THUKELA WATER PROJECT DECISION SUPPORT PHASE

RESERVE DETERMINATION MODULE
THUKELA SYSTEM RESOURCE ECONOMICS REPORT

February 2004

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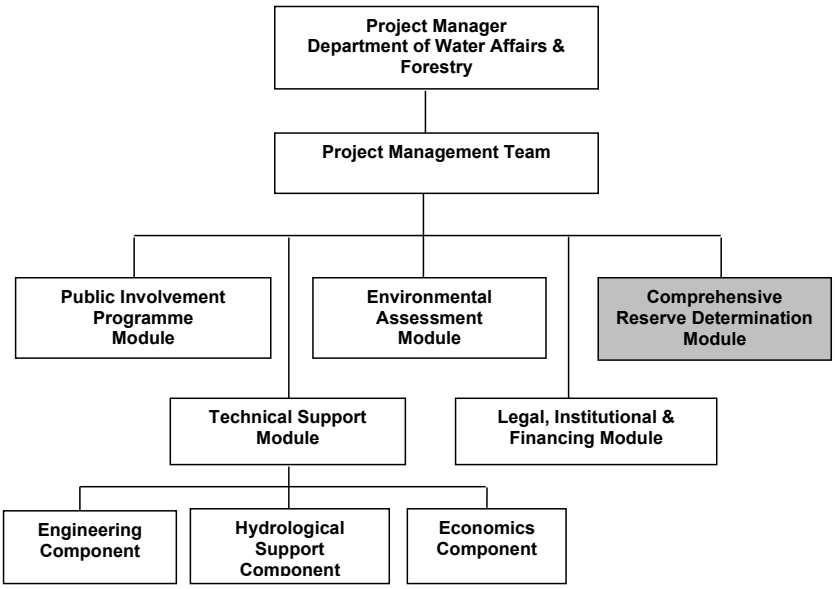

DEPARTMENT OF WATER AFFAIRS & FORESTRY
NATIONAL WATER RESOURCE PLANNING

THUKELA WATER PROJECT DECISION SUPPORT PHASE RESERVE DETERMINATION MODULE THUKELA SYSTEM RESOURCE ECONOMICS REPORT

IWR SOURCE-TO-SEA **FEBRUARY 2004**

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EXECUTIVE SUMMARY

BACKGROUND

The Reserve Determination study is made up of a number of tasks. Among these was a dedicated task, with sub task aimed at generating an overview of the economic implications of the setting of a reserve. It should be noted that this is somewhat of a departure from the usual way in which reserve studies are undertaken. It was however deemed necessary in order to generate a more comprehensive set of information that would enable better decision making as well as facilitating a more informed set of stakeholders. In particular the aim was to generate information that would support the process of making recommendations as the economic impacts of the proposed ecological flows under the various scenarios were identified as potentially being significant.

Although the economic component was designed as a single task, and this report reflects the associated output, the work was undertaken in a set of discrete albeit inter-related steps. These steps were:

- A regional overview that depicts the economic status quo of the catchment *vis a vis* formal water use.
- A goods and services investigation that examined the current utilisation, and value, of resources that are dependant on the water flows in the river.
- A specialist workshop that identified the potential change that each of the key Goods and Services might undergo under the various scenarios considered.

An interactive exercise whereby the economists and hydrological systems analysis team examined the impact that the relevant scenarios would have on current and projected formal utilisation of water and the economic outcomes.

The regional economic overview demonstrates that:

- Overall the economy of the area that depends on the Thukela River for its water supply is showing slow growth and even stagnating in some areas, as indicated by the items below:
- Some growth in irrigation agriculture can be expected. A growth rate of 5 % per year is indicated by sources in the Department of Agriculture.
- Coal mining in the relevant areas is declining.
- Only the Ladysmith-Ezakheni area is experiencing industrial growth while areas such as Newcastle-Madadeni, Mandini-Isithebe are not showing growth.
- The Government Services sector is not an important consumer of water.
- As a result of the incidence of HIV, population growth in the area is expected to slow down. It should also be noted that many young people in the rural areas are moving into metropolitan areas outside the Thukela catchment.
- Although there is a definite need for a regular water supply in certain rural areas, affordability is a constraining if not prohibitive consideration.

The goods and services section analyses the economic implications of changes to ecosystem services that result from changes to the water volume that remains within the Thukela River. The investigation therefore generated a current estimate of the value of goods and services (status quo) and then estimated the value of change. The results show that the change in value between the status quo and Scenarios 2-5 is insignificant. There is also an insignificant overall reduction in value of Scenario 9. In summary Scenario 8 has serious negative impacts on the Thukela community, despite there being an improvement in the Bushmans River and Thukela estuary. This scenario has serious implications for community well being in the Thukela catchment. It should be borne in mind that although the values that are estimated are relatively low, in the greater scheme of things, they represent

changes to communities that can least afford it, and as such, impacts are significant. Of note are the changes to the bilharzia and pathogen regimes. These were deemed to have changed significantly as the amount of water under Scenario 8 was greatly reduced at certain points of the river thereby exposing some communities to greater health risks.

To illustrate the level of impacts of the three scenarios of communities in the Thukela, impacts on individual households was estimated for the catchment as a whole. In Scenario 2-5 and 9, the overall impact on households in the Thukela catchment is negligible. Scenario 8 shows substantial losses for communities, close to R900 loss per household per annum. This is very significant for rural households who can least afford this type of loss.

In addition to the Goods and Services investigations, a formal market economic study was commissioned. In this regard a regional overview of the Thukela catchment, together with a set of water accounts and a Social Accounting Matrix (SAM) for the region, was required to underpin the economic evaluation of selected scenarios generated by other task teams by providing a base scenario from which other scenarios can proceed and against which these can be evaluated.

Water is an important factor of production in most economic activities, so that changes in the levels of available water have a wide impact on the economy as a whole. This market economic study provides an overview of the economy of the Thukela catchment as it exists at present, and highlights the links between the economy and water usage.

From the market economic perspective, Scenario 2 would have the greatest negative impact. Scenarios 9 and 6 would have much lesser impacts on the economy of the sub-region.

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

DC	District Council
ERC	Ecological Reserve Category
FV	Future value
IFR	Instream Flow Requirements
GDP	Gross Domestic Product
GGP	Gross Geographic Product
KZN	KwaZulu-Natal
PES	Present Ecological State
SAM	Social Accounting Matrices
TWP	Thukela Water Project

1. INTRODUCTION

The "Reserve Determination" Module (Module 3 of 5 for the Thukela Water Project Decision Support Phase) is designed, *inter alia*, to meet the requirements of the National Water Act No 36 of 1998. As such the study has been guided by three major requirements. These are:

- The objectives of Chapter 3 of the National Water Act No 36 of 1998 for a comprehensive reserve determination and the subsequent RDM protocols released by DWAF.
- The requirements of the Terms of Reference as supplied by the Department of Water Affairs and Forestry (Tender WF7405).
- The needs of the Thukela Water Project and relevant departments within the Department of Water Affairs and Forestry. These include broad based planning required to meet overall water resource management objectives in the catchment.

The specific objectives of this Reserve Determination Module are, therefore to:

- Develop scenarios and test these with the Management Team of the Thukela Water Project and stakeholders.
- Recommend one of these scenarios to represent the Ecological Reserve for the quality, quantity and groundwater components for the river and estuary.
- Determine the impact of the recommended Reserve on the allocatable yield.
- Determine whether it is possible to supply the Reserve from existing and proposed schemes.
- Provide mitigation measures if it is not.

As such it is made up of a number of tasks and this report considers the outcomes of the economic investigations. The economic investigations were required in order to generate a more comprehensive set of information that would enable better decision making as well as facilitating a more informed set of stakeholders. In particular the aim was to generate information that would support the process of making recommendations. This was deemed to be necessary as the economic impacts of the proposed ecological flows under the various scenarios were identified as potentially being significant, and of direct interest to stakeholders. The scenarios that were examined were the same as those identified for the ecological component of the study. These scenarios are described in Table 1.1

Table 1.1 Scenario Descriptions

Scenario Number	Description
1	Current situation of development (2000) with flows set to improve the Present Ecological State (PES) to a state above the recommended Ecological Reserve Category (ERC). This was abandoned as it was regarded as unrealistic.
2	Current situation of development using the flows set for the recommended ERC. These flows are generally lower than those set for scenario 1. The recommended flows were intended to maintain the recommended ERC. An interesting point is that when the flows for this scenario were modeled, the ecological conditions at a number of the IFR sites improved, i.e. the ERC that was achieved would be better than the PES.
3	The current level of development with flows set to achieve a lower than recommended ERC. Flows required are generally lower than for Scenarios 1 and 2.
4	Current level of development with flows set to achieve the ERC at all sites apart from IFR 4. As this scenario still included floods that could not be provided, it was unrealistic and abandoned.
5	Current level of development with flows set to achieve the ERC at all sites apart from IFR 4. Floods that could not be provided were removed and in some cases flows associated with drought periods were adjusted.
6	Current level of development with flows set to achieve the ERC lower than the

Scenario Number	Description
	recommended. Floods that could not be provided were removed and in some cases flows associated with drought periods were adjusted.
7	Current level of development and flows. Flows with more efficient operating rules for the dams.
8	A 2015 level of development with no Instream Flow Requirements (IFRs) provided. The developments included are Spring Grove Dam, increased transfer from Driel Dam, Middledrift transfer and the proposed Fairbreeze transfer. This scenario is a worst case for the ecology.
9	This scenario was designed to achieve a better balance between ecological requirements and impact on water available to other users. Scenario 9 is a combination of scenario 5 and 6 and with changes in flood patterns.

Although the economic component was designed as a single task, and this report reflects the associated output, the work was undertaken in a set of discrete albeit inter-related steps. These steps were:

- A regional overview that depicts the economic status quo of the catchment *vis a vis* formal water use.
- A goods and services investigation that examined the current utilisation, and value, of resources that are dependant on the water flows in the river.
- A specialist workshop that identified the potential change that each of the key Goods and Services might undergo under the various scenarios considered.
- An interactive exercise whereby the economists and hydrological systems analysis team examined the impact that the relevant scenarios would have on current and projected formal utilisation of water and the economic outcomes.

2. REGIONAL OVERVIEW OF ECONOMIC SITUATION

2.1 INTRODUCTION

A regional overview of the Thukela catchment, together with a set of water accounts and a Social Accounting Matrix for the region, was required to underpin the economic evaluation of scenarios generated by other task teams by providing a base scenario from which other scenarios could proceed and against which these can be evaluated.

Water is an important factor of production in most economic activities, so that changes in the levels of available water have a wide impact on the economy as a whole. .

The regional overview is presented in two parts, namely an analytical description of the existing situation followed by a look into the future with special reference to the socio-economic effect that changes in water usage in the Thukela catchment might have in this and other areas.

2.2 NATURAL RESOURCES AND THE ENVIRONMENT

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The area under consideration in this report and for the purposes of the economic investigation is as described in Table 2.1.

