 2004f).

2.2.2.3 Groundwater

There is limited use of groundwater in both the Sand and Sabie sub-areas (DWAF, 2004f). This may be attributable to the "well watered nature of most of the Inkomati Water Management Area" (DWAF, 2004a), the limited potential of dolomitic formations for groundwater use in the west of the Sabie sub-area, and the absence of these formations in the Sand sub-area (DWAF, 2004f). In addition, sufficient data with regard to groundwater use may have not been collected since groundwater use in the Sabie sub-area is considered to be a Schedule 1 use, which does not need to be registered (DWAF, 2004f).

2.2.2.4 Aquatic ecosystems

The stream bed, flow, and riparian/banks of the rivers in the Sabie/Sand sub-areas are mostly modified to slightly modified. Most of the instream biota is indigenous, with SASS scores ranging between three (modified) and five (natural). With regard to aquatic ecosystems, watershed services in this sub-area may include maintenance or protection of the water resources in their current state (DWAF, 2004f)

2.2.2.5 Implications of hydrological issues for developing payments for catchment protection services in the Sabie-Sand sub-catchment

Alien vegetation, forestry, and irrigation sectors use the most water in the Sabie and Sand sub-areas (DWAF, 2004f). Possible interventions to ensure the availability of sufficient water in these sub-areas to meet current demands and future developments would include: reallocation of surplus water (and to some extent, irrigation water) to other uses including poverty alleviation projects, and the transfer of water into the Sand sub-area. Watershed services would also include the removal of invasive alien vegetation.

2.2.3 Land tenure and ownership in the Sabie-Sand sub-catchment

One of the critical components for the development of payments for catchment protection services is clearly defined property rights. This includes property rights associated with land and land-based activities that impact on the water resources in the catchment. This section reviewed the land tenure and ownership arrangements in the Sabie-Sand sub catchment and their implications for payments for catchment protection services.

Land ownership in the central lowveld (of which the Sabie/Sand catchment forms part) is mostly restricted to state conservation, private conservation, villages and communal grazing

lands (Pollard et al, 2003). The central lowveld is described as the area contained between the Sabie and Olifants Rivers.

In the upper reaches of the Sand Sub-Area, some areas of government-owned forest recently burned down and plans are in place to re-establish indigenous forests in the area. This shift in land use (from plantation to indigenous forest) may increase water availability in the catchment. DWAF will surrender the additional water available (due to decreased water usage by commercial forests) to the ecological reserve[3]. The upper reaches of the Sabie catchment are occupied by government-owned plantations, with some 308 km² covered by eucalyptus plantations and 449 km² under pine plantations.

The central area of the Sabie-Sand catchment is the site of many rural villages and communal grazing lands that were formally part of the KaNgwane, Gazankulu and Lebowa homelands. The largest rural settlement in this area is Bushbuckridge. The total population of the Sabie/Sand catchment is 617,530 with 407,413 of this population situated in the communal lands of the Sand catchment (66 percent of the total catchment population) (DWAF 2004f).

The lower reaches of the Sabie/Sand catchment are dominated by conservation areas, both private (Sabie Sand Game Reserve) and state owned (Kruger National Park). Approximately 70 percent of the Sabie Sub-Area of the Greater Inkomati Water Management Area falls within the Sabie Sand Game Reserve and the Kruger National Park.

According to DWAF, the water users in the Sabie/Sand catchment are the main reason for pollution of the river system3. The water quantity in the catchment is not sufficient to meet the needs of water users and over-utilisation is a problem[3]. In the communal areas, irrigation projects established by the Apartheid government are now non-functional. It can be expected that water demand in the catchment will increase as government continues with its plans to provide a basic level of services (the so-called “RDP standard”) to residents of the catchment area by 2010.

The years from 1985 onwards marked the start of water shortages in the Sabie/Sand catchment. This was due to rapid population increases in the former homelands and allocation of water to meet the water requirements of the aquatic and riparian ecosystems in the Kruger National Park and the Sabie Sand Game Reserve (DWAF, 2004f). With the rapid increase in population that occurred in the former homeland areas, water supplies from the rivers and boreholes became inadequate and a few extensive regional rural and semi-urban domestic water supply schemes were constructed in the period from 1975 onwards, such as the Bushbuckridge Water Board.

The communal lands of the central lowveld are characterized by high population densities (from 150 people / km² to 300 people / km²) (Pollard et al, 2003). The residents of this area rely mainly on subsistence agriculture and natural resources for their livelihoods. According to Pollard et al (2003) only 6 percent of the local cash economy is generated by agriculture. Direct use values of home consumption from livestock, agriculture, and natural resource harvesting are high, accounting for more than 50 percent of the total livelihood streams (Pollard et al, 2003). Agriculture consists of maize cultivation at the homestead or in demarcated fields adjacent to the villages, intercropped with fruit trees and vegetables (Pollard et al, 2003). Land not utilised for agriculture is used for natural resource harvesting and grazing (Pollard et al, 2003). Woodland resources are sold for income.

[3] Interview with Mr Eddie Deacon, DWAF Nelspruit, 26 October 2004.

2.2.3.1 Institutions in the Sabie Catchment and potential power imbalances in the catchment

Pollard et al (2003) contend that relationships between the residents of the communal lands and conservation authorities are strained and that people do not support conservation initiatives due to past injustices from conservation authorities.

Authority structures in the communal areas are unclear. According to the Association for Water and Rural Development (AWARD) – an NGO based at the Wits Rural Facility near Acornhoek in the Sand Catchment – there are 7 functional traditional authorities in the Sand Catchment[4]. Pollard et al (2003) report that, although the land is under communal tenure, a common property systems does not exist anymore due to a degeneration in the Apartheid years from this system to one of open access. People view the resource as a public asset that can be used for personal gain (Pollard et al, 2003).

Stakeholders in the Sabie/Sand Catchment will consist of conservation authorities (private and state), DWAF, the provincial department of environment, AWARD, the Wits Rural Facility, municipalities, traditional authorities, community-based organisations and other NGO's.

2.2.4 Identification of poor and marginalized groups in the Olifants catchment

The "densely populated, impoverished communities of the former Gazankulu, Lebowa and KaNgwane" (Pollard et al, 2003) – comprising 66 percent of the total population of the Sabie/Sand catchment – form the main population group of the catchment. The livelihood activities of the residents of the communal lands are discussed in the section on land tenure and ownership. The main settlement in this area is Bushbuckridge. According to Census 2001 statistics, 99.7 percent of the population of the Bushbuckridge Municipality is African (as opposed to White, Coloured and Indian) and the main languages spoken in the area are Xitsonga (57 percent of the population), Sepedi (27 percent) or Siswati (7 percent) (Statistics South Africa, 2001).

The average age of the population is below 34 (77 percent of the population is younger than 34). A large proportion of the population is therefore either of the age where they can be economically active or will be there soon. The limited employment opportunities in a catchment with mostly rural settlements, few industries and few urban areas, coupled with a young population, creates a situation of severe unemployment. Sixty-two percent of those that can be economically active, do not participate in the formal labour market (i.e. they are not economically active) (Statistics South Africa, 2001). Only 37 percent of those that engage in the labour market are employed (Statistics South Africa, 2001).

The livelihoods of the population are mainly centred on direct-use values of agriculture and woodland resources. Woodland resources are sold for cash. The large population of the area and limited woodland resources have resulted in severe degradation of the natural resource base in the area. Overgrazing and unsustainable cultivation practices exacerbate this situation (Pollard et al, 2003).

The Bushbuckridge area has been, and continues to be, the site for many research studies and development initiatives. This has been happening to such an extent that NGOs in the area

[4] Interview with Dennis of AWARD – 26 October 2004 at AWARD offices, Acornhoek, Mpumalanga.

report "community fatigue" within the area[5], with community members growing increasingly wary of new "projects". Many research projects are undertaken that need community input but community members rarely see the benefits of these studies. They are often merely the "guinea pigs" for research.

The Wits Rural Facility – a centre of the University of the Witwatersrand for rural-focussed research – is situated near Acornhoek in the Bushbuckridge area. AWARD is also based here. The Bushbuckridge Municipality has called for greater integration and coordination of research- and development projects[5] . The organisations based at the Wits Rural Facility, with years of experience in the area and established relationships with communities and traditional authorities, will most probably head up these coordination efforts to ensure that communities are empowered through these processes[5]. Researchers will collaborate with the Wits Rural Facility organisations to ensure that repetition of processes does not take place.

The Working for Water (WfW) and LandCare initiatives of DWAF and the National Department of Agriculture (NDA) are also active in this area. These initiatives are aimed at poverty alleviation through natural resource management. Through the WfW programme, individuals in rural communities receive training and an income for the removal of alien invasive tree species. The Land Care programme is aimed at land rehabilitation. The Save the Sand Project (SSP) was established by AWARD to promote natural resource management in the Sand Catchment and is a national pilot project for integrated catchment management (ICM) and LandCare. One of the projects that make up the larger SSP is a school-based rain water harvesting project working with rural schools and communities to build new ways of approaching problems (such as limited access to water), learning and improving quality of life (the benefits brought by increased water availability) (AWARD, 2004).

2.2.5 Land use

The main land uses in the Sabie-Sand catchment are commercial agriculture, forestry, rural settlements, and nature and game reserves (DWAF, 2003a). These land uses are distinctly sub-divided across the catchment. Upstream in the catchment there are mainly forest plantations. Land uses such as rural settlements, agriculture and grazing land are located in the middle of the catchment. Downstream the main land use is conserved natural areas (Pollard and Walker, 2000). Table 2.14 presents the area within each land use type. Nature reserves and afforested areas occupy the largest areas within the catchment. The main impact or issue from a water resource perspective is the lack of water downstream for rural households and the nature reserves during dry seasons as agriculture and forestry use most of the water (AWARD, 2004).

Table 2.14: Area under specific land use in the Sabie-Sand catchment

Land use	Area (km2)	Area (%)
Irrigation	126.0	1.65
Afforestation and indigenous forests	898.0	11.77
Rural settlements	335.0	4.39
Nature reserves	6 272.0	82.19

Source: DWAF (2003a)

[5] Interview with Dennis of AWARD – 26 October 2004 at AWARD offices, Acornhoek, Mpumalanga.

2.2.5.1 Agriculture and forestry

Agricultural activities in the Sabie-Sand catchment include irrigated cash and subsistence crops, commercial agriculture and livestock farming. The main crops being grown in this catchment are maize, bananas, citrus and vegetables (DWAF, 2003c). Subsistence crops include vegetable gardens, typically onions, tomatoes and leafy vegetables (e.g. cabbage and spinach). Individual households also grow fruit trees in their backyards. These subsistence irrigation activities usually utilise some of the household's domestic water (Mokgope and Butterworth, 2001).

The upper Sabie and Sand River sub-catchments have some 898 km^2 of land under forest plantations. The main types of trees within forest plantations are pine (480 km^2 or 53 percent of land under forestry) and Eucalypts (311km^2 or 35 percent of land under forestry). Indigenous forests make up the remaining 106 km^2 (12 percent) of this area (DWAF, 2003c). These forest plantations are managed by Sappi, Mondi Forests, Komatiland Forests (previously Safcol) and Global Forests.

Subsistence or small-scale livestock farming becomes a problem to downstream users when communities overgraze close to the riparian zone. This results in the extensive local erosion of riverbanks and an increase in the sediment load of the river (State of the Rivers, 2001b; Bushbuckridge Municipality, 2002). However, erosion is a natural phenomenon in the catchment due to the highly erodible soils (King, et al., 2003; van Wyk et al, 2001).

The forestry (during drier seasons) and agriculture sectors are the highest consumers of water but do not pay the full cost for the use of water. The problems associated with land uses such as forestry and agriculture are as follows: firstly, the inefficient application of irrigation abstractions by agriculture leads to wastage, and secondly, the overuse of water resources upstream by forestry specifically during drier times of the year jeopardises the ecological integrity of downstream natural areas and the availability of water resources for basic needs. Afforestation, emphasized by the environmental degradation caused by communities, has led to alien vegetation invading riparian zones and wetlands in the catchment (Pollard and Walker, 2000). Thus leading to increased water use in these areas (Scholes et al., 1995; Dudley, Stolton and Jeanrenaud, 1996).

2.2.5.2 Rural settlements

Rural communities live in relatively densely populated villages (State of the River, 2001b). According to Perez and Mabelane (2001), rural communities engage in informal sector activities ranging from food processing and beer brewing, small-scale retailing of fruit and vegetables, low-cost household goods, woodcarving, reed mats, other craftwork, and wild herbs. Dressmaking, knitting, weaving, furniture manufacture, car repairs and welding are also common enterprises. Households often engage in a combination of activities for income. There is little water available for domestic uses and thus informal activities and water vending is a common business. This makes water an expensive commodity for poor households. An additional minimum of 25 to 40 litres of water per person per day over and above the basic provision of 25 litres for basic human needs is needed to maintain this range of informal activities. This was calculated using the quantity of water used per economic activity and averaging this amount across the total number of households in the villages surveyed.

The Bushbuckridge Municipality (2002), note that rural settlements have a negative impact on water resources. The impact is as a result of poor sanitation facilities, litter, deforestation and environmental degradation. The use of pit latrines and other improper methods result in sewage leakages that flow into local water resources. Deforestation occurs as communities

remove trees for firewood; subsistence agriculture activities; construction material; and crafts. This practice leads to increased run-off and soil erosion.

2.2.5.3 Nature and game reserves

Several nature reserves and game farms are situated downstream of Sabie-Sand catchment (State of the Rivers, 2001b). Sabi-Sabi and the Kruger National Park (KNP) are the main nature reserves in the area. The existence of these nature reserves leads to significant ecotourism possibilities in the area. However, during dry periods, these reserves experience serious water shortages, which compromise the attractiveness, and the ability to maintain the wildlife carrying capacity, and thus the sustainability of this land use. Game-based eco-tourism is a vibrant industry in this catchment. Management of the Sabie and Sand River (with respect to quantity, quality and temporal flow distribution) is thus of particular importance with respect to ecosystems in the Kruger National Park and other game parks or reserves (DWAF, 2003c).

2.2.5.4 Conclusion

The main impacts from land uses in the catchment are water pollution, in terms of sediment loads and depletion of water resources during dry periods. The main drivers of sediment loads are environmental degradation from overgrazing and deforestation activities in rural settlements as well as growth in informal settlements. The shortage of water during dry seasons is primarily due to the streamflow reduction of forestry activities in the upper portion of the catchment. These impacts affect downstream users, particularly the game and nature reserves, by reducing the quantity of water available to meet human and ecosystem needs. The most important impact of land use patterns is on the availability of water supply for productive and basic human needs.

2.2.6 Economic review

The Sabie-Sand catchment is largely comprised of the Bushbuckridge Municipality. The economic data at municipal level were not always available for the Sabie-Sand catchment, and thus the data for the Bohlabela District Municipality have been used where necessary.

The main economic activities are forestry, agriculture and eco-tourism. However, the Sabie-Sand catchment is a relatively poor catchment, approximately 85 percent of households in the district municipality earn less than R18,000 per annum (Bohlabela District Municipality, 2002). A large proportion of communities rely on informal and subsistence economic activities as well as remittances for survival. The lack of water for productive use within communities is considered to be a deterrent to the economic development of the catchment. Eco-tourism is one of the largest contributors to the economy in this area but is highly dependent on the availability of water.

2.2.6.1 Gross geographic product

The GGP of the Bohlabela District Municipality was R2,032 million in 2002. The largest contributing economic sector is the community and social services sector (56.9 percent of total GGP), however it is expected that the contribution of this sector will decline over time. The other important economic sectors are trade (21.3 percent including tourism sector), construction (6.3 percent) and transportation (5.9 percent) (Bohlabela District Municipality,

2002). The Kruger National Park and other nature reserves play a key role in drawing tourists through the area (DWAF, 2003c).

2.2.6.2 Employment

The rate of unemployment in the Sabie-Sand catchment was 65.5 percent using the restricted definition of unemployment (Statistics SA, 2003). The statistics from the Bushbuckridge municipality were used to estimate the unemployment rate in the Sabie-Sand catchment. Figure 2.5 displays the distribution of employed individuals across the various economic sectors. The economic sector with the highest employment level is community and social services (33.2 percent) followed by the trade sector (17.7 percent). The mining agriculture and construction sectors employ 8 percent and 6.5 percent of the economically active population respectively (Statistics SA, 2003). There is thus a strong tendency toward the informal and subsistence economies.

Households often engage in a combination of activities for income. However, the range of possible economic activities is limited by the availability of water. In other words, certain small-scale businesses such as hairdressing, brick-making and small nurseries are not viable where there are water shortages (Pollard and Walker, 2000). Water is considered a relatively expensive commodity for poor households. An additional minimum of 25 to 40 litres per day of water will be needed to maintain their current activities and slightly more to enable economic development in these areas (Perez and Mabelane, 2001).

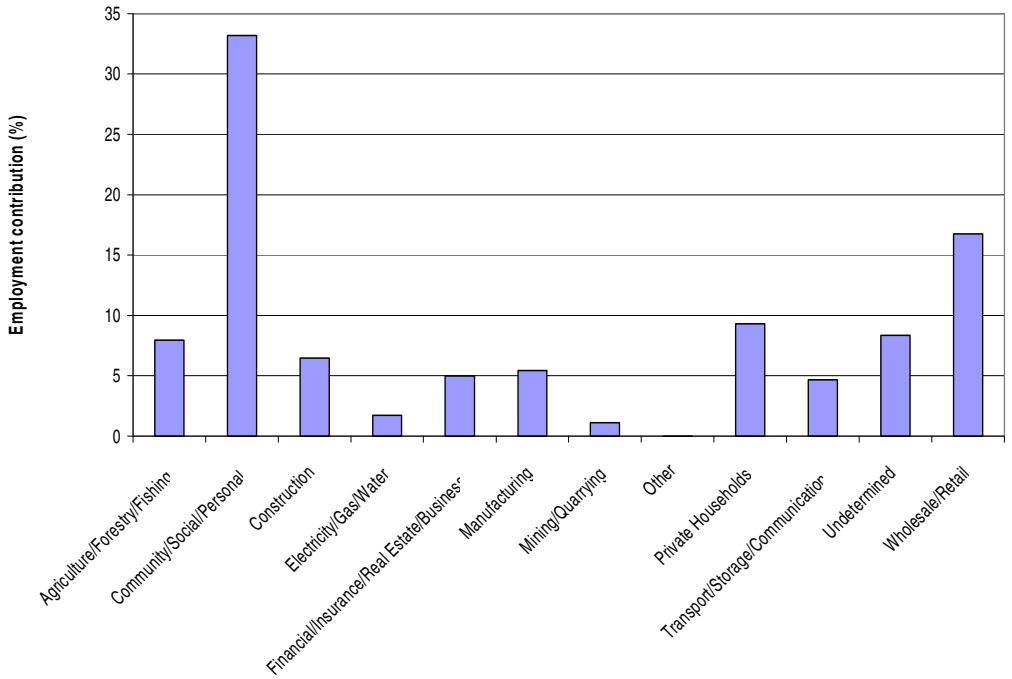

Figure 2.5: The contribution to employment by the economic sectors in the Bushbuckridge area in 2001. (Source: Statistics SA, 2003)

2.2.6.3 Resource use

The main water users within the Sabie-Sand catchment are the Kruger National Park and other nature reserves (as shown by the ecological reserve), afforestation and agriculture.

Forestry is mostly rain-fed, however forestry water use increases proportionately during dry seasons and droughts. Currently, the domestic sector requires the smallest amount of water. Table 2.15 shows the water requirements for the various economic activities in the Sabie-Sand catchment. The land use with the highest water requirement is natural areas (324 million m^3), i.e. the ecological reserve, followed by forestry (138 million m^3). The estimated water use by alien vegetation is 89 million m^3 per annum). Economic growth in this catchment is highly dependent on resource availability and should be sensitive to fluctuations in the cost of water due to the high levels of poverty.

Table 2.15: Water requirements in the Sabie-Sand catchment

Economic activities	Water requirements (million m3/annum)
Agriculture Irrigation Livestock and game	74.9
Domestic Urban Rural	 6.26 13.01
Afforestation	138.16
Ecological reserve	324
Alien vegetation	88.69

Source: DWAF (2003c)

2.2.6.4 Implications of land use practices and economic power imbalances on payments for catchment protection services

The available land use and economic data show the Sabie-Sand catchment is heavily dependent on eco-tourism. Other important economic and land use activities are commercial forestry and agriculture. Most of the productive land is used for nature reserves and afforestation. The major impacts are that of soil erosion from agriculture and the rural settlements leading to high sediment loads in rivers. The Kruger National Park, Selati Game Reserve and other game reserves are affected by both sediment loads and by the insufficient availability of water especially in the drier seasons. Rural settlements experience negative impacts in terms of water availability due to the inefficient use of the agricultural sector (AWARD, 2004).

The ecological reserve (i.e. ecological system), afforestation, alien vegetation and agriculture have the highest demand for water. Forestry plantations, alien vegetation and agriculture reduce the water supply to downstream users. Potential buyers of watershed services (i.e. improved water supply) are the game reserves downstream; however, this income stream may be limited. Suppliers of improved water quality would be subsistence agricultural farmers and rural settlements such as Acornhoek and Dingleydale.

2.2.7 Identified catchment protection services for the Sabie-Sand catchment

Due to the hydrological landscape outlined in section 2.2.2 and the increasing demand for water of an appropriate quality in the Sabie-Sand catchment, there are numerous opportunities for the identification of catchment protection services and the development of payments for these services. This section reviews the services identified in this report and classifies them into 3 core themes namely, ecosystem goods and services protection and maintenance; water quantity, and water quality.

Table 2.16 lists the catchment protection services identified in the Sabie-Sand catchment and describes the associated activities required to achieve the provision of this service. The table also states whether there is an opportunity for the development of these services in the catchment. It is important to note that almost all of these services could be developed and that there is a demand for them by the users in the Catchment. However, the following criteria have been used as the foundation for this feasibility review and all components need to be at least partially accounted for if payments are to be developed for the provision of the identified services, if they are not then the service is marked with a 'No' for potential development:

- Is there a need for these services from a hydrological perspective?
- Do the land tenure and ownership practices in the catchment support property rights and hence the provision of these services?
- Can these services be provided by poor and marginalised groups in order to allow for the improvement of livelihoods?
- Will the power imbalances in the catchment support or hinder the development and provision of these services?
- Will the land use patterns and practices support the provision of these services?
- Based on the economic returns to the catchment and the identification of key stakeholders, can willing buyers and sellers of these services be identified?

It is not necessarily possible to pursue the development of all the identified services within the scope of this project. The final column in table 2.16 provides a broad statement related to whether it is or is not possible to develop these services in the Sabie-Sand catchment through payments based on the criteria above.

Table 2.16: Identified catchment protection services for the Sabie-Sand catchment

Watershed service	Commodity/ Land use intervention	Opportunities for payments
Ecosystem goods and services maintenance and protection	Restoration of wetlands and 'sponges' in the watersheds of the Sabie and the Sand rivers	Yes
	Restoration and maintenance of aquatic habitat and biodiversity in the Sabie River	Yes
Water quantity	Efficient use of water by water-intensive sectors	No
	Alien invasive species removal in the upper parts of the catchment and along the riparian zone	Yes, but not necessary as the Working for Water programme deals actively with this in the catchment
Water quality	Soil erosion management	Yes
	Sedimentation reduction	Yes

In the Sabie-Sand catchment there are a few distinct opportunities for the development of payments for catchment protection services. These include payments for the maintenance and protection of ecosystem goods and services in particular through the protection of wetlands and 'sponges', and the protection of riparian and aquatic habitat in order to preserve aquatic biodiversity and river ecosystems; improved water quantity through the removal of alien invasive vegetation species throughout the catchment, particularly along the riparian zone; more efficient use of water by water-intensive sectors; and water quality improvement through soil erosion management, reducing sedimentation, and wetland rehabilitation. The Sabie River is regarded as one of the more pristine rivers in South Africa and the largest concern related to water is that of supply. However concerted efforts are required to maintain the river in its current state. Conversely, the Sand River flows through highly erodible soils and the high levels of soil erosion cause adverse sediment impacts on the flow of the river and

the quality of the water. Opportunities to address the sediment problems are limited as the scale of the problem is very large compared to the number of potential demanders for the service.

2.2.8 Opportunities and risks for developing catchment protection services in the Sabie-Sand catchment

In the Sabie Sand catchment there are opportunities for the development of catchment protection services for water supply if irrigators in the region focus on becoming more efficient. This is particularly critical during the drier months of the year when low flows are experienced and there is a higher demand for water. At such times, it may be possible to establish agreements for emergency water releases from upstream dams. The most noticeable area for impact in terms of community development relates to payments to communities for land management specifically when related to land lying adjacent to conservation areas. Often these types of payments are set up as social responsibility exchanges and the monetary component of these exchanges is not really large enough to generate substantial interest. There is however opportunity for community development focussed programmes that are beneficial to tourism. This section of the report assesses these opportunities and risks in relation to these three activities.

2.2.8.1 Hydrological arrangements in the Sabie-Sand catchment

Based on the findings in section 2.2.2, catchment protection service opportunities exist for the protection of 'sponges', the removal of alien invasive species and the control of soil erosion and sediment reduction in the Sabie-Sand catchment. Table 2.17 below lists the opportunities and risks for the development of catchment protection services in the Sabie-Sand based on the hydrological landscape.

It is important to recognise that any catchment protection services identified here must not fall under the classification of a licensed activity according to the Department of Water Affairs and Forestry as these activities are governed by the National Water Act (Act No. 36 of 1998). However, it will be possible to address issues around catchment protection services such as sediment management. It is also necessary to consider whether it is beneficial to pursue these ideas in the context of the current regulatory framework and to further understand the level of incentives required for people to give up certain allocations or practices.

