Investigating the Mechanism and Processes Used in Setting Water Services Tariffs

A Study jointly funded by the WRC & SALGA

Report to the
Water Research Commission

by

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Executive Summary

BACKGROUND TO AND AIMS OF THE PROJECT

Water is an indispensable natural resource – vitally necessary to sustain life, the environment, food production, a key element in maintaining hygiene and a sustainable and environmentally attractive option for electrical power generation. Prosperity in South Africa depends, among other things, on the sound management of water (Intergovernmental Fiscal Relations Act, 1997), but with expanded aspirations and political commitments, municipalities and central government in South Africa have found themselves in a challenging situation with respect to the provision of water services for the last decade (Bond, Ruiters and Stein, 2002: 255-300). The municipalities depend heavily upon central government assistance to meet their mandate to provide water services to the local communities they serve.

Water service tariffs are associated with the supply of potable water and with the managing and sanitising the used (waste) water.

There are several approaches to the setting of potable water service tariffs (Field, 2001:301):

- Average Cost Pricing: setting a flat tariff equal to the costs and dividing by the amount of water sold;
- Increasing Block Pricing: setting successively higher tariffs for additional water demand (so prioritising the basic access).
- Declining Block Pricing: setting a high tariff for an initial delivery (to recapture connection costs) and reduced tariffs for successive quantities.

In addition there are two approaches taken for setting of water service tariffs for managing and treating outflow (sewerage) water:

- Tariffs based on volume of inflow: calculated using a percentage of the potable water consumed;
- Tariffs based on level of access to the outflow system provided: calculated using size of pipes providing access to the outflow structure or the number of toilets in a household or nature of the business.

OBJECTIVES OF THIS STUDY

The primary aim of this study was to estimate the customer valuations of municipal water services provided within the context of a water tariff setting framework. The investigations were required to:

- determine service options for alternative combinations of water services provided in three municipalities in the Eastern Cape
- assess the marginal value of water service delivered to customers, by use of the choice experiment method
- draw conclusions about the tariff-service connection in the light of the results of the choice experiment.

The secondary aim of the study was to provide insights into the discretionary elements of South African municipal water service tariff setting (the structures, not VAT). Insight into the discretionary elements of the water service tariff structures were derived through:

- a survey of the information used in water service tariff setting in 3 specified municipalities in the Eastern Cape, the Nelson Mandela Bay Municipality, the Kouga Municipality and the Amathole Municipality
- a survey of the information used in water service tariff setting in 15 other randomly selected municipalities in South Africa outside of the Eastern Cape

The structure of municipal water service tariffs describes the set of costs per cubic metre different individual consumers are charged for potable water reticulated and for waste water received and sanitised. It is a structure rather than a single rate because the costs vary according to which user group the consumer belongs. There are separate charges for availability, for use of potable water and for receiving and sanitising used water.

The role of the structure of water service tariffs is to allocate water services among competing uses to where they are most needed, to facilitate efficient environmentally sustainable abstraction and to generate revenue to cover the cost of providing the water service. In pursuing these objectives this role needs to be integrated and coordinated with other policy options, instruments and social objectives. Other prominent economic instruments employed in other countries for guiding the allocation of water include abstraction charges, tradable water use permits, environmental taxes and supplementary social tariffs. The main tax levied on municipal water services provided in South Africa is VAT. It acts as a wedge between supply and demand – it reduces the affordability of water but it does not add to municipal revenues and so assist them to recover the costs water service provision.

An alternative approach to a tariff structure for allocating water is the rights based allocation mechanism, where water is not allocated according to willingness to pay but on the basis of public merit, as a right to receive. People are allocated a right to receive a certain allowance of water (irrespective of willingness to pay) and the environment is allocated a right to receive water. The costs of provision are collected through the general taxation system. South African municipalities simultaneously follow tariff and rights based allocation approaches.

There are three options for the structure of potable water tariffs: declining block, average cost and increasing block (or mixes of these three). In order to apply these structures use of the water service must be measured and recorded volumetrically (per cubic metre flow of water). Average cost tariffs are determined by dividing the total cost by the amount of water sold and this tariff is levied as a flat rate on the volume of water each user is supplied. This tariff is also called the tariff level. The tariff level is efficient to the extent that its calculation includes all costs. Typically, it does not, for instance, the implicit (opportunity) cost of the river (or underground) water used and external costs are excluded. Declining block tariffs are determined with reference to the marginal cost of production, typically high for initial water service supplied and lower for subsequent units of water supplied. Increasing block (or progressive) tariffs levy the first units of water service at a lower rate than subsequent units. The first steps of tariff are below the (average) tariff level and the subsequent steps above it. This structure is touted as being a good redistributive and demand regulatory tool, rationing the available water service supply among competing individual users/customers so that customers are incentivised to limit their demand. It is a structure where customers with a low capacity to pay are not forced to compete with the demand of customers with a high willingness to pay.

During the last twenty years increasing block tariff structures have become increasingly popular, internationally and in South Africa, even though they yield the least efficient outcomes. They result in

consumption where the difference is greatest between marginal social benefit (the price of water) and marginal social cost.

One of two approaches is normally taken in setting the tariff structure for managing and sanitising the used (sewerage) water. The tariff may be based on the volume of inflow or on the amount of access to the outflow (receiving) system provided. The reticulation of treated sewerage water to selected urban consumers can be efficient and attractive under certain circumstances, for instance, where the opportunity cost of river or underground water is high.

South African municipalities are guided in the economics of their choices of water service tariff structures by a combination of national regulation and law and the integrated development planning processes they are all required to follow.

Case studies in the Eastern Cape and other parts of South Africa show that the municipalities calculate their water service tariffs by balancing their tariff revenue and explicit financial costs. It is a **cost accounting exercise.** Based upon 15 responses received covering the financial information relevant to tariff setting and 8 responses relating to the thinking that underlay their tariff setting, it was found that the financial information is available to set water service tariffs that reflect the costs of provision, there is under-recovery of costs due to under-provision for depreciation and excluded environmental costs and that there is widespread support for the increasing block tariff structure. The latter was reported to be an easy means to provide cross–subsidisation of the poor and to curtail demand for a scarce resource and capital (to build new water infrastructure). However, it was also found that analyses of water demand or the interests of the residents were not explicitly taken into account by the municipalities in their water service tariff setting.

Using insights gained through the case studies the process followed by South African municipalities in setting their water tariff levels was modelled. Municipalities are constrained to comply with the relevant law and policy and aim to achieve their development goal and plans as specified in their Integrated Development Plans, of which the Water Service Development Plan is an important part. The water supplied by South African municipalities may be categorised into: non-tariff water, water charged at average financial cost (the tariff level) and water charged to balance total revenue with total financial cost. Non-tariff water relates to all water losses and water supplied is provided at no charge or without national government subsidy support. Water services are charged at their average financial cost of production to government, selected business firms, other municipalities and residents whose tariffs are paid out of equitable share on their behalf by National Government. The remainder of water service users are charged in a way that balances total revenue with total cost, namely, full tariff paying residents and businesses not qualifying for average cost tariffs. Revenue (and captured consumer surplus) is maximised from this group by means of price discrimination. Those who are prepared to pay more for their water are charged more for it.

This tariff and water classification system is reported by the municipalities to work well, but there are two obvious economic concerns that it gives rise to:

- the responsiveness of supply to demand is undermined. Several municipalities reported an advantage of the system being that they could solve the problem of excess demand (cheaply) through a tariff hike rather than an increase supply (the more expensive option);
- this system is accommodative to water wastage/loss (and high non-tariff water levels). The supplier (municipality) does not bear the burden of this loss, because the cost is captured from consumers (transferred consumer surplus) using monopolistic power.

Given that municipalities do not know much about the nature of demand for the water service they provide, there is an information gap that needs filling. This study administered 5 choice experiments to assess customer demand (willingness to pay) from water service delivery at 3 selected municipalities in the Eastern Cape: the Nelson Mandela Bay Municipality, the Kouga Municipality and the Amathole Municipality.

In the field of marketing, where choice modelling was originally applied, it is called conjoint analysis. Conjoint analysis, or the choice experiment method, is a survey based method that models preferences for goods and services, where potential buyers of these goods and services are asked to make hypothetical choices between different combinations of levels of the attributes (characteristics) in these goods and services. Its conceptual roots may be traced back to Lancaster's (1966) characteristics theory of value. In this random utility maximizing theory of choice, the *ex post* utility from consuming goods (choice) is modelled in terms of selected (specified) *ex ante* utilities from the attributes of the good, and those attributes that are omitted (as reflected in the error term).

This study applied choice modelling surveys to 5 groups of current consumers within 3 selected Eastern Cape municipalities. Randomly selected consumers were presented with alternative packages of attributes and levels and requested to indicate a preference. Their responses are described, modelled and analyzed. Maximum likelihood estimation procedures were applied to generate predictive models of choice and of marginal values of choices from the tariffs associated with those choices. The price of the composite good was included as one of the attributes, so that willingness to pay (welfare) values could be determined for the component attributes.

Table 1: Estimated WTP per month for Kouga residents and NMBM business owners

Variable	*WTP* per month (R) per increase in attribute level	
	Kouga residents	**NMBM business owners**
Sew disposal	57.29	35.93
Quality of water	65.05	62.26
Security	21.90	35.68
Interruptions	9.83	5.51
Rate of flow	-2.77	8.92

The willingness to pay for a marginal improvement in sewerage disposal within the Kouga municipality was R57.29 per month; the relevant marginal improvement being from
"*many areas affected by disposal and spills of sewerage into the environment*",
to
"*only isolated areas affected by disposal and spills into the environment*".

By way of contrast, the NMBM business owners were willing to pay R35.93 per month for the same improvement (Table 1).

The quality of water was an attribute for which both the Kouga residents and NMBM business owners were prepared to pay even higher amounts than this for marginal improvements. Both groups were willing to pay over R60 per month. Improved security of supply was also an attribute that both sets of users were willing to pay more for per month; R21.90 in the case of the Kouga residents and R35.68 in the case of the NMBM businesses.

The experiment yielded inconclusive values for the rate of flow and interrupted flow attributes for water service delivery. The results shown in the shade cells are statistically insignificant and included for completion rather than interpretive purposes. There was a positive willingness to pay found for less interruption in water flow, but the values were low and findings statistically insignificant. Businesses within the NMBM value a faster rate of flow (higher water pressure), but not as much as they do the other attributes. Nothing in this connection could be deduced about the residents of the Kouga municipality.

The concluding findings of the report are that:

- The primary current influence on municipal tariff design is compliance with water and municipal governance law and policy.
- For many of South Africa's municipalities meeting the compliance goals are challenging, to the point of being almost overwhelming.
- Net external cost is not included in the calculation of South African municipal water service tariffs and there is under-provision for depreciation.
- Many municipalities use limited (if any) accounting information to determine the availability tariff.
- There is uncertainty within South African municipalities as to the underlying economic rationale of the water service tariff (price) structure. The use of increasing block tariff structures is appropriate for curtailing individual user demand, but other more targeted instruments are superior for the pursuit of other goals, such as cross-subsidising to cost of providing water services to the poor. Increasing block tariff structures may redistribute income in unintended ways.
- Analysis of choice with respect to the characteristics of municipal demand for water services, show that the most valued improvements in water service are: quality of water, security of supply and sanitisation of waste water. Still valued, but less so, are interruptions in service and rate of flow (water pressure).