Table 2.1 Sub-catchment components of the Thukela

Sub-catchment	Towns	Dams
Buffalo	Newcastle, Utrecht, Charlestown, Dannhauser, Dundee, eastern half of Clencoe	Zaaihoek, Chelmsford
Mooi	Mooi River, Rosetta, Muden	Craigie Burn
Bushmans	Estcourt, Weenen	Wagendrift
Sundays	Western half Glencoe, Pommeroy	
Upper Thukela – down to confluence with Sundays	Bergville, Ladysmith, Ezikaweni	Spioenkop, Woodstock Driel.
Lower Thukela – down from Sundays to thee estuary	Thukela Ferry, Mandini	Mandini weir

It should be noted that the demarcations were on a sub-Catchment basis and did not necessarily relate to river reaches as defined by the biological components of the Reserve Study. Sub-catchments were deemed to be the most suitable unit for economic analysis. Where towns fall partly within and partly without the relevant subcatchment an appropriate percentage of their resources and economy have been regarded as forming part of the subcatchment. The major determinant is the extent to which they use water from the subcatchment. The boundaries of the Thukela catchment thus defined are shown in Map 1.

The Thukela catchment is an area with a relatively high rainfall and is the second most significant surface water resource in South Africa. As far as the water balance situation in KwaZulu-Natal as a whole is concerned, the area not only has the potential to meet future demands under most likely scenarios, but also the capacity to export water1. However, export of water is only possible from a few catchments such as the Thukela. As such it is not the lack of water per se which is a limiting factor to economic development in KwaZulu-Natal, but rather its distribution within the Province.

The catchment area of the Thukela River is 29 046 km^2 although the area covered by this study is a little larger. This is so since the demarcation of magisterial districts along the river does not coincide exactly with the boundaries of the catchment area, especially towards the

[1] Overview of Water Resources in South Africa, Department of Water Affairs and Forestry, May 1997.

sea where the actual catchment area is much smaller than the relevant magisterial districts. Nevertheless, the catchment area represents some 31,8 % of KwaZulu-Natal's total surface area of 91 481 km^2.

The Drakensberg Mountain range is the source of three of the Province's major rivers, namely the Thukela, Nkomazi and the Mzimkhulu. Almost 50 percent of this source is contained within the Thukela catchment. Considering the fact that South Africa is a water scarce country the Drakensberg Mountains catchment area is of incalculable importance.

What is more, these mountains and their wilderness areas are pre-eminent for their natural beauty and biological diversity, although current land use practices pose various threats to these resources. These include encroachment of alien vegetation, overgrazing and the potential for over afforestation. The wetlands in the Drakensberg are important from an ecological perspective. There are five major dams in the Thukela catchment. The Department of Water Affairs and Forestry is considering building two more dams (the Jana and Mielietuin) as part of the Thukela Water Project.

The KwaZulu-Natal Nature Conservation Service has successfully spearheaded a drive to have the mountain range classified as a World Heritage Site. This is likely to directly stimulate growth in tourism to the Drakensberg, which may increase future demand for hospitality services throughout the rest of the region and the province and more potable water will be required to meet the needs of tourists.

Extreme variations in climate, topography, vegetation and soils create widely divergent land use opportunities and limitations within the Thukela catchment. Agricultural land uses within the region also vary significantly according to climatic variations. For example intensive farming takes place along the banks of the Little Thukela River and other tributaries. Subsistence farming prevails in areas such as Emnambithi as well as the Land Reform Pilot Project District, which consists of Estcourt, Weenen, part of Umvoti and part of Msinga. These land and water use patterns will doubtless influence stakeholders' perceptions of appropriate reserve determinations, and will also have a significant impact on the economic indicators of the area, including GDP, employment levels and balance of payments.

~~3.~~2.3 HUMAN RESOURCES

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2.3.1 Overview

Economic development requires three factors of production, *viz.* labour, capital and land. Thus demographic aspects such as size, growth, age structure, educational levels, life expectancy and mortality rates, spatial distribution and population density impact on the economy.

Changes in population growth have far-reaching effects on the demand for goods and services. As a result of population growth, the private sector stands to grow financially in a free market environment.

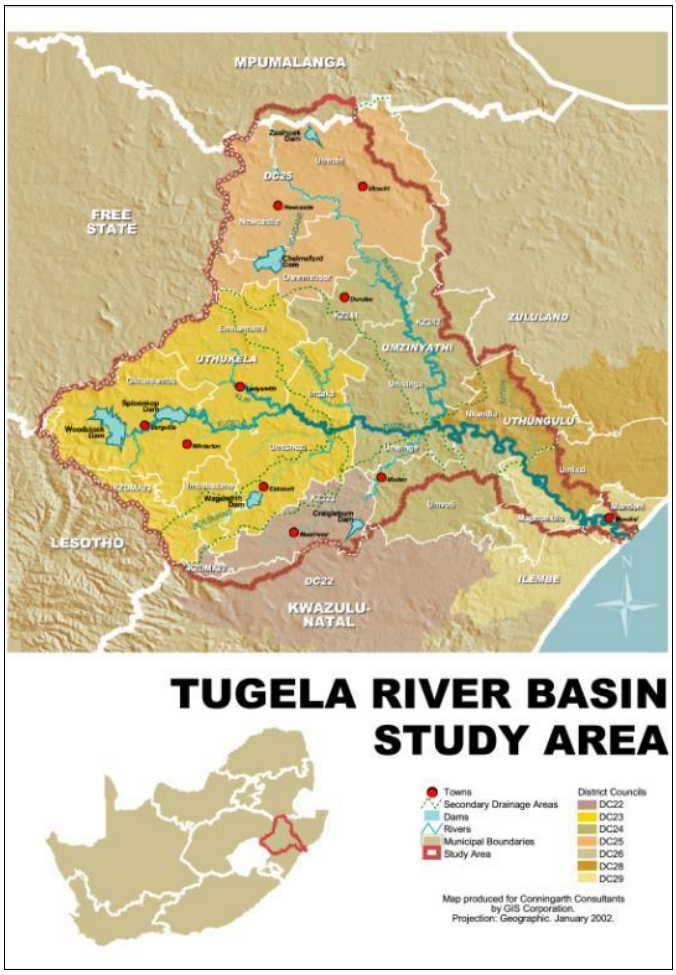
On the other hand some parts of the public sector find it increasingly difficult to manage their financial affairs in a situation of rapid population growth and the concomitant demand for public services such as water provision, education, health, housing and the associated infrastructure.

Population forecasts enable business and socio-economic planners involved in the process of strategic management to create images and scenarios of the future which can enhance the design of preferable futures to exploit opportunities or to deal with possible threats or emerging adverse situations.

It is estimated that between 1970 and 1996 the population in the Thukela catchment has grown at a rate of 2,2 percent per annum. However, as a result of the incidence of HIV/AIDS, population growth is not expected to continue at this rate.

Population density clearly has an impact on water usage, and hence on river Reserve determination. In order to establish reserves that are not only meaningful, but also sustainable, a clear picture of future growth patterns is essential. Population projections by DBSA Demographics Unit[2] based on high HIV/AIDS and low HIV/AIDS incidence are reflected in Tables 2.2 and 2.3 below. (See Figure 2.1 for identification of the District Council (DC) areas which are referred to in these Tables.)

Fig 2.1 District Councils of the Thukela River basin



[2] Personal communication.

Table 2.2 Population growth rate projections for high HIV/Aids impact

Old District Council Names (see Map 1)	Average annual growth rate				
	1996-2001	2001-2006	2006-2011	2011-2016	2016-2021
DC 23 - uThukela	1.77	1.50	1.00	0.62	0.11
DC 24- uMzinyathi	1.95	1.67	1.18	0.79	0.28
DC 25- uMchezi	0.55	0.32	-0.13	-0.47	-0.93
DC 29 -Uthungulu	1.47	1.24	0.78	0.44	-0.04

Source: Ashton, PJ (2000). The potential implications of HIV/AIDS for the Thukela Water Project – confidential report number ENV/P/C/2000/014 to the Department of Water Affairs and Forestry, 2000.

Table 2.3 Population growth rate projections for low Hiv/Aids impact

Old District Council Names	Average annual growth rate				
	1996-2001	2001-2006	2006-2011	2011-2016	2016-2021
DC 23 - uThukela	2.23	2.00	1.85	1.57	1.38
DC 24- uMzinyathi	2.41	2.18	2.02	1.73	1.54
DC 25- uMchezi	1.01	0.82	0.71	0.48	0.33
DC 29 -Uthungulu	1.93	1.74	1.63	1.38	1.23

Source: Ashton, PJ (2000. The potential implications of HIV/AIDS for the Thukela Water Project – confidential report number ENV/P/C/2000/014 to the Department of Water Affairs and Forestry, 2000.

2.3.2 Population Structure

The majority of the population (95 percent) are below the age of 65. Of this, nearly half are between the ages of 16 and 64 years. The region therefore has a relatively young population of persons that could be drawn into employment. However, this youthful population will put additional pressure on social services such as need for additional schools and clinics and concomitant pressure to create jobs in urban and rural areas will increase, all of which will have an impact on development and water usage patterns.

Table 2.4 Age distribution

0-5 years	6-15 years	16-64 years	65+ years
16 %	32 %	48 %	4 %

Source: KwaZulu-Natal Development Profile, Development Bank of Southern Africa, 1998.

The gender composition is 48 percent male and 52 percent female.

2.3.3 Geographic distribution of population, density and urban-rural composition

According to the uThukela Regional Development Plan (2000) the urban/rural population split is 64:36. The region is substantially biased toward the rural areas relative to the entire province of KwaZulu-Natal where the population split is 54:46. This has implications for local government structures in the delivery of services to the rural areas. Service delivery is usually more expensive and less efficient in rural areas relative to urban areas.

The uThukela Regional Development Plan (2000) also contends that the majority of the population is also likely to continue living in rural areas for a long time to come[3]. This implies that particular attention needs to be given to the spatial structuring[4] of the rural areas and their integration into the "formal" spatial economy. The uThukela Regional Development Plan aims to integrate the conventional pattern of a hierarchy of development nodes with the reality of the spatial patterns found in rural areas.

In order to reflect the existing spatial structure of the rural areas, a hierarchy of development webs are identified. The concept of a web relates to the recognition that the reality of the spatial development patterns in the rural areas are such that there are seldom, if ever, a clear hierarchy of settlements. It is therefore more appropriate to refer to a web of settlements in the rural areas between which a network of social, economic and institutional linkages exists. The regional plan, however, proceeds further and identifies web cores. A web core is the point of highest activity within the web of settlements that should in future form the centre of the development activity. The implications of the spatial plan as presented by the uThukela Regional Plan are the following:

- Recognition is given to the fact that the settlements in the rural areas are there to stay for a long time. The planning and the provision of the development services must therefore take place within the context of the majority of the region's people living in the rural areas. It is suggested that the further densification of the rural areas should be promoted to occur towards the centres of the web cores;
- Recognition is given to the spatial complexity of the rural areas and the fact that there is currently no clear spatial development pattern. The apparently unstructured spatial composition of the rural areas and a lack of understanding by service providers of the dynamics of the rural spatial patterns, render the long-term planning for the provision of services, difficult. The demarcation of the webs of settlements and the early identification of the web cores are therefore important in providing guidance for the future development of the region.
- The spatial development plan makes provision for transportation and development corridors that link the important components of the region together, including the settlement webs and cores.