Table 2.17: Opportunities and risks for catchment protection services in the Sabie-Sand catchment based on the hydrological landscape

Opportunities	Threats
• Need to remove more **alien invasive vegetation f**rom the riparian zones and the upper watershed in order to improve water supply. • Water scarcity is a constraint to development in the catchment. • The concepts and methods for removing alien invasive species are already widely understood and adopted as appropriate solutions. • The removal of alien invasive vegetation is ongoing and follow up actions need to be taken providing the opportunity for long term planning and payment systems.	• The national government is already responsible for removing alien invasive vegetation through the working for water programme and hence there is little incentive for demanders of the service to pay for it.
• **Restoration and maintenance of aquatic habitat and biodiversity** will help to maintain the Sabie River is a 'pristine' state. • Surrounding communities will be able to monitor the river and poaching activities as well as maintain the river banks.	• None
• Soil erosion is pervasive in the catchment and hence sediment in the rivers and dams is problematic. There is a need to have good **soil erosion control** and **sediment management** programmes. • Many dams have poor storage capacity due to accumulated silt. For example the Phalaborwa Barrage only has a 10 percent storage capacity due to siltation. • The water quality is also poor in parts of the river due to sediment concentrations and is not suitable for users. • There are a number of solutions for managing soil erosion and sediment that can be provided by the poor.	• The quantified cause-effect relationship between land use activities, soil erosion and sediment accumulation is not well known. • The assigning of responsibility for soil erosion and sediment is unclear. In some areas the soils are naturally highly erodible and unstable in other parts of the catchment practices such as overgrazing, deforestation and poor farming practices compound the situation. • The scale of the impact area is enormous and the costs associated with effecting change are expected to be high. • Evidence of improvement downstream takes a long time. • Monitoring change is difficult.
• Need for **wetland rehabilitation** in the catchment in order to improve water quality and supply. • There are examples of successful projects where wetlands have been rehabilitated on communal lands through conservation initiatives.	• Communities are dependent on harvesting goods from wetlands for their livelihoods and the impacts of converting to conservation need to be understood. • Subsistence agriculture also occurs in wetlands.
• **Water supply** needs to be addressed through the efficient use of water within the sub-catchment.	• Water use is regarded as a licence activity and will fall under the DWAFs licensing programme.

2.2.8.2 Land tenure and ownership in the Sabie-Sand catchment

Based on the findings in section 2.2.3, the Sabie-Sand catchment is characterised by many different land ownership and management regimes. These have different implications for the provision of catchment protection services. Table 2.18 below lists the opportunities and risks for the development of catchment protection services based on land ownership and tenure in the Sabie-Sand.

Table 2.18: Opportunities and risks for catchment protection services in the Sabie-Sand catchment based on the land tenure and ownership arrangements

Opportunities	Risks
• Land tenure and ownership is well defined and land use activities can be implemented. • Land ownership is mixed between private (forestry, commercial agriculture, and conservation), government owned (forestry, conservation) and communally owned (villages with communal grazing areas). • Communal land falls under the authority in the area, typically a tribal leader or tribal chief. • Where land falls under the auspices of a municipality, private ownership is encouraged.	• Where communal land lies under the authority of the tribal leader, this leader needs to support and grant permission for any land use activities to be undertaken, this includes visitation rights and traversing rights in the communal areas. • Collusive behaviour may become evident in areas that compete for projects. • Households that are excluded may be motivated to act 'destructively' in order to qualify for land rehabilitation projects. • There have been a number of stakeholder initiatives in this region and stakeholder 'fatigue' is evident, reducing peoples willingness to participate in new projects. • Population densities are high making it difficult to isolate a few key households to participate and provide services. • Households are dependant on subsistence agriculture and the harvesting of natural resource products such as firewood. Alternatives need to be provided if these activities are to be discouraged.

2.2.8.3 Land use patterns in the Sabie-Sand catchment

Based on the findings in section 2.2.5, the major sources of catchment pollution arise from soil erosion due to overgrazing, rural deforestation and dense rural settlements. There is also a reduction in water availability due to the over allocation of water within the catchment compounded by water use by alien invasive plants. Table 2.19 below lists the opportunities and risks for the development of catchment protection services in the Sabie-Sand catchment through changing land use practices by land owners.

Table 2.19: Opportunities and risks for catchment protection services in the Sabie-Sand catchment based on the land use patterns

Opportunities	Risks
• **Communal land activities** have a large impact on the volumes of soil erosion and transported sediment in the catchment. Opportunities exist for communities to improve their farming, grazing and harvesting activities.	• The communities are often dependent on marginal land to meet their basic livelihood needs. Any land use changes will need to take cognisance of this and make provision for basic livelihoods needs as well as compensate for changing current patterns of land use.

2.2.9 Opportunities and risks for using payments in the Sabie-Sand catchment

Within the Sabie-Sand catchment, many of these required market elements are tentative and efforts are required to address these clearly and effectively prior to engaging in actual payments. The institutional arrangements, the economic potential, the value of the catchment service and the associated transaction costs are all discussed further in table 2.20 below.

Table 2.20: Opportunities and risks for catchment protection services in the Sabie-Sand catchment based on the land use patterns

Opportunities	Risks
Willing buyers • In the upper and lower Sabie-Sand catchment there are potential buyers in the form of forestry, agriculture and conservation tourism. • Specifically identified buyers are the following: Sappi, Various commercial farmers, the private game reserves such as Londolozi or Mala Mala, and the Kruger National Park.	**Willing buyers** • The buyers are unable to make payments for the required catchment service for various reasons. For example it may be legislated that the service be provided, or the buyer may be unable financially to make a payment. • The number of buyers or amount available for 'payments' may not be large enough to effect measurable improvement in the water supply or quantity.
Willing sellers • In the middle area of the Sabie-Sand catchment there are a large number of people dependent on subsistence livelihoods with the potential to provide land management options for catchment protection services. • Communities are willing to participate in activities that can potentially reduce their dependency on subsistence agriculture and improve their livelihoods. • Communities have been involved in stakeholder processes and have an understanding of how they work	**Willing sellers** • The sellers are very large in number and identifying a specific community may be difficult. • Language and cultural diversity may make it difficult to communicate the complex ideas behind payments for catchment protection services. • Literacy rates vary across communities and regions. • Community leaders need to support initiatives if they are to be adopted by communities. • Stakeholder fatigue is evident in the region.
Institutional arrangements • There are a number of community-based groups and NGOs working in the area that could act as intermediaries for payments, for example the KNP People and Environment Center and AWARD.	**Institutional arrangements** • For payments to be made between multiple buyers and sellers, an intermediary or community based organisation, or forum needs to be established to assist with facilitating payments and monitoring progress.
Economic potential for payments • The economic base from which to make payments is relatively small in relation to the scale of the problem but there are already some initiatives underway such as the private game reserves paying the working for water programme to clear alien plants in their reserves.	**Economic potential for payments** • The buyers may not be able to effect change as individuals due to the scale of the catchment. • Buyers may not regard payments for catchment protection services as something they should be paying for but rather services the government should provide.

Table 2.20 continued

Opportunities	Risks
Value/price of identified service • None	**Value/price of identified service** • The value or price of the identified catchment protection services is not known. • The catchment management agency will be established here first and all water users in the catchment will have to pay a catchment management charge, this may hinder any support for payments above this mandatory charge.
Transaction costs • None	**Transaction costs** • The scale of the catchment is very large and the transaction costs associated with payments may be large enough to hinder progress. • Part of these costs may also result from poor information of catchment protection services and the science underlying their provision.

The Sabie-Sand catchment provides opportunities for the development of payments for catchment protection services due to there being lower transaction costs related to the availability of information, accessibility to the area and potential partnerships through established initiatives. Another benefit to working in this area is that there are established NGO's such as AWARD and the KNP Center for Environment and People. These organisations work in the lower regions of the sub-catchment bordering the Kruger National Park and have well-established community links. However, concerns have also been raised around the need for water to be provided for productive use by communities which, in turn, may expand agricultural activities, increasing soil erosion and sediment in the rivers.

2.2.10 Conclusions and recommendations

The Sabie-Sand sub-catchment was selected by the project advisory committee, based on the criteria outlined in section one, as the second potential site for piloting phase 3 of this project. The catchment was selected as it has been targeted by the Department of Water Affairs and Forestry as one of the first catchments in South Africa to be managed by a decentralised catchment management agency (CMA). Furthermore, this catchment has a diverse range of potential buyers and sellers including forestry, commercial agriculture, private and government conservation, and subsistence agriculture. Land degradation, soil erosion, sediment concentrations and water availability are critical issues in the catchment. There is a demand for wetland protection and rehabilitation, as well as the control of alien invasive plants in the riparian zone and the control of agriculture activities that involve the clearing of ground cover leading to soil erosion (RHP, 2001). A number of potential studies were also identified based on the issues, risks and opportunities identified in the previous section (section 2.2). These are discussed below.

2.2.10.1 Alignment with the roll-out of a catchment management agency

Can payments for catchment protection services support the mandate of catchment management agencies? Critical to the payments for catchment services is the establishment of an effective and supportive institutional framework for managing payments and monitoring

activities. This project initially considered the possibility for catchment management agencies in South Africa to accommodate this role. However, it has become clear that although such activities fall within the mandate of CMAs, they effectively have other priorities to meet. These include water allocation reformation and water resources classification. Once the CMA has been established a catchment management charge will be levied on all water users. This charge is designed to cover the costs of maintaining the catchment, though it will initially be used to cover the administrative costs of the CMA. This means that users who want the catchment protection services to be provided will have to consider whether or not they would want to pay for them as an additional cost. The implications for catchment services payments within this context, needs to be clarified and recommendations for implementation made.

2.2.10.2 Education and awareness

Payments for catchment protection services are effectively recognised as new, innovative, 'radical' instruments that have emerged almost too quickly for them to be adopted. At this time in South Africa the National Water Act (Act No.36 of 1998) is being carefully unpacked, guidelines and toolkits for implementation are being developed, and the legislative and governance environment is being established. As a result, there are uncertainties around how the resource is classified, who is allocated water and how this is effected, who pays for water and catchment protection services, how are these payments structured, which users are excluded from payment (if any), and what are the trade-offs between water resource protection and socio-economic development. As a result, awareness of payments for catchment protection services and their added value is poor. This project has an opportunity within the Sabie-Sand to address this awareness issue by holding seminars or training workshops with key stakeholders in the region.

2.2.10.3 Clarity on the baselines

The scientific support for payments for catchment protection services in the Sabie-Sand and elsewhere in the country is limited. There is an opportunity, in conjunction with the establishment of the CMA, to develop the baseline information required for decision-making on payments for catchment protection services in the Sabie-Sand.

2.2.10.4 What are the ecological thresholds for economic and social development in a catchment and can payments be used to support economic development within these thresholds?

A critical question for the Department of Water Affairs and Forestry is the issue of thresholds for economic and social development within a catchment based on the ecological state and requirements thereof. There is an opportunity to investigate how payments can be used to change these thresholds and support socio-economic development in the Sabie-Sand.

2.3 SITE THREE: UPPER VAAL - KLIP RIVER

2.3.1 Introduction

The Upper Vaal catchment area covers about 2,282 km^2. The mean annual precipitation is 687 mm with an annual evaporation of 1,637 mm and a run-off of 92 million m^3. The Klip River extends from Johannesburg to the town of Parys in the Free State Province, where it joins the Vaal River. The Klip River catchment is one of the most heavily impacted river systems in South Africa and is subjected to almost every type of pollution (City of Johannesburg, 2000). It serves all five recognised user groups identified by DWAF namely: domestic, agricultural, recreation, industrial and the natural environment (City of Johannesburg, 2000). A natural wetland occurs in the upper reaches of the river in the vicinity of the settlements of Soweto and Orange Farm. The communities living in the vicinity of the wetlands were envisaged by IIED project members as potential providers of watershed services in the Klip River Watershed.

The area around Soweto and Orange Farm within the City of Johannesburg Metropolitan Municipality is described in the State of the Environment (SoE) Report for Johannesburg (City of Johannesburg, 2000) as one of a number of areas in the municipality with the "poorest environmental quality". Although this is the result of a combination of factors, water pollution is a factor of major concern. The two main sources of water pollution in the upper Klip River watershed are industrial effluent and sewage pollution from informal settlements (City of Johannesburg, 2000). To the south of Soweto, there is high incidence of diseases related to bacteriological contamination of water among the communities located there (City of Johannesburg, 2000). Weak infrastructure and poor management of the existing infrastructure are also causes of contamination by raw sewage. Freeman et al (1997) note that continued disruption of maintenance of water and sewage systems in areas such as central Johannesburg, Soweto and townships in the Rietspruit catchment (located in the greater Jukskei catchment) result in raw sewage and polluted water entering the river system, posing a health threat to communities further downstream.

Inadequate waste removal services – linked to growing informal settlements - have resulted in waste being another source of environmental pollution throughout the residential areas of the upper reaches of the watershed. Littering and unmanaged waste (such as illegal dumping) increase the intensity of this problem. Diarrhoeal diseases related to inadequate waste services, are reported in some areas of the upper catchment area (City of Johannesburg, 2000).

The current state of the environment of the upper Klip River is of concern to the municipality and many residents of the area. Therefore, various community-based initiatives, such as the Mayibuye Klip River Wetlands Project, were launched in the area to address this problem. In Regions 6 and 10 of the municipality, "cleanup campaigns" were launched with the aim of encouraging residents to take ownership of their surrounding areas in terms of responsibility for waste management. The Klip River Wetland Project aims to rehabilitate the wetland. Preventing illegal dumping of waste is one of the strategies employed to achieve this aim. Region 6 forms part of this initiative. The Schools Water Project – involving 6 Soweto schools along the Klip River – utilises the river as a study site. Pupils perform various tests on the river water with the use of basic equipment to determine water quality in the river. This project is instrumental in raising awareness of the natural environment, and the role of human impacts on the natural environment, among students.

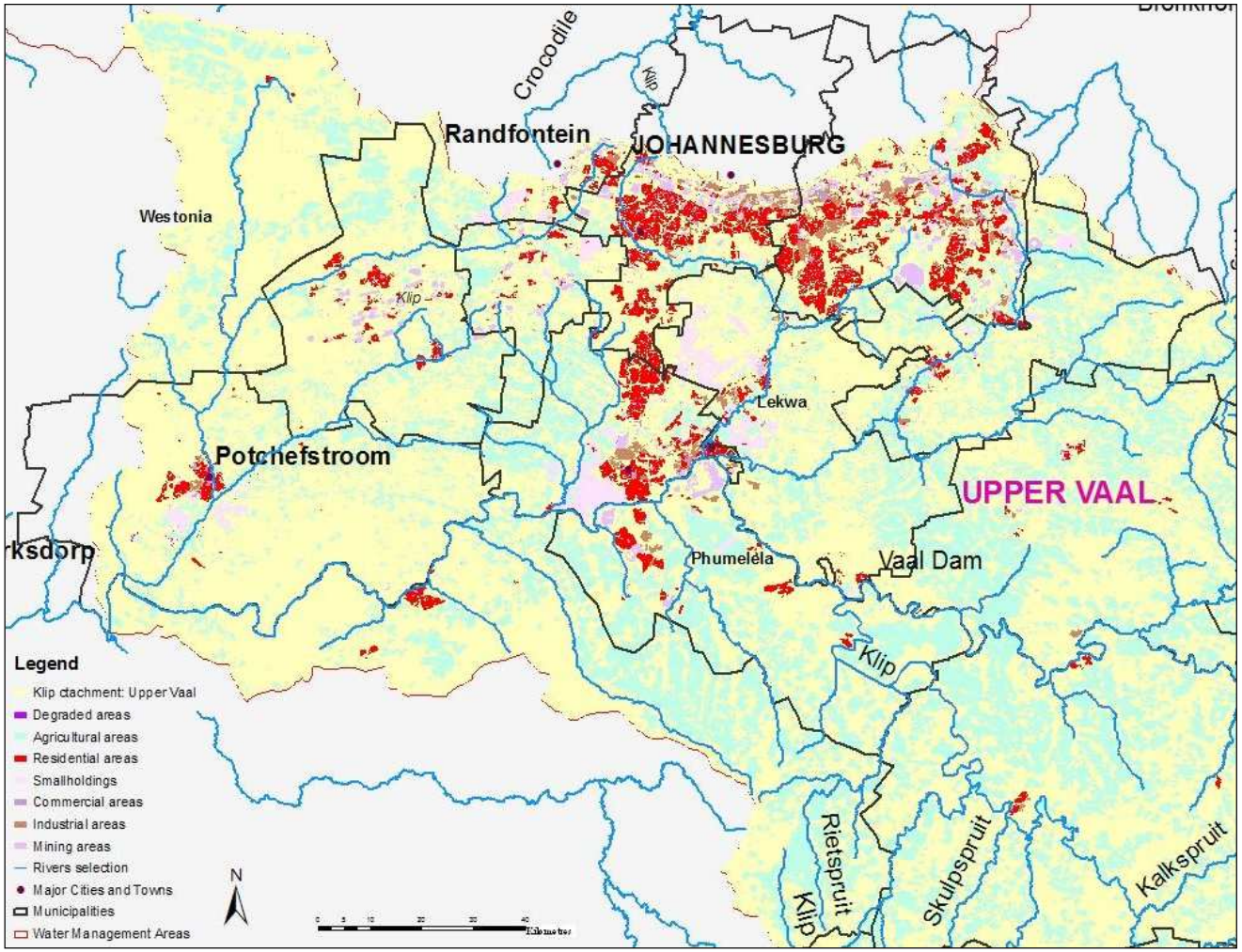

Figure 2.6: Map showing land cover types in the Upper Vaal catchment

2.3.2 Hydrological review

Four hydrological components were addressed namely: water quantity, water quality, groundwater and aquatic ecosystem services. The implications of these four components on the potential development of payments for watershed protection services are discussed below.

2.3.2.1 Water quantity

The Upper Vaal Water Management Area has a natural MAR of 2,423 million m^3/year (DWAF, 2004a). Urban water use is highest in the sub-area downstream of the Vaal Dam, whereas in the sub-area upstream of the Vaal Dam, mining and bulk industrial activities are the highest water use sectors (Table 2.21) (DWAF, 2004d). The Upper Vaal Water Management Area is highly developed and water transfers in and out of the WMA are in response to the population needs for water and economic growth in this WMA and neighbouring WMAs namely: the Middle Vaal and Olifants WMAs.

Table 2:21 Water requirements for the year 2000 (million m^3/year)

Sector/ sub-area	Irrigation	Urban1	Rural1	Mining and Bulk Industrial2	Power generation3	Afforestation4	Total local requirements
Wilge	18	27	15	0	0	0	60
Vaal Dam-upstream	29	32	17	99	39	0	216
Vaal Dam-downstream	67	576	11	74	41	0	769
Total for WMA	114	635	43	173	80	0	1045

1) Includes component of Reserve for basic human needs at 25 litres / person / day
2) Mining and bulk industrial water uses that are not part of urban systems
3) Includes water for thermal power generation only
4) Quantities refer to the impact on yield only

2.3.2.2 Water quality

Land uses in the Upper Vaal Water Management Area include agriculture, extensive gold and coal mining, power generation, industrial activities and urban developments. The industrial activities include mineral processing plants, steel industry, petrochemical industries, fertiliser manufacture, pulp and paper and light industry located around the urban centres. All these activities impact on the surface water and groundwater quality in the WMA (DWAF, 2004d). Return flows from urban, mining and industrial sectors, and intensive mining activity have serious adverse effects on the quality of water in the Vaal River (DWAF, 2004a). In addition, the ISP report (DWAF, 2004d) notes that the clean water transferred into the catchment leads to algal blooms in Vaal Dam due to increased light penetration in surface water. This causes problems with the Rand Water water treatment plants (DWAF, 2004d).

2.3.2.3 Groundwater

Groundwater is used in the Upper Vaal Water Management Area largely for domestic use and irrigation (DWAF, 2004d), while substantial amounts are abstracted for urban use (DWAF,

2004a). The exact quantity of the exploitable groundwater and groundwater use is still unknown. However, there is a large potential for groundwater use in the Upper Vaal WMA (DWAF, 2004d). Groundwater dewatering is taking place extensively in this WMA, and this may impact on surface water flow if there is a strong link between surface and groundwater systems. In addition, the salinity loads associated with dewatering of groundwater for mining activities contribute to the high salinity load of the downstream Vaal River system DWAF, 2004d). Another key issue that the ISP report states is that of over-abstraction of groundwater for irrigation especially in the Heidelburg area (DWAF, 2004d).

2.3.2.4 Aquatic ecosystems

The riverbed, flow, and riparian/flow conditions of the rivers in the Upper Vaal Water Management Area range from severely modified to slightly modified. Most instream biota is indigenous, and it has been modified. Watershed services with regard to aquatic ecosystems would include rehabilitation of the riparian vegetation especially in areas where riverbanks have been severely modified (DWAF, 2000).

2.3.2.5 The implications of catchment protection services in the Upper Vaal Water Management Area: Klip River sub-area

A number of potential catchment protection services have been identified for the Klip River. These include rehabilitation of wetlands to minimise pollution of water from the land; treatment of water from urban and industrial sectors; and proper management of both mining and agricultural activities to minimise the release of polluted water into the associated streams and rivers.

2.3.3 Land tenure and ownership

A critical component for the development of payments for catchment protection services is clearly defined property rights. This includes property rights associated with land and land-based activities that impact on the water resources in the catchment.

The City of Johannesburg is divided into 11 regions for administrative purposes (see Figure 2.7). For the purpose of this study, regions 6, 10 and 11, situated within the Klip River catchment, are of interest. Soweto is spread across regions 6 and 10. Housing in Soweto is of a mixed nature. Informal- and formal housing stand side by side. In Region 10, large houses, constructed by more affluent residents of Diepkloof Extension, are situated close to informal settlements and the well-known "matchbox houses" of Soweto. Hostels – which were used to house migrant workers – now often serve as residences for families in need of housing.

Informal settlements are common in regions 6, 10 and 11 (Figure 2.7). The most extensive informal settlements in Region 6 are found in Doornkop/Thulani, Ebumnandini, Protea South, Chris Hani, Slovo Park and Freedom Square (Johannesburg News Agency, 2004). In one "neighbourhood" of Region 6 alone, 58 000 residents live in informal settlements. The southern section of Region 11 – the Orange Farm area – is characterised by large areas of agricultural land and extensive informal settlements. Informal settlements develop where land is available, whether owned privately or by the municipality. In Region 11, the invasion of planned residential areas, on both public and private land by informal dwellers is a major concern to the municipality due to the problems experienced when removing or relocating people from the land.

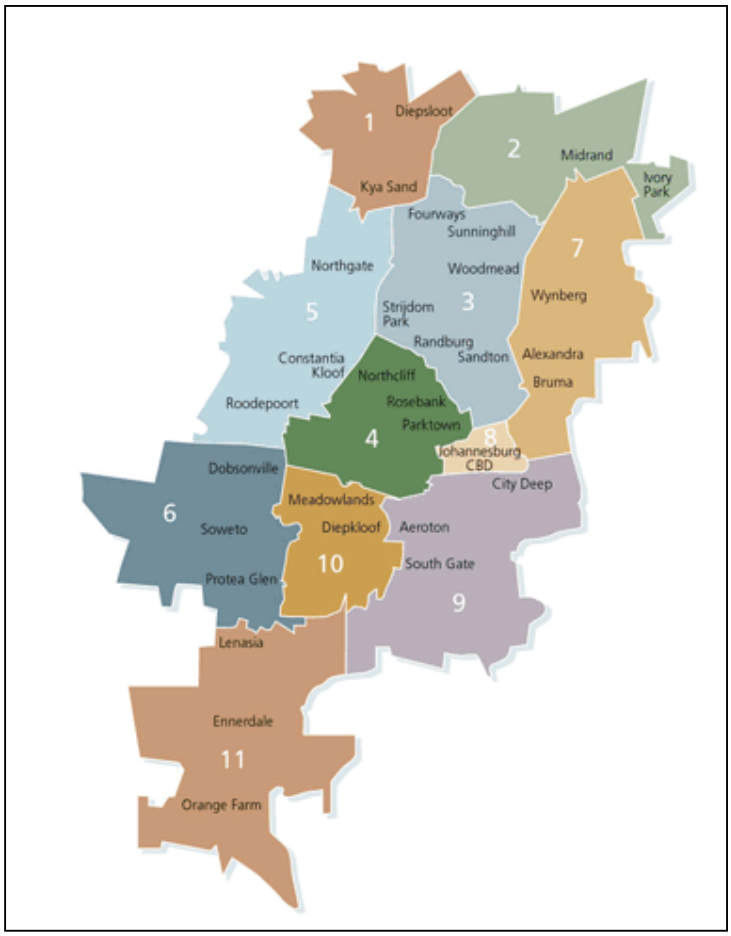

Figure 2.7: The administrative regions of the City of Johannesburg Metropolitan Municipality (Johannesburg News Agency, 2004).

In Region 10, informal settlements have mainly developed on government-owned land. Where ownership of land is specified as "unknown", land is usually privately owned[6]. Table 2.22 indicates that the majority of settlements will remain where they are for the near future, except for those situated on private land (refer to the "development status" column of Table 2.22). Although chemical latrines are provided to residents, service delivery often does not keep up with the growth rate of these settlements.

[6] Telephonic conversation with official of Department of Housing Region 10, City of Johannesburg Metropolitan Municipality; October 2004.

Table 2.22: The development status of informal settlements in Region 10, City of Johannesburg

Area	Name of Settlement	Total Number of Informal Houses	Ownership of Land	Development Status	Water Supply	Sanitation Supply
Kliptown	Kliptown Informal Settlement	2930	Council	In Situ	Taps	Chemical
Golden Triangle	Freedom Park	4730	Council	In Situ	Tanks and stand taps	Chemical
	Ruth First		Council	In Situ	Tanks and stand taps	Chemical
Diepkloof	Motswaledi	1289	Province	In Situ	Tap points	Chemical
Orlando East	Nomzamo	403	Council	In Situ	Tap points	Sewer connected
	Lahlamlenze	148	Council	Relocation	Tap points	Chemical
	St Mary's	109	Unknown	Relocation	No supply	No sanitation
	Coalyard	178	Unknown	Relocation	No supply	No sanitation
Klipspruit	Holomisa	978	Council	In Situ	Tap points	Chemical
Meadowlands	Mshenguville	465	Unknown	Relocation	Tap points	Chemical
	Mofolo North	74	Unknown	Relocation	No water	No sanitation

Source: City of Johannesburg – Region 10; Department of Housing; 2004 (faxed document)

Informal settlements are characterised by poor or non-existent service delivery. Inadequate sanitation infrastructure, waste management services and water infrastructure in these settlements have resulted in increased pollution of the Klip River Wetland due to polluted run-off from settlements. Continuous growth of these informal settlements, due to rural-urban migration, pushes the boundaries of the settlements closer and closer to the banks of the wetland. This further increases the impact of communities, in terms of pollution, on water quality. High levels of faecal coliform bacteria, such as E.coli, are found in water courses in the vicinity of informal settlements (City of Johannesburg, 2000). Individuals living in these settlements are exposed to risks of waterborne disease on a daily basis.