The recommendations towards improving tariff setting suggested are:

(1) The level of demand accommodated

Free basic water per person.

The Constitution of South Africa defines municipal water service obligations with reference to individuals, so the interests of these individuals should be taken into account in the determination of the tariff structure. There are two important implications of this interest for the way municipalities levy tariffs. Firstly they way they charge domestic clusters (households) must reference to the number of people making up the domestic cluster or household; something they are not doing. Secondly, they should not charge anyone for free basic water (such as is done by the NMBM, for instance).

The need to better link tariff setting with the construction of new water service infrastructure

If the planning horizon is set long enough forward a number of water service infrastructure schemes become economically feasible. When the demand for water services increases in the face of a fixed supply, increasing the tariff is a way to allocate the water service, but at some point the higher tariff makes a new (supplementary) water service supply scheme feasible (with tariff-revenue covering costs). It is an abuse of the monopoly position of municipalities and a government failure if the new water supply schemes are not brought into operation when the tariff level is high enough to justify these. Eliminating excess demand for water services by increasing the tariffs charged does not rectify the problem of inefficient supply.

There are long time horizons in bringing new water supply schemes into operation. A schedule of schemes needs to planned, the various approvals obtained (land-use and financing) and the costs estimated of each scheme, and this has to be done well in advance of the time these schemes are likely to need to be brought into operation. The costs of each scheme need to be converted into tariff levels (average cost tariffs at which these schemes become feasible). Given the potential for government failure to provide economically justifiable water service infrastructure, municipalities that practice demand management tariff setting should be made to justify (account for) why they have not commenced with bringing a new supply scheme into operation, or have negotiated with DWA for this to be done on their behalf.

(2) Formulating a policy on how to incorporate excluded costs such as under-depreciation provision and environmental costs. Currently there is typically under-recovery of the costs of providing water services.

(3) The division of the water users into tariff groups
There is a good economic rationale for applying flat tariffs to some consumers and stepped tariffs to others but this rationale is not valid under all circumstances.

(4) The distinction between availability and use tariff, the number of steps in the tariff and the size of these steps
The case for charging for access and use separately
The economic rationale for charging for both the provision of access to new users and for the extent of use is based on the difference between marginal cost of providing access and of service after access is provided. There are fixed costs incurred in providing access, and it is not financially feasible to provide all users with access – because the cost is too high relative to the benefit (what the consumers are willing to pay). The correct way of determining which new users it is feasible to provide water services is to compare the relevant provision of access cost with the user's willingness to pay. If the latter is higher it is feasible to provide access. This particular rationale is rendered largely irrelevant in South Africa by the Constitutional of right of access to water services. The provision of access is rights determined rather than tariff determined.

There is a less clear-cut rationale for charging users for both the provision of access and use to long-standing users where connection costs are minimal (have already been provided). The rationale for two separate tariffs under these circumstances is to cover the fixed costs with the access charge and the variable costs with a use charge. The revenue collection and efficiency benefits of this accounting exercise need to outweigh the extra costs of doing so. This study found that most municipalities could and do distinguish fixed from variable costs, and thought that there were net benefits in translating fixed costs into an access (availability) charge and variable costs into a use tariff, but that they levied an availability tariff that was lower than the average fixed cost (because it would otherwise be unacceptably high to the users).

When to use stepped (increasing block) tariffs and when to use flat (average cost) tariffs
(a) Residents
The increasing block tariff for water services used by domestic residents is widely supported by the municipalities of South Africa. The main benefits of the structure are:
- it enables the cost of water not charged for to be recovered
- it facilitates the cross-subsidisation of low water users by high water users
- it discourages the demand for water services among residents and the workers they employ.

However, the rationale for discouraging this particular demand (residential demand) is unclear. One of the consequences of efforts to discourage demand has been the construction of boreholes and abstraction of water from water sources under-exploited by the municipality – leading to the reduction of underground sources of water supply and rate of flow in the under-exploited rivers. The rationale for cross-subsidising water wasted within municipalities is also unclear.
The least controversial case for the introduction of progressive stepped tariffs is in crisis situations (of government failure) where supply is insufficient and has to be rationed in the short run. It is undesirable that the short-run crisis case should be extended to 'normal' short-run circumstances or the medium and long run because this accommodates government failure.

(b) Business and Government
A flat rate related to average cost is applied to business and government because municipalities do not feel that distorting demand for this segment of the market will serve any purpose.

The size and number of the steps
The volumetric scale and tariff differential, and number of the blocks employed by the various municipalities are key features of the tariff structure. This study found that there was no economic rationale was employed in establishing these features – the blocks were arbitrarily set and adjusted.

It recommends that only three blocks be employed – the first being the average cost rate (the tariff level), the second being 50% above this and the third 100% or more above the tariff level, and that the size of the blocks (defined by volume) are set to whatever is required to reign in demand to available short-run supply. It is not recommended that fixed volume block sizes and one tariff scale be adopted for all municipalities, because each municipality faces different demand and cost circumstances – the variations in their tariff structure will reflect the particular circumstances of the municipality.

(5) The tariff structure as the appropriate instrument of intervention or regulation
(a) There is a need for better coordination of the water service tariff structure with other water charges.
The different aspects of water policy are linked, but the instruments by which each aspect is addressed are distinct. The primary function of the tariff structure is allocation, but there are many other important related aspects of water services supply policy, for instance, efficiency and environmental sustainability in abstraction, the impact of waste water not adequately sanitised before disposal back into the environment and meeting the water service need of the poor. These problems and challenges are best addressed with other instruments (not tariffs), such as abstraction charges, environmental taxes based on cost of sanitising or pollution load, and redistributive public financial arrangements.

Specifically with respect to charges for abstraction of water for urban use, municipalities must participate in the process of determining the prices they pay DWA for bulk water (in terms of the Municipal Financial Management Act (2003)). The DWA are mainly responsible for bringing the new schemes into operation. The nature of these negotiations should be such that there does not develop a disjoint between water service tariffs and bringing into operation new water supply schemes. Each municipality should know at what tariff levels new supply schemes (DWA or their own) are feasible.

(b) There is little merit in applying VAT to municipal water services.
The gains achieved in the form of revenue raised by levying VAT on municipal water services are increased general revenue, but the impact is to reduce the affordability of the service to the poor and

the sustainability of the service from the municipal perspective. There is little gained in taking this water service income away for the municipalities – it has to be given back (with interest) anyway.

In general there remains many very interesting aspects of water service provision that do not fall within the scope of its aims and readers should not expect to find addressed. It was not an aim of this study to assess the merits of private versus public provision of water services within the metropolitan areas. It was also not an aim of this study to investigate the many interventions that hold the potential to increase the efficiency of water services provided by various municipalities in South Africa. An improvement in efficiency occurs when the revenue or welfare value benefit yielded by an action exceeds its costs. During meetings with the members of the research team many suppliers of services to the water services sector argued that our research team were not paying sufficient attention to important actions that would improve the efficiency of water service delivery and or lower water service tariffs. These actions included, *inter alia*:

- improved metering and mitigation of losses of water within the reticulation system
- increased use of electrical power during off-peak times
- appointment of more skilled staff
- treatment of water outflows up to the standard that would enable it to be added back into the potable water reticulated
- improved debt collection
- upgrading of old infrastructure
- actions to decrease vandalism of water infrastructure
- increased effort to internalise external (environmental) costs.

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The members of the WRC Reference Group that advised this study were:

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Mr W Moraka	SALGA
Dr D Mullins	Conningarth Economists
Mr M Vawda	Department of Water Affairs
Mr U Natha	National Treasury
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The Nelson Mandela Bay Municipal Officials that assisted in the focus group work were:

Kevin Jacoby, CFO – Facilitator
Stan Groenewalt, Infrastructure and Engineering Assistant Director responsible for water distribution
Selwyn Thys, Director Budgeting and Financial Management
Barbara de Scande, Director Expenditure Management and Financial Control – hands on involvement during the research
Charmaine von Berg, Chief Accountant – responsible for the budget of water and sanitation services
Kevin Gillmer, Chief Accountant – National Treasury reporting and general co-ordination of information
Herman Vosloo, Principal Chief Accounts Officer – responsible tariff analysis and liaison officer and major consumers

The Amathole District Municipality Officials that assisted with the focus group work were:

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Sharon Kalis, Budget and Treasury – Budget element
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The Kouga Local Municipality Officials that assisted with the focus group work were:

Ridwaan Abdullah, Accounting and Financial Control, Kouga Municipality

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LIST OF ACRONYMS

ADM	Amathole District Municipality
ATTP	Assistance to the Poor
CE	Choice Experiment
CMA	Catchment Management Agency
DM	Demand Management
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWEA	Department of Environmental and Water Affairs
ES	Equitable Share
IDP	Integrated Development Plan
KLM	Kouga Local Municipality
MNL	Multi Nomial Logit
NMBM	Nelson Mandela Bay Municpality
OMI	Outflow Management Infrastructure
PW	Potable Water
RDP	Reconstruction and Development
SALGA	South African Local Government Association
SANS	South African National Standards
TC	Total Cost
TFC	Total Fixed Cost
TVC	Total Variable Cost
WSP or WSA	Water Services Provider or Authority
WSA	Water Services Act
WSDP	Water-Service Development Plan
WUA	Water-User Associations
WTP	Willingness to Pay

SECTION A: AN ANALYSIS OF SOUTH AFRICAN MUNICIPAL WATER SERVICE TARIFF SETTING

CHAPTER 1
INTRODUCTION

All of these approaches have merit within specific contexts, but not a general one. In order to apply any of these tariff structures the use of the water service must be measured and recorded volumetrically (per cubic metre flow of water). The average cost (flat) tariff is also called the tariff level. The tariff level is an efficient way of charging users for their use of water to the extent that all relevant economic costs are included in its calculation. This would not be the case if implicit (opportunity) cost of the river (or underground) water used and external costs were excluded. Declining block tariffs are determined with reference to the marginal cost of production, assuming these are known. Increasing block (or progressive) tariffs are touted as an effective demand regulatory tool. They aim at rationing the available water service supply among competing individual users/customers so that customers are incentivised to limit their demand and those with higher willingness do not crowd out the other demand. During the last twenty years increasing block tariff structures have become increasingly popular, internationally and in South Africa, even though they result in consumption where the difference is greatest between marginal social benefit (as reflected in the price of water) and marginal social cost (the full cost of providing the last unit of water); given a decreasing marginal cost structure.

One of two approaches is normally taken in setting the tariff structure for managing and sanitising the used (sewerage) water. The tariff may be based on the volume of inflow or on the amount of access to the outflow (receiving) system provided. The reticulation of treated sewerage water to selected urban consumers can be efficient and attractive under certain circumstances, for instance, where the opportunity cost of river or underground water is high.