Recognition of this spatial development pattern is critical to Reserve determination considerations if the water needs of the communities are to be fully satisfied as they develop.

2.3.4 Population size, composition, education and employment levels

In 1994 KwaZulu-Natal had a work force of which 29% had received no formal education and 29,1 % had received only primary education. In comparison, the total constituent magisterial districts of the Thukela catchment contained a labour force of which 15% had no formal education and 34% only primary education. Notably, the more urbanised districts such as Newcastle (58%), Dundee (45%), Madadeni (45%), Emnambithi (43%); and Glencoe (46%) recorded labour forces with higher secondary education levels than most of the more rural areas[5]. Table 2.5 shows the number of workers per sector and per district area in 2001.

[3] The situation is not quite as straightforward as this, as there is also a contention that the rate of urbanisation is actually quite high in KwaZulu-Natal (KZN) and rural areas are steadily being "abandoned". However, the only authoritative source available at this time is the uThukela Regional Development Plan (2000), and no definitive reference has been found giving more details of this "urban drift" in the area.

[4] The word "spatial" occurs frequently in the ensuing discussion, and may be subject to various interpretations. In this context it is used to indicate the way the population is physically distributed on the ground.

[5] KwaZulu-Natal Development Profile, Development Bank of Southern Africa, 1998.

Table 2.5 Number of workers per sector per area, 2001

	uMchezi	uMzinyathi	uThukela	uThungulu
Agriculture, hunting, forestry and fishing	3 282	6 213	3 765	12 062
Mining and quarrying	4 004	184	98	1 750
Manufacturing	13 539	2 156	11 294	8 071
Electricity, gas and water supply	827	184	807	869
Construction	2 139	849	1 954	3 640
Wholesale and retail trade	8 171	4 479	8 721	10 781
Transport, storage and communication	4 026	1 716	4 545	7 549
Financial, insurance, real estate and business	2 891	1 257	2 631	4 463
Community, social and personal services	12 034	6 594	9 928	16 028
Private households	8 603	4 159	6 781	9 590
Industry unspecified	11 208	6 461	15 174	16 640

Source: DBSA Development Information Business Unit, personal communication.

Table 2.6 shows the number of workers per occupation and area in 2001.

Table 2.6 Number of workers per occupation per area, 2001

	uMchezi	uMzinyathi	uThukela	uThungulu
Legislators, senior officials and managers	1 917	879	1 685	2 550
Professionals	7 113	4 045	6 299	10 446
Technicians and associate professionals	2 174	828	1 610	3 115
Clerks	3 511	1 430	2 900	5 793
Service workers, shop and market sales workers	7 239	3 472	5978	8 669
Skilled agricultural and fishery workers	2 292	3 036	2 575	4 113
Craft and related trades workers	16 027	3 750	10 185	13 083
Plant and machine operators and assemblers	7 236	1 884	6 549	7 164
Elementary occupations	16 229	10 125	15 825	21 233

Source: DBSA Development Information Business Unit, personal communication.

Workers are an essential factor of production in any economy: the number and skill base of workers in an area are a major determinant of that region's economic indicators. An understanding of the nature and distribution of the workforce as set out in Tables 2.5 and 2.6 above is necessary to effectively evaluate the impact on job opportunities of the various water use scenarios presented by different Reserve requirements.

2.4 HOUSEHOLD INCOMES

Table 2.7 shows the number of household incomes according to category of income and area during 2001.

Table 2.7 Monthly household income per category and areas – 2001

	uMchezi	uMzinyathi	uThukela	uThungulu
Household income: None	10 075	16 776	17 258	17 518
Household income: R1-2401	5 987	10 024	7 745	8 269
Household income: R2401-R6001	13 499	19 048	16 230	20 890
Household income: 6001-R12001	10 091	10 490	11 678	15 159
Household income: R12001-R18001	7 160	4 394	7 253	8 847
Household income: R18001-R30001	6 200	3 375	6 443	7 110
Household income: R30001-R42001	3 270	1 669	3 065	3 975
Household income: R42001-R54001	2 626	1 279	2 320	3 017
Household income: R54001-R72001	2 769	1 101	1 932	3 301
Household income: R72001-R96001	1 816	626	1 237	2 552
Household income: R96001-R132001	1 734	554	1 147	2 637
Household income: R132001-R192001	971	300	525	1 645
Household income: R192001-R36001	493	185	329	910
Household income: R36001-	147	148	178	262
Household income: Unspecified	450	7 247	15 777	17 136

Source: DBSA Business Information Unit, personal communication.

As the price of a commodity changes, the demand for this commodity does not necessarily remain constant. This relationship between price and demand is referred to as the price elasticity of demand, and is measured as the ratio of the percentage change in price to the percentage change in demand. Price elasticity of demand for water by households has been shown to be sensitive to household income[6].

2.5 THE PHYSICAL INFRASTRUCTURE OF THE STUDY AREA

The Thukela catchment is characterised by generally adequate provision of physical and social infrastructure in the urban and industrial areas, but inadequate provision of physical and social infrastructure in the rural areas. This physical infrastructure impacts on access to water, and hence its potential availability to different communities.

~~4.1~~2.5.1 Water related infrastructure

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Three dams, the Woodstock, Spioenkop and Kilburn, constructed in the uThukela Region currently supply water to not only parts of KwaZulu-Natal, but also to other provinces in the Vaal River System. At present the infrastructure is able to supply the water demanded by commercial agriculture, as well as by urban and industrial consumption within the region. There are, however, major concerns with respect to provision of water for domestic purposes in the rural areas. According to the uThukela Regional Development Plan only 13 percent of the total population who are living in settlements in the region have access to 25 litres or more per person per day. This inaccessibility, which inhibits the development of an improved standard of living within these communities, is attributed, not to a shortage of water, but to inadequate water infrastructure in the settlement areas. Plans for the implementation of bulk water schemes have been prepared, three of which have already been implemented.

The various forms of access to water for the respective communities in are shown in Table 2.8.

[6] Veck, GA and Bill, MR. Estimation of the residential price elasticity of demand for water by means of a contingent valuation approach. Water Research Commission Report No. 790/1/00.

Table 2.8 Access to water by households 1996[7]

Source	uMchezi	uMzinyathi	uThukela	uThungulu
Piped water in dwelling	31797	11894	21561	28649
Piped water on site	9998	5304	11550	3809
Public tap	14706	9209	25437	7721
Water-carrier/tanker	592	1016	906	1342
Borehole/rainwater tanker	10340	10410	15916	12795
Dam/river/stream/tanker	5204	38855	18205	58354
Other	1347	303	608	646
Unspecified	379	770	712	1362

Source: DBSA Business Information Unit, personal communication

As the availability of water for direct economic use changes under the various river classification scenarios proposed, it is possible to bring water demand management into consideration. For this to be effective, knowledge of the delivery mechanisms is essential.

~~4.2~~2.6 TRANSPORT

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Accessibility of the catchment and its resources play a role in the overall economic impact arising from various Reserve scenarios. Some details of the transport infrastructure are provided here as background.

Road and rail transport networks are well developed in the Thukela catchment relative to the rest of the province. The main access routes (rail and road systems) between Gauteng and Durban run through the Thuklela catchment. Further, the junction point of national routes that serve the Free State and the Cape are located in close proximity to the Thukela catchment. Main roads in the region are:

- N3 National highway
- N11 from Ladysmith to Newcastle and Volksrust
- N2 from Durban to Richards Bay
- R74 Old main route Bergville-Weenen-Greytown
- R103 Ladysmith-Mooi River
- R600 Main access from Ladysmith to central Berg
- R616 Main route Bergville to Ladysmith.

This transport network provides the Thukela catchment with an advantage of location for the development of industry, the movement of tourists within the region, and establishes strong economic linkages between the region and the provincial and national economies.

The national and provincial Departments of Transport are responsible for the construction and maintenance of national and provincial roads, whilst local authorities are responsible for this function within the respective Municipalities. The macro network currently meets the demands placed upon it and is relatively well maintained, the same applies to the internal transport systems within the majority of the DCs. The provision and maintenance of roads within the former KwaZulu towns and rural areas is also currently meeting the needs of the users.

Although the region has one of the best industrially orientated rail systems, crime, violence, poor service and high rates on goods lines, have in recent years led to a decline in use of rail transport in the region. Currently all rail facilities in the region are under-utilised.

[7] These figures are based on the 1996 census, and are considered to be the most reliable at the time of writing.

Consequent increased reliance by industry on road transport has placed increased pressure on the road network.

2.7 ELECTRICITY/ENERGY

Electricity generation is an important user of water. Some 43% of the energy requirements of the catchment are provided by electricity (Table 2.9). Availability of electricity is a major element in development initiatives, and care needs to be taken that water available for power generation is consistent with developmental aspiration in the catchment.

Electricity provision in more formal urban areas is adequate, with the exception of many of the former "township" areas. Rural reticulation requires serious attention. According to the uThukela Regional Development Plan (2000) it was estimated that in 1998 only 28,6 percent of households in tribal areas had electricity connections. The number of planned connections by 2003 represents 14 percent of the backlog. Inability of poor households and towns to pay for an electricity service has inhibited growth in the proportion of households receiving the service.

Table 2.9 Source of energy per area (Households), 1996[8]

Source	uMchezi	*Umzinyathi*	*uThukela*	*uThungulu*
Electricity: Direct from authority	53 745	13 487	40 902	14 411
Electricity: From other local source	88	125	354	244
Gas	300	324	794	498
Paraffin	1 527	8 795	7 115	6 230
Candles for lighting	18 184	53 995	44 667	59 212
Other	6	4	12	6
Unspecified	467	1 031	1 051	1 711

Source: DBSA Business Information Unit, personal communication.

2.8 POST AND TELECOMMUNICATIONS

The Telecommunications infrastructure is adequate in the formal towns and settlements. Telkom facilities within the rural areas are generally inadequate. Poor road linkages and difficult terrain impede the quality of the postal service to more remote areas. These services are important drivers of development.

~~4.5~~2.9 SANITATION AND SOLID WASTE

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As with many of the services mentioned above, sanitation and solid waste disposal tend to be adequate in the formal urban areas, but are inadequate and often absent in the rural areas.

Table 2.10 Sanitation in the respective areas, 1996 (Households)[9]

Means	UmChezi	Umzinyathi	uThukela	uThungulu
Sanitation: Flush or chemical toilet	39 541	1 393	22 901	30 004
Sanitation: Pit latrine	31 215	28 586	52 648	46 763
Sanitation: Bucket latrine	330	851	3 206	930
Sanitation: None of above	2 923	34 239	15 442	36 665
Sanitation: Unspecified	353	392	698	1316

Source: DBSA Business Information Unit, personal communication.

8 See footnote 6.
9 See footnote 6.

Socio-economic development and adequate sewerage go hand-in-hand. The figures in Table 2.10 indicate that some 29%of households have water borne or chemical toilets. The development aspirations of the catchment will have an impact on the demand for reticulated water, and this needs to be taken into account when Reserve scenarios are being considered.