Figure 2.8 shows the position of informal settlements in the City of Johannesburg. The map indicates that informal settlements are especially prevalent in-and-around Soweto (Regions 6 and 10).

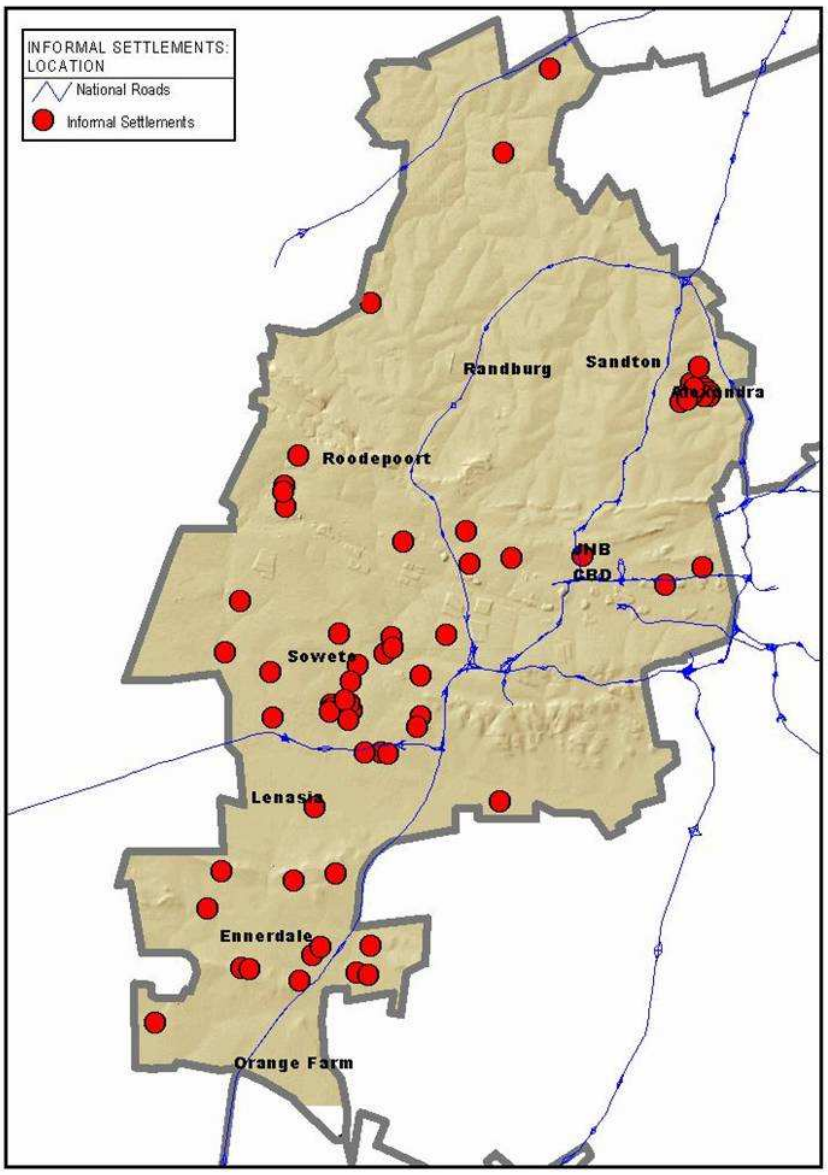

Figure 2.8: Sketch map showing the locations of informal settlements in the City of Johannesburg (City of Johannesburg, 2000)

The settlements and residential areas of Region 11 are quite isolated from the other regions of the metropolitan municipality (Figure 2.8). Lenasia, Zakariya Park and Ennerdale comprise middle-income neighbourhoods. However, according to the City of Johannesburg (Johannesburg News Agency, 2004), the bulk of the houses in these formal settlements still fall into the lower income bracket.

The southern section of Region 11 - Orange Farm and surrounds – is comprised of agricultural land and some informal settlements. Many residents of this section of Region 11 are poor and unemployed (Johannesburg News Agency, 2004). The isolated position of this region makes it costly to provide infrastructure for service delivery (Johannesburg News Agency 2004). The largest portion of the population of Region 11 lives in the southern section – 170,000 of the total population of 270,000 (Johannesburg News Agency 2004).

According to the City of Johannesburg (Johannesburg News Agency 2004), significant areas of underdeveloped and vacant agricultural land in the southern section of Region 11 are publicly owned. This holds promise for future developments in the area and possible relief to those experiencing unemployment and poverty.

2.3.3.1 The implications of payments for catchment protection services for power imbalances in the Klip river

Poverty, unemployment, inadequate housing, and inadequate service delivery are the main issues, that confront many of the residents of the upper Klip River. There is a definite need for additional livelihood activities in the area. However, the role of a market for watershed services in this watershed, with services supplied by poor and marginalized groups, can easily be questioned. Improvements in the environmental quality of the watershed will mainly be addressed by factors such as decreased urbanisation, increased service delivery, increased housing opportunities, improvement in sewage infrastructure, increased environmental awareness within communities (to address problems of littering, etc). Communities can contribute to the environmental quality of the watershed through initiatives such as improved waste management (reduced littering). Yet, in many instances, poor environmental quality is a symptom of wider problems caused by urbanisation, population growth, unemployment, and inadequate education.

The onus for environmental management of the Upper Klip River Catchment seems to rest with the metropolitan municipality. This is a mammoth task considering the continuous influx of people into the area – people needing shelter, services and, most of all, jobs. Current sewage infrastructure is reported to be insufficient for the present demand in the municipality. And with ever present urbanisation, the demand is not expected to decrease.

An example of power imbalances in the catchment is displayed in the southern section of Region 11 (the Greater Orange Farm / Weilers Farm area) where civil disobedience is reported by the municipality. Apparently, the community has strong political and local groupings and fail to comply with municipal regulations (Johannesburg News Agency, 2004).

Owners of agricultural land in region 11, where informal settlements are encroaching onto both privately- and publicly-owned land, are unlikely to be willing to pay for catchment protection services provided by the very communities that are living on their land illegally, or are encroaching on their land. The relationships between the various role players in the catchment must be considered carefully before any development initiative is taken. Many residents of Johannesburg attribute much of the high crime rate in the city to residents of informal settlements and this places extra strain on relationships between different residents in the catchment.

If the City of Johannesburg Metropolitan Municipality can successfully address the current crisis in terms of a backlog in service provision in the Upper Klip Catchment, a big step towards a cleaner and healthier river system would have been taken. With improved housing, increased employment opportunities and increased income for residents of the catchment, the impact on the environment will even be greater. However, the reality of the situation has to be kept in mind. These challenges are common across South Africa.

2.3.4 Identification of poor and marginalized groups

The population of the Upper Klip Catchment is generally poor compared to the rest of Johannesburg. Average employment and income levels are low – with the percentage of

unemployed residents being the highest in the southern parts of Johannesburg (City of Johannesburg, 2000). In Region 11, 50 percent of the population has no income and approximately 62 percent of the remainder earn less than R1 500 per month (Johannesburg News Agency, 2004). Therefore, the majority of residents of this region live below the breadline (Johannesburg News Agency, 2004). Unemployment in Region 11 is estimated at 70 percent (Johannesburg News Agency, 2004). The largest percentage of residents of Johannesburg lives towards the south of Johannesburg, according to Census 1996 figures (City of Johannesburg, 2000). Education levels in this region are also the lowest in the municipality.

The most marginalised of the residents in these parts of the City of Johannesburg, live in the informal settlements where unemployment is rife and service delivery poor. In these settlements, people live in houses built with corrugated iron and other waste materials. These shelters do not provide much protection from the weather, especially in the cold winter months on the Highveld.

Inequity is engrained into South African society and it is no different for Soweto and the surrounding townships. In many areas of Soweto, rich and poor live side by side. In the Apartheid years, black people employed in Johannesburg had to live on the outskirts in "townships" established by the government of that era specifically for this purpose. In Soweto, a vibrant "township life" emerged and today still, despite the logistical difficulties that come with living far from the work place, many Johannesburgers still prefer to stay close to friends and families in the township. This has resulted in a situation where high income housing is built next to matchbox houses and informal settlements. The reality of the Apartheid city model should be taken into consideration concerning the quality of life of the residents of the Upper Klip Catchment. Unemployment and poverty in Region 11, for example, can be attributed, in part, to geographical isolation from the employment opportunities of Johannesburg.

Environmental management projects in the Upper Klip Catchment - related to the rehabilitation of the wetland and the Klip River - are mostly run on a volunteer basis and rely on participation by concerned citizens. Initiatives, such as the Mayibuye Klip River Wetlands Project, aim to involve community members to be in activities such as removal of illegally disposed waste. The Schools Water Project initiative in Gauteng involves six schools along the Klip River in Soweto to monitor the quality of the river. Whereas these projects might receive funding to continue with activities, they do not pay community members to participate. In 2002, the Mondi Wetlands Project arranged for a woman with skills in weaving of wetland products into traditional crafts to visit Soweto and teach a group of young girls how to make crafts using products from the Klip River (Mondi Wetlands Project 2002). Such an initiative raises awareness of the value of environmental services and provides training to community members that can in future serve as a source of income to community members. However, poverty relief interventions linked to wetland rehabilitation has not been implemented on a large scale in the Upper Klip as yet.

2.3.5 Land use

The main land uses along the Klip River are industry and mining, urban settlements, irrigated and subsistence agriculture and wetlands. Most of these land use types do not use water directly abstracted from the Klip River but instead receive water from the Rand Water Board. However, these land uses impact on the water quality as a result of discharged wastewater. One of the key land use impacts in the Klip River catchment is the increase in surface run-off due to the impermeability of urban land surfaces.

Table 2.23: Approximate area under specific land use in the Klip River catchment

Land use	Area (km2)	Area (%)
Irrigation	21.3	0.93
Alien vegetation	26.6	1.17
Urban settlements	395.9	17.35
Other (including nature reserves, dryland irrigation and rural settlements)	1838.2	80.55

Source: DWAF (2002a)

2.3.5.1 Agriculture

Commercial agriculture is practiced along the lower reaches of the Klip River catchment. Agricultural activities include crop and livestock farming. The main summer irrigated crops are maize and Kikuyu pastures, in addition soyabeans, groundnuts, summer vegetables and flowers. The main winter irrigated crop is wheat. Subsistence agriculture is practiced on a small scale within some informal settlements. Irrigation water is sourced from the Klip River. Livestock farming includes cattle, sheep and horses (DWAF, 2002a).

2.3.5.2 Mining

Mining has been a dominant land use along the Klip River. However, mining activities have been on the decline as mines reach the end of their economic life and become inactive. However, these inactive mines still have an impact on water resources despite their dormant state. One of the major impacts of mining is acid mine drainage, where water is decanted out of the mine and discharged into the river. Specific mines in the area are Durban Roodepoort Deep Gold Mine and Glen Douglas Dolomite Mine.

2.3.5.3 Urban settlements

Many large informal settlements occur around the Soweto area. Informal settlements have been spreading and are encroaching on sensitive wetland areas thus leading to the destruction of these ecosystems. Wetlands sustain biological diversity, and improve the quality of return flows of water from industrialised areas by absorbing nutrients such as ammonia and bacteria such as E.coli, provide recreational opportunities, and create a sanctuary for birdlife, small animals and aquatic organisms. The ecosystem services that are provided by wetlands are damaged or eliminated through encroaching human settlements. Therefore, there is need for wetland rehabilitation in the Klip River catchment to maintain its ability to improve water quality.

2.3.5.4 Wastewater treatment plants

Water and sewerage systems have experienced continuous maintenance-related disruptions in areas such as central Johannesburg, Soweto and townships in the Rietspruit catchment. This has lead to raw sewage and polluted water entering the river system. This water pollution impacts on the ammonia levels in the river as well as bacteriological water quality (Freeman, et. al, 1997).

It was found that bacterial counts in approximately 67 percent of water samples within the Klip River catchment ranged between unacceptable and bad levels (Davie, 2002). One of the areas with high bacterial counts was along a Klip River tributary running through the Protea

area in Soweto. Another study by Taylor, Cox, Very and Grabow (2001) found evidence of high concentrations of Hepatitis A virus and human astrovirus in the Klip River. These viruses are excreted in human faeces and have the ability to survive in water environments; consequently, their presence in water sources used for domestic or recreational purposes could pose a potential health problem. This study found traces of sewerage in its water samples. There is a need for the City of Johannesburg needs to repair and maintain the water and sewerage system in the Klip River catchment area.

2.3.5.5 Natural and protected areas

Natural areas exist such as the Rondebult Bird Sanctuary fulfil important recreational and conservation needs. These areas provide recreational opportunities ranging from non-contact to full contact activities such as riparian home ownership, fishing, bird watching, boating, swimming, windsurfing and water-skiing. The Rondebult Bird Sanctuary, specifically, is located on the outskirts of Germiston and comprises a 95 ha vlei and marshland fed by discharge of treated effluent from Rondebult Sewage Treatment Works. The reserve is home to over 156 bird species (mainly waterfowl), including avocet, flamingos, herons, spoonbill, ibis and purple gallinule (DWAF, 2002a). Therefore, there is a need to maintain water quality within ranges that are suitable for the continued functioning of these protected areas.

2.3.5.6 Conclusion

The main land use impacts in the Klip River catchment are related to urban growth and industrial development. These have had diverse impacts on the water quality of the river (RHP, 2004). The water quality in the Klip River is poor due to the discharging of effluents and litter into the system from mining and industrial land uses and urban settlements as well as leakages from the wastewater treatment plants in the area. A potential health threat due to the poor water quality is where the river is used for recreational and for domestic (e.g. washing clothes) purposes by recreational users and the human settlements in the Soweto area.

2.3.6 Economic review

The GGP statistics for the City of Johannesburg were used as indicative of the Klip River catchment. The employment statistics were calculated based on the wards in the metropolitan that were adjacent to the Klip and Rietspruit Rivers. Despite its high economic productivity, areas of poverty and unemployment exist within townships and rural settlements (City of Johannesburg, 2003). Economic activities specific to the Klip River area are agriculture, mining, manufacturing and recreation. Water is predominantly used by urban settlements (specifically in townships) and thus benefits from watershed services that may be provided would predominantly accrue to this segment of society and downstream users (DWAF, 2002a).

2.3.6.1 Gross geographic product

According to the City of Johannesburg's (2003) Integrated Development Plan of 2003/04, the GGP was R86 million in constant 1995 prices. The four main contributing sectors are finance and business (31.7 percent of total GGP), reatail and wholesale trade (20.7 percent of total GGP), community and social services (12.4 percent of total GGP) and manufacturing (15.1

percent of total GGP) sectors. The metropolitan area has grown at an average annual rate of 2 percent over the last 10 years (City of Johannesburg, 2003).

2.3.6.2 Employment

Formal employment statistics have been calculated based on the wards in the City of Johannesburg that are adjacent to the Klip River. There was 40.9 percent unemployment in this part of Johannesburg in comparison to 37.3 percent for the entire metropolitan area (Statistics SA, 2003).

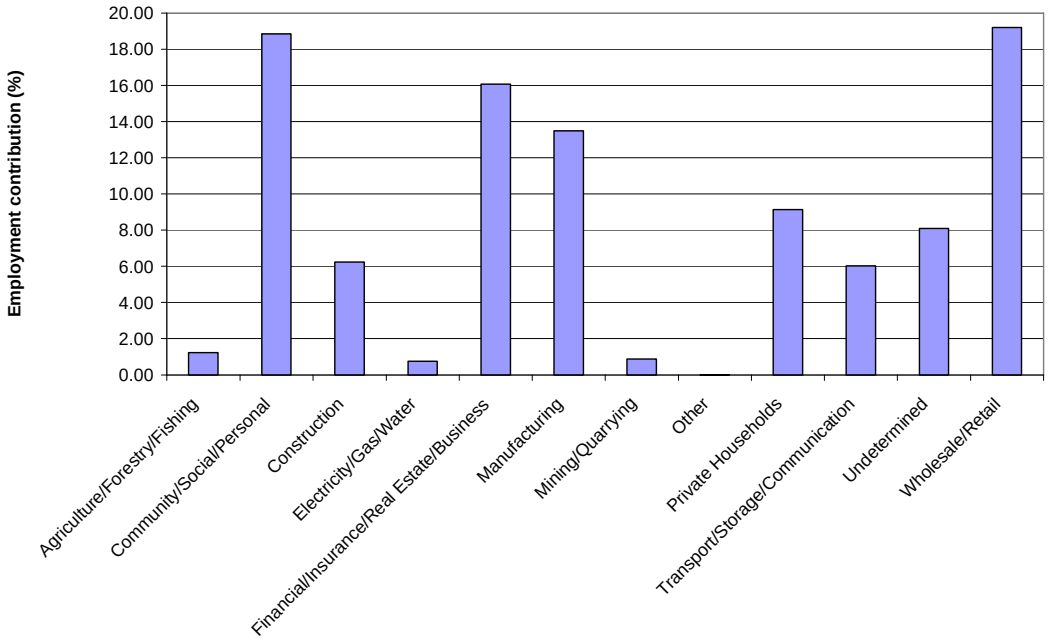

Figure 2.9: The contribution to employment by economic sector in the wards adjacent to the Klip River (2001). (Source: Statistics SA, 2003)

The employment contribution made by each economic sector to the population living adjacent to the Klip River is shown in Figure 2.9. it can be seen that the main employers are retail and wholesale trade (19.2 percent), community and social services (18.9 percent), finance and business (16.1 percent) and manufacturing (13.5 percent) sectors (Statistics SA, 2003).

2.3.6.3 Resource use

The main economic sectors in the Klip River catchment area that require water are agriculture, mining and industry. The economic activity with the highest water requirements is urban settlements (96 percent) followed by irrigated agriculture (3.2 percent). It is important to note that most economic activities do not use water that is directly abstracted from the river but receive their water from the Rand Water Board. However, these land uses discharge effluent into the Klip River catchment.

Table 2.24: Water requirements in the Klip River catchment

Economic activities	Water requirements (million m3)	Water requirements (%)
Agriculture	10.7	3.4
- Irrigation	10.3	3.2
- Livestock and game	0.4	0.1
Domestic	306.6	96.0
- Urban	306.4	95.9
- Rural	0.2	0.1
Bulk users	1	0.3
- Mining	0.8	0.3
- Other	0.2	0.1
Alien vegetation	1.1	0.3
Total	319.4	100.0

Source: DWAF (2002a)

2.3.6.4 Implications of land use practices and economic power imbalances on payments for catchment protection services in the Klip river

The major land uses in the catchment include nature reserves, dryland agriculture, rural and urban settlements. Most of these land uses receive water directly from Rand Water Board and not from the Klip River catchment. The lower reaches of the Klip River are characterised by nature reserves and protected areas such as Rondebult Bird Sanctuary and wetlands.

Water demand is concentrated in domestic urban areas that are supplied by the Rand Water Board and are not directly affected by the quality of the water resources in the Klip River. Most economic sectors do not use water directly from the catchment but use the Klip River to discharge or dump wastewater, including acid mine drainage and industrial effluent. Leakages from wastewater treatment plants have added to the contamination of the Klip River and the increased health risk to informal settlements and recreational users. Rondebult bird sanctuary provides a watershed service to recreational users and improves the water quality from treated discharged effluent. Other natural areas that provide recreational opportunities are affected by the poor water quality of the river. There is also a problem relating to degradation of the wetlands by the informal settlements.

The potential buyers of watershed services (such as improved water quality and ecological functioning) are recreational users and third parties such as environment friendly organizations. The suppliers of wetland rehabilitation services (i.e. improved water quality) include the Rondebult Bird Sanctuary. There is a weak potential for a market for watershed services, as there are no strong economic links to improve or rehabilitate watershed services in the catchment.

2.3.7 Identified catchment protection services in the Klip river

Based on the hydrological landscape outlined in section 2.3.2 and the increasing demand for water of an appropriate quality in the Klip River, there seem to be numerous opportunities to identify catchment protection services and develop payments for these services. This section

reviews the services identified in this report and classifies them into 3 core themes namely, ecosystem goods and services protection and maintenance; water quantity, and water quality.

Table 2.25 lists the catchment protection services identified in the Klip River and describes the associated activities required to achieve the provision of this service. The table also states whether or not there is an opportunity for the development of these services in the catchment.

It is not necessarily possible to pursue the development of all the identified services within the scope of this project. The final column in table 2.25 provides a broad statement related to whether or not it is possible to develop these services in the Klip River through payments based on the criteria in section 1.

Table 2.25: Identified catchment protection services for the Klip River

Watershed service	Commodity/ Land use intervention	Opportunity for payments
Ecosystem goods and services maintenance and protection	Restoration of wetlands and 'sponges' in the watersheds of the Sabie and the Sand rivers	Yes
	Restoration and maintenance of aquatic habitat and biodiversity in the Sabie River	Yes
Water quantity	Efficient use of water by water-intensive sectors	No
	Alien invasive species removal in the upper parts of the catchment and along the riparian zone	Yes, but not necessary as the Working for Water programme deals actively with this in the catchment
	Security of supply	No (as interbasin transfers address this issue)
Water quality	Agro-chemical pollution and soil run-off reduction	Yes
	Human health protection	Yes
	Mine water discharge management and quality improvement	Yes

According to the hydrological review in section 2.3.3, the Upper Vaal catchment is a closed water system dependant on interbasin water transfers to meet its growing user demands for water. The system also faces serious water quality problems (DWAF, 2004a). The Klip river flows into the Vaal river and is also characterised by these issues. The Klip river faces severe water quality problems that affect human health, it is also prone to frequent flooding events, and there is a demand for more water of an appropriate quality from this river. Catchment protection services may be used to overcome or at least address some of these issues. The opportunities and risks for developing these are discussed further in section 2.3.8.

2.3.8 Opportunities and risks for developing catchment protection services in the Klip river

Opportunities for watershed services in the Klip River focus on the maintenance of water quality for industrial, mining and domestic use and for the protection and rehabilitation of the aquatic ecosystem. Table 2.26, outlines the opportunities and risks associated with developing catchment protection services in the Klip river based on the hydrological landscape, the land tenure and power imbalances and the land use patterns.

Table 2.26: Opportunities and risks for catchment protection services in the Klip river

Opportunities	Risks
Hydrological assets • Need in the catchment to have more alien **invasive vegetation removed** from the riparian zones and the upper watershed in order to improve water supply. Follow up actions also need to be taken to provide the opportunity for long term planning and payment systems. • **Water scarcity** is a constraint to development in the catchment and there is a need for improved efficiency in water use. • **Restore aquatic habitat and biodiversity** will help to improve water quality in the Klip River. There is a specific need to focus on wetland rehabilitation for water purification. (Surrounding communities will be able to monitor the river and poaching activities as well as maintain the river banks and restore and protect the wetlands). • **Better water management** by the industrial and agricultural sectors to improve the quality of water discharges.	**Hydrological assets** • The national government is responsible for removing alien invasive vegetation through the Working for Water programme and there is little incentive for demanders of the service to pay for it. • The catchment protection services need to be carefully understood so as not to have counter impacts. • Part of the water quality concerns arise from disposal of human waste due to the lack of sanitation and other services, if these services. If these services are provided to communities along the Klip River, there will be a reduced demand for quality improvements. • The cost to clean industrial and mining effluent may be too high for payments to be considered. • If communities are to provide the catchment protection service, they may not have an alternative way of disposing of their waste or a substitute for their domestic use of the river and may be forced to undermine the 'clean-up' work they support.
Land tenure and power imbalances • None	**Land tenure and power imbalances** • Land tenure for communities living in the Klip River sub-catchment is characterised by formal and informal settlements. Hence land tenure is relatively precarious and property rights are not clearly defined or assigned. This makes it difficult for communities to take responsibility for changing land use activities.
Land use • Where private property rights are established the issues for catchment protection services relates to water discharges and the quality thereof. Agriculture land management may be improved but industrial and mining technology improvements are required to achieve improvements in these effluents.	**Land use** • The opportunities for catchment protection services relate to wetland rehabilitation. The insecure property rights assigned to communities diminishes their potential to provide this service unless there is an intervention by DWAF that allows them to engage in 'best' land management practices.

2.3.9 Opportunities and risks for using payments in the Klip river

Within the Klip River catchment, many of the required market elements are tentative and efforts are required to address these clearly and effectively prior to engaging in actual payments. The institutional arrangements, the economic potential, the value of the catchment service and the associated transaction costs are discussed further in table 2.27 below.

Table 2.27: Opportunities and risks for catchment protection services in the Klip River

Opportunities	Risks

Willing buyers
• There are a number of buyers available ranging from industry, agriculture and mining, to the financial sector and other services sectors.
• From the perspective of demanders, they are:
  • domestic potable use and recreational use such as birding and fishing, and
  • small income producers with potential, therefore small payments may not be enough to entice participation,
	Willing buyers
	• The buyers are unable to make payments for the required catchment service for certain reasons; for example, it may be legislated that the service be provided, or the buyer may be unable financially to make a payment.
	• The number of buyers or amount available for 'payments' may not be large enough to effect measurable improvement in the water supply or quantity.
	• There is no incentive for industries to pay for watershed services, as they do not abstract water directly from the river.
	• If industries are the main polluters then the potential for alleviating poverty is limited as industries would want payment to 'clean up' their activities.
	• There is not enough information available regarding the potential demanders in terms of how many recreational users would be willing to pay.