Water tariffs serve an important allocation role in the water market – with users adjusting their demand to the cost of the water. One of the criteria relevant for assessing the merit of these tariffs is the efficiency of them. Efficiency is achieved where the users adjusted their use until their marginal social benefit was brought into equivalence with the marginal social cost tariff. In order to achieve this, the municipality would have to set the tariff at the marginal social cost. The market would do the rest, providing that no wedge was driven between the producer and the purchaser. Such a wedge does exist in South Africa, namely VAT. The latter reduces the affordability of water services to purchasers but it does not add to municipal revenues and so assist them to recover the costs water service provision.

Frequently water tariffs are not set that include all costs. Important costs omitted are depreciation at full replacement cost and sewerage that bypasses treatment and is discharged directly into the environment (Kahn, 1997:401). There are various reasons why this discharge occurs, e.g. overflow in flooding and underinvestment in waste water management and sanitation capacity.

OBJECTIVES OF THIS HISTORY

To address the above-mentioned challenges, the South African Local Government Association (SALGA) together with the Water Research Commission (WRC) commissioned this study to develop a framework for municipal water service tariff setting. This report describes the research undertaken and findings of that research. It incorporates an analysis of the processes followed by municipalities in

setting water tariffs, and a choice experiment analysis of and perspective on the demand for municipal water services.

The primary aim of the Study was to estimate the customer valuations of municipal water services provided within the context of a water tariff setting framework. The investigations were required to:

- determine service options for alternative combinations of water services provided in three municipalities in the Eastern Cape
- assess the marginal value of water service delivered to customers, by use of the choice experiment method
- draw conclusions about the tariff-service connection in the light of the results of the choice experiment.

The secondary aim of the study was to provide insights into the discretionary elements of South African municipal water service tariff setting (the structures, not VAT). The relevant WRC reference group placed more emphasis upon this objective; and requested that the report reflect this objective accordingly. Insight into the discretionary elements of the water service tariff structures were derived through:

- a survey of the information used in water service tariff setting in 3 specified municipalities in the Eastern Cape, the Nelson Mandela Bay Municipality, the Kouga Municipality and the Amathole Municipality
- a survey of the information used in water service tariff setting in 15 other randomly selected municipalities in South Africa outside of the Eastern Cape

The report is structured into three sections. Section A of the report analyzes South African municipal water service tariff setting at 3 Eastern Cape and 14 other South African municipalities, while Sections B analyzes willingness to pay for municipal water services through the administration of choice experiments at three Eastern Cape municipalities: Nelson Mandela Bay Municipality (NMBM), a category A municipality, Kouga Local Municipality (KLM), a category B municipality, and Amathole District Municipality (ADM), a category C municipality. Section C draws conclusions and proposes guidelines.

1.1 A NATIONAL PERSPECTIVE ON WATER

In South Africa the natural monopoly of water service supply is reinforced by the constitution and statutes. The Bill of Rights in the Constitution of South Africa Act (Act 108, 1996) states that there are three fundamental objectives to managing South Africa's water:

- *"Equitable access to water and to the benefits from the use of water resources;*
- *Sustainable use of water by making progressive adjustments to water use with the objective of striking a balance between water availability and legitimate water requirements and by implementing measures to protect water resources;*
- *Efficient and effective water use for optimum social and economic benefit"*

The Constitution of South Africa (Section 4B) vests the responsibility for the provision of water and sanitation services in local government (the municipalities). This provision is subject to statutory regulation by national government; the relevant statute being the National Water Act (1998) and the relevant organ of national government being the Department of Water Affairs (DWA). The

management of water resources from which the municipalities must draw is an exclusive national competency (Water Services Act, Number 108, 1997).

Water sources include rivers, streams, groundwater and rainfall. In order to facilitate the use of this water it is captured and contained in dams. Municipalities take this water to treatment plants to make it ready for use. South Africa's tap water is typically of a high quality (by international standards) but there are areas and periods when this quality has lapsed.

South Africa is a semi-arid country with an annual rainfall far below the world average of 860 mm. As a result South Africa's water resources are scarce and extremely limited. The demand for water is dominated by agriculture, specifically irrigation and livestock watering. Other major users of water are domestic and industrial customers.

It is expected that much of the future growth in water demand will be in the rural municipalities in order to reduce backlogs, but there will also be much growth in demand within the metropolitan municipalities. There are currently six of the latter.

A complicating factor on the demand side of water use is striking a balance between private demand and public (subsidized) demand. Substantial poverty exists and constrains the water service that can be accommodated in the economy. The mandate of the DWA in supplying water to municipalities (http://www.info.gov.za/aboutsa/water.htm, 2009) is to:

(1) ensure the availability and supply of water at national level to facilitate equitable and sustainable social and economic development

(2) ensure the universal and efficient supply of water services at local level

(3) promote the sustainable management of forests.

In the execution of its mandate the DWA has organised itself partly with respect to the geography of river systems and partly with respect to established political administrative regions. The geography of river systems determines its division of water management areas. There are 19 water-management areas identified within South Africa. Political administration regions determine all the rest of the DWA organisational structures. It maintains regional offices in each of the nine provinces and these offices support and oversee the work of catchment management agencies (CMAs), water boards, water services authorities (WSAs) and water-user associations (WUAs).

In terms of the 1998 National Water Act each water management area has to be managed by a CMA. Its mandate is to provide equitable, efficient and sustainable water-resource management. In order to carry out its task the CMA must establish a governing board to develop and manage a catchments management strategy. The members of these boards must be constituted so as to represent water users, potential water users, local and provincial government, and environmental interest groups.

Water Boards are providers of bulk water services and advise to water service authorities. They build infrastructure to build, transport and treat water, and receive and treat water outflows (waste and effluent) from users. Perhaps the most prominent water board is the Rand Water Board. In regions where water boards do not function, WSAs or the DWA perform this function.

WSAs and WUAs respectively, are the providers of water services to urban users and providers of water services to non-urban users, e.g. irrigation boards. The DWA support in their functioning takes the following forms **(http://www.info.gov.za/aboutsa/water.htm, 2009):**

- planning support for integrated development plans (IDPs) and water-services development plans (WSDPs)
- monitoring the water-purification and wastewater treatment works' operations
- facilitating study selection, feasibility studies and service-level options
- supporting the implementation of a tariff structure and the free basic water policy
- determining the division of powers and functions for water services between district and local municipalities and selecting water-services providers
- training councillors and officials in water-services and water-demand management
- mobilising resources to support municipalities.

The administrative framework within which this support occurs is laid out in the *Strategic Framework for Water Services* (September, 2003) (http://www.info.gov.za/otherdocs/2003/waterstrat.pdf, 2009). Commitment to this strategy was jointly made by the DWAF and the South African Local Government Association (SALGA) in 2003.[1] It includes a provision for local governments to apply for grants to fund water service infrastructure needed in order to meet minimum water service provision targets, as set by the national government.

In the light of this legal framework, user choice (demand) is limited to the overall quantities, qualities, service, management and tariffs local government decide to offer them.[2] The users have discretion in the specific proportion of the total provided they wish to receive, but little else.

The limitation in the choice users have does not make irrelevant the economic issue of choice. Under this arrangement, local government makes the choices in water service provision by proxy (on their customer's behalf). There is legal and technical guidance available to them from the DWA policy and Water Laws on how to approach these choices, and they specify the economic goals they wish to

[1] The main targets of the Strategic Framework for Water Services were (http://www.info.gov.za/aboutsa/water.htm#framework_services, 2009):

- eliminating the backlog in basic service provision
- providing higher levels of service
- providing free basic services (water supply and sanitation)
- controlling credit
- a decentralising the fiscal framework
- transferring all assets of water-services schemes from the DWAF to WSAs

[2] In some instances local governments have attempted to hand over water service supply to others, through privatisation and outsourcing. The first South African town to privatise its water services was Queenstown. In 1988 the local government commissioned the firm Aqua-Gold (now Suez) to provide water services to its residents. Its example was followed by the local governments of Stutterheim in 1994 and Fort Beaufort in 1995 (Ruiters 2005; Ruiters, 2002).

The merits of these privatisation initiatives have been the subject of debate. In the case of Fort Beaufort a saving of 8% was anticipated, but municipal payments for water services escalated fourfold within 2 years (Ruiters, 2005), and user charges increased by 22% between 1997 and 1998 (Ruiters, 2002).

pursue in water service provision in integrated development plans (IDPs) that they are required by statute to draw up and update.

Water Law limits service to the provision of safe water, but allows some flexibility and interpretation in the healthiness and taste of the water. For instance, it is a municipal discretion as to whether or not to add fluoride to the water it reticulates. There is greater scope permitted for variation in the delivery of the water. The distribution network for potable water must reach to within 200 metres of a household's dwelling and the water pressure and pipe diameter at the final stage of reticulation should not be less than permits a flow to 10 litres per minute. The legal framework does not specify that water supply should be continuous, nor does it define acceptable levels of notification of changes to services.

The primary economic guideline provided in the National Water Act of 1998 is that water service tariffs to be set at a level that enables sufficient revenue to be raised to recover the costs of water service supply. Financial (not economic) cost recovery, as defined by central government accounting principles, is required of local government with respect to water service provision by local government (water service providers), but assistance in achieving this is also provided by selective grants from the central government (Equitable Share). These costs should be real (full) costs and not underestimates. The provision for depreciation should be at replacement cost rather than historical cost so that scarcity cost is incorporated into the average cost.

1.2 INSTITUTIONAL ARRANGEMENTS IN THE WATER SERVICES SECTOR

As already stated above, the Department of Water Affairs, water boards and municipalities are the primary players in the water services sector. Water services refer to water supply and sanitation services and include regional water schemes, local water schemes, on-site sanitation and the collection and treatment of wastewater.

A two-tiered local government system requires the powers and functions be divided between categories B (local municipality) and C (district municipality) to avoid duplication and co-ordination problems. An asymmetric approach has been followed in relation to water and sanitation authority. All category A municipalities (metropolitan municipalities) are water service authorities (WSAs), category B municipalities are also WSAs and in certain instances so are category C municipalities (The Local Government Structures Act 117, 1998 and The Intergovernmental Relations Framework Act 13, 2005).

1.3 THE LEGAL AND PLANNING FRAMEWORK FOR PROVIDING MUNICIPAL WATER SERVICES

Section 25 of the Local Government Municipal Systems Act (MSA) (2000) makes it a legislative imperative that a municipality must adopt an IDP. This plan remains in place for the duration of a Council, being five years, and is reviewed on an annual basis, as per Section 34 of the MSA (2000). The IDP is the core strategic planning document of a municipality and provides direction for the compilation of the medium term budget, which covers a period of three years.

A number of sector plans are developed and used to direct the strategy of a municipality. One such sector plan is the Water Services Development Plan (WSDP). The WSDP is a water service management and planning tool. Appendix 1 shows the relationship between the IDP and the WSDP.

The MSA (2000:80), section 73 (2), deals with matters relating to municipal services. A municipal service must –

(a) be equitable and accessible;
(b) be provided in a manner that is conducive to –
    (i) the prudent, economic, efficient and effective use of available resources; and
    (ii) the improvement of standards of quality over time;
(c) be financially sustainable;
(d) be environmentally sustainable;
(e) be regularly reviewed with a view of upgrading, extension and improvement.