2.10 TOURISM FACILITIES

The Drakensberg has a long established reputation as a nature-based holiday destination, offering a wide range of accommodation establishments and nature- and sport-based outdoor activities. The area's natural attractions and the established tourist traffic provide significant commercial tourism development potential. Again this is important in terms of potential water usage.

The fascination and general interest in Zulu culture has opened entrepreneurial doors to a growing number of rural communities and they are encouraging tourists to take a closer look at their culture, customs and crafts.

As this region covers the battlefields of the Anglo-Boer war and the Anglo-Zulu war plus the Bloodriver area, a very lucrative tourist industry has developed around these historic places. Large opportunities still exist for expansion not only into the local market but also into the foreign tourist market.

Some other notable developments are:

- The Spioenkop Lodge on the edge of a scenic dam, the lodge being a restored turn of the century homestead which served as headquarters for the British forces in the days leading up to the Battle of Spioenkop. Visitors use it as a base to tour the surrounding battlefields.
- The proposed erection of a 93m high statue of King Shaka in the central Drakensberg on Impimbo Mountain. The statue will house a museum dedicated to the history of the Zulu nation and access to the facility will be by cableway only.
- Tourist opportunities such as fishing and camping.
- The Cannibal Route based on the history of the area.
- Dinosaur Valley – of considerable paleantological significance.
- Adventure – rafting and canoeing in the Bushmans, Thukela and Buffalo Rivers.

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Tourism is an important part of the economy of the region (the contribution of Tourism to the GGP of KwaZulu-Natal is 12.7%)[10], and the existence of many World Heritage sites should increase tourist numbers. This will inevitably put some pressure on water usage levels.

2.11 SOCIAL SERVICES

A notable problem in the area is the lack of co-ordination between the various providers of services such as housing, health care and water supply. This makes the formulation of an integrated water plan a necessity in the Thukela catchment.

If this issue is adequately addressed, it should lead to more stable and expanding communities in the region, with the concomitant growth in demand for water.

[10] Simulated National Satellite Accounts for South African Travel and Tourism, Grant Thornton Kessel Feinstein, September 2000. Confidential report to SATOUR.

2.12 PRODUCTION STRUCTURE OF THE REGION

2.12.1 Enterprises

Table 2.11 presents information pertaining to incomes earned by commercial enterprises in the Thukela catchment in 1998. Total earnings by enterprises amounted to R5 070.5 million, measured in 1998 Rands. Large, urban-based enterprises and rural enterprises together earned more than 75 percent of the total income earned by enterprises. Commercial contractors, form the next most important group. Community based businesses, the hospitality industry and emerging contractors each earned less than five percent of the total.

Table 2.11 Enterprise earnings in Thukela catchment, 1998 (1998 R Millions)[11]

	Thukela Catchment	% of total
Urban	2 291.8	45.2
Rural (incl. Small villages)	1 632.7	32.2
Community based businesses	96.4	1.9
Commercial contractors	679.4	13.4
Emerging contractors	207.9	4.1
Hospitality industry	162.3	3.2
TOTAL	**5 070.5**	**100**

Source: Conningarth Consultants, Social Accounting Matrix, unpublished (1998)

The urban-rural split in earnings of enterprises in the Thukela catchment compared to the whole of KwaZulu-Natal is presented in table 2.12:

Table 2.12 Comparison of enterprise earnings

	Thukela Catchment	KZN
% Urban	60.1	94.3
% Rural	39.9	5.7

Source: Conningarth Consultants, Social Accounting Matrix, unpublished, (1998)

Although urban-based enterprises earn the majority of income earned by enterprises within the Region, the urban-rural split is smaller than for the entire province, reflecting the absence of major towns in the catchment although Newcastle, Ladysmith and Estcourt are in the region.

The following table analyses the contribution of the Thukela catchment to provincial earnings by enterprises with respect to the rural and urban economies. Earnings by rural enterprise relative to earnings by urban-based enterprises are large compared to the rest of the province.

This phenomenon can be ascribed to the fact that the Thukela catchment has many smaller urban centres which historically had no black townships and that most of the rural people therefore do their shopping in the rural areas where they live.

[11] Tables 2.10 to 2.18 inclusive are sourced from a set of Social Accounting Matrices (SAMs) based on 1998 data. These SAMs are being updated at the time of writing, and when this is complete, these Tables will be revisited.

Table 2.13 Comparison of contribution of provincial earnings by enterprises

	Thukela Catchment	Thukela as % KZN
Urban	3 047.4	7.57
Rural	2 023.1	5.03
TOTAL	5 070.5	12.6

Source: Conningarth Consultants, Social Accounting Matrix, unpublished (1998)

The developmental aspirations in the catchment, with concomitant changes in the urban/rural enterprise distribution, will have an impact on water demand and this needs to be taken into account when evaluating water use scenarios.

2.12.2 Regional GGP

The size of the Thukela catchment economy, measured in Gross Geographic Product (GGP) terms, was R13.9 billion in 1998 (See Table 2.14 below). Approximately 46 percent of this value-added quantity was paid as remuneration to labour and 49 percent to gross operating surplus. Less than 5 percent of the total was paid as net indirect taxes.

Table 2.14 Composition of the GGP of the Thukela catchment at market prices (1998 R Millions)

	Values	Percentage Distribution
Labour remuneration	6 430.1	46.23
Gross operating surplus	6 808.2	48.94
Net indirect tax	670.95	4.83
TOTAL	**13 909.25**	**100**

Source: Conningarth Consultants, Social Accounting Matrix, unpublished, (1998)

Table 2.15 indicates the contribution of the Thukela catchment to the KwaZulu-Natal and South African economies, given in R million at market prices during 1998.

Table 2.15 Contribution by Thukela catchment to the KwaZulu-Natal and South African economies (1998 R Billion)

	Thukela Catchment	KZN	Rest of RSA
Value	13.91	110.437	737.813
Thukela as percentage of	N.A	12.6%	1.9%
KZN as percentage of	N.A	N.A	15%

Source: Conningarth Consultants, Social Accounting Matrix, unpublished, (1998)

The Thukela catchment accounted for more than 12,6 percent of the provincial economy and 1,9 percent of the national economy in 1998. Considering that the population of this region represents more than 22 percent of the provincial population, it follows that the mean per capita contribution to economic activity in the region is well below the provincial average. This indicates that there is likely to be a move to encourage development to improve this situation. The implications on water use will be as discussed in the previous sections.

2.12.3 Sectoral analysis: Formal and informal sectors

Table 2.16 presents a sectoral analysis of GGP at market prices. The manufacturing sector constitutes the largest GGP contribution of the regional economy of the Thukela catchment.

Trade, Business and Financial Services, and Agriculture are respectively next largest in magnitude.

Table 2.16 Thukela catchment GGPsSectoral analysis (1998 R Millions)

	Gross Geographic Product	Production	Salaries & Wages	Gross operating Surplus	Net indirect Taxes
Agriculture	1 620	2 572	229	1 347	43
Mining	23.68	43	3	20	1
Manufacturing	3 978	11 673	1 984	1 886	107
Electricity and Water	877	1 883	252	583	41
Construction	917.56	3 109	613	169	134
Trade	222.1	4 125	1 096	1 068	57
Transport	1 475	2 134	704	661	109
Business and Financial Services	1821	2 679	892	796	132
Government, Community and Social Services	974	2 406	655	274	43

Source: Conningarth Consultants, Social Accounting Matrix, unpublished, (1998)

A distinction is drawn between the economic contributions of the formal and informal economies of the region in the table below, indicating that the informal economy accounts for approximately 28 percent of production in the Regional economy. Figures are reported in R million 1998.

Table 2.17 Comparison of formal and informal economies (1998 R Millions)

	Gross Geographic Product
Formal Economy	1 332.51
Informal Economy	584.15
Informal Economy as % of Total Economy	28%

Source: Conningarth Consultants, Social Accounting Matrix, unpublished, (1998)

2.12.4 Public sector

Total government income raised through taxes and levies is estimated to be R3 525 million. Government expenditure on the other hand is approximately R5 779 million on services in the Region. The Region has a fiscal deficit of approximately 39 percent of total government expenditure.

Table 2.18 Government income and expenditure in the region (1998 R Millions)

		Value (R Million)	Percentage of Total
Income:	National	3 489	99
	Regional	35	1
TOTAL INCOME		3 524	100
Expenditure:	National	1 546	26.8
	Provincial	3 469	60.0
	Regional	762	13.2
TOTAL EXPENDITURE		5 778	100%
FISCAL DEFICIT		2 253	39%

Source: Conningarth Consultants, Social Accounting Matrix, unpublished, (1998)

Provincial government expenditure accounts for approximately 60 % of all government expenditure in the Region. The majority of provincial government expenditure is focussed on providing education and health as shown in Table 2.19 below.

Table 2.19 Government expenditure (1998 R Millions)

Item	Expenditure	Percentage of Expenditure
Central Government	1546.7	26.8
Provincial Government:		
Education	1 329.08	23
Health	751.22	13
Other	1 389.33	24
Regional	762.27	13.2
TOTAL	**5 778.6**	**100**

Source: Conningarth Consultants, Social Accounting Matrix, unpublished, (1998)

All of the economic issues discussed in this section will have an impact on the level of water usage in the area, either as a result of industrial activity, or in the provision of jobs which will have an impact on residential water usage. Until such time as formal water accounts are drawn up, and the Social Accounting Matrix is updated it is premature to decide which are the greatest impacts.

2.13 CONCLUSION

There are some indicators of the state of the economy in the region at present and its future direction that emerges from this overview. These include:

- Overall the economy of the area that depends on the Thukela River for its water supply is showing slow growth and even stagnating in some areas, as indicated by the items below:
  - Some growth in irrigation agriculture can be expected. A growth rate of 5 % per year is indicated by sources in the Department of Agriculture.
  - Coal mining in the relevant areas is declining.
  - Only the Ladysmith-Ezakheni area is experiencing industrial growth while areas such as Newcastle-Madadeni, Mandini-Isithebe are not showing growth.
  - The Government Services sector is not an important consumer of water.
- As a result of the incidence of HIV, population growth in the area is expected to slow down. It should also be noted that many young people in the rural areas are moving into metropolitan areas outside the Thukela catchment.
- Although there is a definite need for a regular water supply in certain rural areas, affordability is a constraining if not prohibitive consideration.

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3. GOODS AND SERVICES

3.1 INTRODUCTION

To assist decision-making in the evaluation of options, the economic implications of the various Reserve scenarios are identified to highlight the implications of the various Reserve options. The economic implications can be analysed from two perspectives, the implications of changes to the volumes of water available for abstraction from the river (largely the formal economic or 'out-of-river' implications) and the implications of changes to the level of services supplied by the water that remains within the river (the 'in-river' services). This section analyses the economic implications of changes to ecosystem services that result from changes to the water volume that remains within the Thukela River. This economic assessment highlights the trade-off's that will need to be made in the evaluation of Reserve scenario options, including:

- The trade-off's between different services supplied in each scenario;
- the trade-off's in terms of the benefits and costs to different River users in each scenario, and
- the trade-off's between the tributaries for each scenario.