Willing sellers • Communities along the Klip River experience poverty, unemployment, inadequate housing and inadequate service delivery. They need supplemental income that could be provided through payments for catchment protection services and hence improve their livelihoods. • Schools are well structured to participate in providing watershed services through community activities.	**Willing sellers** • Increased competition for control over the wetlands or other areas being set aside for catchment services in order to gain access to the benefits. • Erosion of community cohesiveness due to increased divisions between those who gain and those who lose from payments.
Institutional arrangements • An intermediary will need to be established and it can be done specifically to meet the requirements of the Klip River and the associated payments mechanism. • Community structures are well organised through limited initiatives but are site specific and involve small numbers of people.	**Institutional arrangements** • For payments to be made between multiple buyers and sellers, an intermediary or community based organisation, or forum needs to be established to facilitate payments and monitor progress. • No formal institutional arrangements exist in the catchment that could facilitate payments for catchment protection services.
Economic potential for payments • The economic base from which to make payments is relatively small but there are already some initiatives underway such as the Nedcor 'green' project aiming at cleaning up the Klip River.	**Economic potential for payments** • Buyers may not regard payments for catchment protection services as something they should be paying for but rather services the government should provide.

Table 2.27 continued

Opportunities	Risks
Value/price of identified service • There is an observable value for the clean up of the Klip River and the reduced risk of flooding events.	**Value/price of identified service** • The value or price of the identified catchment protection services is not known. • The catchment management agency will be established here first and all water users in the catchment will have to pay a catchment management charge, this may hinder any support for payments above this mandatory charge.
Transaction costs • The scale of the river is relatively small when compared to other potential sites in South Africa, this may reduce the transaction costs for payments.	**Transaction costs** • Poor information will lead to higher transaction costs for payments in this area. • There is an urgent need to address service delivery and focus on the demand for basic needs, before the provision of catchment protection services.

2.3.10 Conclusions and recommendations

Overall, the opportunities for development of a pilot project in this catchment were positive. A clear potential, although perhaps idealistic, pointed towards the rehabilitation of wetlands along the Klip River. This would improve recreational fishing grounds and the bird sanctuary downstream. Potential buyers of these services would be recreational users, conservationists and corporate companies. A potential spin-off to this initiative would be improved water quality, a catchment service for which industries may be willing to pay. Further benefits to focusing on this area are the size of the river and the confined and direct relationship of the watershed services intervention and the ability to measure the impact thereof. Due to the proximity of the demanders and the sellers, transaction costs are expected to be relatively low.

A risk to focussing on this river is that communities in the area are highly dependent on the river for domestic use and waste disposal and there are concerns that if the community is to provide a service related to the provision of clean water, without providing them with an alternative source of water for their basic needs, then they may have no alternative water supply.

This site was recognised as a potentially good site by the project advisory group based on the fact that a pilot project could be implemented at a relatively small scale and that good initiatives were already underway in the area through corporate social responsibility projects. However, it was also recognised that the need to address service delivery for sanitation and water supply first was an outweighing factor. Therefore, the site was not selected for piloting in phase 3 of this project.

There may however be potential for developing payments around services that are not directly related to water such as the provision of security by the community for conservation and recreation related activities.

2.4 SITE FOUR: MHLATUZE CATCHMENT

2.4.1 Introduction

The Mhlatuze catchment forms part of the Usutu to Mhlatuze Water Management Area is situated in KwaZulu-Natal. It has a mean annual runoff of 938 million m3 per annum. The northern parts of this water management area border Swaziland and also have international water obligations to Mozambique. The Mhlatuze catchment lies in the southern region of this water management area. Overall the water demand and supply needs in the Mhlatuze catchment are relatively well balanced although there are localised areas of imbalance. These imbalances are to be addressed through the compulsory water licensing process currently being rolled out by the Department of Water Affairs and Forestry (DWAF, 2002c). The Mhlatuze is also planned by the Department of Water Affairs and Forestry to be one of the first catchments to roll-out a catchment management agency. Figure 2.10 below depicts the Mhlatuze catchment. The catchment is characterised by commercial forestry, commercial agriculture, residential areas and limited mining. In terms of the broader scale of the catchment the area of land classified as degraded is relatively small.

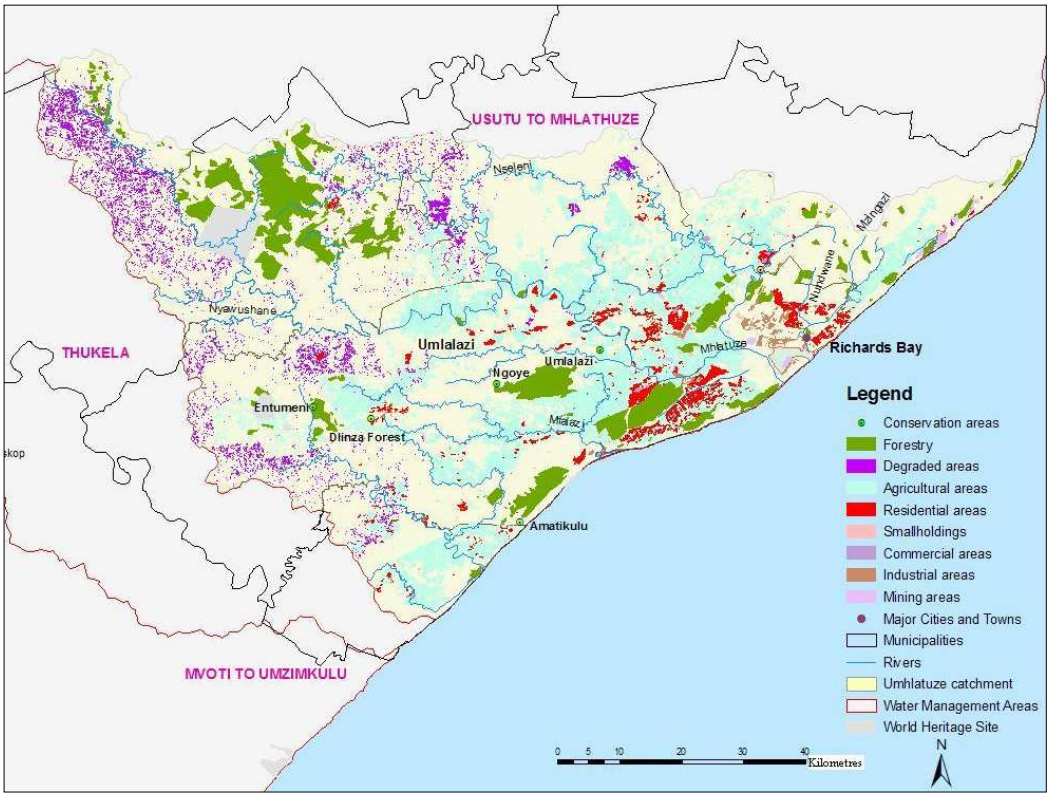

Figure 2.10: Map showing land cover in the Mhlatuze catchment

2.4.2 Hydrological review

This section addressed whether the hydrological issues of the Usutu to Mhlatuze Water Management Area: Mhlathuze sub-area hindered or supported the development of payments

for catchment protection services. Four hydrological components were examined namely: water quantity, water quality, groundwater and aquatic ecosystem services. The implications of these four components on the potential development of payments for catchment protection services are discussed below.

2.4.2.1 Water quantity

The Mhlatuze sub-area has a natural MAR of 938 million m^3/year (DWAF, 2004a). Land use in this sub-area is dominated by afforestation and irrigated crops (predominantly sugar cane and citrus), with most of the irrigated areas located along the Mhlatuze River downstream of the Goedertrouw Dam. The Goedertrouw Dam was constructed in the upper reaches of the Mhlatuze sub-area to provide water for the increasing domestic and industrial water requirements in Richards Bay. Provision was made that this dam may also be used as a source of water for large-scale irrigation (DWAF, 2004e). Irrigation, mining and industrial water use sectors are the largest water users in the Mhlatuze sub-area. Sufficient water is available to meet the requirements for all water use sectors in this sub-area, though the resource has been over allocated (DWAF, 2004e). Options to ensure sufficient water is supplied to the sub-area in the future include: reallocation of irrigation water to industrial and urban water sectors, and conversion to dry land production of sugarcane (DWAF, 2004e).

Table 2.28: Water requirements for the year 2000 (million m^3/year)

Sector/ sub-area	Irrigation	Urban1	Rural1	Mining and Bulk Industrial2	Power generation3	Afforestation4	Total local requirements
Mkuze	61	1	10	0	0	6	78
Mhlatuze	94	28	8	86	0	19	235
Total for WMA	432	50	40	91	0	104	717

1) Includes component of Reserve for basic human needs at 25 litres / person / day
2) Mining and bulk industrial water uses that are not part of urban systems
3) Includes water for thermal power generation only
4) Quantities refer to the impact on yield only

2.4.2.2 Water quality

The ISP report estimate that 10 million m^3/year of return flow from irrigation, industrial/mining, and urban sectors contribute to the total yield of the water resources in this sub-area. However, the quality of water from industrial/mining sector is of unacceptable quality such that it is not returned to the surface water resources but eventually discharged into the sea. Furthermore, all the effluent originating from Richards Bay is discharged into the sea through a marine outfall pipeline (DWAF, 2004e). The water quality problems are from the smaller developments in Empangeni and from irrigation in the middle reaches of the sub-area. These include eutrophication of the coastal lakes (e.g. Lake Nsezi) and problems related to biological contaminants such as Cholera. Other problems relating to the quality of surface water include sedimentation within the Goedertrouw dam. This is attributable to the poor quality water that is being imported from the Thukela River via the Middledrift emergency scheme (DWAF, 2004e).

2.4.2.3 Groundwater

Groundwater resources in the Usutu to Mhlatuze Water Management Area are poorly understood and under utilised (DWAF, 2004e). However, groundwater contributions to the total water used in the Mhlatuze sub-area amount to 12 million m^3/year. Pollution of the groundwater resource is a key concern to water resource managers in this sub-area (DWAF, 2004e). This occurs as a result of a variety of activities in the whole Usutu to Mhlatuze WMA such as mining for heavy metals (DWAF, 2004e).

2.4.2.4 Aquatic ecosystems

The state of river channels in the Mhlatuze sub-area varies between natural and modified, while the riparian zone conditions vary from natural to severely modified. The instream biota is still undisturbed (natural), regardless of the flow conditions that vary between heavily modified and natural. The watershed services with regard to aquatic ecosystem in this sub-area may be limited. However, the protection and maintenance of the current state is vital (DWAF, 2000).

2.4.2.5 Implications of hydrology for the development of catchment protection services in the Mhlatuze catchment

In those areas where there is a potential demand for water quality improvements, there may be potential for the upstream water users to change their land management practices to reduce sediments thus improving the quality of water. There are also opportunities for the improvement of stream flow and water supply by removing invasive alien vegetation from the riparian zones along rivers.

2.4.3 Land tenure and ownership

The Mhlathuze catchment is one of the most deeply rural catchments in South Africa. The Mhlathuze catchment falls under the uMhlathuze Municipality which currently serves the area of Richards Bay and Empangeni. According to City of Umhlathuze (2003) the Municipality mainly serves the urban and peri-urban communities. The uMhlathuze municipality is situated 170 km from Durban with a population of 340,000 and 39,000 households (City of Umhlathuze, 2003). The area is about 800 km^2. About 37 percent of the population is rural, 3 percent occupy farms and 59 percent are urban. About 50 percent of Mhlathuze catchment is communally owned. With rural communities only allocated 3-7 percent of water use. However, due to the diverse nature of the communities in the Mhlathuze area, the feasibility study will focus on one community as an example of the complexities around land tenure and land ownership as well as cultural practices within the region. This example is indicative of some of the land tenure and land ownership issues observed in the area.

Lake Mzingazi is used as a case study to highlight the land tenure issues in the Mandlazini community within the catchment. The case study is used as an example and does not represent all the possible scenarios of land tenure and ownership in the Mhlathuze catchment.

Only 45 percent of Lake Mzingazi falls within the uMhlathuze Municipality which serves the Mandlazini community. Therefore, the study will only concentrate on the portion of the lake that is within the uMhlathuze Municipality to highlight issues pertaining to land ownership in the Mandlazini community.

The Mandlazini community has a population of 3,580 people, with 668 households all of which receive piped water supplied from Lake Mzingazi. Mandlazini village represents a peri-urban area within the uMhlathuze Municipality. In the Mandlazini community most people are unemployed and cannot afford the high cost of municipal services from nearby Richards Bay.

Box 2.1: Mandlazini community case study

In 1975 and 1976 the Mthiyane tribe (Mandlazini group) were removed from reserve 6 because it formed an island within the white suburbs of Richards Bay (Ministry of Land Affairs, 1996). According to Mthethwa, (Undated), people were loaded onto trucks and were taken to the rural Mtambanana area which is about 45 kms from the present Richards Bay.

The Mandlanzini community has claimed their land over Richards Bay and their claim has been accepted and it is valued at R390 million by KwaZulu Natal Land Claims Commission. However, according to the Ministry of Land Affairs, 1996 communities believe that they were not adequately compensated for the loss of their land. As a result, the Richards Bay City Council made land bordering the municipal area of Richards Bay available to the Madlazini community since they were aware of the legitimate claim of the community (Ministry of Land Affairs, 1996).

According to Mthethwa, (undated), the land claim covers 4 865 ha, an area bounded on the east by Mzingazi lake and on the west by Imfezi lake. It appeared that the claim covers the whole of Richards Bay as confirmed by Zwelihle Memela, spokesman for the provincial land claims commissioner in Mthetwa (Undated). This land claim was lodged by the late chief Mphangwa Mthiyane in September 1998 and since the claim was successful, the commission had identified 600 beneficiaries.

The Mandlazini community is now being resettled at Mandlazini Agri Village, an area between Richards Bay airport and Lake Mzingazi (M Nel, 2004, personal communication, October). Mandlazini Agri village is approximately 1000 ha in size and had an original population of 750 families, 3600 people (M Nel, 2004, personal communication, October). At the time of resettlement, not all people who were removed were resettled in Agri Village as another group chose to remain in the Ntambanana area because there is evidence of development in that area. For, example, there is a community hall, water has been piped to the people. Agri village is a municipal area where one has to pay for municipal services. This inhibited some people from resettling at the Agri village. Generally they do not like to stay in municipal areas because they do not like the municipal by-laws. Also, in the Agri village there is limited or no grazing land for their livestock (T Jordan, 2005 personal communication, 15 February).

The Mandlazini Agricultural Village land is communally owned and forms part of the tribal authority land. The communal land is run by Mandlazini Community Trust. The community is headed by the Nkosi (Zulu name for Chief) who lives in the Ntambanana area.

Payments for catchment protection services in Lake Mzingazi could be supported, especially in the Mandlazini community, because the land is communally held with communities depending heavily on the natural resources and water from Lake Mzingazi. Payments for catchment protection services could be established in the Lake Mzingazi area, through species and biodiversity conservation. However, this activity would require commitment not only from the community but also from the conservational authority in the area, the KwaZulu Natal Nature Conservation Service, and commitment from the government since it regulates water use from the lake.

2.4.3.1 Implications of institutional arrangements and power imbalances for developing catchment protection services

There are many stakeholders in the study area since the uMhlathuze Municipality only manages 45 percent of Lake Mzingazi which is within their jurisdiction (Diederichs et al, 2004), the municipality is recognised as a stakeholder. The Department of Water Affairs and Forestry is the custodian of the water in the Lake Mzingazi and other stakeholders within the case study area are the Mandlazini community, the Mandlazini Development Trust and the chief of the Mandlazini community. Other stakeholders include the uThungulu District Municipality, which the uMhlathuze Municipality falls under as a local municipality. The Mhlathuze-Usuthu catchment Management Agency is a lead management water institution and responsible for implementing catchment management strategies at local level. The Spatial Development Initiative is also a Stakeholder due to the Zulu Cultural Centre that will be built in the centre of Mandlazini village with an estimated cost of R0.9 million and the initiative will be funded through SDI. The Department of Agriculture is also recognised as another stakeholder because they had planned to support community vegetable gardens during the resettlement period.

The uMhlathuze Municipality has access to high value natural assets. These include: Lake Mzingazi which has a high potential for recreational use, but will require improved access and security. There are negative environmental aspects associated with Lake Mzingazi catchment, including increased pressure on local water quality due to poor serviced informal settlements upstream and surrounding Lake Mzingazi (Diederichs et al, 2004). However, some of the negative environmental aspects of the catchment are not from the uMhlathuze Municipal area since more than half of the catchment lies outside the municipal area.

Therefore, uMhlathuze Municipality needs to engage with upstream and adjacent local municipalities and relevant provincial departments to promote improved land use management as a way to protect environmental quality. According to (Diederichs et al, 2004) an alien plant management programme should be implemented in Lake Mzingazi catchment.

The well established community structure can be used to support the institutional requirements for payments. Further, the Nkosi supports communal land ownership as it gives him better management of the community, creates a communally defined property right, and gives the community members a framework under which to implement land management activities. The Nkosi also participates actively in community 'betterment' projects and hence would be supportive of initiatives such as those defined under payments for catchment protection services, for example the clearing of alien invasive vegetation.

However, there are a number of different communities and stakeholders with interests in Lake Mzingazi. They all support the overall goal of "using the lake resources in a sustainable manner" but have different objectives regarding what is prioritised and how the objectives are reached. As a result, a clearly defined management structure or intermediary will need to be established in this area to facilitate exchanges and monitor land management activities if all people are to co-operate effectively.

2.4.4 Identification of poor and marginalized groups

Bezuidenhout et al (2002) noted that rural communities around Mhlatuze River depend on the river for all their water needs, including water for drinking, washing, recreation and agriculture. Treated water is mostly unavailable to these communities, and communities have been prone to water borne diseases. However, Marcus (2004) noted that most communities in

the Mhlatuze River catchment depend on Lake Mzikazi for their drinking water[7]. In general, water in the Mhlatuze is regarded as over allocated (DWAF, 2002c). Water borne diseases are prevalent as people do not practice safe disposal of faeces.

Most communities around Lake Mzingazi depend on the lake for their water needs. There is a water pipeline that runs from the residential areas of Birdswood, Richards Bay to the western shore of Lake Mzingazi. Apart from supplying water to Mandlazini community and its neighbouring residents, the lake also supplies water to the town of Richards Bay.

It is important to note that the issues around the poor and marginalised communities do not represent the whole Mhlatuze River catchment, but are only an indicative example of the poor and marginalised communities represented by the Mandlazini community.

The Mandlazini community

The Mandlazini community is living in poverty in the Mandlazini Agri Village. The village is classed as peri urban, and few people are employed. The rate of unemployment for the uMhlathuze Municipal area is 40 precent (Diederichs et al, 2004). However, the unemployment rate only relates to employment in the formal sector, thus not a true reflection of the situation. This is due to the fact that economic activity in tribal areas, such as production for own use, arts and crafts, and informal sales are generally disregarded and create the impression that the tribal people are without any source of income.

The reason for low levels of employment is the high levels of illiteracy in the community. This was substantiated by uMhlathuze Municipality, (undated) that 18.5 percent of people older than 20 years in the uMhlathuze Municipal area have no formal schooling at all. This makes it difficult for people to find employment in the secondary and tertiary sectors of the economy (uMhlathuze Municipality, Undated).

When people where resettled in the Agri Village, it was thought that the community would produce vegetables from their gardens and these activities were initiated by the Department of Agriculture. However, the sandy soil in the Lake Mzingazi catchment, has limited agricultural potential and the communities have since discontinued these activities.

There is a high population growth rate in the area because the original 565 stands that were allocated at the time of resettlement have now grown to more than 1000 (M Nel, 2004, personal communication, 15 April). Another factor contributing to the high levels of poverty in the area is the low levels of infrastructure. The reason for this is that banks would not finance any development in the area because the land in Mandlazini is communally owned. Most banks prefer to finance development in areas where land is privately owned (M Nel, 2004, personal communication, October).

Currently, the community is alleged to be contaminating Lake Mzingazi by burying their dead in their yards. Based on geohydrological and other considerations there is a possibility of contamination of ground water resources due to such behaviour. These environmental factors will also influence the likelihood of contamination of surface water via ground water resources. Therefore, the community needs to be given environmental education so that they are able to protect their natural assets like the lake which currently serves thousands of people with drinking water. Another possible source of contamination comes from the informal and poorly serviced

[7] Personal communication with Marcus Nel (Mhlatuzi Municipality), 2004

settlements (inside and outside the uMhlathuze Municipality) that threaten the lake as a water supply and recreational asset (Diederichs et al, 2004).

In conclusion, Lake Mzingazi is threated with contamination. The Lake should be protected from contamination and this creates an opportunity for payments for catchment protection services. Training could be given to a few members of the community and they could then disseminate the information in and outside their community. An arrangement could then be made to compensate the trainees for disseminating information.

Another opportunity for payments for catchment protection service arises in terms of subsistence farming. The community was allocated some land for vegetable gardens, though most of them are not used now (M Nel, 2004, personal communication, 15 April). The community could revive their vegetable gardens and improve the water productivity. The vegetable gardens could also reduce the possibility of soil erosion as they provide land cover and stabalise the soils in the Mandlazini community.

2.4.5 Land use

The main land uses in Mhlathuze catchment includes agriculture, forestry, industry, mining, rural and urban settlements and tourism (DWAF, 2003c). Table 2.29 lists the area under different land uses. The other land use category includes industries and mining and these land uses account for approximately 46 percent of the area in Mhlathuze catchment. The second largest land use is rural settlements (19.58 percent) followed by forestry (13.7 percent). The major sources of pollution in the catchment are domestic effluent, agricultural waste, and sewage, which contaminate the water resources (Vos et al., 2002).

Table 2.29: Area under specific land use types in the Mhlatuze catchment

Land use	Area (km2)	Area (%)
Agriculture Irrigated area Dryland sugarcane	130.8 268	4.46 9.15
Forestry Afforestation Indigenous forest	401 33.6	13.69 1.15
Alien vegetation	61.9	2.11
Nature reserves	23.5	0.80
Domestic Urban Rural	80.1 573.6	2.73 19.58
Other (including industries and mining)	1357.5	46.33

Source: DWAF (2003g)

2.4.5.1 Agriculture and Forestry

The main commercial agricultural enterprises are sugarcane, maize and timber (DWAF, 2003g). Commercial irrigated and dry land agriculture have poor farming practices such as over-fertilisation, poor land management and badly timed spraying, which lead to high concentrations of salts, nutrients, sediment, pesticides and herbicides in the aquatic system

(DWAF, 2002c). Subsistence farming in rural areas consists mainly of livestock farming. Overgrazing and poor land management practices have led to erosion and increased sediment loads in the area (DWAF, 2002c).

There are approximately 400 km^2 of pine and wattle forestry plantations upstream of the Goedetrouw Dam. Forestry plantations reduce the ability of the river to dilute and stabilize the pH and metal concentrations through its streamflow reduction activities (Anonymous, 2000).

2.4.5.2 Mining

Richards Bay Minerals (RBM) and the Ticoris Hillendale Mine have extensive mining operations in the coastal dunes and produce titania slag, high purity pig iron, rutile and zircon. Richards Bay and Ninians quarries are open cast quarries in the Mhlatuze catchment. Richards Bay quarry produces dolerite, while Ninians quarry mines granite. Mine effluent creates high concentrations of metals such as iron, manganese and aluminium in the aquatic system.

2.4.5.3 Industry

There are several large industries in the Mhlatuze catchment namely Mondi's Richards Bay and Felixton pulp mills, Richards Bay Iron and Titanium Works, Iscor, Tongaat Hulett, Alusaf and Felixton sugar mill. These are listed in Table 2.30. The release of poorly treated industrial effluents into the river causes acidification and salinisation in the area (DWAF, 2003g).

Table 2.30: Major industries in Mhlathuze catchment

Area	Industry
Felixton	Mondi Felixton - Pulp Mill
	Tongaat Hulett Felxton - Sugar Mill
Richards Bay	Bayside & Hillside Aluminium - Aluminium Smelter
	Indian Ocean Fertilizer – Fertilizer factory
	Richards Bay Iron Titanium works
	Mondi Richards Bay - Pulp Mill

Source: DWAF (2003g)

2.4.5.4 Rural settlements

Several factors lead to the deterioration in water quality of this area. These include the lack of adequate water purification systems and/or inadequate sanitation facilities in rural communities, untreated medical waste and sewage spillage from the town of Nkandla due to blockages and overflows in the sewage system (Bezuidenhout et al., 2002b).

2.4.5.5 Conclusion

The main water resource issues associated with land use activities are water quality, increased sediment concentrations and reduced river flow due to alien vegetation growth in the riparian zones. Water quality is also affected by the lack of adequate basic water supply and sanitation

facilities in the rural settlements and industrial and mining effluents in the Richards Bay area. The soil erosion and hence sediment concentrations are related to commercial and subsistence agricultural activities in the catchment.

2.4.6 Economic review

The Mhlatuze catchment forms part of the Usutu to Mhlatuze WMA and is located within the uThungulu District Municipality (mainly comprising of the following municipalities within the Mhlathuze catchment: Umhlathuze, Ntambanana, Umlalazi, and Mthonjaneni). The best available data in Uthungulu was used for this area. The main economic activities identified in this area are mining, manufacturing, agriculture and forestry.

2.4.6.1 Gross Geographic Product

Manufacturing is the largest contributor to GGP in uThungulu with 51.4 percent. Billiton's Bayside and Hillside Smelters contribute R1.7 and R3.9 Billion respectively, to GGP and 33 percent and 100 percent of their output is exported, respectively. Mondi Kraft (and SilvaCel) contributes R2.5 Billion, 80 percent of their output is exported. Foskor (Indian Ocean Fertilizer) contributes R1.2 Billion, 80 percent of its output is exported (DWAF, 2003c). The other significant sector is the transport sector contributing 15.1 percent to the GGP. Mining contributed 1.4 percent (in 1997) to the GGP of uThungulu District Municipality. Richards Bay Minerals (RBM) contributes R3.5 - 4 Billion to GGP.