The MSA (2000:80), section 74, further provides that a municipality must adopt and implement a tariff policy on the levying of fees for municipal services provided by the municipality:

(a) Users of municipal services should be treated equitably in the application of tariffs.
(b) The amount individual users pay for services should generally be in proportion to their use of that service.
(c) Poor households must have access to at least basic services through:
    (i) tariffs that cover only operating and maintenance costs;
    (ii) special tariffs or life line tariffs for low levels of use or consumption of services or for basic levels of service; or
    (iii) any other direct or indirect method of subsidization of tariffs for poor households.
(d) Tariffs must reflect the costs reasonably associated with rendering the service, including capital, operational, maintenance, administration and replacement costs, and interest charges.
(e) Tariffs must be set at levels that facilitate the financial sustainability of the service, taking into account subsidization from resources other than the service concerned.
(f) Provision may be made in appropriate circumstances for a surcharge on the tariff for a service.
(g) Provision may be made for the promotion of local economic development through special tariffs for the categories of commercial and industrial users.
(h) The economical, efficient and effective use of resources, the recycling of waste and other appropriate environmental objectives must be encouraged.
(i) The extent of subsidization tariffs for poor household and other categories of users should be fully disclosed.

Section 10 of the Water Services Act (Act 108, 1997), addresses the norms and standards of water tariffs. In accordance with the Act, a municipality, in its capacity as a WSA, must apply a tariff for water services which is not substantially different from any norms and standards which the Minister of Water Affairs, with the concurrence of the Minister of Finance, has prescribed in terms of the present Act.

Section 21 of the Water Services Act (Act 108, 1997), deals with matters relating to by-laws, whereby a municipality, in its capacity as a WSA, must adopt by-laws which contain conditions for the provision of water services, and which provide for at least the following (inter-alia):

(a) the standard of service;
(b) the technical conditions for supply;
(c) the determination and structure of tariffs in accordance with section 10 of the Water Services Act (Act 108, 1997).

The general financial management functions covered in section 62 of the Municipal Finance Management Act (Act 56, 2003) includes the implementation of a tariff policy.

1.4 CONCLUSION

Water resource scarcity and poverty make the provision of water services a major challenge in South Africa's municipalities. The challenge is managed both at the national and local government levels. At the local government level there are three categories of municipality. Some are WSAs but others are merely water service providers (WSPs). Virtually all categories of municipality are involved in the provision of water services some way or other.

Their economic thinking with respect to water service provision is guided by integrated development plans, of which water service provision is an important element (WSDPs). Compliance with nationally determined rules, directives, policy and locally generated integrated development plans (IDPs) characterise the environment within which water service tariffs are set. The standard economic criteria by which merit is typically assessed, namely efficiency and welfare, are not primary sources of reference (but see Appendix 2).

CHAPTER 2
FEATURES AND PRACTICE OF EASTERN CAPE MUNICIPAL WATER SERVICE TARIFF SETTING

2.1 A PROVINCIAL PERSPECTIVE – WATER SERVICE DELIVERY IN THE EASTERN CAPE

Of the 1 601 199 households served in 2009 by the 17 water service authorities in the Eastern Cape 73,7% are served with free basic water (Table 2.1). The households targeted for research on their WTP in this study are those in the NMBM (284 833), KLM (21 380) and the ADM (241 088) (Table 3.2). Of the total in the Eastern Cape they make up 34% (547 301 of 1 601199), just over one third. They represent all three types of municipality – local, district and metropolitan.

Table 2.1: Summary of free water service level of provision in the Eastern Cape as at January 2009

Total Households Served						
Service Level	No Infrastructure	Below RDP	at RDP	Above RDP	Total	
Total	162,548	89,398	545,046	804,208	**1,601,199**	
Free Service	8,091	89,396	513,706	568,476	**1,179,670**	
%	**4.98%**	**100.00%**	**94.25%**	**70.69%**	**73.67%**	

Total Poor Households Served						
Service Level	No Infrastructure	Below RDP	at RDP	Above RDP	Total	
Total	112,992	49,410	358,608	335,702	**856,713**	
Free Service	5,287	49,407	202,446	279,277	536,418	
%	**4.68%**	**99.99%**	**56.45%**	**83.19%**	**62.61%**	

Table 2.2: Water Service level of provision to Eastern Cape by Water Service Authority

Water Service Authority	Households	Served	%	Poor	Served	%	Provide free service
Alfred Nzo District municipality (DC44)	100,139	77,269	**77.2%**	77,631	60,188	**77.5%**	**YES**
Amatole District municipality (DC12)	241,088	202,072	**83.8%**	161,189	88,160	**54.7%**	**YES**
Baviaans Local Municipality (EC107)	4,219	3,571	**84.7%**	2,893	2,885	**99.7%**	**YES**
Blue Crane Route Local Municipality (EC102)	10,294	10,060	**97.7%**	4,706	4,599	**97.7%**	**YES**
Buffalo City Local Municipality (EC125)	206,454	204,807	**99.2%**	69,518	69,011	**99.3%**	**YES**
Cacadu District municipality (DC10)	2,161	499	**23.1%**	930	442	**47.5%**	**YES**
Camdeboo Local Municipality (EC101)	11,132	11,132	**100.0%**	4,716	4,716	**100.0%**	**YES**
Chris Hani District municipality (DC13)	199,411	168,629	**84.6%**	122,752	61,599	**50.2%**	**YES**
Ikwezi Local Municipality (EC103)	2,957	1,583	**53.5%**	1,856	1,582	**85.3%**	**YES**
Kouga Local Municipality (EC108)	21,380	19,648	**91.9%**	6,587	6,586	**100.0%**	**YES**
Kou-Kamma Local Municipality (EC109)	10,447	6,799	**65.1%**	4,470	4,470	**100.0%**	**YES**
Makana Local Municipality (EC104)	19,164	9,110	**47.5%**	11,352	6,979	**61.5%**	**YES**
Ndlambe Local Municipality (EC105)	17,379	13,708	**78.9%**	7,463	7,401	**99.2%**	**YES**
Nelson Mandela Metropolitan Municipality (NMA)	284,833	114,072	**40.0%**	49,541	49,446	**99.8%**	**YES**
O.R. Tambo District Municipality (DC15)	368,061	257,903	**70.1%**	263,057	143,583	**54.6%**	**YES**
Sunday's River Valley Local Municipality (EC106)	10,748	9,953	**92.6%**	3,871	3,569	**92.2%**	**YES**
Ukhahlamba District Municipality (DC14)	91,332	68,855	**75.4%**	64,182	21,201	**33.0%**	**YES**
Total	1,601,199	1,179,670	**73.7%**	856,713	536,418	**62.6%**	

Ref: (http://www.dwaf.gov.za/dir_ws/fbw/Default.asp?Pageid=7&PageHeading=IMPLEMENTATION%20STATUS&ProvID=2, 2009)

Notes to Tables 2.1 and 2.2

No Infrastructure	Household have no access to any infrastructure i.e. those people that still drink unsafe water from a dam, spring, river or receives water from **vending (e.g. trucking) studies**.
Below RDP	Household have access to infrastructure but at a BELOW RDP standard, e.g. Standpipe > 200 m
at RDP	The infrastructure necessary to supply 25 litres of potable water per person per day supplied within 200 metres of a household and with a minimum flow of 10 litres per minute (in the case of communal water points) or 6 000 litres of potable water supplied per formal connection per month (in the case of yard or house connections).
Above RDP	Household have access to `in-house` or `in-yard` water supply connections.
Poor Classification :	
Poor household	A household who has a total income of less than R800 p/m
Poor population	Total number of people that live in poor households
Definitions :	
Free service	Population or Household that receives a basic water supply at **no charge** / **for free**

2.2 THE SELECTED MUNICIPALITIES

Three municipalities in the Eastern Cape and fourteen outside of the Eastern Cape (Chapter 3) were selected as reference sites to informing the modelling of South African municipalities water service tariff setting processes (Chapter 4). These municipalities were limited to the Eastern Cape and represent category A, B and C municipalities. As already mentioned, the municipalities selected were Nelson Mandela Bay Municipality (NMBM), a category A municipality; Kouga Local Municipality (KLM), a category B municipality; and Amathole District Municipality (ADM), a category C municipality.

For the purpose of this enquiry, at each of the municipalities chosen, a reference group was constituted consisting of staff responsible for water service provision (including extraction, treatment, supply, reticulation, sewerage outflow and sewerage treatment), budget compilation (including a linkage to Integrated Development Plan (IDP) and Water Service Development Plan (WSDP)), and an official responsible for the consumer databases.

2.3 THE REFERENCE MUNICIPALITIES

Each municipal council must adopt an IDP within a prescribed period, as per the Local Government Municipal Systems Act (MSA) (Act 32, 2000).

Appendix 2 includes details of the location, composition and economy of the reference municipalities.

2.4 WATER SERVICE PROVISION BY THE REFERENCE MUNICIPALITIES

All of the NMBM population has access to a basic level of water within a 200 m radius of their residences and 91% of households have access to a basic level of sanitation (NMBM IDP, 2008). The NMBM is both a Water Service Authority (WSA) (responsible for ensuring access to water services as described by DWAF, 2002) and a Water Service Provider (WSP), that is, an organisation that provides water services to consumers or to another water services institution. Refer Appendix 3 for further detail on the NMBM water resource infrastructure.

Of the population of KLM (KLM WSDP, 2008) in June 2007, 76.74% had access to RDP water standard or above (25 litres per person per day within a 200 m walking distance) and 25.91% had access to basic sanitation standard or above (waterborne or VIP toilet).

The Cacadu District Municipality, comprising of KLM and other local municipalities in the district, is the WSA in terms of the powers and functions devolved by the Local Government Municipal Structures Act (Act 117, 1998). The KLM is responsible for water service provision within its area of jurisdiction and is therefore the WSP.

Of the ADM population 68.2% has access to RDP water service level or above, and 17.91% has access to basic sanitation service level or above (ADM WSDP, 2008). The ADM is a WSA in terms of the powers and functions devolved by the Local Government Municipal Structures Act (Act 117, 1998). The ADM is responsible for water service provision in all of its local municipality areas except the Buffalo City Municipality, which is a (stand alone) WSA.

2.5 THE MUNICIPAL BUDGET PROCESS UNDERLYING TARIFF SETTING

The primary planning tool for the water services of a municipality is the WSDP. The WSDP formalizes the level of service provision, it assesses and determines the backlog in service level, it determines the cost of achieving the service level and defines a strategy of eradicating backlogs. The WSDP must allow for the assessment of all water related infrastructure, and must reflect on the socio-economic profile of the municipal area, including consumer, service, water resource, customer service and financial profiles. The WSDP further takes stock of the water balance and provides for strategies on how to reduce unaccounted for, or alternatively, non-revenue water.

Water and sanitation services are reflected as separate cost centres in a budget of a municipality. These services are financially ring-fenced and their accounting statements reflect own assets, liabilities and operational costs and income.