This section quantifies the status quo as it forms the basis for making comment on proposed changes in water flow. This section of the report focuses on the economic implications of service changes that are likely to result from the various scenarios. The evaluation is not complete and is based only on information that is readily available. Importantly, the specific figures are not important in themselves, but provide an indication of the direction of change and the orders of magnitude of the potential change in the supply of ecosystem services to user groups.

During the analysis several assumptions had to be made. Some of the assumptions are based on previous research undertaken in the Crocodile River catchment by the team, where a similar methodology was used to estimate values of selected ecosystem services supplied by a river catchment. These assumptions are reflected in the discussion that follows.

The area under consideration in this section of the report is referred to as the Thukela catchment, and comprises the following sub-catchments or tributaries:

- Buffalo River
- Bushmans River
- Little Thukela River
- Lower Thukela River
- Mooi River
- Sundays River
- Upper Thukela River

3.2 METHODS

A number of IFR scenarios were developed as potential options for implementation within the Thukela catchment. These scenarios were clustered in three groups with similar impacts, *viz*:

- Scenarios 2 to 5,
- Scenario 8 and
- Scenario 9.

These three scenarios have been identified as most reasonable, and consequently an understanding of their economic implications is required to inform the trade-off's that may need to be made.

Assessing the economic impacts of the scenario essentially identifies the direction of change (either positive or negative) and estimates the magnitude of the change in benefits and costs that may be experienced within the Thukela catchment. The process adopted was as follows:

- The analysis of potential economic changes is based on a valuation of the status quo, that is, the value of the services currently provided by the water that currently remains within the Thukela and its tributaries. For example, the value of subsistence fishing in the Upper Thukela was estimated to be R2.7 million per annum. The mechanism by which this was undertaken is set out in Appendix A.
- The potential change that each key service may undergo in the each of the three scenario clusters was noted as a factor. For example, no change = 1, a 50% increase = 1.5, and a 20% decrease = 0.8.
- The current value of services was then multiplied by the factors of change for each tributary in each scenario to provide an indication of the potential future value of the service, and the change in value was measured. For example, in the Upper Thukela, scenario 8 was estimated to cause a reduction in subsistence fishing by 10%. The calculation used was:

  Future value (FV) of fishing = change factor x the current value of fishing
  FV = 0.9 x R2.7million
  FV = R2.44 million per annum
  With a reduction of R272 000 per annum
- The numbers of people or households impacted was also noted to provide an idea of how many people or households may be impacted by the potential changes. For example, in the Upper Thukela some 4 800 households may be impacted by the change in subsistence fishing.

The direction and magnitude of change, together with the numbers of people impacted can then be used to inform decision-making with regard to the choice of IFR. The assessment is largely illustrated in tables. There are 8 tributaries, with 4 scenarios (including the status quo as a base reference), with 17 potential services (or disservices) that may change. Consequently, some 544 different conditions are assessed and are summarised. The report will discuss some of the key findings for the scenarios with respect to changes in services, tributaries and the Thukela catchment.

The tables are the key result of the evaluation. The results of the impacts can be considered from a number of perspectives and these are outlined below:

- The status quo value of ecological services (or the benefits) in each tributary, and the potential positive and negative changes in value associated with the three possible scenarios (2 to 5, 8 and 9).
- The status quo value of ecological disservices (or the costs) in each tributary, and the potential positive and negative changes in value associated with the three possible scenarios (2 to 5, 8 and 9). These tables show the detailed trade-off's that may occur between the scenarios for each disservice and each tributary. These tables will be most useful for local interest groups to identify the potential impacts of each scenario on their activities. The numbers of households or individuals impacted are also listed in these tables and serves to provide an indication of the numbers of people that may be affected. This information will be useful to local and strategic decision-making.

- Overall changes in value for each of the Thukela catchment tributaries for the three scenarios. This can be used to evaluate the implications for each scenario. This information is useful to strategic decision-making at the catchment level.
- Overall changes in value to Thukela catchment households for the three scenarios, helps identify the trade-off's for households between the three scenarios. This information is useful to strategic decision-making at all levels.
- Overall changes in value to the services and disservices supplied by the Thukela catchment. This analysis outlines the trade-off's between the services/disservices associated with each scenario. This analysis will be useful for strategic decision-making at all levels.

The impacts are colour coded in the tables to make for easy reading. The following table outlines the potential nature of the impacts. This enables the reader to make a quick assessment of impacts for their specific areas of interest and to direct their focus on the details associated with a particular impact.

	No problem	Insignificant change in benefits
	Good	Increasing benefits from services
	Caution	Limited loss of benefits
	Bad	Significant loss of benefits

The criteria used to judge the impacts are based on all or some of the following:

- The magnitude of change.
- The magnitude of the financial changes.
- The numbers of people impacted, and
- the vulnerability of people impacted.

Importantly, like an audit sheet, the key results of the economic evaluation are the tables and their colour coding. The discussions associated with tables will only outline major issues arising. The tables are annual estimates.

3.3 RESULTS

Table 3.1 outlines the value of changes to ecological services in each sub-catchment and provides and overview of the results of the Goods and Services investigation.

Table 3.1 The extent of changes to ecological services in each sub-catchment

River service:	FISHES (excl recreational fishing)											
		Status quo	Scenario 2/5			Scenario 8			Scenario 9			
Sub-Catchment	Number of households benefiting	Annual Value of benefits	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value
Bushmans	1,508	579,974	1	579,974	-	1.25	724,967	144,993	1	579,974	-
Mooi	2,037	1,298,396	1	1,298,396	-	0.05	64,920	(1,233,476)	1	1,298,396	-
Sundays	1,294	772,474	1	772,474	-	1	772,474	-	1	772,474	-
Buffalo	2,298	1,199,047	0.9	1,079,142	(119,905)	1	1,199,047	-	0.9	1,079,142	(119,905)
Upper Thukela	4,837	2,718,136	0.5	1,359,068	(1,359,068)	0.9	2,446,322	(271,814)	0.5	1,359,068	(1,359,068)
Lower Thukela	3,343	1,895,223	1.1	2,084,745	189,522	1.1	2,084,745	189,522	1.1	2,084,745	189,522
Little Thukela	1,378	462,935	0.555	256,929	(206,006)	1.1	509,228	46,293	0.555	256,929	(206,006)
Thukela Estuary	500	210,000	1	210,000	-	1.5	315,000	105,000	1	210,000	-
Total Catchment	17,194	9,136,184		7,640,728	(1,495,456)		8,116,703	(1,019,481)		7,640,728	(1,495,456)

River service:	REEDS										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of households benefiting	Annual Value of benefits	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value
Bushmans	716	51,554	1.25	64,443	12,889	1.5	77,331	25,777	1.25	64,443	12,889
Mooi	561	40,420	0.9	36,378	(4,042)	0.6	24,252	(16,168)	1	40,420	-
Sundays	431	31,056	1	31,056	-	1	31,056	-	1	31,056	-
Buffalo	1,450	104,409	1	104,409	-	0.9	93,968	(10,441)	1	104,409	-
Upper Thukela	1,419	102,167	1.1	112,384	10,217	0.9	91,951	(10,217)	1.1	112,384	10,217
Lower Thukela	1,558	112,194	0.9	100,974	(11,219)	1.2	134,632	22,439	0.9	100,974	(11,219)
Little Thukela	459	33,067	1	33,067	-	0.6	19,840	(13,227)	0.9	29,760	(3,307)
Thukela Estuary	300	21,600	1	21,600	-	1	21,600	-	1	21,600	-
Total Catchment	6,895	496,468	1.01875	504,312	7,844	0.9625	494,631	(1,837)	1.01875	505,047	8,579

River service:	SEDGES										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of households benefiting	Annual Value of benefits	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value
Bushmans	1,348	97,063	1.25	121,329	24,266	1.5	145,594	48,531	1.25	121,329	24,266
Mooi	1,932	139,114	0.9	125,202	(13,911)	0.6	83,468	(55,646)	0.9	125,202	(13,911)
Sundays	1,294	93,169	1	93,169	-	1	93,169	-	1	93,169	-
Buffalo	2,298	165,421	1	165,421	-	0.9	148,879	(16,542)	1	165,421	-
Upper Thukela	4,837	348,269	1.1	383,096	34,827	0.9	313,442	(34,827)	1.1	383,096	34,827
Lower Thukela	2,424	174,561	0.9	157,105	(17,456)	1.2	209,473	34,912	0.9	157,105	(17,456)
Little Thukela	1,378	99,200	1	99,200	-	0.6	59,520	(39,680)	1	99,200	-
Thukela Estuary	300	21,600	1	21,600	-	1	21,600	-	1	21,600	-
Total Catchment	15,811	1,138,397	1.01875	1,166,122	27,725	0.9625	1,075,146	(63,251)	1.01875	1,166,122	27,725

Table 3.1 Continued

River service:	WASTE ASSIMILATION											
		Status quo	Scenario 2/5			Scenario 8			Scenario 9			
Sub-Catchment	Number of households benefiting	Annual Value of benefits	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	
Bushmans	7,160	211,600	1	211,600	-	1.5	317,400	105,800	1	211,600	-	
Mooi	5,614	43,800	1.38	60,225	16,425	1.0	43,800	-	1.31	57,214	13,414	
Sundays	4,313	-	1	-	-	1.0	-	-	1	-	-	
Buffalo	14,501	1,833,940	1	1,833,940	-	0.8	1,375,455	(458,485)	1	1,833,940	-	
Upper Thukela	14,190	470,120	1.1	517,132	47,012	0.8	352,590	(117,530)	1.1	517,132	47,012	
Lower Thukela	15,582	1,862,960	1	1,862,960	-	0.8	1,490,368	(372,592)	1	1,862,960	-	
Little Thukela	4,593		1.2	-	-	1.0	-	-	1.2	-	-	
Thukela Estuary	5,000		1	-	-	1.0	-	-	1	-	-	
Total Catchment	63,794	4,422,420	1.08	4,485,857	63,437	1.0	3,579,613	(842,807)	1.08	4,482,846	60,426	

River service:	WASTE DILUTION											
		Status quo	Scenario 2/5			Scenario 8			Scenario 9			
Sub-Catchment	Number of households benefiting	Annual Value of benefits	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	
Bushmans	7,160		1	-	-	1.25	-	-	1	-	-	
Mooi	5,614		1.25	-	-	1	-	-	1.25	-	-	
Sundays	4,313		1	-	-	1	-	-	1	-	-	
Buffalo*	14,501	29,100,720	1	29,100,720	-	0.5	14,550,360	(14,550,360)	1	29,100,720	-	
Upper Thukela	14,190		1	-	-	0.9	-	-	1	-	-	
Lower Thukela	15,582		1	-	-	0.8	-	-	1	-	-	
Little Thukela	4,593		1	-	-	1	-	-	1	-	-	
Thukela Estuary	5,000		1	-	-	0.75	-	-	1	-	-	
Total Catchment	63,794	29,100,720		29,100,720	-		14,550,360	(14,550,360)		29,100,720	-	
*Information only available for Ngagane tributary in the Buffalo												