Table 2.31: Sectoral contribution to GGP in Uthungulu in 1997

Sectors	Percentage (%)
Manufacturing	51.4
Transport	15.1
Agriculture	9.5
Mining	1.4

Source: Uthungulu Municipality (2005)

2.4.6.2 Employment

The unemployment rate in the Mhlathuze catchment is high and some 46 percent of the economically active population are unemployed. The largest employer in the area is the manufacturing sector (18 percent) followed by the community and social services sector (17 percent), and the agricultural sector (15 percent).

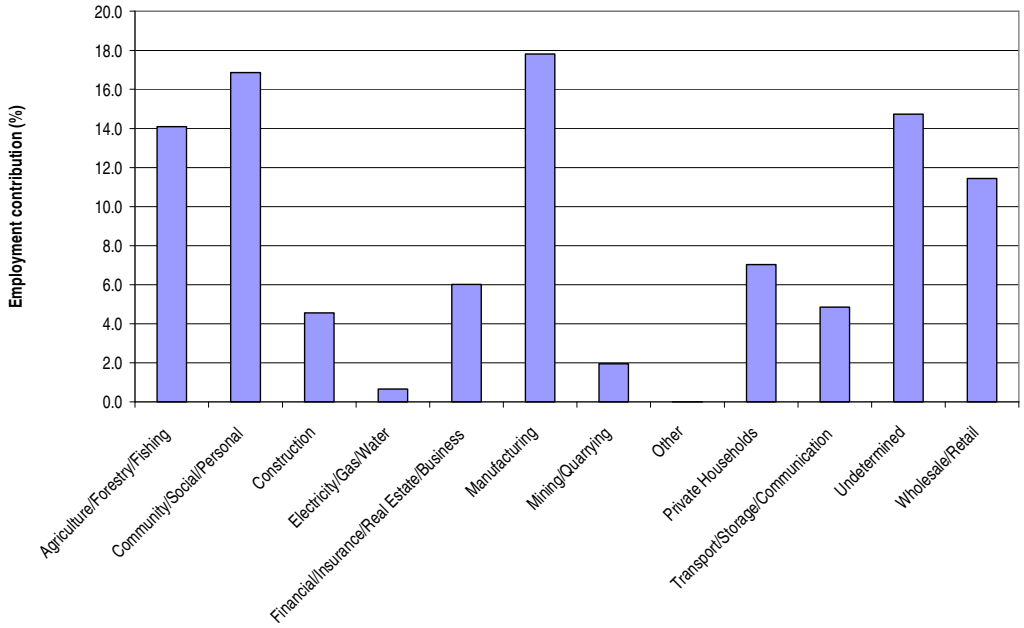

Figure 2.11: The contribution to employment by economic sector in the Mhlathuze catchment in 2001. (Source: Statistics SA, 2003)

2.4.6.3 Resource use

Table 2.32 shows the DWAF estimates of water requirements for the respective economic activities in the Mhlathuze catchment. The land use with the largest water requirements in the Mhlatuze catchment is the ecological reserve (41 percent). While this is the amount of water required to maintain the ecological systems, the ecological reserve has not been allocated yet. Irrigated agriculture (19.9 percent) is the second largest user followed by alien vegetation (12.9 percent).

Table 2.32: Water requirements in the Mhlathuze catchment

Economic activities	Water requirements (million m3/annum)	Water requirements (%)
Agriculture		
Irrigated area	130.6	19.94
Dryland sugarcane	23.1	3.53
Forestry		
Afforestation	43.1	6.58
Indigenous forest		
Alien vegetation	84.8	12.94
Ecological reserve	271.4	41.43
Domestic		
Urban	10.4	1.59
Rural	6.5	0.99
Other		
Mining	44.9	6.85
Other industry	40.3	6.15

Source: DWAF (2003g)

Table 2.33 shows the relative water allocations to the main industries in the Mhlathuze catchment.

Table 2.33: Industrial water users' allocation in Mhlatuze

Consumer	Water allocation (million m3/ annum)
Richards Bay Minerals	55.2
Alusaf	2.3
Mondi Richards Bay	28.5
Mondi Felixton	1.8
Tongaat Hulett	1.8
Irrigation	187
Mhlathuze Water	34

Source: DWAF (2002b)

2.4.6.4 Implications of land use practices and economic power imbalances on payments for catchment protection services

The manufacturing and mining sectors are the largest contributors to GGP in Uthungulu District Municipality, while the community services and manufacturing sectors are the largest employers in the Mhlathuze catchment. The major land uses in the catchment are mining and industries, which are concentrated around the Richards Bay area. Other major land uses are rural settlements, commercial forestry and rain-fed sugarcane.

The largest water requirement is for the functioning of the ecological system, though the ecological reserve is not yet allocated. Irrigated agriculture and alien vegetation also have relatively high water requirements. The removal of alien vegetation through programmes such as the Working for Water Programme would increase the quantity of water available for other uses. This increased quantity of water could be used by large water users such as the Mhlathuze Water Board, Richards Bay Minerals and commercial agriculture. The suppliers of the watershed service, removal of alien vegetation, would be local communities through the Working for Water Programme.

2.4.7 Identified catchment protection services in the Mhlatuze catchment

Based on the hydrological landscape outlined in section 2.4.2 and the increasing demand for water of an appropriate quality in the Mhlatuze catchment, there are several opportunities for catchment protection services and the development of payments for these services. These services can be segmented into 3 core themes, namely: ecosystem goods and services protection and maintenance; water quantity; and water quality.

Table 2.34 lists the catchment protection services identified in the Mhlatuze catchment and describes the associated activities that would be needed to provide this service. The table also indicates whether or not there is an opportunity for the development of these services in the catchment. The final column in table 2.34 provides a broad statement related to whether it is or is not possible to develop these services in the Mhlatuze catchment through payments based on the criteria in section 1.

Table 2.34: Identified catchment protection services for the Klip River

Watershed service	Commodity/ Land use intervention	Opportunities for payments
Ecosystem goods and services maintenance and protection	Restoration and maintenance of aquatic habitat and biodiversity in the catchment	Yes
Water quantity	Alien invasive species removal in the upper parts of the catchment and along the riparian zone	Yes, but not necessary as the Working for Water programme deals actively with this in the catchment
	Security of supply	No
Water quality	Reduced sediment in rivers	No

2.4.8 Opportunities and risks for developing catchment protection services in the Mhlatuze catchment

Opportunities for catchment protection services in the Mhlatuze catchment focus on the rehabilitation and maintenance of the aquatic ecosystem and water supply. Table 2.35, lists the opportunities and risks associated with developing catchment protection services in the Mhlatuze catchment based on the hydrological landscape, the land tenure and power imbalances, and land use patterns.

Table 2.35: Opportunities and risks for catchment protection services in the Mhlatuze catchment

Opportunities	Risks
Hydrological assets • Need in the catchment to have more alien invasive vegetation removed from the riparian zones and the upper watershed in order to improve water supply. The removal of alien invasive vegetation is ongoing and follow up actions need to be taken providing the opportunity for long term planning and payment systems. • Water scarcity is a constraint to development in the catchment and there is a need for improved efficiency in water use. • There is a high demand for water transfers and an opportunity to look at sharing benefits with the Pongola River, for example considering payments for catchment protection services as a transboundary initiative across catchments to the supplier as compensation.	**Hydrological assets** • The national government is already responsible for removing alien invasive vegetation through the Working for Water programme. There is little incentive for demanders of the service to pay for it. • The phosphorus levels in the water are high due to mining activities and commercial farming, but there are no identified community impacts. There is limited opportunity for the communities to provide services themselves.
Land tenure and power imbalances • Land tenure is well defined as communal land and although the tribal chiefs hold the power in terms of community structures there seems to be a willingness to participate in and support initiatives such as the development of catchment protection services.	**Land tenure and power imbalances** • Land tenure for communities living in the Mhlatuze catchment is communal. Tribal chiefs or "Nkozi" are responsible for decisions and land management in these communal areas hence the buy-in of these chiefs is critical to any payment.
Land use • Land use activities such as subsistence agriculture, overgrazing and the removal of alien invasive vegetation can be improved in the Mhlatuze catchment.	**Land use** • Improvements by the provision of catchment protection services need to be supported by the provision of adequate water supply and sanitation facilities to communities for 'real' improvements to be seen.

2.4.9 Opportunities and risks for developing payments for catchment protection services in the Mhlatuze catchment

In the Mhlatuze catchment many of these required market elements are tentative and efforts are required to address these clearly and effectively prior to engaging in actual payments. The institutional arrangements, the economic potential, the value of the catchment service and the associated transaction costs are all discussed in table 2.36 below.

Table 2.36: Opportunities and risks for catchment protection services in the Mhlatuze catchment

Opportunities	Risks
Willing buyers • There are potential buyers in Richards Bay industrial and residential development area.	**Willing buyers** • The buyers are unable to make payments for the required catchment service for certain reasons for example it may be legislated that the service be provided, or the buyer may be unable financially to make a payment. • The number of buyers or amount available for 'payments' may not be large enough to effect measurable improvement in the water supply or quantity. • If industries are the main polluters then the potential for alleviating poverty is limited as industries would want payment to 'clean up' their activities. • Water redistribution issues place further constraints on the catchment and creates uncertainty among buyers about participating in water-related projects.
Willing sellers • Communities use little water as they do not have access to it to improve land, so sellers would not be communities but agricultural users. • Provision of sanitation services will provide an environmental service without direct community based interventions. • There are opportunities for expanding the Working for Water programme into other areas of the catchment. • There is a high level of poverty in area therefore opportunity to address this through payments for environmental services.	**Willing sellers** • Increased competition for control over the wetlands or other areas being set aside for catchment services in order to gain access to the benefits. • Erosion of community cohesiveness due to increased divisions between those who gain and those who lose from payments.
Institutional arrangements • An intermediary will need to be established, specifically to meet the requirements of the Mhlatuze catchment and the associated payments mechanism. • Community structures are well organised through limited initiatives but are site specific and involve large numbers of people.	**Institutional arrangements** • For payments to be made between multiple buyers and sellers, an intermediary or community based organisation, or forum needs to be established to assist with facilitating payments and monitoring progress. • No formal institutional arrangements exist in the catchment that could facilitate payments for catchment protection services.

Table 2.36 continued

Opportunities	Risks
Economic potential for payments • The economic base from which to make payments extends to the manufacturing and mining sectors. As they are the largest contributors to GGP in the Uthungulu District Municipality, they are also dependent on water supply and water quality improvements.	**Economic potential for payments** • Buyers may not regard payments for catchment protection services as something they should be paying for but rather services that the government should provide.
Value/price of identified service • No value currently exists for catchment protection services in the Mhlatuze catchment.	**Value/price of identified service** • The value or price of the identified catchment protection services is not known. • This catchment is targeted for the role out of a Catchment Management Agency. Hence, all water users in the catchment will have to pay a catchment management charge, this may hinder any support for payments above this mandatory charge.
Transaction costs • Information is available for the Mhlatuze catchment through DWAF and the Strategic Assessment done on behalf of DFID.	**Transaction costs** • Poor information will lead to higher transaction costs for payments in this area. • There is a primary need to address service delivery first and hence focus on the demand for basic needs provision, prior to the provision of watershed services. • Capital investment is required to access ground water resources.

2.4.10 Conclusions and recommendations

The Mhlatuze catchment covers a large area with specific needs. However, in terms of opportunities for the development of payments for catchment protection services, these appear to be limited. Water supply and the removal of alien invasive plants are recognised in the hydrology section (section 2.4.2), as potential catchment protection services. The opportunity within the catchment for communities to provide these services is limited because of their location in the lower reaches of the catchment. The critical potential for the development of catchment protection services relates to negotiated exchanges between the forestry and industrial sectors of the economy. As the goal for this project is to understand how payments for catchment protection services can be used to improve livelihoods (the livelihoods of the rural poor), this catchment was not selected for piloting in phase 3.

2.5 SITE FIVE: ST LUCIA WETLAND

2.5.1 Introduction

The St Lucia estuary (28°23' S; 32°25' E) is situated north of the coastal town of Richards Bay in KwaZulu-Natal. It is the largest estuarine system in South Africa and has a catchment area of approximately 9,542 km^2. Approximately 20 percent of the catchment is cultivated, mostly subsistence agriculture and forestry. About 8 percent of the St Lucia catchment is degraded, comprising degraded forest, bushland and grassland. Roughly 73 percent of the catchment is natural and comprised of a mixture of forest and woodland, bushland, and grassland with waterbodies and wetlands linked to the St Lucia system. There was very little urban development in the St Lucia catchment (less than 1 percent) and most of this comprises mines and quarries located in the upper catchment, near the town of Vryheid, as well as some residential development. (DEAT, 2001).

The St Lucia estuary forms part of the Mhlatuze catchment and is situated on the eastern edge of this catchment as it joins the ocean. The estuary is classified as a World Heritage Site. Figure 2.12 shows the catchment of the St Lucia estuary.

2.5.2 Hydrological review

The hydrological landscape of the St Lucia Wetland sub-area consists of four hydrological components, namely: water quantity, water quality, groundwater and aquatic ecosystem services. The implications of these four components on the potential development of payments for watershed protection services are discussed below.

2.5.2.1 Water quantity

The Mkuze sub-area, in which St Lucia Wetland is located, has a natural MAR of 635 million m^3/year (DWAF, 2004a). The St Lucia sub-area is characterised mainly by large-scale irrigation (which is dominated by sugarcane, and uses 61 million m^3/year of water – Table 5) and afforestation (DWAF, 2004e). There is limited water available for irrigation in the St Lucia sub-area since only a single major dam, the Hluhluwe Dam, is in this sub-area. This has led irrigators to use all the flow from the Mkuze River for irrigation purposes (DWAF, 2004e). However, a pipeline (Senekal Trust Pipeline), which transfers 32.6 million m^3/year of water from the Pongolapoort Dam to the middle reaches of the Mkuze sub-area was installed in 2001. This pipeline imports water that is used mainly for irrigation purposes and domestic water supply to rural communities (DWAF, 2004e). In addition to the water imported via this pipeline, significant amounts of return flow from different water use sectors (for instance, agriculture and urban sectors) contribute to the total MAR in this sub-area.

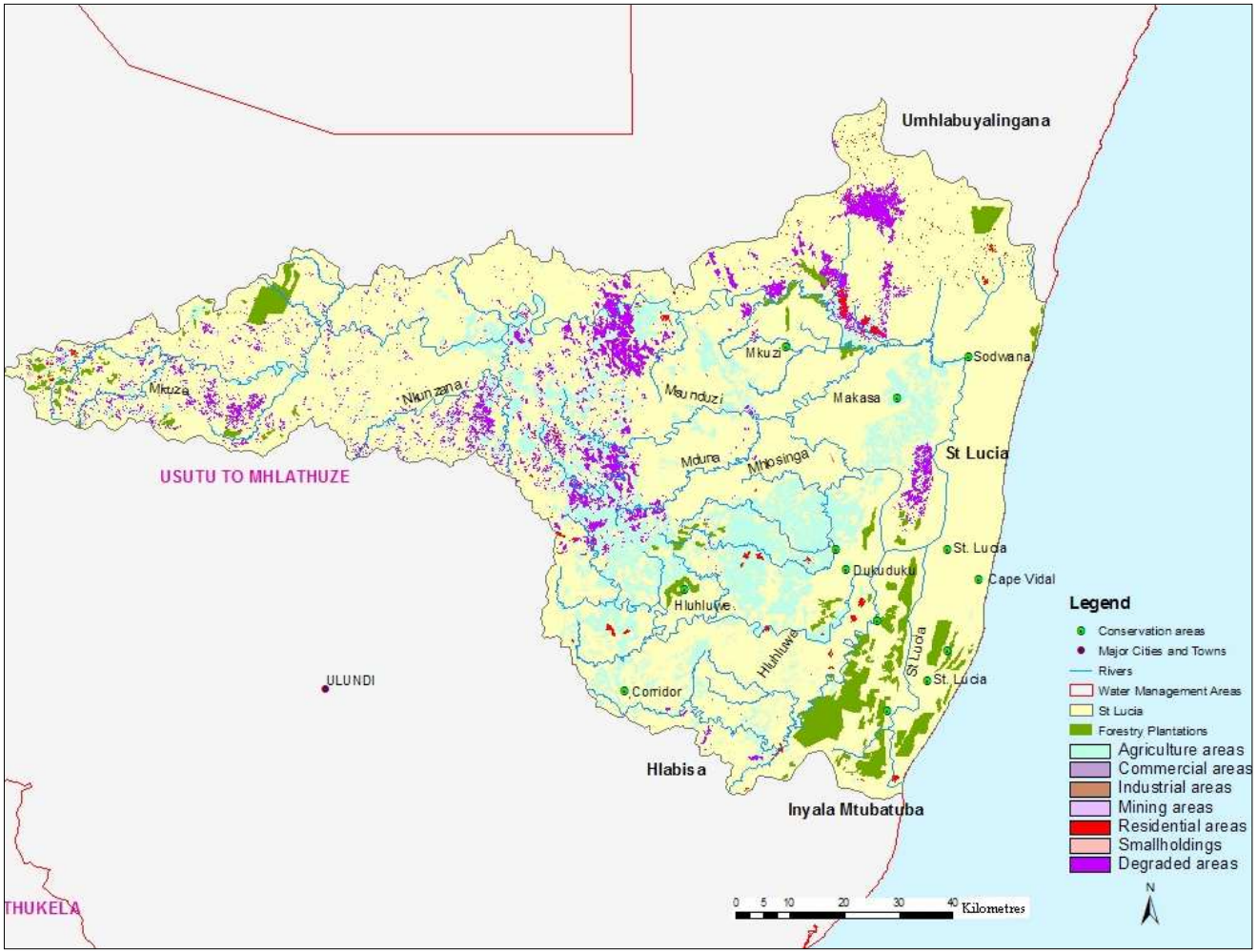

Figure 2.12: Map showing land uses in the catchment of the St Lucia estuary

2.5.2.2 Water quality

Mines located in the Mfolozi catchment have adverse impacts on water quality as a result of mine-water decant into the upper reaches of this sub-area. Other factors contributing to the degradation of water quality include: over-abstraction of water for irrigation, which reduces the dilution of mine-water decant; and the saline and nutrient laden return flows from agriculture (DWAF, 2004e). Sedimentation rates have been reported to be high in this sub-area, although this is not clear yet whether it is because of natural or poor land use practices (DWAF, 2004e).

2.5.2.3 Groundwater

There is potential for groundwater contamination especially in the coastal areas since the aquifer in these areas is highly permeability (DWAF, 2004e). An example of groundwater contamination in coastal areas includes the intrusion of salt-water into the groundwater table. Mining in the Usutu to Mhlathuze WMA impacts on groundwater and on the local surface water resources (DWAF, 2004e).

2.5.2.4 Aquatic ecosystems

The conditions of the bed and flow of the rivers, and the riparian/bank conditions in the St Lucia sub-area vary from natural to slightly modified. The instream biota in this sub-area is classified as natural. The opportunities for watershed services with regard to aquatic ecosystem protection in this sub-area may be limited, though the protection and maintenance of current state is vital (DWAF, 2000).

2.5.2.5 Implications of hydrology on developing catchment protection services in the St Lucia sub-area

The opportunities for payments for catchment protection services in the St Lucia sub-area are limited since water required for further development relies on water transfers into the sub-area. Since there is still a potential for groundwater utilisation, there is an opportunity to ensure that land use development impacts minimally on the natural recharge rates of the groundwater resource. Other options include the utilisation of low-water use technologies for irrigation; and protection of water resources from pollution by agricultural fertilisers or pesticides.

2.5.3 Land tenure and ownership

The Bhangazi community, having made a land claim for the area included in the Greater St. Lucia Wetland Park, is used as a case study to show the complexities of land tenure and land ownership in the Greater St. Lucia Wetland Park. The case study is one example and does not represent all scenarios of land tenure and ownership in the GSLWP.

The GSLWP falls under The Big Five False Bay Municipality. The park is state owned land administered by the KwaZulu Natal Parks Board. The GSWP is an amalgamation of 16 pieces of land (Zuma, 1999) that currently make up the park, bio-diversity conservation and tourism development and where clearing of commercial forestry took place in some parts of the land (Schneider, 1998). St. Lucia already has been declared an international wetland

under the Ramsar Convention (Schneider, 1998) and was declared a World Heritage Site in December 1999 (St. Lucia info, 2003). The area of the park is about 260,000 hectares including the marine reserve. The park has the largest estuarine system in the African continent, the coast line, dune forest, pristine beaches, coral reefs and the Big Five Game Reserve (Schneider, 1998) and it is mainly used for tourism.

Local history records show that the Mbuyasi people (Bhangazi community) lived alongside the park for hundred of years, but lost their land after the annexation of Zululand by the British in 1897. A further loss of land occurred to those who did not find jobs on the plantations through forced removals that occurred in 1974 (Words and Dees, 2005). To date, 60 percent of the Greater St. Lucia Wetland park (GSWP) is under land claim (Mail & Guardian, undated).

The area around Lake St. Lucia underwent a mixture of land management activities. It was once a military missile testing site, has been planted with exotic trees, and had experienced the threat of mining of titanium deposits. Based on the above, the St Lucia case study reflects many of the complexities around land tenure and land ownership. These issues are described in Box 2.2.

Given the complex land tenure issues in the GSLWP, there is still an opportunity for payments to be made for catchment protection services to be established in the area. The fact that the Bhangazi community has been allocated a piece of land inside the park and has also been allocated some funds to develop that land presents an element of community involvement in management of protected areas. The land claim by the Bhangazi community over the GSLWP has paved a new relationship between the communities that are living outside the park and the park management, and has increased the willingness of the community to be engaged in running the park in terms of their own piece of land. Therefore it could be argued that the Bhangazi community case study has shown that development of a method for payments for catchment protection services could be established in GSLWP.

Box 2.2: Communities in the Mhlatuzi catchment

Some 45 to 50 years ago communities were forcibly removed from the area that now forms the GSLWP. This resulted in a land claim being made for the area, and 60 percent of these claims have now been settled. The other communities who have lodged land claims include Kwa Sokhulu, Kwa Jobe, Khula and Kwa Mabaso (Moshe, 2002). However, these communities will not be included in the case study since there is not sufficient information relating to their land ownership and tenure. This study focuses on the Bhangazi community an example to understand the land tenure and land ownership issues in the St Lucia catchment.

The Bhangazi community land claim was made after the 1994 democratic elections. After the acceptance of the claim, the government compensated the community to an amount of R16,68 million in 1999 (Mail and Guardian, undated). Some 550 families were traced as original beneficiaries and each household received an amount of R30,000 as compensation for the land lost to the park. In addition, the Bhangazi community was allocated 5 ha of land inside the park to manage. This piece of land is regarded as an ancestor ceremonial site since some community members were buried in that area approximately 50 years ago.

The land in the St Lucia area is "state land" under the curatorship of Nature Conservation Services with the Bhangazi community partnering the park authorities. The Land Restitution Act prevented the communities from physically resettling on the land because it has been declared a World Heritage Site and the park is protected by international conventions on managing fragile ecosystems (Words and Deeds, 2005). Therefore a 75 years lease agreement was reached between the community and the Park authorities. This will be administered through the collection of gate revenues where 70 percent of the total gate levy is paid monthly to the community. The area is managed by Nkosi Mkwanazi Minias who receives 20 percent while the park takes 10 percent of the gate revenue (E Ntseka, 2004, pers.com., October).

The land ownership in the GSLWP is complex. The 5 ha of land that the park authority had given to the community was actually not registered at the deeds registry and thus the community does not have title deed to the land (Words and Deeds, 2005). The 5 ha of land was still registered as a state property which hampers any development of the land by the community.

The Bhangazi community is scattered, with some community members living up to 50 kilometres away from the park, while others live in the neighbouring country of Swaziland (E Ntseka, 2004, pers.com., October). A greater understanding and cooperation by all community members will be required for the establishment of watershed protection services in the GSLWP. Members of the community who do not stay in Bhangazi community might be barriers to the establishment of payments for watershed protection services. Beneficiaries who are staying in the village would like the money to be used to develop the community in terms if infrastructure such as piped water to the community. Those who are no longer staying in the community would like to have the money in their pockets. This causes conflict amongst community members (S. Ramatlakana 2005, personal communication, April).

Some members of the Bhangazi community are concerned that the Nkosi is not using his 20 percent gate levy to develop the community. Community members felt that the Nkosi should develop his community with the gate levy he receives. As a leader, it is felt by community members that he set a good example to his community; however, the matter has not been discussed with him because the community is still awaiting the land claims commissioner Thabi Shange to discuss the matter with the Nkosi first (E Ntseka, 2004, pers.com., October).

2.5.3.1 Institutional information and implication of power imbalance

Several stakeholders play a role in the conservational issues of the GSLWP. These include The KwaZulu Natal Nature Conservation Service, the KwaZulu Natal Conservation Board, the Big Five Municipality and the local communities. The KwaZulu Natal Nature Conservation Service is responsible for managing conservation inside the park and their

mandate is carried out in collaboration with the KwaZulu Natal Provincial administration. The KwaZulu Natal Conservation Board was appointed by the Minister of Traditional and Environmental Affairs as a decision making body for the GSLWP.

With infrastructure upgrading of the GSLWP, the number of stakeholders has increased to include the Lubombo infrastructure steering committee, chaired by the KwaZulu Natal Tourism Board. The steering committee consists of members of KwaZulu Natal Tourism Board, KwaZulu Natal Nature Conservation Service, the Uthungulu Regional Council and the Department of Environmental Affairs and Tourism. The upgrading of the GSLWP involved an initiative to have the park included as part of a tri-national eco-tourism project, the Lubombo Spatial Development Initiative (LSDI) which involves countries of South Africa, Mozambique and Swaziland (Afrol News, 2000).