A municipality may operate the water and sanitation services as a trading service, which is a service for which the tariffs are fixed in such a way that the provision of the services yields a trading surplus, allowing service cross-subsidisation. The municipality may also operate the services as economic or subsidised services. The former is a service for which tariffs are fixed in such a way that the costs of providing the service may be recovered without providing for a profit, while the latter is a service for which the tariffs are fixed in such a way that the costs of providing the service are recovered as far as possible with the balance of the costs recovered by subsidy.

The National Treasury Local Government Budget and Expenditure Review (2008), provides annual parameters for increases in various cost categories found within a municipal budget. These parameters are used as a guide when compiling budgets over the medium term (three years). A municipality considers the National Treasury parameters during the determination of the municipal budget strategy, which is proposed to Council for adoption. This strategy, in addition to the parameters, considers the cost drivers within a budget, and any unique circumstances over the medium term and economic and other growth factors, for instance, service expansion programmes.

The established municipal parameter is considered during the determination of the medium term expenditure budget (MTEF). A mixture of both zero-based, trend and escalation (inflationary)

budgeting is used in determining the MTEF. During the determination of the costs of providing a service, a municipality takes into consideration:

- The cost of bulk purchases of water from DWAF, when the municipality does not have its own water resource or augments its own water resource with a bulk purchase from a DWAF owned resource;
- Raw water extraction costs from own source;
- Distribution costs to the consumer,
- Distribution losses;
- Maintenance of infrastructure (pump stations, pipelines, reservoirs) and other fixed assets (vehicles, plant and equipment);
- Administrative and service costs, including but not limited to:
    - ❖ Interdepartmental costs (Budget and Treasury, Corporate Service, legal costs, etc.);
    - ❖ Provision for non-payment of services by consumers (provision for bad debts);
    - ❖ All other ordinary overhead costs such as electricity, stationery, insurance, licensing of vehicles, purchase of chemicals, etc.
- The intended surplus or loss to be reflected as an operating result for the period under consideration, depending on whether the service is managed as a trading, economic or subsidised service;
- Contribution to the Asset Financing Fund (AFF), which is used as a reserve to provide for the replacement, refurbishment and extension of water services (infrastructure and other fixed assets);
- The costs of approved indigent relief measures when assisting the poor;
- Finance charge costs associated with the repayment of any external loan funding or other instrument used to fund capital expenditure;
- Depreciation costs;
- Cross-subsidisation to other services, for example, the Rate and General account.

When determining the service costs, the municipality evaluates previous year consumption trends. These trends are measured against past droughts, water restriction, floods and growth in service provision. The result of this evaluation is used as a base for tariff application in order to recover the costs of providing the service.

Before determining the tariff/s, other revenue sources, besides the revenue from consumption are determined, for example, revenue from water and sewage connections, water delivery by tankers, search fees, meter testing, etc. For the purposes of this study, such income will be referred to as other income, as the focus of the research is on tariffs associated with consumption rather than once off revenue.

The operating costs comprise of variable and fixed costs. Variable costs vary with a unit of measure and fixed costs are incurred irrespective of a unit of measure, for example, salaries and finance charges. Table 2.3 provides the basis employed in this study for the financial classification of operating variable and fixed costs, as well as the identification of the transfer (redistribution) cost.

Table 2.3: Analysis of the variable and fixed costs and cost transfers

COST DESCRIPTION	VAR COST	FIX COSTS	TRANS-FERS	COMMENTS
Bulk water costs		X		Cost of the purchase of water either purified or raw from various sources – dams, canals, pipes
ATTP cost of relief			X	Cost varies with consumption. The cost is offset against the government grant which is recorded as an income
Contribution to the capital replacement reserve		X		The annual contribution to the capital replacement reserve is used as a source finance to either rehabilitate or acquire new assets. The cost does not vary directly with service consumption
Repairs and maintenance of infrastructure and other fixed assets	X			Does vary with service consumption
Assets as a result of public contributions and donations			X	Assets associated with new developments including infrastructure extension to cater for development. The cost does not vary directly with service consumption – from non-tariff sources
Administrative and service costs, incl. interdepartmental costs (Budget and Treasury, Corporate Services, Legal, etc.)	X			Can be expected to vary directly with service consumption. Costs are allocated to ensure "ring-fencing" of services
Provision for bad debts			X	Costs amount to transfers from those who do pay
Administrative overheads		X		A cost not dependent on consumption of services – Salaries, insurance, etc.
Finance charge costs		X		Loan charges, not linked at all to service consumption
Depreciation		X		Not directly linked to service consumption
Cross-subsidisation			X	Pre-determined cross allocations before determining consumptive income.
Planned result			X	Pre-determined cross allocations before determining consumptive income.

Certain members of the reference group disagreed with the categorisation of costs in Table 2.3. For instance, they argued that one should not treat bulk water as a fixed cost because municipalities enjoyed discretion on how much bulk water they purchased from the DWA. The project team agreed that there are discretion elements in bulk water acquisition by municipalities (especially in so far as they buy this water from the DWA), but contend that the main proportion of the cost associated with bulk water provision is ultimately for dams, canals, pipes and pumping equipment, things that are not subject to short-run discretionary variation.

Nevertheless, Table 2.3 was used as the guide to distinguish fixed from variable costs and identifies the transfers for the operating budgets of the three reference municipalities for the 2008/09 financial year. This analysis is shown in Table 2.4. The information for this table was derived from the ADM Operating and Capital Budget (2008), the KLM Operating and Capital Budget (2008) and the NMBM Operating and Capital Budget (2008). New infrastructure for water services is primarily funded from external sources and the operating cost of the new infrastructure is already included in the figures provided in Table 2.4. The operating budget provides a balance between operating costs and revenue. The latter is derived primarily from tariffs.

The total operating budgets for the water and sanitation services of three of the reference municipalities amounted to R772 million and R477 million, respectively. The operating budgets of the NMBM water and sanitation service account for 69% and 85%, respectively, of the reference municipalities total operating budgets for these services.

The operating costs are primarily funded from consumptive income, interest earned on outstanding debts, government grants (equitable share) and sundry income. The latter includes public contributions and donations. Consumptive income, which is calculated from a unit of measure and tariff, accounts for 53% of the operating income. Almost a quarter (24%) of the operating income is derived from

government grants, that is equitable share – an unconditional grant primarily used to fund the provision of basic services, and also linked to the tariff. Government grants are influenced by the unit of measure and tariff used to calculate the consumptive income.

Consumptive income is made up of availability charges, sale of water to other municipalities or entities, and per unit (kilolitres of water) metered charges for water supplied and effluent discharged or disposed of. Availability charges are fixed charges levied monthly, irrespective of the actual volume of water supplied or amount of effluent discharged or disposed of. Availability charges account for 7% of total income of the reference municipalities and 18% and 9% respectively, of water and sanitation consumptive income.

Table 2.4: Operating budget analysis of reference municipalities using 2008/09 financial year budget data

Operating Costs	NMBM Water	NMBM Sanitation	ADM Water	ADM Sanitation	KLM Water	KLM Sanitation	TOTAL Water	TOTAL Sanitation	% of Total
Variable Costs	**117,569,020**	**146,532,550**	**8,527,586**	**1,563,242**	**5,096,370**	**2,839,170**	**131,192,976**	**150,934,962**	**23%**
Repairs and maintenance of infrastructure and other fixed assets	78,205,000	97,583,850	8,527,586	1,563,242	2,525,840	1,763,260	89,258,426	100,910,352	**15%**
Administrative and service costs, including but not limited to:			-	-			-	-	**0%**
Interdepartmental costs (Budget and Treasury, Corporate Service, legal costs, etc);	39,364,020	48,948,700	-	-	2,570,530	1,075,910	41,934,550	50,024,610	**7%**
Fixed Costs	**249,067,400**	**143,457,960**	**178,320,990**	**23,501,389**	**25,512,300**	**16,660,960**	**452,900,690**	**183,620,309**	**51%**
Bulk Water costs	36,160,000		28,872,493	-	8,850,890		73,883,383	-	**6%**
Contribution to the capital replacement reserve	62,990,050	26,881,440	20,516,000	-	2,004,800	81,820	85,510,850	26,963,260	**9%**
Administrative overheads	116,159,380	75,083,020	100,298,116	11,998,172	8,749,030	8,744,950	225,206,526	95,826,142	**26%**
Finance charge costs	8,479,830	10,792,500	1,706,338	300,000	2,865,320	3,494,360	13,051,488	14,586,860	**2%**
Depreciation costs	25,278,140	30,701,000	26,928,043	11,203,217	3,042,260	4,339,830	55,248,443	46,244,047	**8%**
Cost of transfers	**167,764,730**	**114,401,090**	**8,910,284**	**19,853,552**	**11,117,540**	**7,648,600**	**187,792,554**	**141,903,242**	**26%**
ATTP cost of relief - varies according to consumption	65,517,500	63,050,640	8,712,311	6,409,539	4,197,440	2,617,420	78,427,251	72,077,599	**12%**
Assets as a result of public contributions and donations	77,600,000	47,800,000	-	-			77,600,000	47,800,000	**10%**
Provision for non-payment of services by consumers (provision for bad debts);	4,647,230	3,550,450	17,662,307	12,383,499	1,994,020	1,045,200	24,303,557	16,979,149	**3%**
Cross-subsidisation [Rate and General or other service]	20,000,000		-	-			20,000,000	-	**2%**
Planned result [surplus/loss/break even]	-		-17,464,334	1,060,514	4,926,080	3,985,980	-12,538,254	5,046,494	**-1%**
TOTAL OPERATING EXPENDITURE [A]	**534,401,150**	**404,391,600**	**195,758,860**	**44,918,183**	**41,726,210**	**27,148,730**	**771,886,220**	**476,458,513**	**100%**
Proportion of Total Service	**69%**	**85%**	**25%**	**9%**	**5%**	**6%**			
Operating Income									
Consumptive Income									
Availability Charges	-40,144,590		-18,088,697	-18,938,548	-2,440,200	-1,675,550	-60,673,487	-20,614,098	**7%**
Kouga Municipality	-9,123,360		-	-			-9,123,360	-	**1%**
Metered when not categorised			-36,108,351	-12,587,999	-30,793,530	-15,185,490	-66,901,881	-27,773,489	**8%**
Metered Charges Within - Commercial	-49,147,260	-48,394,800					-49,147,260	-48,394,800	**8%**
Metered Charges Within - Industrial	-46,633,800	-28,758,530	-	-			-46,633,800	-28,758,530	**6%**
Metered Charges Within - Residential	-169,097,650	-132,418,220	-	-			-169,097,650	-132,418,220	**24%**
Reclaimed Water	-882,690						-882,690	-	**0%**
	-315,029,350	**-209,571,550**	**-54,197,048**	**-31,526,547**	**-33,233,730**	**-16,861,040**	**-402,460,128**	**-257,959,137**	**53%**
Interest Earned - Outstanding Debtors	**-21,346,000**	**-10,663,130**	**-**	**-**			**-21,346,000**	**-10,663,130**	**3%**
Government Grants and Subsidies National Government -E-share ATTP	**-74,045,400**	**-63,050,640**	**-139,496,876**	**-13,376,768**	**-4,671,640**	**-6,044,020**	**-218,213,916**	**-82,471,428**	**24%**
Other Income									
Sundry Income	-23,902,910	-10,036,010	-306,935	-14,868	-800,000	-584,040	-25,009,845	-10,634,918	**3%**
Public contrib. & Donations Revenue	-77,600,000	-47,800,000	-290,000	-			-77,890,000	-47,800,000	**10%**
Internal charges Distribution Statements	-1,701,000	-6,926,910	-1,468,000	-			-3,169,000	-6,926,910	**1%**
Future Depreciation -CR & DPC	-20,776,490	-26,190,800	-	-	-3,020,840	-3,659,630	-23,797,330	-29,850,430	**4%**
Pail Service		-16,202,840	-	-			-	-16,202,840	**1%**
Trade Effluent		-13,949,720					-	-13,949,720	**1%**
	-123,980,400	**-121,106,280**	**-2,064,935**	**-14,868**	**-3,820,840**	**-4,243,670**	**-129,866,175**	**-125,364,818**	**20%**
TOTAL OPERATING INCOME [B]	**-534,401,150**	**-404,391,600**	**-195,758,859**	**-44,918,183**	**-41,726,210**	**-27,148,730**	**-771,886,219**	**-476,458,513**	**100%**
Equitable Share as a proportion of total income	**14%**	**16%**	**71%**	**30%**	**11%**	**22%**	**28%**	**17%**	
Availability charges in comparision to consumption charges	**15%**	**0%**	**50%**	**150%**	**8%**	**11%**	**18%**	**9%**	