River service:	CULTIVATED FLOODPLAIN AGRICULTURAL LAND											
		Status quo	Scenario 2/5			Scenario 8			Scenario 9			
Sub-Catchment	Number of households benefiting	Annual Value of benefits	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	
Bushmans	1,348	41,177	1.1	45,294	4,118	1	41,177	-	1.1	45,294	4,118	
Mooi	1,932	102,549	0.8	82,039	(20,510)	0.5	51,274	(51,274)	0.72	73,835	(28,714)	
Sundays	1,294	339,898	1	339,898	-	1	339,898	-	1	339,898	-	
Buffalo	2,298	1,751,284	1	1,751,284	-	0.8	1,401,027	(350,257)	1	1,751,284	-	
Upper Thukela	4,837	184,525	1.2	221,429	36,905	0.8	147,620	(36,905)	1.2	221,429	36,905	
Lower Thukela	2,424	92,495	1.1	101,744	9,249	0.8	73,996	(18,499)	1.1	101,744	9,249	
Little Thukela	1,378	572,629	1	572,629	-	1	572,629	-	1	572,629	-	
Thukela Estuary	10	15,163	1	15,163	-	0.9	13,647	(1,516)	1	15,163	-	
Total Catchment	15,521	3,099,718	1.025	3,129,481	29,762	0.85	2,641,267	(458,451)	1.015	3,121,277	21,558	

Table 3.1 Continued

River service:	RECREATIONAL SWIMMING											
		Status quo	Scenario 2/5			Scenario 8			Scenario 9			
Sub-Catchment	Number of beneficiaries	Annual Value of benefits	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	
Bushmans	10,740	7,303,526	1	7,303,526	-	1	7,303,526	-	1	7,303,526	-	
Mooi	8,421	5,726,222	1	5,726,222	-	0.7	4,008,355	(1,717,867)	1	5,726,222	-	
Sundays	6,470	4,399,639	1	4,399,639	-	1	4,399,639	-	1	4,399,639	-	
Buffalo	23,951	16,286,917	1	16,286,917	-	1	16,286,917	-	1	16,286,917	-	
Upper Thukela	21,517	14,631,442	1	14,631,442	-	1	14,631,442	-	1	14,631,442	-	
Lower Thukela	23,374	15,894,114	1	15,894,114	-	1	15,894,114	-	1	15,894,114	-	
Little Thukela	6,736	4,580,232	1	4,580,232	-	1	4,580,232	-	1	4,580,232	-	
Thukela Estuary	15,000	10,200,000	1	10,200,000	-	1	10,200,000	-	1	10,200,000	-	
Total Catchment	116,209	79,022,093	1	79,022,093	-	0.9625	77,304,226	(1,717,867)	1	79,022,093	-	
River service:	RECREATIONAL FISHING (Trout)											
		Status quo	Scenario 2/5			Scenario 8			Scenario 9			
Sub-Catchment	Number of beneficiaries	Annual Value of expenditure	Change Factor	Annual Value of expenditure	Change in value	Change Factor	Annual Value of expenditure	Change in value	Change Factor	Annual Value of expenditure	Change in value	
Bushmans			1	-	-	1	-	-	1	-	-	
Mooi			1	-	-	1	-	-	1	-	-	
Sundays			1	-	-	1	-	-	1	-	-	
Buffalo			1	-	-	1	-	-	1	-	-	
Upper Thukela			1	-	-	1	-	-	1	-	-	
Lower Thukela			1	-	-	1	-	-	1	-	-	
Little Thukela			1	-	-	1	-	-	1	-	-	
Total Catchment	312	4,223,232	1	4,223,232	-	1	4,223,232	-	1	4,223,232	-	
River service:	RECREATIONAL FISHING (estuary)											
		Status quo	Scenario 2/5			Scenario 8			Scenario 9			
Sub-Catchment	Mass of fish (tonnes)	Annual Value of expenditure	Change Factor	Annual Value of benefits	Annual Value of expenditure	Change Factor	Annual Value of expenditure	Change in value	Change Factor	Annual Value of benefits	Annual Value of expenditure	
Thukela estuary	2	1,000,000	1.1	1,100,000	100,000	1.5	150,000	50,000	1.1	1,100,000	100,000	

Table 3.1 Continued

River service:	CYNODON LAWNS										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of households benefiting	Annual Value of benefits	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value
Bushmans	1,348	3,440,418	1	3,440,418	-	1.1	3,784,460	344,042	1	3,440,418	-
Mooi	1,932	5,203,318	0.8	4,162,654	(1,040,664)	0.5	2,601,659	(2,601,659)	0.72	3,746,389	(1,456,929)
Sundays	1,294	13,514	1	13,514	-	1	13,514	-	1	13,514	-
Buffalo	2,298	10,559,681	1	10,559,681	-	0.8	8,447,744	(2,111,936)	1	10,559,681	-
Upper Thukela	4,837	3,218,381	1.2	3,862,057	643,676	0.8	2,574,705	(643,676)	1.2	3,862,057	643,676
Lower Thukela	2,424	34,923	1.1	38,415	3,492	0.8	27,938	(6,985)	1.1	38,415	3,492
Little Thukela	1,378	18,623,315	1	18,623,315	-	1	18,623,315	-	1	18,623,315	-
Thukela Estuary	-			-	-		-	-		-	-
Total Catchment	15,511	41,093,549	1.01429	40,700,054	(393,495)	0.85714	36,073,335	(5,020,214)	1.00286	40,283,788	(809,761)
River service:	WHITE WATER RAFTING AND KAYAKING										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of beneficiaries	Annual Value of expenditure	Change Factor	Annual Value of expenditure	Change in value	Change Factor	Annual Value of expenditure	Change in value	Change Factor	Annual Value of expenditure	Change in value
Bushmans	-	8,850	0.9	7,965	(885)	1	8,850	-	0.9	7,965	(885)
Mooi			1	-	-	0.1	-	-	1	-	-
Sundays			1	-	-	1	-	-	1	-	-
Buffalo	250	29,250	0.9	26,325	(2,925)	0.8	23,400	(5,850)	0.9	26,325	(2,925)
Upper Thukela			1.1	-	-	1	-	-	1.1	-	-
Lower Thukela	2,740	1,259,800	1	1,259,800	-	0.8	1,007,840	(251,960)	1	1,259,800	-
Little Thukela			1	-	-	0.5	-	-	1	-	-
Thukela Estuary			1	-	-	0.6	-	-	1	-	-
Total Catchment	2,990	1,297,900	0.9875	1,294,090	(3,810)	0.725	1,040,090	(257,810)	0.9875	1,294,090	(3,810)
River service:	CANOEING										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of beneficiaries	Annual Value of benefits	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value	Change Factor	Annual Value of benefits	Change in value
Bushmans			0.9	-	-	1	-	-	0.9	-	-
Mooi			1	-	-	0.1	-	-	1	-	-
Sundays			1	-	-	1	-	-	1	-	-
Buffalo	200	35,400	0.9	31,860	(3,540)	0.8	28,320	(7,080)	0.9	31,860	(3,540)
Upper Thukela	800	780,000	1.1	858,000	78,000	1	780,000	-	1.1	858,000	78,000
Lower Thukela			1	-	-	0.8	-	-	1	-	-
Little Thukela	700	145,800	1	145,800	-	0.5	72,900	(72,900)	0.9	131,220	(14,580)
Thukela Estuary			1	-	-	0.6	-	-	1	-	-
Total Catchment	1,700	961,200	0.9875	1,035,660	74,460	0.725	881,220	(79,980)	0.975	1,021,080	59,880

It is important to note the value of the dilution service supplied by the river. The value estimated is for the Ngagane River, only one sub-catchment and only considering the outfalls of the mining industry. With large companies like Iscor unaccounted for, and the numerous mines in the other tributaries feeding into the Buffalo River, this value may be 2 to 3 times higher. The implication of this is that losses may increase by an additional R15m to R30million per annum in scenario 8.

While rivers supply benefits with positive values to the Thukela community, they may also supply disservices to the community. Rivers may host water-borne diseases, and therefore changes to these disservices can be measured by assessing the changes to the costs (rather than the benefits) that they generate for communities. In the following tables the estimates in brackets (…) denote a reduction in costs and are therefore positive for communities.

Table 3.2 The extent of changes to ecological dis-benefits in each sub-catchment

River service:	BILHARZIA: treatment costs*										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of people infected	Annual Value of costs	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value
Bushmans			1	-	-	1.2	-	-	1	-	-
Mooi	37,617	5,454,494	1.05	5,727,218	272,725	1.15	6,272,668	818,174	1.15	6,272,668	818,174
Sundays			1	-	-	1.25	-	-	1	-	-
Buffalo	9,033	1,309,848	1	1,309,848	-	1	1,309,848	-	1	1,309,848	-
Upper Thukela	2,361	342,346	1.15	393,697	51,352	1	342,346	-	1.15	393,697	51,352
Lower Thukela	58,500	8,482,512	0.9	7,634,261	(848,251)	3	25,447,537	16,965,025	0.9	7,634,261	(848,251)
Little Thukela			1	-	-	1	-	-	1	-	-
Thukela Estuary			1	-	-	1	-	-	1	-	-
Total Catchment	107,512	15,589,199	1.0125	15,065,025	(524,175)	1.325	33,372,398	17,783,199	1.025	15,610,474	21,275
*Note that these values are COSTS											

River service:	BILHARZIA: loss of productivity*										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of infected	Annual Value of costs	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value
Bushmans			1	-	-	1.2	-	-	1	-	-
Mooi	37,617	4,213,126	1.05	4,423,782	210,656	1.15	4,845,095	631,969	1.15	4,845,095	631,969
Sundays			1	-	-	1.25	-	-	1	-	-
Buffalo	9,033	1,011,744	1	1,011,744	-	1	1,011,744	-	1	1,011,744	-
Upper Thukela	2,361	264,432	1.15	304,097	39,665	1	264,432	-	1.15	304,097	39,665
Lower Thukela	58,500	6,552,010	0.9	5,896,809	(655,201)	3	19,656,029	13,104,019	0.9	5,896,809	(655,201)
Little Thukela			1	-	-	1	-	-	1	-	-
Thukela Estuary			1	-	-	1	-	-	1	-	-
Total Catchment	107,512	12,041,313	1.0125	11,636,433	(404,880)	1.325	25,777,301	13,735,988	1.025	12,057,745	16,433
*Note that these values are COSTS											