While many stakeholders play a role concerning the functioning of the GSLWP, alien invasive plants pose a serious threat, although the area affected is limited (Protected Areas Programme, Undated). There are management programmes in place aimed at the elimination of all infestations of alien plants in the park. Land use changes within certain portions of the park and upstream areas led to the closure of St. Lucia Estuary mouth by sedimentation. threat arose from the transformation of the upper Umfolozi Swamps by agriculture.

Given these threats to the GSLWP, an opportunity exists for payments for catchment protection services to be established that will benefit both the local communities and the park management. Since the park has been declared a World Heritage Site, all stakeholders involved in the GSLWP are working towards one aim "to protect the park and manage it sustainably for future generations". They will therefore support markets for watershed protection services that will not degrade the natural environment of the GSLWP. The local communities could be engaged in "control of sedimentation" as a watershed service. The Bhangazi community might not benefit from this watershed service, but rather other communities who are practising agriculture in the upper Umfolozi. Communities that are practicing agriculture in the upper Umfolozi could be encouraged to improve their agricultural practises so as to limit sedimentation in the mouth of St. Lucia Estuary. The Bhangazi community could participate in markets for watershed services by helping to clear alien plants from the affected areas of the park. Since management plans are already in place with regard to clearing alien plants, it should be ensured that the Bhangazi community is part of the plan and are engaged in the clearing process.

2.5.4 Identification of poor and marginalized groups

Rural communities living close to the park are living in poverty and the area has some of the poorest households in the country (Mail & Guardian, undated), with 95 percent of homesteads earning less than ZAR450 per month.

Currently, the Lubombo Spatial Development Initiative (LSDI), a joint venture between the government of South Africa, Mozambique and Swaziland," has been forced to stimulate cross border tourism and agriculture to uplift local communities through sustainable job creation, economic growth, and the development of entrepreneurial opportunities (Ministry of Environmental Affairs and Tourism, 2000). The initiative will create 900 permanent jobs (Mail & Guardian, Undated), some of which will go to the people from St. Lucia. The initiative is expected to alleviate poverty in the area with a total of R44 Million to be invested in infrastructure upgrades in the GSLWP.

The Greater St Lucia Wetland Park is state owned land with communities in partnership with the park authorities to manage the area. There is a 75 year lease agreement during which time

the community will continue to derive 70 percent of the gate levy. The community could support the markets for watershed services since they are already engaged in biodiversity protection. The local structure is strong and understands management of their allocated 5 ha of land in the park. However, it is not entirely clear what other payments could be established in the area.

Based on the above, the community could engage in species and biodiversity protection especially inside the park as a watershed protection service. Since the community has access to the park and are currently engaged in activities that are taking place inside the park (e.g. training) there is a need for environmental education to be given to the wider community members for continual support of the wetland park. The fact that the Bhangazi Community Trust understands management of their allocated 5 ha of land in the park is a positive aspect and could be used as an advantage for the establishment for markets for watershed services. Land ownership and land tenure in GSLWP creates a good opportunity for markets for watershed services since there will be more than one stakeholder responsible to ensure that markets for watershed services identified are sustainable.

2.5.5 Land use

The land uses identified in the St Lucia area are irrigated agriculture, forestry, natural areas, urban areas and rural settlements. Table 2.37 shows the area of each land use. The other land use category includes activities such as mining and industries.

Table 2.37: Area under specific land use in the St. Lucia Estuary

Land use	Area (km2)	Area (%)
Agriculture Irrigated area Dry land sugarcane	15.8 0	0.44 0.00
Forestry Afforestation Indigenous forest	250.7 174.2	7.04 4.89
Alien vegetation	20.2	0.57
Nature reserves	1139.1	31.98
Domestic Urban Rural	2.5 554.4	0.07 15.56
Other (including mining and industry)	1405.1	39.45

Source: DWAF (2003g)

2.5.5.1 Agriculture and Forestry

Agriculture is a relatively minor land use in the St Lucia area as it only accounts 0.44 percent of the area. The main crops grown are irrigated sugarcane and maize. Forestry occupies 11 percent of the area with commercial forestry and indigenous forestry accounting for 7 percent and 4 percent, respectively. Eucalyptus (90.6 km^2) and pine (160 km^2) are the main tree species planted in this area (DWAF, 2003g).

2.5.5.2 Natural and protected areas

The second largest land use in the St Lucia area is conservation informally proclaimed. The main nature reserve is the Greater St Lucia Wetland Park, which was declared a World Heritage Site in 1999. The maintenance of the St. Lucia ecosystem is dependent on the level of salinity in the estuary Weston, et al. (1995), which controls aquatic species richness. During the wetter periods, the freshwater levels of the lake rise and the salinity of the lake system remains below that of seawater. During drier periods, seawater flows into the lake system and increases salinity in the lake (Weston et al. 1995). However, increased water demand due to development also lengthens the high salinity periods within the lake. Urban and industrial water use is in the order of 0.5 percent of the MAR. Irrigated agriculture is the largest water user. In addition, increased afforestation has a significant reduction of the stream flow. The combination of these two land uses will lead to higher salinity level, and lower overall ecosystem health (Weston, et al. 1995). Another key determinant of the ecosystem's well-being is the maintenance of the estuary's mouth. The mouth is dredged regularly to remove excessive deposits of marine sands from human activities in the rest of the catchment (Anon, S.a.).

2.5.5.3 Tourism

The Greater St. Lucia Wetland Park supports a wide variety of fauna and flora, including: leatherback turtles, hippopotamus, flamingos, pelicans and Nile crocodiles. The park provides non-consumptive tourism activities such as game viewing, bird watching and turtle viewing, swimming, snorkelling, scuba-diving, hiking, overnight accommodation and fishing. Approximately one million visitors visit the park each year. The tourism related activities are dependent on the St Lucia Wetland and therefore changes in the water quality and quantity of the wetland will also have negativeeffects on tourism in the area.

2.5.5.4 Alien vegetation

The presence of alien vegetation has a negative impact on the breeding patterns of the Nile crocodiles and on stream flow (Leslie and Spotila, 2001). The majority of nesting Nile crocodiles select open, sunny, sandy areas in which to deposit their eggs. The temperature of crocodile nests determines the male-female ratio of crocodiles born. Alien vegetation shades nesting sites, thus reducing the average temperature of the nest, producing a female-biased sex ratio and possibly preventing embryonic development altogether. This change in breeding conditions poses a serious threat to the continued survival of the Nile crocodile in the Greater St. Lucia Wetland Park.

2.5.5.5 Conclusion

The main water resource impacts from land use activities in the St Lucia wetland area were flow assurance and increased sediment loads. Flow variability is due to the increasing use of water by upstream rural settlements, industry and forestry, while sediment loads are influenced by agricultural activities and rural settlements.

2.5.6 Economic review

The main economic activities are agriculture, forestry, recreation and eco-tourism, light industry and the community maintenance of beehives along with the local honey sellers.

Specific economic data were not available for the St Lucia area and thus data for the uMkhanyakude District Municipality were used as the St Lucia area forms part of the Mtubatuba Municipality in the uMkhanyakude District Municipality.

2.5.6.1 Gross Geographic Product

The data on sectoral contribution to GGP in the St Lucia area are unavailable and the data for uMkhanyakude District Municipality are used instead. The St Lucia area is located within the uMkhanyakude District Municipality. The total GGP for the uMkhanyakude district was estimated to be R1,219 Million in 2000 (Umkhanyakude District Municipality, 2005). Figure 2.13 shows the contribution to GGP by sector in uMkhanyakude District Municipality. Community service (government services) is the largest contributor to GGP in this district municipality followed by the agricultural sector. The IDP indicates that the municipality has comparative advantage in agriculture and tourism and development should be focused in these sectors. Apart from government, there is no other sector that can afford to pay for watershed services. However, the development of the tourism sector will benefit from improved water quality and quantity.

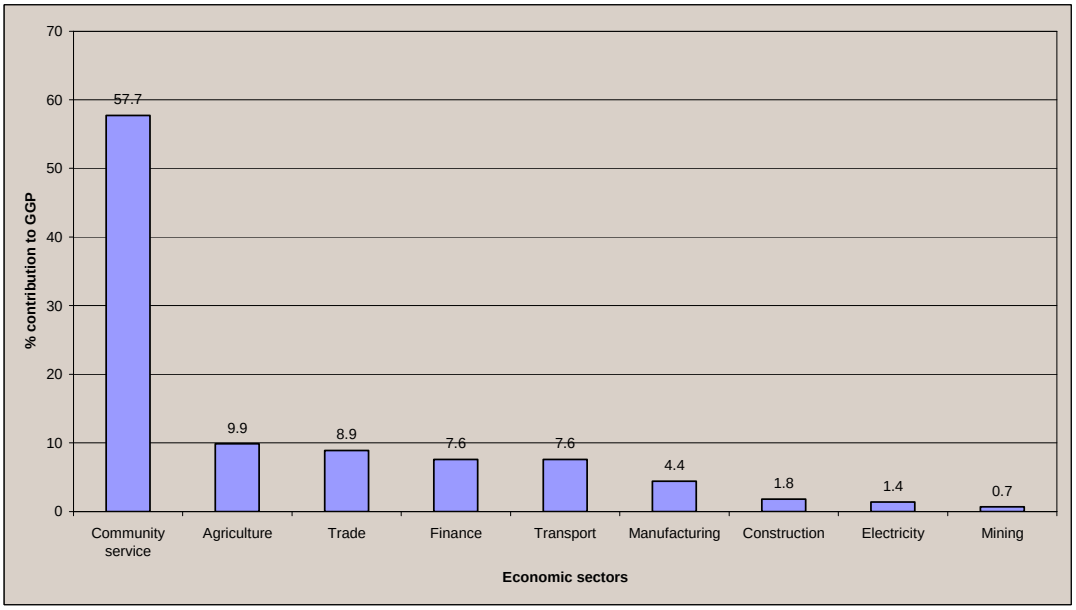

Figure 2.13: Sectoral contribution to GGP in Umkhanyakude District Municipality
Source: Umkhanyakude District Municipality (2005)

2.5.6.2 Employment

The unemployment rate in the St Lucia area is approximately 44 percent based on the data from the Mtubatuba Municipality. The community and social services sector (31 percent) is the largest employer in the area followed by the agriculture and forestry sector (17 percent), and the wholesale and retail trade sector (12 percent) (Statistics SA, 2003).

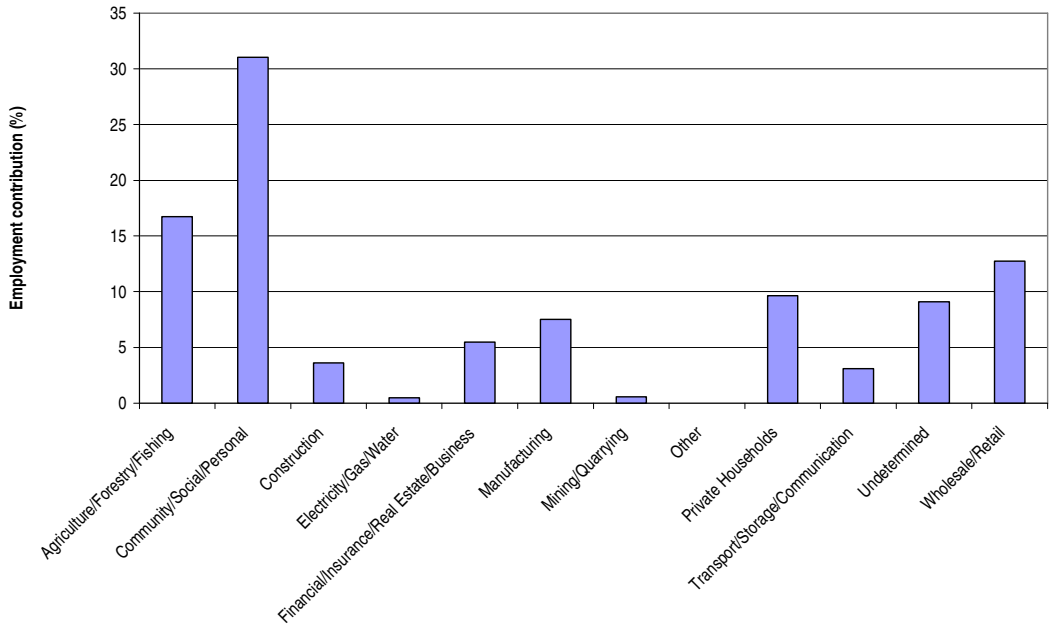

Figure 2.14: The contribution to employment by economic sector in the St Lucia area in 2001.
(Source: Statistics SA, 2003)

2.5.6.3 Resource use

The largest water users in St Lucia are nature reserves, afforested areas and irrigated agriculture. The "other" land use category includes mining and industry. Table 2.38 shows the water requirements for the respective economic activities in the St Lucia area. The water use is fairly similar between different activities.

Table 2.38: Water requirements in the St Lucia area

Economic activities	Water requirements (million m3)
Agriculture	
Irrigated area	13.3
Dry land sugarcane	0.0
Forestry	
Afforestation	15.6
Indigenous forest	7.52
Alien vegetation	1.8
Nature reserves	17.6
Domestic	
Urban	0.2
Rural	1.9
Other	165.1

Source: DWAF (2003g)

2.5.6.4 Implications of land use practices and economic power imbalances on payments for catchment protection services

The major land uses in St Lucia area are nature reserves (such as the Greater St Lucia Wetland Park) and rural settlements, while commercial and indigenous forests are also large land uses in the area. The major contributors to GGP in the uMkhanyakude District Municipality (of which St Lucia forms part) are the government (through community services such as education and health), agriculture and trade sectors.

The economic activities with the highest water requirements include irrigated agriculture, commercial forestry, nature reserves and mining and industry. There is a high water demand in the St Lucia wetland in the drier periods and the water quantity and quality in the estuary is important for tourism in the area (Weston et al., 1995). According to the IDP for the uMkhanyakude District Municipality, the area has a comparative advantage in agriculture and tourism and these economic sectors could require an increase in water supply in future.

2.5.7 Identified catchment protection services for St Lucia

Based on the hydrological landscape outlined in section 2.5.2 and the increasing demand for water of an appropriate quality in the St Lucia area, there are several opportunities for catchment protection services and the development of payments for these services. These include: payments for improved water quality through sedimentation control; increased water supply through flow assurance; the maintenance of ecosystem goods and services through species and biodiversity rehabilitation and conservation; wetland protection and wetland rehabilitation; and the removal of alien invasive species. The identified services are segmented into 3 core themes namely: ecosystem goods and services protection and maintenance; water quantity, and water quality.

Table 2.39 lists the catchment protection services identified in the St Lucia area and describes the associated activities required to achieve the provision of these services. The final column in Table 2.39 provides a broad statement related to whether it is or is not possible to develop these services in the St Lucia area through payments based on the criteria in Section 1.

2.5.8 Opportunities and risks for developing catchment protection services in St Lucia

Opportunities for catchment protection services in the St Lucia area focus on the rehabilitation and conservation of the aquatic ecosystem for the World Heritage Site. Table 2.40 below, lists the opportunities and risks associated with developing catchment protection services in St Lucia based on the hydrological landscape, the land tenure and power imbalances and land use patterns.

Table 2.39: Identified catchment protection services for the St Lucia area

Watershed service	Commodity/ Land use intervention	Opportunities for payments
Ecosystem goods and services maintenance and protection	Restoration and maintenance of aquatic habitat and biodiversity in the area	Yes
	Wetland rehabilitation and protection	Yes
Water quantity	Alien invasive species removal in the upper parts of the catchment and along the riparian zone	Yes, but not necessary as the Working for Water programme deals actively with this in the catchment
	Security of supply	No
	Reduced flow variability	No (the estuary requires two big floods a year to keep the mouth of the estuary open to the ocean, therefore do not want to reduce insecurity)
	Removal of alien invasive plants	No (these plants are used to protect crocodile breeding grounds in the St Lucia estuary)
	Flow assurance	Yes (keep the estuary mouth open to the ocean)
Water quality	Reduced sediment in rivers	Yes

Table 2.40: Opportunities and risks for catchment protection services in St Lucia

Opportunities	Risks
Hydrological assets • Restoring aquatic habitat and biodiversity will help to improve water quality in the St Lucia Estaury, there is a specific need to focus on wetland rehabilitation for water purification. • Improved water supply will lead to the river mouth remaining open. • Maintenance of water supply will lead to the sustainability of eco-tourism in the area.	**Hydrological assets** • Assuring water supply and hence protecting the ecosystem inhibits/limits the ability to develop the catchment upstream as this will increase the demand for water during low flow periods. • Removing alien vegetation without re-stabilising the banks may lead to increased erosion and sedimentation.
Land tenure and power imbalances • Most of the land tenure within St Lucia is government owned conservation land. Surrounding communities have communal land rights and have land claims to parts of the GSWP but these are conditional on conservation activities being maintained.	**Land tenure and power imbalances** • Land tenure issues have been addressed through the land claims process in South Africa. However, there is a risk that if other communities land claims are not settled then they may not support tourism activities and conservation initiatives, and may undermine initiatives to establish catchment protection services.
Land use • If service delivery is improved, the potential for watershed service delivery by communities will be reduced in terms of managing sedimentation, however supply-side provision options still exist. This is a rural area with limited peri-urban development opportunities and sanitation facilities will be provided slowly.	**Land use**

2.5.9 Opportunities and risks for developing payments for catchment protection services in St Lucia

In the St Lucia area, many of the required market elements are tentative and efforts are required to address these clearly and effectively prior to engaging in actual payments. The institutional arrangements, the economic potential, the value of the catchment service and the associated transaction costs are all discussed in table 2.41.

Table 2.41: Opportunities and risks for catchment protection services in the Mhlatuze catchment

Opportunities	Risks
Willing buyers • There are potential buyers in Richards Bay industrial and residential development area. • Potential to target the tourism sector both nationally and internationally for payments as the area has been declared a world heritage site. • Hhluhluwe and Mkuze game reserves, as well as other private game reserves, do have potential to make payments for services.	**Willing buyers** • The buyers are unable to make payments for the required catchment service for certain reasons for example it may be legislated that the service be provided, or the buyer may be unable financially to make a payment. • The number of buyers or amount available for 'payments' may not be large enough to effect measurable improvement in the water supply or quantity. • There is currently controversy around the new forestry licence applications in the area. Extending forestry will reduce instream flow. The question is then asked whether there are other options for the catchment rather than the planting of commercial forests.
Willing sellers • Community structures are well organised in the area, it is therefore possible to identify and establish strong community based organisations.	**Willing sellers** • Increased competition for control over the wetlands or other areas being set aside for catchment services in order to gain access to the benefits. • Erosion of community cohesiveness due to increased divisions between those who gain and those who lose from payments.
Institutional arrangements • Community structures are well organised through limited initiatives but are site specific and involve large numbers of people. • A number of stakeholders are prominent in the area and may support the development of services, they include: the KwaZulu Natal Nature Conservation Service, the KwaZulu Natal Conservation Board, the Big Five Municipality and the communities. It is important that the appropriate intermediary is established to support a payment mechanism within this area.	**Institutional arrangements** • An intermediary or community based organisation, or forum needs to be established to assist with facilitating payments and monitoring progress.

Table 2.41 continued

Opportunities	Risks
Economic potential for payments • The maintenance of water supply may lead to the preservation of the recreational fishing grounds and the bird sanctuary, thereby increasing the potential for tourism activities and local livelihoods.	**Economic potential for payments** • Buyers may not regard payments for catchment protection services as something they should be paying for but rather services the government should provide.
Value/price of identified service • With the classification of the area as a Ramsar Site it became evident that the calculated value of ecotourism outweighed the value of the mining option indicating the potential for payments to be made based on affordability.	**Value/price of identified service** • The value or price of the identified catchment protection services is not known.
Transaction costs • None	**Transaction costs** • Poor information will lead to higher transaction costs for payments in this area, however there is a good scientific foundation that removing aliens leads to improved water flow. • The level of urbanisation high and unemployment high therefore level of security risk is high but has not yet been realised.

2.5.10 Conclusions and recommendations

The St Lucia area raised a number of concerns for piloting in phase 3. Although it is a potentially good site in terms of its classification as a World Heritage Site, the site was not selected because of a lack of information around clarity in identifying a provider / or the required catchment protection services. It was further recognised that the bulk of water use in the catchment was by the commercial agriculture sector through irrigation, and that the needs for the catchment related more towards efficiency in irrigation. Compensation in this regard would then potentially be made by the tourism sector (recreational users and conservationists would want to see the estuary preserved) to farmers for changing their irrigation practices and thereby improving water flow. In so doing the livelihoods improvement component of the project would not be adequately addressed.

2.6 SITE SIX: LEVUVHU AND LETABA: LUVUHU SUB-AREA

2.6.1 Introduction

The Levuvhu and Letaba catchment area covers some 25,016.12 km^2 in the north eastern part of South Africa. The landscape is characterised mainly by degraded land and residential areas with some forestry plantations upstream. Downstream the catchment comprises the Kruger National Park conservation area. Mean annual evaporation is 1600 mm and mean annual runoff is about 520 mm. Figure 2.15 shows the main rivers and the land cover of the catchment.

The Luvuvhu/Mutale sub-area comprises the catchments of the Luvuvhu River and the Mutale River. Nearly 45 percent of the total surface runoff from the Luvuvhu and Letaba water management area flows down the Luvuvhu/Mutale sub-area, whilst a further 45 percent is contributed by the Klein and Groot Letaba rivers. The area has a single lake (Lake Fundudzi) and there are no large wetlands in the area.

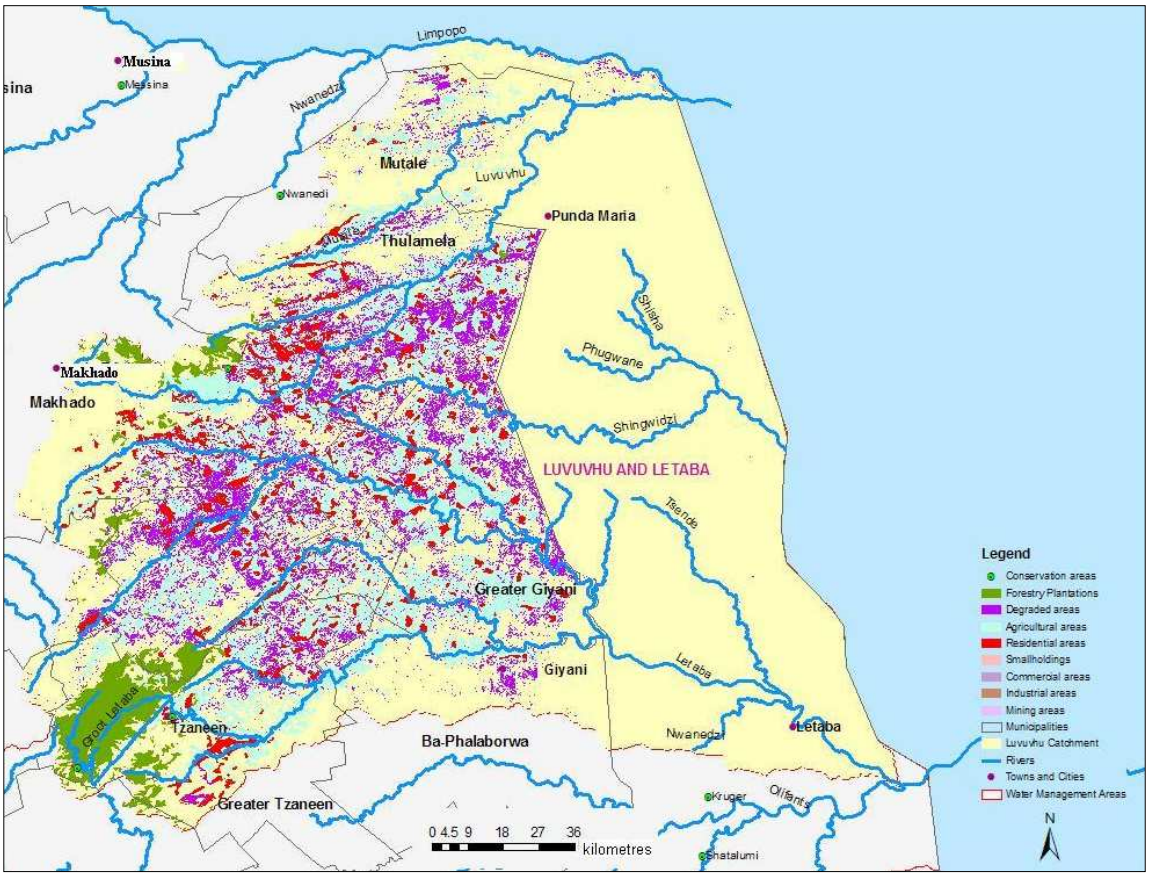

Figure 2.15: Map showing the different land uses in the the Levuvhu catchment

2.6.2 Hydrological review

The hydrological landscape of the Luvuvhu and Letaba Water Management Area comprised four hydrological components, namely: water quantity, water quality, groundwater and aquatic ecosystem services. The implications of these four components on the potential development of payments for watershed protection services are discussed below.

2.6.2.1 Water quantity

The Luvuvhu/Mutale sub-area has a mean natural runoff of 520 million m^3/year (DWAF, 2004a). Irrigation is the largest water use sector in this sub-area and it accounts for 73 million m^3/year (DWAF, 2004g). It must be noted that, together with the Mutale sub-area, the total water requirement for the Luvuvhu/Mutale sub-area amounts to 97 million m^3/year (Table 2.42). Key issues in the Luvuvhu sub-area includes the presence of alien vegetation, over-utilisation of the available resource to cater for all water requirements, and afforestation. Alien vegetation is a particular problem in the upper reaches of the Luvuvhu sub-area and together with afforestation, reduce the available yield in this sub-area (DWAF, 2004g). Afforestation, in particular, is located upstream of both the Vondo and Albasini dams, and it has a significant impact on the available yield. Other issues include the potential for power generation in the north and mining developments, which have not been specifically provided for in the projected future demand for water; and ensuring the availability of water of appropriate quality with respect to the Kruger National Park (DWAF, 2004g).