Of the operating costs the purchase of bulk water account for 6%, repairs and maintenance for 15%, administration and service costs for 36%, contributions from the public and donations 10% and relief to the poor 12%. Variable costs account for 23% of total operating costs and fixed costs for 51%. The costs of transfers account for 26% of total operating costs.

The NMBM provides a service that is capable of cross-subsidising rate and general services. The reference municipalities employ a mixture of operating strategies (trading, economic or subsidised). NMBM classifies its water service as a trading service. The same strategy is employed by ADM for sanitation and KLM for both water and sanitation. NMBM provides for an economic service when providing for sanitation and ADM provides for a subsidised service when providing for water. These strategies are of minor financial significance. They provide for an accumulated 1% (2% for cross-subsidisation less 1% for operating loss) of total operating costs.

There is no empirical basis informing the level of cross-subsidisation. Where cross-subsidisation has taken place it is evident that it has been based on a historical demand at a point in time and has simply been carried through. The reason for not tampering with the level of cross-subsidisation is primarily linked to the tariff base of the considered service and the service that is being cross-subsidised. A decision to transfer the cross-subsidisation from water service to property rates would result in approximately a 1% decrease in water tariff and a 5% increase in property rates. There would also be distributional implications (at least in the short run) – shifting the costs from tenants responsible for water services to landlords.

Although distribution losses are not added to the operating cost of providing the services, they are taken into consideration in the determination of the consumptive tariffs. The NMBM balanced its budgeted expenditure, sewer and water separately, against the likely income based on previous consumption spread across consumer categories and a prediction of what future consumption would be. The same practice was followed by the KLM and ADM. Water losses are implicitly rather than explicitly considered. This is true for both sewer and water tariffs for those reference municipalities applying hydraulic reductions when calculating sewer consumption charges.

2.6 FROM THE FINANCIAL ACCOUNTING STATEMENTS TO THE TARIFF STRUCTURES

The constraints faced by the municipalities are reflected in the financial accounting statements of the municipalities (Table 2.4) and also the tariff structures. Tables 2.5 to 2.7 describe the tariff structures of the reference municipalities for the 2008/09 financial year, while Tables 2.8 to 2.10 analyse the basic elements of these tariff structures. The information used to compile these tables was derived from the ADM Operating and Capital Budget (2008), the KLM Operating and Capital Budget (2008) and the NMBM Operating and Capital Budget (2008). The tariff structures comprise of variable tariffs applied to a unit of measure and a fixed tariff charged monthly. Variable and fixed tariffs are charged for both potable water and sanitation.

VARIABLE TARRIFS

A variable tariff is applied to both potable water and sanitation for all 7 areas that fall under the control of the ADM. The variable tariff differs from area to area. Consumers are charged a stepped tariff that allows for 6 categories of consumption. Tariffs increase progressively with consumption (increasing blocked tariff) except for the category with a monthly consumption of greater than 501 kl. This category is charged a lower tariff than the previous category. For example, the Amahlathi water service consumers are charged for progressive consumption. The tariffs for the water service increase by 19%

from category 1 to category 2, by 15% from category 2 to category 3, by 25% from category 3 to category 4 and by 17% between category 4 and category 5. The tariff then decreases by 17% from category 5 to category 6. Although this principle applies to all areas the percentage variances are different for each area. The ADM uses a hydraulic reduction to determine the unit of measure for sanitation. The sanitation tariff is applied to 80% of the potable water consumed.

The ADM's variable tariff is applied from the first kilolitre of water consumed. The cost of the first 6 kl consumed per month is recovered from the equitable share (ES) for the indigent consumers residing in the targeted areas, but the municipality does not maintain an indigence register.

The NMBM tariff structure is the simplest of all three municipalities (see Table 2.6). A variable tariff is applied to both potable water and sanitation. The variable tariff is uniform for all areas included in the municipal boundary. Domestic consumers are charged an increasing blocked tariff. Only 3 categories of consumption are provided for. The tariff increases progressively with consumption for potable water.

Firms (inclusive of industrial and commercial firms, government departments and agencies) are charged a flat variable tariff. The tariff does not vary with level of consumption. A variable tariff for sanitation remains the same for all levels of consumption for all categories of consumers (domestic and firms). The NMBM uses a hydraulic reduction to determine the unit of measure for sanitation, similar to the ADM. The NMBM uses a factor of 60% for domestic consumers and 95% for commercial corners.

The NMBM's variable tariff is applied from the first kilolitre of water consumed. The equitable share (ES) is used to fund the first 8 kl of potable water consumed and consequent sanitation charge. The municipality maintains an indigence register for the ATTP beneficiaries.

The KLM tariff structure provides for 5 categories of potable water progressive domestic consumer as part of the increasing block tariff structure (see Table 2.7). High-density consumers and shops are charged the same tariff as the first domestic category and the industrial area in Humansdorp is charged a separate tariff. The tariff is almost equivalent to the average tariff charged to domestic categories consuming between 26 to 45 kl/month and 46 to 65 kl/month. The domestic category tariff increases are progressive and are only inclusive of potable water. A variable charge for sanitation is not provided for in the tariff structure. The tariff increases by 25% from category 1 to category 2, by 60% from category 2 to category 3, by 25% from category 3 to category 4 and 20% from category 4 to category 5.

The KLM charges a variable tariff for trade effluent based on a hydraulic formula (see Table 2.7). Although the tariff structure for the KLM provides for a 0-25 kl/month category of domestic consumers, all consumers in the KLM receive the first 6 kl/month free. The municipality follows the universal approach to the provision of the first 6 kl/month free. The KLM maintains an indigence register. The verified indigent beneficiaries are provided with a monthly allowance, which is allocated to the indigence consumer accounts.

FIXED TARIFF

The ADM fixed tariff structure includes fixed tariffs per month for both potable water and sanitation (Table 2.5). The fixed tariff is referred to as an availability charge. The tariffs differ per service and per area managed by the ADM. The fixed tariffs are charged to property owners of vacant erven that have

been developed. The highest fixed water service tariff is charged in the Amahlathi area (R152.00/month) and the lowest in the Nkonkobe area (R88.00/month).

The NMBM charges a monthly fixed tariff for the water service only. The fixed tariff is based on the water meter size and type. Types of meters catered for are semi-positive or inferential meters (Table 2.6). The fixed tariff is referred to as a water availability charge.

The KLM charges a fixed tariff for sanitation (availability charge) and a fixed tariff for water. There are two fixed tariffs charged for water; one being an availability charge and the other being a charge for minimum consumption (Table 2.7). The fixed tariff structure for sanitation is more detailed than the tariff structures of the other two reference municipalities for the same service. This is mainly due to uniform tariffs not being applied and varying levels of service. The municipality provides for waterborne sewage, the bucket system and septic tanks.

A uniform fixed tariff is charged for water availability and minimum consumption. The KLM has a high peak season migration resulting in many of the households remaining vacant during off-peak seasons. This has resulted in the municipality charging a fixed tariff for minimum water usage.

Table 2.5: Amathole District Municipality water service tariffs for the 2008/09 financial year

(all pricing excludes VAT)

	AMAHLATHI				NGQUSHWA				NKONKOBE				NXUBA			
Potable water usage per month kl	**Tariff use potable water R/kl**	**Tariff for sanitation R/kl**	**Water service tariff R/kl**	**Increase**	**Tariff use potable water R/kl**	**Tariff for sanitation R/kl**	**Water service tariff R/kl**	**Increase %**	**Tariff use potable water R/kl**	**Tariff for sanitation R/kl**	**Water service tariff R/kl**	**Increase**	**Tariff use potable water R/kl**	**Tariff for sanitation R/kl**	**Water service tariff R/kl**	**Increase**
0-6	4.15	1.05	5.20		4.20	1.90	6.10		3.15	1.05	4.20		2.70	1.05	3.75	
7-10	4.50	1.70	6.20	19%	4.80	2.10	6.90	13%	3.65	1.25	4.90	17%	3.15	1.25	4.40	17%
11-20	5.00	2.10	7.10	15%	5.20	2.50	7.70	12%	4.20	1.65	5.85	19%	3.45	1.65	5.10	16%
21-50	6.25	2.60	8.85	25%	6.15	3.75	9.90	29%	5.00	1.90	6.90	18%	3.85	1.90	5.75	13%
51-500	6.80	3.55	10.35	17%	6.80	4.50	11.30	14%	6.80	2.30	9.10	32%	4.40	2.60	7.00	22%
501>	5.92	2.71	8.63	-17%	6.60	4.27	10.87	-4%	5.89	2.06	7.95	-13%	4.06	2.26	6.32	-10%
Availability charge per month (vacant erf)	77.00	75.00	152.00		47.50	63.00	110.50		32.00	56.00	88.00		46.00	44.00	90.00	

	MBASHE				MNQUMA				GREAT KEI			
Potable water usage per month kl	**Tariff use potable water R/kl**	**Tariff for sanitation R/kl**	**Water service tariff R/kl**	**Increase**	**Tariff use potable water R/kl**	**Tariff for sanitation R/kl**	**Water service tariff R/kl**	**Increase**	**Tariff use potable water R/kl**	**Tariff for sanitation R/kl**	**Water service tariff R/kl**	**Increase**
0-6	3.65	1.90	5.55		3.35	1.05	4.40		3.10	1.05	4.15	
7-10	4.50	2.10	6.60	19%	3.75	1.25	5.00	14%	3.35	1.25	4.60	11%
11-20	5.75	2.70	8.45	28%	4.00	1.70	5.70	14%	3.55	1.65	5.20	13%
21-50	6.35	4.70	11.05	31%	4.20	1.90	6.10	7%	4.20	2.10	6.30	21%
51-500	6.80	5.20	12.00	9%	4.80	2.10	6.90	13%	6.25	2.30	8.55	36%
501>	6.18	4.38	10.56	-12%	4.24	1.75	5.99	-13%	5.75	2.28	8.03	-6%
Availability charge per month (vacant erf)	62.00	48.00	110.00		35.00	95.00	130.00		74.00	47.00	121.00	