Table 3.2 continued

River service:	PATHOGENS: Diarrhoea										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of infected	Annual Value of costs	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value
Bushmans	2,891	72,280	1	72,280	-	1.5	108,419	36,140	1	72,280	-
Mooi	2,545	63,626	1	63,626	-	1.15	73,169	9,544	1.05	66,807	3,181
Sundays	2,065	51,631	1	51,631	-	1.25	64,539	12,908	1	51,631	-
Buffalo	7,001	175,029	1	175,029	-	1.1	192,532	17,503	1	175,029	-
Upper Thukela	7,328	183,207	0.8	146,565	(36,641)	1.3	238,169	54,962	0.8	146,565	(36,641)
Lower Thukela	7,699	192,485	0.8	153,988	(38,497)	1.3	250,231	57,746	0.8	153,988	(38,497)
Little Thukela	2,304	57,594	1	57,594	-	2	115,189	57,594	1	57,594	-
Thukela Estuary	4,000	1,000	1	1,000	-	1.25	1,250	250	1	1,000	-
Total Catchment	35,834	796,851	0.95	721,713	(75,138)	1.35625	1,043,497	246,646	0.95625	724,894	(71,957)
*Note that these values are COSTS											
River service:	PATHOGENS: Diarrhoea: loss of productivity										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of infected	Annual Value of costs	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value
Bushmans	2,891	654,371	1	654,371	-	1.5	981,557	327,186	1	654,371	-
Mooi	2,545	576,024	1	576,024	-	1.15	662,428	86,404	1.05	604,825	28,801
Sundays	2,065	467,433	1	467,433	-	1.25	584,291	116,858	1	467,433	-
Buffalo	7,001	1,584,593	1	1,584,593	-	1.1	1,743,053	158,459	1	1,584,593	-
Upper Thukela	7,328	1,658,631	0.8	1,326,904	(331,726)	1.3	2,156,220	497,589	0.8	1,326,904	(331,726)
Lower Thukela	7,699	1,742,632	0.8	1,394,106	(348,526)	1.3	2,265,422	522,790	0.8	1,394,106	(348,526)
Little Thukela	2,304	521,421	1	521,421	-	2	1,042,842	521,421	1	521,421	-
Thukela Estuary	4,000	9,053	1	9,053	-	1.25	11,317	2,263	1	9,053	-
Total Catchment	35,834	7,214,159	0.95	6,533,906	(680,253)	1.35625	9,447,129	2,232,970	0.95625	6,562,707	(651,451)
*Note that these values are COSTS											
River service:	PATHOGENS: Cholera										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of infected	Annual Value of costs	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value
Bushmans			1	-	-	1.5	-	-	1	-	-
Mooi			1	-	-	1.15	-	-	1	-	-
Sundays			1	-	-	1.25	-	-	1	-	-
Buffalo			1	-	-	1.1	-	-	1	-	-
Upper Thukela			0.8	-	-	1.3	-	-	0.8	-	-
Lower Thukela			0.8	-	-	1.3	-	-	0.8	-	-
Little Thukela			1	-	-	2	-	-	1	-	-
Thukela Estuary			1	-	-	1.25	-	-	1	-	-
Total Catchment	4,908	319,020	0.95	303,069	(15,951)	1.36	432,671	113,651	0.95	303,069	(15,951)
*Note that these values are COSTS											
^ Dept Health Total number people infected within the catchment											

In scenario 2/5 all the disservices are reduced, with a significant reduction of costs to user communities. In scenario 9, the impacts are similar to scenario 2/5, except that there is a significant increase in costs associated with bilharzia in the lower Mooi River. In scenario 8 all the disservices are aggravated, with serious increases in costs being borne by communities. The costs of bilharzia infections to communities may increase by R30 million per annum.

Table 3.2 continued

River service:	PATHOGENS: Cholera: loss of productivity										
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Number of infected	Annual Value of costs	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value	Change Factor	Annual Value of costs	Change in value
Bushmans			1	-	-	1.5	-	-	1	-	-
Mooi			1	-	-	1.15	-	-	1	-	-
Sundays			1	-	-	1.25	-	-	1	-	-
Buffalo			1	-	-	1.1	-	-	1	-	-
Upper Thukela			0.8	-	-	1.3	-	-	0.8	-	-
Lower Thukela			0.8	-	-	1.3	-	-	0.8	-	-
Little Thukela			1	-	-	2	-	-	1	-	-
Thukela Estuary			1	-	-	1.25	-	-	1	-	-
Total Catchment	4,908	1,374,240	0.95	1,305,528	(68,712)	1.36	1,863,813	489,573	0.95	1,305,528	(68,712)
*Note that these values are COSTS											
^ Dept Health Total number people infected within the catchment											

Table 3.3 Summary of changes in the value of benefits from the Thukela sub-catchments

Thukela River : Summary of subcatchment benefits											
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Sub-Catchment	Households impacted	Total value	Value change per Hh	Total value	Total change in value	Value change per Hh	Total value	Total change in value	Value change per Hh	Total value	Total change in value
Bushmans	7,160	11,007,511	6	11,047,898	40,387	43	11,313,329	305,818	6	11,047,898	40,387
Mooi	5,614	2,246,549	(275)	700,466	(1,546,083)	(1,286)	(4,975,631)	(7,222,180)	(529)	(721,717)	(2,968,266)
Sundays	4,313	5,130,685	-	5,130,685	-	(30)	5,000,919	(129,766)	-	5,130,685	-
Buffalo	14,501	56,984,855	(9)	56,858,485	(126,370)	(1,220)	39,297,942	(17,686,913)	(9)	56,858,485	(126,370)
Upper Thukela	14,190	20,004,426	(16)	19,773,345	(231,080)	(118)	18,336,906	(1,667,520)	(16)	19,773,345	(231,080)
Lower Thukela	15,582	4,356,630	132	6,420,694	2,064,064	(1,993)	(26,696,111)	(31,052,741)	132	6,420,694	2,064,064
Little Thukela	4,593	23,938,162	(45)	23,732,156	(206,006)	(143)	23,279,633	(658,529)	(49)	23,714,270	(223,893)
Thukela Estuary	5,000	11,458,310	-	11,558,310	-	20	10,559,280	100,970	-	11,558,310	-
Thukela River	**70,954**	**137,657,099**	**2.53**	**137,836,674**	**179,575**	**(840)**	**78,043,015**	**(59,614,084)**	**(0.02)**	**136,396,605**	**(1,260,494)**

In scenarios 2/5 and 9, the value of benefits from the Mooi River is significantly negatively impacted, while the benefits of the Lower Thukela are significantly improved. Overall, the change in value between the status quo and scenario 2/5 is insignificant. There is an insignificant overall reduction in value of scenario 9 (just less than 1%). However, this loss has a significant impact within the Mooi, which accounts for most of the reduction in value. It must be noted that particular groups are impacted by these changes despite overall values not changing.

Scenario 8 has serious negative impacts on the Thukela community, despite there being an improvement in the Bushman's River and Thukela estuary. There is an overall decline in value by R63 million per annum. This scenario has very serious implications for community well-being in the Thukela catchment. The reasons for the significant changes in services are listed in Table 3.4 below.

Table 3.4 Reasons for significant changes in values of goods and services

Change In Service	Sub catchments	Scenario	Extent Of Change	Reason For Change
Subsistence fishing	Upper and Little Thukela	2/5, 9	0.5	Reduction in water volume, with habitat loss
Subsistence fishing	Mooi	8	0.05	No flows in winter with major habitat loss
Subsistence fishing	Thukela estuary	8	1.5	Low flows result in salt water intrusion with entry of marine fish
Reed and sedge harvesting	Bushmans	8	1.5	Increase flows increase habitat available for reeds
Reed and sedge harvesting	Mooi & Little Thukela	8	0.6	Low flows result in habitat reduction for reeds and sedges
Waste assimilation	Bushmans	8	1.5	Increased flows result in greater assimilation capacity
Waste dilution	Buffalo	8	0.5	Lower flows reduces dilution capacity
Floodplain agriculture	Mooi	2/5, 8, 9	0.5	Lowering of water table in surrounding floodplain
Floodplain agriculture	Buffalo	8	0.5	Lowering of water table in surrounding floodplain
Cynodon lawns	Mooi,	2/5, 8, 9	0.5	Lowering of water table in surrounding floodplain
Canoeing	Little Thukela	8	0.5	Lower water levels with insufficient water depth
Recreation fishing	Thukela estuary	8	1.5	Low flows result in salt water intrusion with entry of marine fish
Bilharzia treatment costs and productivity loss	Lower Thukela and Mooi	8, 9	3	Increasing vector habitat, reduced dilution and many people to be potentially infected
Bilharzia treatment costs and productivity loss	Mooi	9	1.15	Increasing vector habitat, reduced dilution and many people to be potentially infected
Pathogens treatment and productivity loss	Bushmans, Upper and Lower Thukela	8	1.5 – 1.3	Decreasing flow in lower regions, with lower dilution and many people to be infected
Pathogens treatment and productivity loss	Little Thukela	8	2	Decreasing flow in lower regions, with lower dilution and many people to infected

3.4 SUMMARY AND CONCLUSIONS

As reflected in table 3.5, overall, the change in value between the status quo and Scenarios 2 - 5 is insignificant. There is also an insignificant overall reduction in value of Scenario 9. In summary Scenario 8 has serious negative impacts on the Thukela community, despite there being an improvement in the Bushmans River and Thukela estuary. This scenario has serious implications for community well being in the Thukela catchment. It should be borne in mind that although the values that are estimated are relatively low, in the greater scheme of things, they represent changes to communities that can least afford it, and as such, impacts are significant. Of note are the changes to the bilharzia and pathogen regimes. These were deemed to have changed significantly as the amount of water under Scenario 8 was greatly reduced at certain points of the river thereby exposing some communities to greater health risks.

To illustrate the level of impacts of the three scenarios of communities in the Thukela, impacts on individual households was estimated for the catchment as a whole. In Scenario 2-5 and 9, the overall impact on households in the Thukela catchment is negligible. Scenario 8 shows substantial losses for communities, close to R900 loss per household per annum. This is very significant for rural households who can least afford this type of loss

Table 3.5 Summary of changes to benefits and costs of ecological services and disservices

Thukela River : Summary of service benefits and costs											
		Status quo	Scenario 2/5			Scenario 8			Scenario 9		
Services and dis-services	Households or individuals impacted	Total value	Value change per Hh	Total value	Total change in value	Value change per Hh	Total value	Total change in value	Value change per Hh	Total value	Total change in value
Services as benefits											
Fish*	17,194	9,136,184	(87)	7,640,728	(1,495,456)	(59)	8,116,703	(1,019,481)	(87)	7,640,728	(1,495,456)
Reeds*	6,895	496,468	1	504,312	7,844	(0)	494,631	(1,837)	1	505,047	8,579
Sedges*	15,811	1,138,397	2	1,166,122	27,725	(4)	1,075,146	(63,251)	2	1,166,122	27,725
Waste assimilation*	63,794	4,422,420	1	4,485,857	63,437	(13)	3,579,613	(842,807)	1	4,482,846	60,426
Waste dilution*	63,794	29,100,720	-	29,100,720	-	(228)	14,550,360	(14,550,360)	-	29,100,720	-
Cultivated floodplains*	15,521	3,099,718	2	3,129,481	29,762	(30)	2,641,267	(458,451)	1	3,121,277	21,558
Cynodon lawns*	15,511	41,093,549	(25)	40,700,054	(393,495)	(324)	36,073,335	(5,020,214)	(52)	40,283,788	(809,761)
Rafting	2,990	1,297,900	(1)	1,294,090	(3,810)	(86)	1,040,090	(257,810)	(1)	1,294,090	(3,810)
Canoeing	1,700	961,200	44	1,035,660	74,460	(47)	881,220	(79,980)	35	1,021,080	59,880
Swimming	116,209	79,022,093	-	79,022,093	-	(15)	77,304,226	(1,717,867)	-	79,022,093	-
Trout fishing	312	4,223,232	-	4,223,232	-	-	4,223,232	-	-	4,223,232	-
Estuary fishing	5,000	1,000,000	20	1,100,000	100,000	10	150,000	50,000	20	1,100,000	100,000
Dis-services as costs											
Biharzia treatment	107,512	15,589,199	(5)	15,065,025	(524,175)	165	33,372,398	17,783,199	0	15,610,474	21,275
Biharzia productivity loss	107,512	12,041,313	(4)	11,636,433	(404,880)	128	25,777,301	13,735,988	0	12,057,745	16,433
Pathogens treatments	35,834	796,851	(2)	721,713	(75,138)	7	1,043,497	246,646	(2)	724,894	(71,957)
Pathogens productivity loss	35,834	7,214,159	(19)	6,533,906	(680,253)	62	9,447,129	2,232,970	(18)	6,562,707	(651,451)
Cholera treatment	4,908	319,020	(3)	303,069	(15,951)	23	432,671	113,651	(3)	303,069	(15,951)
Cholera productivity loss	4,908	1,374,240	(14)	1,305,528	(68,712)	100	1,863,813	489,573	(14)	1,305,528	(68,712)
* These services benefit households while the rest (including costs) are for individuals											