Table 2.42: Water requirements for the year 2005 (million m^3/year)

Sector/sub-area	Irrigation	Urban	Rural	Mining and Bulk Industrial	Power generation	Afforestation	Total local requirements[1]
Luvuvhu	73	4	8	0	0	6	91
Total for WMA	255	10	31	1	0	43	340

Source: DWAF 2004g

[1]This excludes water transfers out of the Water Management Area to the Limpopo and Olifants Water Management Areas, which amount to 357 million m^3/year for the Luvuvhu/Letaba WMA, and 98 million m^3/year for the Luvuvhu sub-area.

2.6.2.2 Water quality

The ISP report indicates that the quality of water in the Luvuvhu sub-area is of adequate quality for human consumption, though increased nutrients from washing and bathing in rivers stimulate algal growth (DWAF, 2004g). The riparian zone has been damaged by the removal of vegetation for firewood and overgrazing; this makes surface water more vulnerable to pollution from surrounding areas. In addition, there are inadequate facilities to dispose of solid waste, and this adds to the potential degradation of surface water in the sub-area.

2.6.2.3 Groundwater

Groundwater is said to 'constitute the only dependable source of water in the Luvuvhu/Letaba WMA' and the resource is estimated to yield about 16 million m^3/year (DWAF, 2004g). Large scale utilisation of the groundwater resource occurs mostly downstream of the Albasini

Dam for irrigation, since this dam does not yield sufficient volumes of water to meet all the requirements of irrigators in the Levubu Government Water Scheme in particular. In addition to groundwater use as a supplement to the water requirements downstream of the Albasini Dam, irrigators use small farm dams a sources of water for irrigation purposes. Large-scale utilisation of groundwater also occurs in the vicinity of Thohoyandou for domestic rural supply. Other groundwater uses in the Luvuvhu sub-area include: stock watering, game farming, and domestic rural supply. Groundwater use in the Luvuvhu sub-area is not monitored and there is no certainty with regard to the impact of over-utilisation of groundwater on surface water resources. Furthermore, there is insufficient knowledge on the long-term sustainable yield from groundwater (DWAF, 2004g).

2.6.2.4 Aquatic ecosystems

The conditions of the bed of the rivers in the Luvuvhu and Letaba vary between modified to heavily modified. The flow of the rivers and riparian/bank conditions vary between severely modified to slightly modified. Most instream biota in this WMA is indigenous. With regard to aquatic ecosystem, watershed services would include the rehabilitation of riparian vegetation and proper management of land use, especially in the most heavily affected areas (DWAF, 2000).

2.6.2.5 Watershed services

Possible opportunities for development in the Luvuvhu sub-area would depend on reallocation of water from the agricultural sector to other water use sectors and, where possible, changing from commercial forestry to other types of agriculture so as to make water available for other uses. Furthermore, equitable allocation of the available water resource has some potential to encourage the development of the rural economy to contribute to poverty alleviation. Since groundwater has been identified as the only dependable source of water for many users (DWAF, 2004g), proper groundwater management could be a potential water service.

The concerns around the development of payment for watershed protection services in this catchment relate specifically to domestic water demand. Water management issues in this sub-area relate to the provision of sanitation and water for drinking, cooking, bathing, and small-scale productive uses such as subsistence agriculture.

2.6.2.6 Land tenure and ownership

One of the critical components for the development of market-based mechanisms for catchment protection services is clearly defined property rights. This includes property rights associated with land and land-based activities that impact on the water resources in the catchment.

The Luvhuvhu Catchment can be divided into four main areas based on land tenure and type of land use practice (Hope et al, 2003). These areas are large scale commercial farming in the upper catchment (irrigated crops, dryland crops, and rangeland cattle production), forestry (mostly state-owned plantations in the upper catchment), conservation areas (including the Kruger National Park in the lower reaches of the river) and the so-called communal areas (in the middle and lower reaches of the catchment) (Hope et al, 2003).

The upper reaches of the catchment fall under the jurisdiction of the Makhado Municipality. Ownership of land in this area is fairly straightforward. Commercial farms – which form 13 percent of the catchment - are privately owned while the majority of plantations (4 percent of the catchment area) are state-owned (DWAF and SAFCOL) with the exception of a few small plantations. Forestry, although not the largest land user in the catchment, is the main water user. The location of the forestry sector in the upper reaches of the catchment results in decreased water availability for users downstream of plantations, mostly the residents of the communal areas and the conservation sector. Land restitution claims on commercial farms in the upper catchment might, if settled, impact upon the tenure regime in this section of the catchment.

The northern section of the Kruger National Park forms the lower reaches of the catchment whereafter the Luvhuvhu drains into the Limpopo River System in Mozambique. Conservation areas in the Luvhuvhu Catchment are mainly state-owned and comprise 30 percent of the catchment.

The former Venda homeland area of the catchment falls under the Thulamela Municipality. Land use systems and tenure regimes in these areas are described as "complex" by Hope et al (2004). The area is generally divided into rural villages where households have kitchen-gardens (Hope et al 2003). Some residents have access to dryland fields and in a few locations there is access to irrigated fields on government developed irrigation schemes (Hope et al 2003). The woodland surrounding these areas is communal, administered by the tribal authority and available to all villagers for cattle grazing and the collection of woodland products (Hope et al, 2003).

Thohoyandou is the main urban centre of the catchment and the base of the Thulamela Municipality. Land in the town is, in most instances, either privately- or state-owned. A number of educational- and training institutions are found in Thohoyandou, most notably the University of Venda. Various businesses, such as a hotel and a filling station, hold land in town. Formal neighbourhoods with private ownership of land are also found in Thohoyandou – mainly in area in the vicinity of the University of Venda.

2.6.2.7 Institutional structures and land ownership in Venda

Land ownership and land use in the communal areas evolved from tribal customary authority (Hope et al 2003). Land ownership and land use are contested issues in this area, influenced by the complex history of the area and the Venda people. Any development initiative in the area will have to take cognisance of this fact. The history and culture of the Venda people, the effects of colonial and apartheid rule on traditional authority systems in this area, as well as democratisation in post-1994 South Africa have resulted in confusion regarding the roles and responsibilities of various institutions in allocating and demarcating land. Although the communal areas of the catchment is said to fall under the jurisdiction of the Thulamela Municipality, tribal authorities are still in power in most of these areas. In the tribal areas, chiefs and headmen are responsible for the allocation of land to individuals as well as the demarcation of land. Individuals are given permission to occupy or cultivate a piece of land but the tribal authority retains the power to take away the land if he deems it necessary. Therefore, individuals do not own land. In some chiefdoms, a small fee is paid by individuals to be allocated land (approximately R50). However, in areas under the jurisdiction of the municipality (such as Thohoyandou), individuals can purchase land and obtain private ownership.

Tenure regimes and governance structures in the communal areas of the catchment can only be understood in terms of the historical context of the Venda people. Venda history is a

complex matter and "the subject of unending dispute among different parties and dynastic groups that inhabit the territory" (Fokwang 2003). The disagreements amongst the Venda people in terms of their history and the authority of the various chiefdoms might be disheartening to an outsider attempting to understand the intricacies of tribal rule in this area. From an outside perspective, the Venda are a distinct cultural group speaking the Tshivenda language. But the Venda do not regard themselves as a culturally homogenous or politically united nation (Loubser, 1990). For most of their history, except for the time of the rule of Chief Thohoyandou, Venda consisted of several autonomous chiefdoms (Fokwong, 2003). Colonialism served to exacerbate this situation. Colonial and apartheid rulers exploited traditional systems to achieve their own aims with severe effects on these systems, powers of tribal authorities and the relationship amongst the Venda people and their rulers. In the Apartheid years of South African history, the Bantu Authorities Act (Act No. 68 of 1951) provided for the creation of 'tribal', regional and territorial authorities. In the former Venda homeland, 25 tribal authorities, three regional authorities and one territorial authority were established. Fokwang (2003) notes that the demise of the Apartheid state and the abolition of the homeland government led to the re-assertion of the autonomy of individual chiefdoms in the Venda region. Renewed emphasis was placed on the independence of each Venda chiefdom.

The chiefdoms of the Venda are part of the fabric of the Venda people and even today, there is continuous rivalry among the Venda chiefs. As mentioned earlier, post-1994 South Africa has seen the re-emergence of independent Venda chiefdoms and chiefdom politics but, as Fokwang (2003) emphasises, contexts have changed. The reasons for these changes can mainly be attributed to colonialism and Apartheid, as well as the introduction of democratic rule in post-Apartheid South Africa.

Today, Venda is still made up of 25 tribal authorities, each constituting a separate chiefdom. Rivalry exists between some of the chiefdoms, such as the Mphephu and Tshivashe chiefdoms. The main source of rivalry here is the perception of the Tshivase that the Mpephu was accommodating to colonisers. Strained relationships between these chiefdoms remain today.

Relationships between tribal authorities and the Venda people also deteriorated due to the re-organisation of tribal systems during the Apartheid regime. Fakwong (2003) states that Mphephu influenced the appointment of headmen into the Venda government who supported him and his party and, therefore, "a significant number of headmen in Tshivhase and other chiefdoms owed their position to the Apartheid system and to Patrick Mphephu in particular" (Fokwang 2003). These traditional rulers exploited their positions by demanding irrelevant taxes and tributes, and free labour of people in their chiefdom and utilized tax money for their own benefit. They were also responsible for the roll-out of Apartheid policies, such as granting permits to migrant workers to go to the city. Resentment towards chiefs grew and reached a climax during unrest in the late 1980s. However, resentment in the chiefdoms was quelled to a large extent by a new awareness of the legitimacy of chiefs in a modern era with the formation of the Congress of Traditional Leaders of South Africa (CONTRALESA) in 1987 (Fokwang 2003) and its relationship with the ANC after 1990.

In contrast with many other former homelands, tribal councils in Venda continued to function after 1994 as they did before then. Of the tribal councils in Venda, 14 of the 25 were integrated into the Thulamela Municipality based in Thohoyandou – of which the municipal area covers most of the Luvhuvhu Catchment. The Tshivhase chiefdom was one of the tribal councils integrated into the Thulamela Municipality. However, the Tshivhase Tribal Council – now known as the 'Tshivhase Territorial Council' – still plays a major role in rural local government but often in conflict with the municipal authorities (Fokwang 2003). The mere size of this chiefdom – consisting of 74 villages and therefore 74 headmen – already makes for a powerful presence in the catchment.

2.6.2.8 The power of tribal authorities in post-1994 Venda

Fokwang (2003) notes that the powers of tribal authorities have been curtailed significantly by the Municipal Structures Act of 1993 and other recent legislation. Tensions between tribal authorities and new local municipalities are a nationwide occurrence – mainly due to overlapping roles in terms of issues such as land allocation (King, 2004; Fokwang, 2003). Many of the roles fulfilled by tribal authorities in the homelands of pre-1994 South Africa have now been assigned to municipalities. A confusion of institutional roles exists on the local level. King (2004) notes that "the institutions of land ownership and allocation that were created during the colonial and Apartheid periods haunt land tenure reform in the post-Apartheid era, as tribal authorities continue to exert control over land and other environmental resources necessary for livelihood production". It is in such an environment that the people of the Luvhuvhu catchment attempt to eke out a living from the land. In many instances it is not clear which governance institution is responsible for which function. King (2004) notes that land reform activists and researchers assert that the tribal authorities are the chief impediment to the transfer of land to disenfranchised populations. Furthermore, this confusion is "contributing to misunderstandings as to the institutions of resource access in rural South Africa, patterns of livelihood production, and governance systems in the former Apartheid homelands" (King, 2004). King (2004) refers to the Matsamo Tribal Authority in the former KaNgwane homeland as an example. This tribal authority continues to exert control over the allocation of land and access to various environmental resources and therefore remains an important institution shaping rural development in the former homeland (King, 2004).

In Venda, post-1994 reorganization of institutional structures left many disillusioned with newly appointed authorities, such as municipal councils, and gave tribal authorities the chance to re-establish their position as leaders of the people. The re-organization of institutional structures also left many tribal authorities feeling threatened about their power and area of jurisdiction. Even today, some tribal authorities insist that newly formed municipalities encroached on their land.

A Transitional Local Council (TLC) and Municipal Demarcation Board were established in Venda after the local council election of 1995. During this time, tribal authorities such as Chief Tshivashe, re-established their relevance amongst the people through strong leadership in terms of issues such as land allocation and judicial matters. When the TLCs did not deliver on the expectation of the people regarding services, where some people even paid for services upfront that they did not receive, the people of Venda became disillusioned with the TLCs and accused them of corruption. TLCs also charged fees to demarcate land for the rural people. The Tshivashe Territorial Council (TTC) – established by Chief Tshivashe - reduced fees that subjects had to pay in order to be allocated land (in comparison with fees charged by the municipal council, and other chiefdoms), demarcation of land was done for free (as opposed to a heavy sum charged by the municipal council) and certain fees that were paid during the homeland era were scrapped (fees to gather firewood, to grow crops on small portions of land, etc) (Fokwang 2003). Chief Tshivashe even granted women the same rights to land as men, a practice unheard of before then (Fokwang 2003). Chief Tshivashe is also a founding member of the Tshivashe Development Trust which aims to lobby funds and initiate development projects in the chiefdom and other Venda territories such as the construction of schools and the provision of small-scale employment opportunities.

As illustrated above, land tenure and ownership in the former homelands of South Africa (such as Venda) makes for a very complex situation, shaped by years of political change. Any initiative in the communal areas of the Luvhuvhu Catchment will be impacted upon by the complexity of land tenure and ownership arrangements in the catchment and the confusion

around the roles and responsibilities of the various authority structures (tribal authorities and the municipality) there.

2.6.2.9 Opportunities for developing payments for catchment protection services considering land ownership and tenure

Land ownership in the Luvhuvhu catchment is either private, communal (under the authority of tribal leaders) or public. The communal areas are located upstream from conservation areas (the Kruger National Park). Watershed services provided by residents in communal areas (such as soil rehabilitation) will therefore be mainly to the benefit of the Kruger National Park in terms of increased water quality. A potential actor in terms of trading services is the Department of Water Affairs and Forestry (DWAF), with state-owned plantations in the upper reaches of the catchment being the main water user in the area. In the establishment of payments for catchment protection services, actors would include conservation authorities (South African National Parks), government (DWAF and the Department of Land Affairs), municipalities (Thulamela Municipality) as well as the relevant tribal authority (depending on the community). The involvement of commercial farmers (possibly through the local Farmer's Union) should also be considered. DWAF is already involved in poverty alleviation and environmental management in the catchment through its Working for Water (WfW) Programme. Cognisance will have to be taken of power struggles between the municipality and tribal authorities, as well as between different tribal authorities. Negotiations with the residents of the catchment will have to be effected through the correct channels (whether the municipality or the tribal authority).

2.6.3 Identification of poor and marginalized groups

The poor and marginalized groups in the Luvhuvhu catchment are found in the areas of the former Venda homeland, mainly in the Thulamela Municipality and areas under tribal authority. Thohoyandou and surrounding areas fall under this municipality which forms part of the Vhembe District Municipality. The Thulamela Municipality mainly consists of scattered rural villages, with the exception of Thohoyandou. The population in this municipal area consists mainly of black people (99.6 percent) speaking mostly the predominant languages in this area: Tshivenda (66 percent of the population of the municipality) and Xitsonga (33 percent of the population of the municipality) (Statistics South Africa 2001).

Unemployment is a main contributor to poverty in the area. The need for employment is reflected in a finding by Fokwang (2003) that people in the area would prefer employment rather than access to services: "Rural dwellers could not understand why the municipal authorities insisted on treating them in the same way as urban-based residents. According to them, villages are not suburbs, 'locations' or townships where the municipality is obliged to deliver services. What they needed, informants insisted, were jobs, not services".

Of the population of Thulamela Municipality, 54 percent falls between the ages of 14 and 65 (Statistics South Africa, 2001). The potentially economically active population of the area, therefore, makes up the majority of the population. However, of this group, only 44 percent is reported to be economically active (Statistics South Africa, 2001), i.e. in the labour force. Of the total labour force, only 40 percent is employed. Therefore, only 18 percent of the potentially economically active population is employed. The subsistence nature of livelihood strategies in Venda and an active informal economy may contribute to the inactivity of people in the formal labour market. From a macroeconomic perspective, people in this region might be considered poor. However, the people themselves might have an entirely different perspective of their livelihood status.

Related to unemployment figures, income levels in the Thulamela Municipal Area are very low. The majority of households in the study area receive less than R1,600 per month (R19,200 per year) (Statistics South Africa 2001). Of this group, the largest majority (27 percent of the total number of households) survives on less than R400 per month (Statistics South Africa 2001). Initiatives in the area to boost income levels include the Tshivashe Development Trust, of which Chief Tshivashe is a founding member (Fokwang 2003). The Trust owns a plantation and has acquired some farms where a number of unemployed people are employed.

Service delivery in the municipal area is poor. The isolated nature of many of the rural villages makes infrastructure development expensive and challenging. In terms of sanitation provision, 51 percent of households have access to only a pit latrine (Statistics South Africa 2001) which does not meet the DWAF requirements of at least a Ventilated Improved Pit Latrine (VIP latrine). Thirty-one percent of households have no sanitation facilities at all. The residents of the Thulamela municipality live either in formal or traditional housing (mainly in the rural areas). Informal housing and informal settlements are uncommon.

The residents of the communal areas are subsistence farmers and households have kitchen-gardens for food production (Hope et al, 2003). Many engage in other farming activities as well, such as dryland agriculture and livestock farming, while woodland products are also collected for various purposes. Many residents of these communal areas might not necessarily perceive themselves as being very poor. Hope et al (2003) argues that poverty diagnosis in South Africa is built upon national survey data that can be analysed statistically but that this method often does not provide a very accurate reflection of the reality of rural livelihoods in South Africa. For example, research conducted by Hope et al (2003) in a rural community in the Luvhuvhu catchment revealed that the women perceived 33 percent of the community as not being wealthy, poor or very poor but rather "average". The group considered to be "average" has private electricity, a few livestock, own subsistence crop fields, were employed but lost their jobs and were now involved in petty trading (i.e. informal sector activities), were food secure and had healthy children whom they could afford to send to school. From an urban perspective, this description might fit a person considered to be poor but in this community, females perceived such a person as "middle class".

2.6.4 Land use

The main land use types identified in the Luvuvhu catchment are agriculture and forestry, rural settlements and the nature reserves. As water is scarce, there is much competition for this resource among land use types (DWAF, 2003e). Table 2.43 presents the area under each land use in the Luvuvhu Catchment.

Table 2.43: Area under specific land use in the Luvuvhu catchment

Land use	Area (km2)	Area (%)
Agriculture		2.1
Irrigation	123.8	20.5
Dry land	1 217	
Afforestation	168.6	2.8
Domestic		0.4
Urban	23.3	1.1
Rural	64.3	
Other (including nature reserves, mining and industry)	4344	73.1

Source: DWAF (2003e)

2.6.4.1 Agriculture

Along the lower reaches of the catchment, subsistence agriculture and grazing is the predominant land use, comprising approximately 50 percent of the agricultural land. Subsistence farmland is a mix of household plots, community gardens and livestock farming.

There are two commercial farmers' associations in the catchment i.e. the Levuvhu and Makhado Farmers' Associations. Twenty-three percent of the area is cultivated agricultural land (of which 2.1 percent is irrigated). The main commercial grown crops are bananas, macadamia nuts, avocadoes, guavas, mangoes, citrus and litchis (Visser, 2003). Agriculture is the largest water user in the catchment (DWAF, 2003e) and farmers are responsible for the maintenance of the furrows from the water scheme. The furrows are currently degraded, thus there has been a shift towards using private boreholes instead. The table below shows the area planted per crop and each crop's water use where available (Visser, 2003).

Table 2.44: Area and water use for crops grown within the Levuvhu Farmer's Association

Crop	Area (ha)	Water use (m^3/ha/week)
Bananas	1200	40000
Macadamia nuts, avocado		10000 -15000
Guavas	350	
Mangoes	246	10000-15000
Citrus		
Naartjies	60	
"Nawels"	100	
Valencias	190	
Litchis	65 (2-3 ha per farmer)	
Sweet potatoes	100	
Potatoes	100	
Cabbage and tomato	50	
Ginger	15	

Source: Visser (2003).

Poor agricultural practices by subsistence farmers have led to accelerated bank and donga erosion, especially where agricultural activities disturb and remove parts of the riparian zone. The application of herbicides and insecticides has a negative impact on water quality (State of the Rivers, 2001b). It was estimated that 4,414 cattle and horses and 6,632 small livestock were grazing on communal land in the Luvuvhu catchment (DWAF, 2003e).

2.6.4.2 Forestry

Commercial forestry estates and indigenous forests form 2.8 percent of the catchment area. In the Mutale River catchment, a relatively small section of about 2,120 ha of exotic afforestation has been established as part of the Thate Vondo plantation. The main afforested areas within the Luvuvhu catchment occur in the Soutpansberg Mountain Range, while indigenous forests occur in steep inaccessible ravines and mountainous areas (DWAF, 2003e). Forestry led to increased sediment loads and soil erosion, as well as streamflow reduction. The forestry sector consists of large previously government owned plantations (Safcol and DWAF managed) and a few small private plantations.

2.6.4.3 Mining

Two mines existed in the Luvuvhu catchment in 1995, namely the Tshikondeni coal mine and Geocapro Magnesite (formerly known as Venmag mine). Geocapro Magnesite has since ceased to operate and is being rehabilitated. There are also many other inactive mines in this catchment.

The Tshikondeni coal mine is an underground coal mine owned by Kumba Resources Limited, formerly Iscor Mining. The mine is partially situated within a protected area and is authorised to use 22,027 ha of land, of which 4,616ha is disturbed. The mine has a long-term supply contract with Iscor Works. It produces 380,000 tonnes of hard coking coal per annum, which it sells to Iscor at cost price plus a 3 percent management fee (Kumba Resources, 2003).

According to DWAF (2003b), the water use of mining is fairly low. Kumba has indicated that there is a risk within its disposal of processed water from the mine. One of its environmental impacts is the exposure of pyrite to air and water during mining operations creating sulphuric acid, which leaches into the aquatic systems. This leaching may continue to have ecological health impacts long after the mining has stopped. According to Zhuwakinyu (2003), Tshikondeni has a life span of approximately 13 years.

2.6.4.4 Industry

The Luvuvhu catchment has three warehouses for processing and packing macadamia nuts. These warehouses are the Greenfarms warehouse, Royal Macadamia and Zetmac. The warehouses process about 6,500 tonnes of nuts per annum. In addition, there are two citrus packing warehouses situated in the catchment (Visser, 2003).

2.6.4.5 Ecotourism

Thirty percent of the catchment is comprised of protected nature or game reserves (Hope et al., 2003). These protected areas include the Kruger National Park, Roodewal Nature Reserve, Brackenridge Zanguebarica Reserve, Mphaphuli Cycad Reserve, Makuya Reserve, Ratombo Nature Reserve, Mathivha and Matondoni.

2.6.4.6 Rural settlements

Rural communities are engaged in subsistence and income generating activities such as fishing, brick manufacturing, collecting firewood and washing clothes. These activities often have negative impacts on the environment due to the high dependence on environmental resources for survival, the lack of infrastructure and planning for sustainable utilisation. Some of these impacts are sediment inflow from poorly planned settlements, removal of clay from the riverbank for the manufacturing of bricks and the destruction of riparian vegetation and overstocking of livestock (State of the Rivers, 2001b).

2.6.4.7 Other issues

According to State of the Rivers Report (2001a), sawmills, numerous road bridges crossing the river and flood prevention structures cause high turbidity. Highly turbid waters are murky, stain clothes, block irrigation sprays and pipes or harm aquatic organisms. Turbidity reduces

the activity of plants and animals in the food chain of the riverine ecosystem. High turbidity can also reduce the effectiveness of water treatment plants in removing potentially harmful micro-organisms.

Rainfall is unevenly distributed in the catchment and the presence of commercial forestry reduces the availability of water for domestic and other productive uses. Combined abstractions from the various land uses utilize all of the low flows in the river, particularly during the critically dry period of August to November (Moshe and McClintock, 2001; King, 2003).

2.6.4.8 Conclusion

The main impacts on water resources due to land use practices in the Luvuvhu catchment are lack of water availability in dry seasons, increased sediment loads and leaching from mines. The lack of water resources is primarily due to the sparse rainfall but is aggravated by the high demand for water in the catchment for human needs and agricultural activities. The leaching of sulphuric acid into water resources from mines has a negative effect on water quality and potentially human and ecological well-being.

2.6.5 Economic review

The economy of the Luvuvhu catchment is based on subsistence farming and informal trading, coal mining, commercial agriculture, forestry and ecotourism. Economic opportunities within the catchment appear to have been declining, while the low economic base has led to a high degree of poverty and unemployment with a high dependence on remittances and subsistence activities (DWAF, 2003e).

2.6.5.1 Gross Geographic Product

The Luvuvhu/Letaba Water Management Area contributes less than 1 percent to national GDP. The gross geographic product (GGP) for the Luvuvhu/Letaba catchment has declined at an approximate average annual rate of more than 7 percent over the 1988 -1997 period (DWAF, 2003e). The Luvuvhu catchment is contained within the Mutale, Thulamela and Makhado municipalities in the Vhembe District Municipality as well as the CBDMA4 municipality (Kruger National Park). The IDPs of the Vhembe municipalities were consulted in terms of the contributions of the economic sectors to the GGP of the catchment. The Thulamela and Makhado municipalities had sufficient data and thus only these two IDPs were considered as part of the GGP review.

Within the Thulamela Municipality (2002), the GGP was R2,975 million in 2000. The community and social services sector contributed the most to GGP (62.1 percent) followed by the trade (10.2 percent), the manufacturing (6.7 percent) and the financial (5.8 percent) sectors. According to the Makhado Municipality (2002), the largest contributors to GGP in 1997 were the government (30.7 percent), trade (25.6 percent), agriculture (16.4 percent) and manufacturing (7.8 percent) sectors. However, the Makhado Municipality is relatively large and the portion that lies within the catchment does not consist of the main economic actors.