A hydraulic reduction of 80% is applied to the water consumption to determine the outflow usage

Table 2.6: Nelson Mandela Bay Municipality water service tariffs for the 2008/09 financial year

(all pricing excludes VAT)

Description	Meter Description	Tariff use potable water R/kl	Tariff for sanitation R/kl	Water service tariff R/kl	Increase
VARIABLE CHARGES					
Residential premises:					
Up to 1kl/day		4.76	5.82	10.58	
Next 1kl/day		5.97	5.82	11.79	11%
Additional consumption (per kl)		7.16	5.82	12.98	10%
A hydraulic reduction of 60% is applied to the water consumption to determine the outflow usage					
Firms:					
Per/kl		4.76	5.82	10.58	N/a
A hydraulic reduction of 95% is applied to the water consumption to determine the outflow usage					
FIXED CHARGES		**R/month**	**R/month**	**R/month**	**Increase**
Water Availability Charges					
Nominal water meter size					
15mm	Semi-positive	15.11			
20mm	Semi-positive	22.68			50%
25mm	Semi-positive	30.24			33%
40mm	Semi-positive	45.33			50%
50mm	Semi-positive	68.03			50%
75mm	Semi-positive	146.04			115%
100mm	Semi-positive	312.31			114%
15mm	Inferential	15.11			
20mm	Inferential	22.68			50%
25mm	Inferential	30.24			33%
40mm	Inferential	37.81			25%
50mm	Inferential	75.57			100%
75mm	Inferential	453.45			500%
100mm	Inferential	680.17			50%
150mm and larger	Inferential	1,133.62			67%

Notes : There is no availability charges for sanitation
Firms include industrial and commercial firms, government departments and agencies

Table 2.7: Kouga Local Municipality water service tariffs for the 2008/09 financial year

(all pricing excludes VAT)

Description kl		Tariff use potable water R/kl	Tariff for sanitation R/kl	Water service tariff R/kl	Increase
VARIABLE CHARGES					
Residential premises (Potable water usage) -					
0-25		3.84		3.84	
26-45		4.79		4.79	25%
46-65		7.67		7.67	60%
66-85		9.59		9.59	25%
85>		11.51		11.51	20%
Hgh density consumer and shops		3.84		3.84	
Industrial area (Humansdorp)		5.75		5.75	
Trade effluent (industry) reduced by an applied hydraulic formula dependent on the nature of the business (flow meters are used to assess)[1]			1.68	1.68	
FIXED CHARGES		**R/month**	**R/month**	**R/month**	
Sanitation availability fee:					
Hankey -					
Low cost housing (waterborne)			34.63	34.63	
Septic tanks - domestic			112.22	112.22	
Septic tanks - business			120.24	120.24	
Humansdorp -					
Vacant stands - domestic			72.64	72.64	
Buckets - domestic			60.92	60.92	
Households/flats (waterborne)			87.97	87.97	
Hospitals	**Per 10m^2 or part thereof of the area of buildings and improvements**		136.39	136.39	
Government			109.10	109.10	
Business/Local Government			63.65	63.65	
Others non residential			32.91	32.91	
St Francis Bay -					
All properties (developed)			129.20	129.20	
Serviced properties (undeveloped)			152.08	152.08	
Jeffreys Bay -					
Low cost housing (waterborne)			38.31	38.31	
Households/flats (waterborne)			129.20	129.20	
Patensie -					
Septic tanks - domestic			112.22	112.22	
Septic tanks - business			120.24	120.24	
Water availability fee:					
All areas		58.33		58.33	
Water Minimum/basic charge:					
Domestic and commercial		43.00		43.00	
Industry (Humansdorp/Jeffreys)		75.00		75.00	

Note: Kouga Local Municipality has an extremely complex tariff structure that is applied differently in each of the areas represented by the municipality. The tariff also differs in many instances where the structure might be the same.

Table 2.7: continued

[1] The charge payable in terms of paragraph (a) and (b) above shall be assessed according to the formula : **R=Vx[CA + B] + C X S X 10~~3]** where:

R = The treatment cost.
V = The volume of industrial effluent discharged from the premises during the cycle concerned in cubic meters.
A&B = The capital cost (interest and redemption) plus maintenance cost for the cycle concerned on the pipe system as used by the concerned consumer divided by the total flow for the cycle. The value of **A** being 69.56 cents per cubic meter. The value of **B** being 60.11 cents per cubic meter.
C = The cost of treating one cubic meter of waste water. The value of **C** being 38.27 cents per cubic meter.
S = The average chemical oxygen demand in mg/l measured on the industrial effluent during the cycle

2.7 AN ANALYSIS OF THE TARIFF STRUCTURES

There are various features that stand out in the various municipalities' tariff structures:

- **The steps of the structure are uneven and there are differences in the scale of steps between potable water and sanitation.** ADM applies an increasing blocked tariff to full charge-paying households. The blocked tariffs have a range of six tariffs with the largest block being 500 kl and above, which is classified as a bulk tariff and represents the highest tariff. ADM reduces the potable water (PW) consumption by 80% to determine the consumption of outflow management capacity. KLM applies a fixed tariff, which is almost an average of the five blocked tariffs used to charge for PW consumption of the full paying household. The municipality only charges Jeffreys Bay a consumption charge for outflow management capacity. NMBM charges firms a fixed tariff per kilolitre consumption and does not apply a blocked tariff. The tariff is equal to the first block of the full charge-paying household. The municipality applies a hydraulic reduction of 95% for firms. Increasing blocked tariffs are applied by all of the reference municipalities. The difference is the tariff charged and the varying number of steps in the blocked tariff structure. The block threshold for the municipalities also differ (ADM=500 kl; NMBM=60 KL and KLM=85 KL). Jeffreys Bay is the only area in KLM that is charged for consumption of the outflow management system. ADM and NMBM reduce the PW consumption by the hydraulic value of 80% and 60% respectively in order to determine the charge.
- **Regarding a Demand Management (DM) charge** for the degree of access to PW and the OMI, KLM charges varying tariffs for access to OMI dependent on the service provided. NMBM also charges this category for availability but does not charge for access to the OMI systems, a consistent practice for all of the NMBM categories. The reference municipalities do not consider the size of the household when determining the availability charge.
- **There is an "assistance to the poor" (ATTP) policy but, generally speaking, users are charged for first 6 kl/m despite the constitutional right of receipt.** Both the KLM and ADM refer to the assistance provided to the poor and pensioners as indigent support. The KLM provides free basic water for all of its households (6 kl/month) which is billed to the ES, there is no charge for outflow management capacity. The charge for the degree of access to both potable water (PW) and outflow management infrastructure (OMI) is recovered from ES. ADM does not charge households for any of the elements if the household receives an RDP level of service. Other households with a higher level of service in the category receive a free allocation of 6 kl per month. In the case of outflow management, the charge for access and the PW

hydraulic reduction of 80% (of 6 kl) is also free and in all instances recovered from ES. NMBM provides for a programme formalised as, "assistance to the poor" (ATTP). The programme provides assistance from ES, which funds the degree of access for both PW and OMI. It also funds 8 kl of PW consumption per month and the hydraulically reduced consumption of outflow management capacity. Registration for assistance is determined by using household income as an indicator, which differs from reference municipality to reference municipality.

- **The availability charge is levied in some cases but not others**. Although the reference municipalities have a sound understanding of the costs of providing water services, both variable and fixed, these costs are not applied to the extent of determining the total fixed costs (TFC) or total variable costs (TVC) for each of the categories of consumers. Both the KLM and ADM charge for access to both the PW and OMI systems, the NMBM does not charge for access to the OMI system. The charges differ between schemes controlled by ADM and the charges also differ in KLM. They depend on area. NMBM, on the other hand, provides for a variety of availability charges dependent on the size and type of water meter.
- **High tariffs for water service users in poor areas.**
- **Large differences in tariff structures between the different Local Municipalities**, for instance, the initial rate is twice as high in Ngqushwa as in Mbhashe.
- **In municipal areas serving the poor 75% of revenue from water service provision is from the treasury (from the Equitable Share fund),** while in areas serving the communities that mainly pay for service (like NMBM), this proportion is 25%. There are a number of variances in how the poor and pensioners benefit from the equitable share (ES); a national grant received and used for the provision of basic services to the poor at the various reference sites. An equal number of variances are also found within the application of tariffs, as determined from the tariff books of each of the municipalities (which are reviewed annually).
- Tables 2.8 to 2.10 summarize the key features of the relevant selected water service tariff systems.

Table 2.8: NMBM water service tariff analysis

Broad identified user category	Charge for degree of access to potable water (PW)	Charge per kilolitre (kl) for consumption of potable water (PW)	Charge for degree of access to the outflow management infrastructure (OMI)	Charge per kilolitre (kl) for consumption of outflow management capacity	Demand management adjustment
Those qualifying for reduction/exemption (poor and pensioners – ATTP)	ATTP qualifying households are charged for the full cost. The charge is paid on behalf of the registered household from equitable share (ES). The tariff is linked to a cost structure of a 15 mm connection.	ATTP qualifying households are charged for the full cost of consumption. The cost of 8 kl per month is paid on behalf of the registered household from ES. All consumption above 8 kl is paid by the household and is subject to increasing blocked pricing.	The municipality does not charge for degree of access to the outflow management infrastructure.	Qualifying households are charged for the full consumption of potable water per month less 60% multiplied by the tariff. The charge equivalent to 8 kl of potable water being consumed is paid on behalf of the registered household from ES. All charges above this amount are paid by the household.	None
Industrial and commercial firms, government departments and agencies (Firms)	A range of availability charges are applied depending on the nominal meter size of the meter (15 mm to 150 mm and larger) this is an indicator of the supply required.	Firms pay a fixed tariff for consumption. Firms are not subject to block pricing. The charge is equal to the first block used for household consumption.	The municipality does not charge for degree of access to the outflow management infrastructure.	The total potable water consumed less 95% and multiplied by the tariff provides the charge for consumption of outflow management capacity.	None
Full charge paying household	All households are charged an availability tariff. The tariff is linked to a cost structure of a 15 mm connection.	Increasing blocked pricing is used for consumption 0 kl to 30 kl, 31 kl to 60 kl and consumption thereafter.	The municipality does not charge for degree of access to the outflow management infrastructure.	The total potable water consumed less 60% and multiplied by the tariff provides the charge for consumption of outflow management capacity	None