4. MARKET ECONOMIC CONSEQUENCES OF THE OPERATIONAL SCENARIOS

4.1 OVERVIEW

In addition to the Goods and Services investigations, a formal market economic study was commissioned. In this regard a regional overview of the Thukela catchment, together with a set of water accounts and a Social Accounting Matrix (SAM) for the region, was required to underpin the economic evaluation of selected scenarios generated by other task teams by providing a base scenario from which other scenarios can proceed and against which these can be evaluated.

Water is an important factor of production in most economic activities, so that changes in the levels of available water have a wide impact on the economy as a whole. This market economic study provides an overview of the economy of the Thukela catchment as it exists at present, and highlights the links between the economy and water usage.

4.2 METHODS

The total amount of economic activity per sector in the Thukela-Basin was calculated. The main economic variable which was used as an indicator of the nature of economic activity in this Region is the Gross Domestic Product (GDP). The Methodology of how GDP per sector was derived is also explained in the preceding chapters of the document.

The GDP figures derived served as an input to the structure of the SAM that was originally constructed for the Thukela Water Project (TWP).

The total employment for the basin was calculated from data received from Statistics South Africa. Also a complete set of water accounts was set up for each sub-catchment. This data was then used to calculate the so-called Value added and Employment multipliers for the total catchment. In the two tables below the Value Added Coefficient and the Employment Coefficients are represented.

The results presented below are a summary of the main impacts per scenario per catchment area. More detailed quantities information in terms of values calculated in currency is presented in Appendix B.

Table 4.1 Value added coefficients

	Value added R Million 2000 prices per annum	Water consumption Mm^3 per annum	Coefficients Rand/Mm^3 per annum
Irrigation Agriculture	200.6	285.0	0.70
Livestock	303.8	11.42	26.59
Afforrestation	63.9	30.00	2.13
Sugar Cane	5.4	5.12	1.05
Mining and Heavy Industries	960.3	32.32	29.71
Urban Requirements (incl. Light industries)	4 182.7	20.55	203.51

Table 4.2 Employment Coefficients

	Employment Number (2000)	Water Consumption Mm^3 per annum	Coefficients Jobs/Mm^3
Irrigation Agriculture	4 531.7	285.0	15.90
Livestock	5 993.7	11.42	524.63
Afforrestation	2 080.9	30.00	69.36
Sugar Cane	209.9	5.12	41.02
Mining and Heavy Industries	5 318.4	32.32	164.55
Urban Requirements (incl. Light industries)	50 108.8	20.55	2 438.02

These coefficients were multiplied with the estimated water consumed by each sector in each sub-catchment to establish the so-called base scenario. The base scenario was in 2000 prices and employment opportunities and the water consumed in 2000.

The estimated influence of Reserve scenarios on water provision to each economic sector was calculated in water volume terms and multiplied with the relevant coefficients to calculate its specific influences on the economics of the sub-catchment.

- Baseline (Scenario 8) with development projected to the year 2015. Projected economic development was based on historic trends as well as likely growth.
- Scenario 2 with development projected to the year 2015.
- Scenario 6 with development projected to the year 2015.
- Scenario 9 with development projected to the year 2015.

The study further disaggregated the Thukela system into the following sections:

- Upper Thukela (from source to confluence with the Sundays River)
- Lower Thukela (from confluence with the Sundays River to the mouth)
- Little Thukela
- Bushmans
- Sundays
- Mooi
- Buffalo

It should be noted that all minor catchments e.g. the Klip River, fall within one or other of the above sections. It should also be noted that the value of water exported to other catchments has not been included in these calculations.

4.3 RESULTS

The results are summarised per sector and per river reach in the following tables. Where the sector would grow from the present day to 2015, an up-arrow is shown. Where projected growth will be affected, a red down-arrow is shown. A down-arrow means that this sector will not grow at the projected rate but does not necessarily mean that existing development will be negatively affected. It should be noted that for Scenario 6 and 9, no existing development would need to be curtailed.

Table 4.3 Impact per scenario and river section on the irrigation sector

Scenario	Upper Thukela	Lower Thukela	Little Thukela	Bushmans	Sundays	Mooi	Buffalo
8	↑	↑	↑	↑	↑	↑	↑
2	↓	↓	↓M	↑	↓M	↑*	↑
6	↑	↑	↓M	↑	↓M	↑*	↑
9	↑	↑	↓M	↑	↓M	↑*	↑

M marginal loss of value
* If Spring Grove Dam is not built, the arrows would be pointing down and red.

Scenario 6 and 9 both have negative economic impacts on projected irrigation growth in the Little Thukela and Sundays Rivers. The potential for the irrigation sector to expand particularly in the Little Thukela and Sundays River is very limited. Although projected growth is shown to be restricted under Scenarios 2, 6 and 9, the actual value of this growth is very small (marginal).

Table 4.4 Impact per scenario and river section on the forestry sector

Scenario	Upper Thukela	Lower Thukela	Little Thukela	Bushmans	Sundays	Mooi	Buffalo
8	↑	↑	NA	↑	NA	↑	↑
2	↓	↓	NA	↑	NA	↑*	↑
6	↑	↑	NA	↑	NA	↑*	↑
9	↑	↑	NA	↑	NA	↑*	↑

* If Spring Grove Dam is not built, the arrows would be pointing down and red.

Only Scenario 2 has a negative impact on projected (marginal) afforestation growth in the main Thukela River.

Table 4.5 Impact per scenario and river section on the mining and heavy industry sector

Scenario	Upper Thukela	Lower Thukela	Little Thukela	Bushmans	Sundays	Mooi	Buffalo
8	↑	↑	NA	NA	↑	NA	↑
2	↓	↓	NA	NA	↓	NA	↑
6	↑	↑	NA	NA	↓	NA	↑
9	↑	↑	NA	NA	↓	NA	↑

* If Spring Grove Dam is not built, the arrows would be pointing down and red.

Scenarios 6 and 9 both have negative economic impacts on the projected growth in the Sundays River.

Table 4.6 Impact per scenario and river section on the commercial and light industrial sector

Scenario	Upper Thukela	Lower Thukela	Little Thukela	Bushmans	Sundays	Mooi	Buffalo
8	↑	↑	↑	↑	↑	↑	↑
2	↓	↓	↑	↑	↓	↑*	↑
6	↑	↑	↑	↑	↓	↑*	↑
9	↑	↑	↑	↑	↓	↑*	↑

* If Spring Grove Dam is not built, the arrows would be pointing down and red.

Scenarios 6 and 9 both have negative economic impacts on projected growth in the Sundays River only.

In terms of the livestock and sugar cane sectors, the scenarios have negligible impact on projected growth.

4.4 CONCLUSION

From an economic perspective, Scenario 2 would have the greatest negative impact. Scenarios 9 and 6 would have much lesser impacts on the economy of the sub-region. Results are summarised in Table 4.7 and 4.8.

Table 4.7 Impact of scenario expressed in terms of loss of value

	Scenario 2	Scenario 9	Scenario 6
	R million	R million	R million
Irrigated Agriculture	57.59	17.68	9.69
Livestock	0.00	0.00	0.00
Afforrestation	0.55	0.03	0.03
Sugar cane	0.01	0.01	0.00
Mining & Heavy Industries	283.97	67.95	50.96
Urban Requirements (incl. light industries)	547.73	85.96	49.39
Total value lost if scenario is implemented	889.85	171.64	110.07
Estimated value added in 2015(constant 2000 prices)	8424.46	8424.46	8424.46
Estimated value added in 2015 for scenario (constant 2000 prices)	7534.61	8252.83	8314.39
Percentage impact of scenario	10.56%	2.00%	1.31%

The negative impacts of Scenario 6 and 9 are only relevant for the Little Thukela and Sundays River (irrigation) and only on the Sundays River for the other sectors. A comparison is provided in Table 4.8. It should, however, be noted that without Spring Grove Dam in place, there is a potential negative impact on projected growth in the Mooi River under all the scenarios.

Table 4.8 Summary of negative impacts of Scenario 6 and 9 on projected economic growth

Scenario	Little Thukela	Sundays
IRRIGATION		
6	↓M	↓M
9	↓M	↓M
MINING AND HEAVY INDUSTRY; URBAN, COMMERCIAL AND LIGHT INDUSTRIAL		
6	NA	↓
9	NA	↓

5. CONCLUSION

From the results of the economic analysis the following conclusions may be drawn. Firstly the indicators of the state of the economy in the region demonstrate that:

- Overall the economy of the area that depends on the Thukela River for its water supply is showing slow growth and even stagnating in some areas, as indicated by the following:
    - Some growth in irrigation agriculture can be expected. A growth rate of 5 % per year is indicated by the Department of Agriculture.
    - Coal mining in the catchment is not expanding.
    - At this stage only the Ladysmith-Ezakheni area is experiencing industrial growth while areas such as Newcastle-Madadeni, Mandini-Isithebe are not showing growth.

- As a result of the incidence of HIV/AIDS, population growth in the area is expected to slow down. It should also be noted that many young people in the rural areas are moving into metropolitan areas outside the Thukela catchment.
- Although there is a definite need for a reliable water supply in certain rural areas, affordability is a constraining if not prohibitive consideration.

The Goods and Services analysis shows that the resource base generated by a healthy riverine system is highly important to some of the poorest households in the catchment. For Scenario 2-5 and 9, the overall impact on households in the Thukela catchment is negligible. Scenario 8 shows substantial losses for communities, close to R900 loss per household per annum. This is very significant for rural households who can least afford this type of loss.

The results of the social accounting matrix demonstrate that from an economic perspective, Scenario 2 would have the greatest negative impact. Scenarios 9and 6 would have much lesser impacts on the economy of the sub-region. On balance Scenario 9 is the acceptable compromise from the perspective of the various economic elements (Market economics as well as goods and services).