Agricultural products such as litchis, avocadoes and macadamia nuts are produced for the export market. Fruit production earns between R420 – R5,000 per tonne depending on the type of fruit, purpose it is sold for and the quality of fruit (Visser, 2003).

2.6.5.2 Employment

The level of employment in the Luvuvhu catchment was estimated from the following municipalities that falls within the catchment: Mutale, Thulamela and Makhado. The unemployment rate in this catchment is estimated at approximately 55 percent in 2001. Figure 2.16 below shows the contribution that each economic sector has made to employment within the three municipalities in 2001. The major employers in the Luvuvhu catchment are government (32 percent), private households (11 percent) and agriculture (10 percent) (Statistics SA, 2003).

The Levubu Farmer's Association has approximately 1,800 labourers employed earning the minimum wage of R650 per month. Subsistence and small-scale farming plays a major role in the economies of the Luvuvhu catchment due to the high levels of poverty and unemployment. There has been an increase in the existence of small-scale farms, irrigated informal gardens and traditional cattle farming practices (State of the Rivers, 2001a).

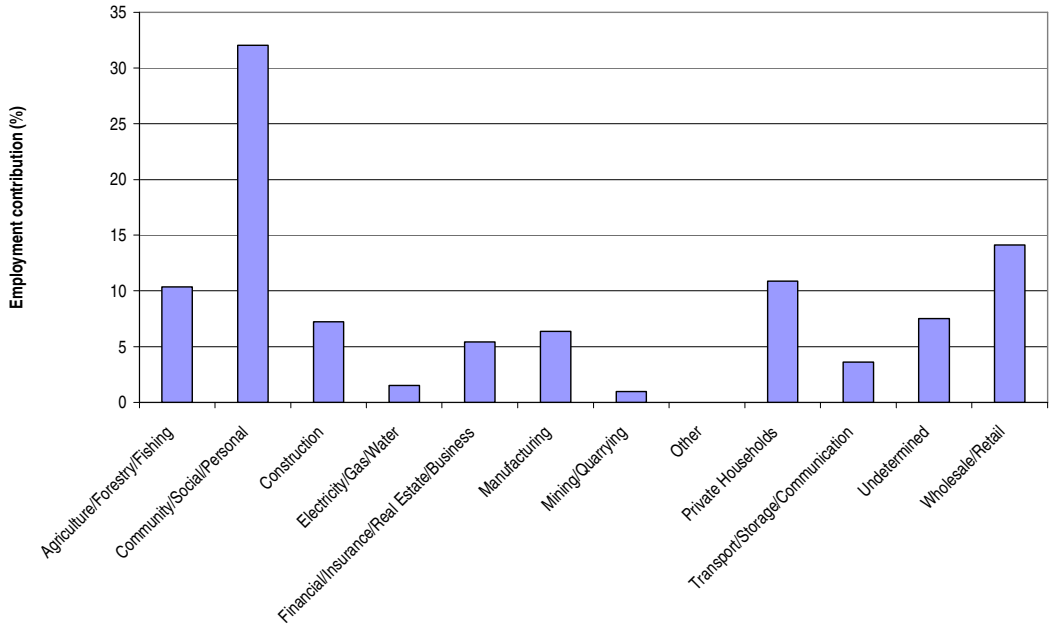

Figure 2.16: The contribution to employment by economic sectors in the Luvuvhu catchment during 2001.
(Source: Statistics SA, 2003)

2.6.5.3 Resource use

This large proportion of unemployed and low income households has led to high dependencies on the available natural resources for survival leading to degradation and overexploitation of natural resources as mentioned in Section 2.6.6.6. In addition, the lack of reliable and adequately accessible water limits the ability of local people to engage in income-generating and expenditure-saving activities such as brewing beer, making bricks, baking bread, kitchen garden farming, irrigated farming, fishing, livestock rearing, and dryland farming (King, 2003). Table 2.45 shows the DWAF (2003e) estimated water requirements for all major users in the Luvuvhu catchment.

Table 2.45: Water requirements by sector in the Luvuvhu catchment

Economic activities	Water requirements (million m3)	Water requirements (%)
Agriculture	103.30	
Irrigation		32.1
Domestic		
Urban	1.80	0.6
Rural	7.52	2.3
Bulk users (Tshikondeni mine)	1.00	0.3
Afforestation	17.60	5.5
Alien vegetation	25.10	7.8
Ecological reserve	165.10	51.4

Source: DWAF (2003e)

Water requirements for maintaining the ecological system is by far the largest (51.4 percent) and this corresponds to the fact that approximately 30 percent of the land in the catchment is comprised of protected areas (Hope et al., 2003). The second largest water user is the agricultural sector (32.1 percent) followed by alien vegetation (7.8 percent). Due to the high requirement of water, it can be deduced that the acceptable quality of water for the functioning of the ecosystem is important in the catchment.

2.6.5.4 Implications of land use practices and economic power imbalances on payments for watershed services

The major land uses in the catchment are dryland agriculture, commercial forestry, irrigated agriculture and other land uses (which include nature reserves, mining and industry). Forestry plantations tend to be situated upstream while agriculture is spread across the catchment.

The major employer within the catchment is community and social services (government) followed by retail, private household and agricultural sectors, respectively. Value-addition industries such as the processing and packing of nuts and fruit and the Tshikondeni coalmine are also sources of income and employment in the region (Kumba Resources, 2003; Visser, 2003). Generally, the people living within the catchment are poor with high levels of unemployment.

The highest demand for water is for the ecological functioning of the catchment, commercial irrigated agriculture, alien vegetation and commercial forestry. The ecological reserve is used as a proxy for water required for the ecological functioning of the catchment. Rural settlements contribute to the degradation of the water resources through the destruction of riparian vegetation and overgrazing (State of the Rivers, 2001a). Forestry has been identified as leading to increased sediment loads and soil erosion as well as reducing the water supply through its stream flow reduction activities, while agriculture has led to the increased degradation of riverbanks and donga erosion. Because forestry is classified as a stream flow reduction activity, leading to less water available in drier periods, it could pay the communities downstream for the lack of water as part of a corporate social investment. Payments for watershed services (such as sediment reduction) will be difficult to determine due to the lack of information regarding the contribution of various users to the problem. The lack of economic activity does not lend itself to the support of markets for watershed services, as government is the major employer and contributor to GGP in the catchment.

2.6.6 Identified catchment protection services in the Levhuvu/ Letaba catchment

Based on the hydrological landscape outlined in section 2.6.2 and the increasing demand for water of an appropriate quality in the Luvuvhu and Letaba Catchment, there appear to be numerous opportunities for the identification of catchment protection services and the development of payments for these services. This section reviews the services identified in this report are segmented into 3 core themes, namely: ecosystem goods and services protection and maintenance; water quantity, and water quality.

Table 2.46 lists the catchment protection services identified in the Luvuvhu and Letaba Catchment and describes the associated activities required to achieve the provision of this service. The table also states whether or not there is an opportunity for the development of these services in the catchment. The final column in Table 2.45 provides a broad statement related to whether it is or is not possible to develop these services in the Luvuvhu and Letaba Catchment through payments based on the criteria in Section 1.

Table 2.46: Identified catchment protection services for the Luvuvhu and Letaba Catchment

Watershed service	Commodity/ Land use intervention	Opportunities for payments
Ecosystem goods and services maintenance and protection	Restoration of wetlands in the catchment	Yes
Water quantity	Alien invasive species removal in the upper parts of the catchment and along the riparian zone	Yes, but the Working for Water Programme deals actively with this in the catchment
	Ground water resources management	Yes
Water quality	Reduced sediment in rivers	Yes

2.6.7 Opportunities and risks for developing catchment protection services in the Levuvhu/ Letaba catchment

The opportunities and risks for the development of payments in this catchment appear to be very limited as the greatest need for change is in the provision of water services and water supply for basic needs. This particular catchment also epitomises the environment where the poor and marginalized groups are situated in the lower reaches of the catchment and are not positioned to take advantage of improving and supplying watershed services. Despite the fact that extensive and innovative work has been conducted in this catchment through initiatives such as the CAMP project that provide useful supportive information for conducting further work, the opportunities for the developments of payments for watershed services are limited.

Table 2.47 below, outlines the opportunities and risks associated with developing catchment protection services in the Levuvhu/ Letaba catchment based on the hydrological landscape, the land tenure and power imbalances and the land use patterns.

Table 2.47: Opportunities and risks for catchment protection services in the Levuvhu/Letaba catchment

Opportunities	Risks
Hydrological assets • Need to have more alien invasive vegetation removed from the riparian zones and the upper watershed in order to improve water supply. The removal of alien invasive vegetation is ongoing and follow up actions need to be taken providing the opportunity for long term planning and payment systems. • Water scarcity is a constraint to development and there is a need for improved efficiency in water use. • Restore of wetlands will help to improve water quality and supply. • Reduced sediment in rivers by changing land management practices of communities.	**Hydrological assets** • The national government is already responsible for removing alien invasive vegetation through the Working for Water Programme and there is little incentive for demanders of the service to pay for it. • There is a need for the provision of basic services in this catchment. The demand by communities is focussed on these services before the provision of catchment protection services.
Land tenure and power imbalances • Land tenure is well defined as communal land, and, although the tribal chiefs hold the power in terms of community structures, there seems to be a willingness to participate in and support initiatives such as the development of catchment protection services.	**Land tenure and power imbalances** • Land tenure for communities living in the Levuvhu/Letaba catchment predominantly communal. Tribal chiefs are responsible for decisions on land management in these communal areas hence the buy-in of these chiefs is critical to any payment.
Land use • Where private property rights are established, the issues for catchment protection services relates to water discharges and the quality thereof. Agriculture land management may be improved but for industry and mining technology improvements are required.	**Land use** • The opportunities for catchment protection services relate to wetland rehabilitation, due to the insecure property rights assigned to communities their potential to provide this service is limited unless there is an intervention by DWAF that allows them to engage in 'best' land management practices.

2.6.8 Opportunities and risks for using market-based mechanisms

Opportunities for the development of payments for catchment protetcion services in the Levuvhu and Letaba catchment are limited due to the nature of the spatial arrangements of the rural communities in relation to buyers of the services demanded. The communities are situated downstream from buyers. However, the extensive work done in the area through the CAMP project has provided a good source of baseline community relevant data. Communities are also clearly identified and there are already community participation processes in place through the existing initiatives.

Unfortunately, no clear catchment protection services have been identified in the catchment and the focus in terms of needs is on the supply of water for basic needs and the provision of sanitation facilities. Further improved access to water provision for productive uses by communities may in turn lead to increased erosion in the catchment due to intensive land management practices.

There may be a small opportunity for land management practices to be addressed and thereby provide watershed protection service activities by conservation tourism for example the Kruger National Park or the forestry sector upstream. However these opportunities are limited as the incomes generated are small in comparison the scale of the community sites.

2.6.9 Conclusions and recommendations

Based on the opportunities and issues identified above, this catchment was not selected through the workshop selection process as a pilot site for payments for watershed services in South Africa. It was however recognised that there is an opportunity for non- resources related services in the region, for example community provision of security for tourism. The provision of services for basic needs such as water supply and sanitation lie beyond the scope of this research project and hence are recognised here as an opportunity for further investigation but will not be pursued under the piloting phase of this project.

2.7 IMPLICATIONS FOR DEVELOPING PAYMENTS FOR CATCHMENT PROTECTION SERVICES IN TWO CATCHMENTS IN SOUTH AFRICA

This report has reviewed the hydrological landscape, the land tenure and ownership systems, identified the poor and marginalised groups, assessed the power imbalances, land use practices and evaluates the economics of six catchments in South Africa. The primary question asked was whether or not these issues would hinder or support the development of payments for catchment protection services in these catchments.

A dual process was undertaken in order to decide on two catchments in which to implement 'action-learning' for phase 3 of the project. This included: 1) consideration of the results of the feasibility and 2) a consensus discussion by the project advisory group. The result of these two processes was the selected of the Olifants catchment and the Sabie-Sand catchment for piloting phase 3 of this project. The integrated results of this study are discussed in greater detail in the summary section (section 1.3 and 1.4). Implications for implementation are addressed here with a specific focus on the implications for the poor.

2.7.1 Security of tenure

The typical land tenure system for the poor is communal land rights. This forces collective decision-making and requires community buy-in for the selection of land practices. For communal groups to benefit from the 'sale' of catchment protection services they need not only to have security of tenure of the land that provides these services but also must have property rights over the land management intervention required for the provision of services on the communal land if they are to benefit from the income generated by sales of catchment protection services. Where the poor provide these services on someone else's land for example the Working for Water initiative that focuses on the removal of alien invasive plants, security of tenure is not a prerequisite to accessing the benefits of sales. A concern identified by Landell-Mills (2002) is that payments have the potential to raise competition for control over the land or activity that provides catchment protection services, leading in turn, to the exclusion and marginalisation of certain households.

2.7.2 Skills and education

The skills and education levels in South Africa vary across the country and between rural and urban areas. This review has focused on six catchments where the poor are mostly rural poor, apart from the Upper Vaal catchment focusing on the Klip River where the poor live in urban areas. Literacy and language proficiency levels also differ. For payments for catchment protection services to be successful and for the poor to benefit from these, they need to be able to participate in and compete for 'business'. This requires technical skills development in the provision of catchment protection services, managerial skills development of households providing the services, and business skills development for negotiating and contracting (Landell-Mills, 2002). This requires a multi-media approach including the development of materials that convey the concepts of payments for catchment protection services such as posters and print media; plays in different languages that can be used to convey the message; on-site training; workshops and seminars.

2.7.3 Market information

Access to information on the demand of services, the needs of buyers, the land use interventions required to provide the catchment protection services demanded, the 'price' for the service, the duration of contracts and the land area to be set aside for services, is needed to enable sellers of catchment protection services to negotiate as fair deal. In South Africa, access to this information is potentially one of the largest transaction costs for making payments and could potentially lead to the failure of payments.

2.7.4 Market contacts and communication infrastructure

According to Landell-Mills (2002), payments for catchment protection services tend to be segmented, and depend on directly negotiated trades. This applies to South Africa as well.
As a result, access to a trusted intermediary that understands how payments for catchment protection services work is critical to the success of payments. Access to knowledge networks and buyers is also necessary for payments to be made. For the rural poor in South Africa, market and network access needs to be carefully supported, if they are to engage in providing catchment protection services.

2.7.5 Contract design

The provision of catchment protection services takes time and the benefits to buyers are often lagged. Contractual agreements need to take cogniscence of this and be flexible enough to allow sellers to adapt to changing market and environmental demands.

2.7.6 Financial resources

The development of payments has high transaction costs. This includes: training in skills development, information gathering and dissemination, access to markets, defined property rights, and facilitated implementation. Poor access to the financial resources to provide this information and support these processes will hinder the development of payments for catchment protection services in South Africa.

2.7.7 Potential ways forward for developing payments for catchment protection services that improve livelihoods in South Africa

While there is a general recognition in South Africa that payments for catchment protection services have the potential to support catchment management initiatives, much more needs to be done and understood prior to the adoption of these mechanisms as part of the 'status quo'. This includes:

1. Assign property rights: these rights need to be carefully assigned and understood within the context of both communal and private ownership for the provision of catchment protection services.
2. Strengthen capacity for market design: Awareness training and capacity building of all stakeholders (buyers, sellers, government, the interested and affected third party) are critical to developing payments for catchment protection services.
3. Market support centre: A central or decentralised point of contact for information on:
    a. Catchment visions and needs
    b. Potential buyers and sellers

   c. Recent prices and transactions
   d. Design and implementation
   e. Research and science behind best-practice
   f. Legal, institutional and governance regulations
4. Access to finance: Currently financing of these initiatives is driven by international donors in South Africa. The banking sector and Government will need to find new ways of supporting the 'start-up' costs involved in making payments if this approach to natural resource management it to be adopted as a longer-term solution in South Africa.

In conclusion, payments for catchment protection services in South Africa are emerging as potentially useful mechanisms to address water resource security. The National Water Act (Act No. 36 of 1998) aims to ensure the provision and management of the resource in an equitable, efficient and sustainable manner and this includes provision for the use of economic instruments to achieve these goals. However, the demands and implications of such a comprehensive water act are still being unpacked and the focus on emergent economic mechanisms may be regarded as potentially beneficial, if not a little premature for South Africa.

3 OUTLINE OF THE PLANNING WORKSHOP

Pilot markets and/or market-based mechanisms in selected watersheds in South Africa are enabled and their impact on poverty monitored.

The core component of this project will focus on the action-learning activities in the catchments identified through the assessment process and complemented by the governance review at both national and local levels. The precise activities that constitute this component of the project will be developed at a planning workshop that will consider the findings of the assessments of the potential sites, as well as the findings of the governance review. The activities conducted under the action-learning pilots should however reflect the underlying objective of this project, namely: a critical examination of the linkages between markets for watershed services and livelihoods of the poor and marginalized groups within the selected watersheds. The activities that were identified in the workshop for phase 3 implementation are outlined below:

Table 3.1: Phase 3 'action learning' activities

Activities
Stakeholder process • Stakeholders are implementing conservation measures that supply environmental services • Stakeholders are well informed, enthusiastic and committed to the concept of trading catchment protection services • Cohesive clustering of buyers and sellers with a clearly defined commodity to be traded • Sellers are fully aware of the benefits of engaging in PES • An entreprenurial culture is encouraged • Actors are clearly identified • Buyers are clearly aware of the potential benefits • Needs assessment conducted and skills training • Community groups are actively involved • CBO's exist to negotiate, receive and distribute benefits to stakeholders from watershed services • CSIR works in partnership with site based organisations who facilitate payments for watershed services
Technical process • There is an identified product or products and an agreed pricing mechanism • We understand the value of services • A reliable, repeatable baseline measurement of livelihoods exists • Watershed services are clearly defined and understood • The precise nature of the hydrological relationships are understood • The legal opportunities for payments for watershed services are understood • The links between the range of provisions in the ACT and PES are clearly understood

Table 3.1 continued

Activities
Learning process
• National learning group established • Communications plan developed • Website installed and maintained • Distribution list of project documents developed and maintained • Project documents distributed • Review, reflection and planning workshops held (action-learning) • Journal articles prepared, submitted and published • PES advocacy materials developed and distributed • Seminars for identified stakeholders held • Project flyer written and used • Filming of TVE / Hands on supported in south Africa
Project management
• Project management structure established • Contracts with facilitating partners within sites negotiated and signed • Planning workshops held at site level • Contract reporting requirements completed • Steering committee meets, review progress and agrees on future activities • Project leader contributes to Global Project Advisory Team • Potential sources of co-funding identified • At least 2 co-funding applications developed and submitted

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5 APPENDIX 1

Mining operations in the Olifants Catchment

Sub-catchments	Name of Mine	Commodity(ies) Mined	Status	Relative Size	Probable Impact
Wilge	Marble Hall	Limestone / Dolomite	Operating	Medium	Low
	Pienarsrivier	Limestone / Dolomite	Operating	Small	Very low
	Vergenoeg	Fluorspar	Operating	Large	Low – Medium
	Nooitgedacht	Clay minerals	Operating	Large	Low
	Cullinan	Clay minerals	Operating	Large	Low
	Belfast	Clay minerals	Operating	Small	Very low
	Rietfontein	Clay minerals	Operating	Small	Very low
	Enkeldoring	Gold	Closed	Small	Very low
Riet and Little Olifants	Black Wattle	Copper	Operating	Medium	Low
	Vaalbank	Coal	Operating	Small	Low - Medium
	Rondebult	Coal	Operating	Small	Low – Medium
	Elandsfontein	Coal	Operating	Small	Low – Medium
	Landau	Coal	Operating	Medium	Medium – High
	Arnot	Coal	Operating	Medium	Medium – High
	Strathrae	Coal	Operating	Small	Low – Medium
	Greenside	Coal	Operating	Medium	Medium – High
	Middelburg	Coal	Operating	Large	High
	Duvha	Coal	Operating	Medium	Medium – High
	Douglas	Coal	Operating	Medium	Medium – High
	Arnot Optimum	Coal	Operating	Large	High
	Rooikraal	Copper	Closed	Small	Very low
	Kruisrivier	Copper	Closed	Small	Very low
	Kameeldoring	Copper	Closed	Very small	Very low
	Waterpan	Coal	Operating	Small	Low - Medium
	Bank	Coal	Operating	Medium	Medium – High
	Kleinkoppie	Coal	Operating	Medium	Medium – High
	Tweefontein	Coal	Operating	Medium	Medium – High
	Phoenix	Coal	Operating	Medium	Medium – High
	Goedehoop	Coal	Operating	Medium	Medium – High
	Koornfontein	Coal	Operating	Medium	Medium – High
	Sterling	Dimension stone	Operating	Small	Very low
	Boschmans	Coal	Operating	Medium	Medium – High
	Khutala	Coal	Operating	Medium	Medium – High
	Kriel	Coal	Operating	Small	Low – Medium
	Leeuwfontein	Coal	Operating	Small	Low – medium
	Stuart Coal	Coal	Operating	Small	Low – Medium
	Delmas Silica	Dimension stone	Operating	Small	Very low
	Leeuwpan	Coal	Operating	Small	Low – Medium
	Tavistock	Coal	Operating	Small	Low – Medium

	Matla	Coal	Operating	Medium	Medium – High
Middle Olifants	Kopermyn	Gold	Closed	Small	Very low
	Doornfontein	Gold	Closed	Very small	Very low
	Mont Mare	Gold	Closed	Very small	Very low
	Marsfontein	Diamond - kimberlite	Operating	Small	Very low
	Hoegenoeg	Andalusite	Operating	Medium	Very low
	Lebowa Kgomo	Manganese	Closed	Small	Very low
	Pelongwe	Chrome, Platinum	Prospecting	Small	Very low
	Wonderboom	Platinum	Prospecting	Small	Very low
	Seogeng Quarry	Clay minerals	Operating	Very small	Very low
	Klipspringer	Diamond - kimberlite	Operating	Small	Very low
	Inca	Limestone / Dolomite	Operating	Small	Very low
	Calais	Clay minerals	Operating	Medium	Very low
	Karkaw	Limestone / Dolomite	Operating	Medium	Very low
	Stavoren	Zinc, Tin	Closed	Small	Very low
	Sekhukune	Andalusite	Prospecting	Small	Very low
	Lebowa Platinum	Chrome, Platinum	Operating	Large	Medium – High
	Freddies	Feldspar	Operating	Medium	Low
	Union Mica	Pegmatite - Muscovite	Operating	Medium	Low
	Union	Feldspar, Mica	Operating	Small	Very low
	Penge	Asbestos	Closed	Medium	Low
	Havercroft	Andalusite	Operating	Large	Low
	Annesley	Andalusite	Operating	Medium	Low
	Atta	Clay minerals	Operating	Medium	Low
	Dilokeng	Chrome	Operating	Large	Medium – High
	Mokoropo	Platinum	Closed	Small	Very low
	Montrose	Chrome	Operating	Large	Medium – High
	Maandagshoek	Vanadium	Closed	Small	Very low
	Pegmatite claims	Pegmatite -Tantalum	Operating	Very Small	Very low
	Perdekop	Fluorspar	Closed	Small	Very low
Steelpoort	Magneetshoogte	Iron, Vanadium	Prospecting	Small	Very low
	Winterveld	Chrome	Operating	Very large	High
	Doornbosch	Platinum	Closed	Small	Very low
	Lannex	Chrome	Operating	Large	Medium – High
	Boskloof	Vanadium	Prospecting	Small	Very low
	Kennedy's Vale	Vanadium	Operating	Medium	Medium – High
	Tweefontein	Chrome, Platinum	Operating	Very large	Medium – High
	Kruger's Post	Andalusite	Operating	Large	Low
	Thorncliffe	Chrome	Operating	Large	Medium – High
	Mapochs Vermiculite	Vermiculite	Operating	Small	Very low
	Nyala	Dimension stone	Operating	Small	Very low
	Belfast Granite	Dimension stone	Operating	Medium	Low
	Belfast #2	Dimension stone	Operating	Small	Very low
	Marlin	Dimension stone	Operating	Small	Very low
	Baviaanskloof	Vermiculite	Prospecting	Small	Very low
	Mapochs	Vanadium, Copper	Operating	Large	Medium – High
	Vanadiumkop	Vanadium	Prospecting	Small	Very low
	Driefontein	Vanadium	Closed	Small	Very low
Blyde	Morgenzon	Gold	Operating	Small	Low
	Astra	Gold	Operating	Small	Low
Selati	Letaba	Zinc, Silver, Copper	Operating	Medium	Low
	Athens	Antimony	Operating	Medium	Low
	Alpha Gravelotte	Antimony	Operating	Medium	Low
	Discovery	Gold	Operating	Medium	Low
	Lenyenye	Clay minerals	Operating	Medium	Low – Medium
	Foskor	Phosphate, Zirconium	Operating	V. Large	Large
	Palabora Copper	Copper, Titanium	Operating	V. Large	Large
	Foskor	Vermiculite	Operating	Large	Low -Medium
	Inyoni Astra	Gold	Operating	Small	Low
	Cobra Emerald	Emerald	Operating	Small	Low-Very low

Middle Letaba and Great Letaba	Soekmekaar	Corundum	Operating	Small	Low
	Giyani alluvial	Gold	Artisan (few)	V. small	Low - Medium
	Giyani Phosphate	Phosphate	Prospecting	Small	Very low
	Letaba Vermiculite	Vermiculite	Prospecting	Small	Very low
	Marikani	Vermiculite	Prospecting	Small	Very low
	Letaba	Vermiculite	Prospecting	Small	Very low
	Main Mine	Gold	Operating	Small	Low
	Main Stone	Dimension stone	Operating	Medium	Very low
	Golden Davey	Gold	Operating	Small	Low
	Davey	Feldspar	Operating	Small	Very low
Shingwedzi	Shingwedzi	Gold	Abandoned	Very small	Very low
	Shingwedzi Alluvial	Gold	Abandoned	Artisan (few)	Very low
	Giyani Alluvial	Gold	Operating	Artisan (few)	Low – Medium
	Golden Pocket	Gold	Prospecting	Very small	Very low

Source: (Adapted from Ashton et al., 2001)