Table 2.9: KLM water service tariff analysis

Broad identified user category	Charge for degree of access to potable water (PW)	Charge per kilolitre (kl) for consumption of potable water (PW)	Charge for degree of access to the outflow management infrastructure (OMI)	Charge per kilolitre [kl] for consumption of outflow management capacity	Demand management adjustment
Those qualifying for reduction/exemption (poor and pensioners – Indigent consumers).	All households are charged an availability tariff. Households registered for indigent support are allocated an amount per month to assist with paying for services.	All households are allocated a monthly free basic allocation of PW – 6 kl. All consumption above this amount is charged to the consumer. Households registered for indigent support are allocated an amount per month to assist with paying for services.	Households are charged an availability fee at different tariffs dependent on service (waterborne sewerage, bucket system, conservancy). Refer indigent support.	No consumption charge is levied via a tariff. Except for Jeffreys Bay where a tariff is levied on consumption.	None
Industrial and commercial firms, government departments and agencies (Firms)	All firms pay an availability charge. The amount is nominal.	Firms pay a fixed tariff for consumption. Firms are not subject to increasing blocked pricing.	Firms are charged an availability fee at different tariffs dependent on service (waterborne sewerage, conservancy).	No consumption charge is levied via a tariff. Except for Jeffreys Bay where a tariff is levied on consumption.	None
Full charge paying household	All households are charged an availability tariff.	Increasing blocked pricing is used for consumption. Five categories of pricing are recognised, the last being 85 kl plus	Households are charged an availability fee at different tariffs dependent on service (waterborne sewerage, bucket system, conservancy).	No consumption charge is levied via a tariff. Except for Jeffreys Bay where a tariff is levied on consumption.	None

Table 2.10: ADM water service tariff analysis

Broad identified user category	Charge for degree of access to potable water (PW)	Charge per kilolitre (kl) for consumption of potable water ([PW)	Charge for degree of access to the outflow management infrastructure (OMI)	Charge per kilolitre (kl) for consumption of outflow management capacity	Demand management adjustment
Those qualifying for reduction/exemption (poor and pensioners – Indigent consumers).	RDP (communal stand pipes) level of service is not charged for access. All other households are charged for access. This cost is billed to the ES.	RDP (communal stand pipes) level of service is not charged for consumption of the first 6 kl potable water consumed. This cost is billed to the ES. Tariffs vary between water schemes	Households are charged an availability fee. This cost is billed to the ES.	Qualifying households are charged for the full consumption of potable water per month less 80% multiplied by the tariff. The charge equivalent to 6 kl of potable water being consumed is paid on behalf of the registered household from ES. All charges above this amount are paid by the household.	None
Industrial and commercial firms, government departments and agencies (Firms)	All firms are charged an availability tariff. The tariff differs between water schemes.	Increasing blocked pricing is used for consumption, six blocks have been recognised. The highest block being 500 kl and above, catering for both household and firm consumption. Tariffs vary between water schemes.	Firms are charged an availability fee.	The total potable water consumed less 80% and multiplied by the tariff provides the charge for consumption of outflow management capacity.	None
Full charge paying household	All households are charged an availability tariff. The tariff differs between water schemes.	Increasing blocked pricing is used for consumption, six blocks have been recognised. The highest block being 500 kl and above, catering for both household and firm consumption. Tariffs differ between water schemes.	Households are charged an availability fee.	The total potable water consumed less 60% and multiplied by the tariff provides the charge for consumption of outflow management capacity	None

2.8 CONCLUSION

The three Eastern Cape reference municipalities are keenly sensitive to the constraints they face. They recover costs, they distinguish between access (fixed) and use related costs (variable), they provide for cross-subsidisation of powerful socio-political groups (the poor) and have tariff strategies for managing short-run water scarcity situations. The ADM applies an increasing block tariff across the board, without there being any link to water supply availability. They all are committed to adhering to National policy on water service provision, but within the poorer ADM this has meant that a minimal service is rendered by some of the local municipalities.

CHAPTER 3

FEATURES AND PRACTICE OF SOUTH AFRICAN MUNICIPAL WATER SERVICE TARIFF SETTING

3.1 INTRODUCTION

For the purpose of describing features and practice of South African municipal water service setting outside of the Eastern Cape, information was elicited from fifteen other municipalities. These municipalities were selected randomly from a list of municipalities that are legislated water service providers. The municipalities selected are representative of all provinces in South Africa and the various categories of municipalities, category A (metropolitan); category B (local); and category C (district).

Table 3.1 lists the 15 additional municipalities that were selected for financial analysis of water service tariff setting. The table indicates the municipality's name, province and category.

Table 3.1: List of 15 other municipalities selected for analysis of water service tariff setting

Municipality	Province	Category
City of Cape Town Municipality	Western Cape	A
Stellenbosch Municipality	Western Cape	B
George Municipality	Western Cape	B
Mangaung Municipality	Free State	B
Emfuleni Municipality	Gauteng	B
Randfontein Municipality	Gauteng	B
Midvaal Municipality	Gauteng	B
uMhlatuze Municipality	KwaZulu-Natal	B
Ugu District Municipality	KwaZulu-Natal	C
Greater Tzaneen Municipality	Limpopo	B
Polokwane Municipality	Limpopo	B
Musina	Limpopo	B
Steve Tshwete Municipality	Mpumalanga	B
Rustenburg Municipality	North West	B
Sol Plaatjie Municipality	Northern Cape	B

In addition to the financial data collected, a survey was also completed that covered, inter alia:

- Processes followed in scheme (cost) selection water service provision options (choices);
- Processes followed in determination of willingness/capacity of users to pay for water services;
- Processes followed in matching cost choices with user willingness to pay;
- Method by which non-financial sustainability objectives are accommodated in the tariff setting; and a
- Self assessment of successes and failures of the current water service tariffs setting arrangements.

A total of 8 municipalities completed the latter surveys (see Table 3.2 below). The analysis of these is reported in Section 3.5 of this chapter.

Table 3.2: List of 8 municipalities responding to processes they followed in setting the tariffs

Municipality	Province	Category
Cape Town	Western Cape	A
Stellenbosch	Western Cape	B
Emfuleni	Gauteng	B
Richards Bay (uMhlatuze)	KwaZulu-Natal	B
Musina	Limpopo	B
Steve Tshwete	Mpumalanga	B
Sol Plaatjie	Northern Cape	B
Potchefstroom	North West	B

3.2 THE MUNICIPAL BUDGET PROCESS UNDERLYING TARIFF SETTING

The primary planning tool for the water services of a municipality is the WSDP. The WSDP formalizes the level of service provision, it assesses and determines the backlog in service level, it determines the cost of achieving the service level and defines a strategy of eradicating backlogs. The WSDP must allow for the assessment of all water related infrastructure, and must reflect on the socio-economic profile of the municipal area, including consumer, service, water resource, customer service and financial profiles. The WSDP further takes stock of the water balance and provides for strategies on how to reduce unaccounted for, or alternatively, non-revenue water.

Water and sanitation services are reflected as separate cost centres in a budget of a municipality. These services are financially ring-fenced and their accounting statements reflect own assets, liabilities and operational costs and income.

A municipality may operate the water and sanitation services as a trading service. This is a service for which the tariffs are fixed in such a way that the provision of the services yields a trading surplus, allowing service cross-subsidisation. The municipality may also operate the services as economic or subsidised services. The former is a service for which tariffs are fixed in such a way that the costs of providing the service may be recovered without providing for a profit while the latter is a service for which the tariffs are fixed in such a way that the costs of providing the service are recovered as far as possible with the balance of the costs recovered by subsidy.

The National Treasury Local Government Budget and Expenditure Review (2008), provides annual parameters for increases in various cost categories found within a municipal budget. These parameters are used as a guide when compiling budgets over the medium term (three years). A municipality considers the National Treasury parameters during the determination of the municipal budget strategy, which is proposed to Council for adoption. This strategy, in addition to the parameters, considers the cost drivers within a budget, and any unique circumstances over the medium term and economic and other growth factors, for instance, service expansion programmes.

The established municipal parameter is considered during the determination of the medium term expenditure budget (MTEF). A mixture of both zero-based, trend and escalation (inflationary) budgeting is used in determining the MTEF. During the determination of the costs of providing a service, a municipality takes into consideration:

- The cost of bulk purchases of water from DWA, when the municipality does not have its own water resource or augments its own water resource with a bulk purchase from a DWAF owned resource;

- Raw water extraction costs from own source;
- Distribution costs to the consumer,
- Distribution losses;
- Maintenance of infrastructure (pump stations, pipelines, reservoirs) and other fixed assets (vehicles, plant and equipment);
- Administrative and service costs, including but not limited to:
    - ❖ Interdepartmental costs (Budget and Treasury, Corporate Service, legal costs, etc.);
    - ❖ Provision for non-payment of services by consumers (provision for bad debts);
    - ❖ All other ordinary overhead costs such as electricity, stationery, insurance, licensing of vehicles, purchase of chemicals, etc.
- The intended surplus or loss to be reflected as an operating result for the period under consideration, depending on whether the service is managed as a trading, economic or subsidised service;
- Contribution to the Asset Financing Fund (AFF), which is used as a reserve to provide for the replacement, refurbishment and extension of water services (infrastructure and other fixed assets);
- The costs of approved indigent relief measures when assisting the poor;
- Finance charge costs associated with the repayment of any external loan funding or other instrument used to fund capital expenditure;
- Depreciation costs;
- Cross-subsidisation to other services, for example, the Rate and General account.

When determining the service costs, the municipality evaluates previous year consumption trends. These trends are measured against past droughts, water restriction, floods and growth in service provision. The result of this evaluation is used as a base for tariff application in order to recover the costs of providing the service.

Before determining the tariff/s, other revenue sources, besides the revenue from consumption are determined, for example, revenue from water and sewage connections, water delivery by tankers, search fees, meter testing, etc. For the purposes of this study, such income will be referred to as other income, as the focus of the research is on tariffs associated with consumption rather than once off revenue.

The operating costs comprise of variable, fixed costs and transfers. Variable costs vary with a unit of measure and fixed costs are incurred irrespective of a unit of measure, for example, salaries and finance charges. Table 2.3 provides the basis employed in this study for the financial classification of operating variable and fixed costs, as well as the identification of the transfer (redistribution) cost (see Chapter 2). This classification analysis is shown in Tables 3.3-3.12. The information for these tables was derived from the operating and capital budgets of the reference municipalities. New infrastructure for water services is primarily funded from external sources and the operating cost of the new infrastructure is already included in the figures provided in Tables 3.3- 3.12. The operating budget provides a balance between operating costs and revenue. The latter is derived primarily from tariffs.

The total operating budgets for the water and sanitation services of the combination of three Eastern Cape and fifteen other reference municipalities (18 in total) amounted to R4,864 billion and R2,348 billion, respectively.

The operating costs are primarily funded from consumptive income, interest earned on outstanding debts, government grants (equitable share) and sundry income. The latter includes public contributions and donations. Consumptive income, which is calculated from a unit of measure and tariff, accounts for 74% of the operating income. Government grants account for 12% of the operating income which is primarily derived equitable share – an unconditional grant primarily used to fund the provision of basic services, and also linked to the tariff. Government grants are influenced by the unit of measure and tariff used to calculate the consumptive income.

Consumptive income is made up of availability charges, sale of water to other municipalities or entities, and per unit (kilolitres of water) metered charges for water supplied and effluent discharged or disposed of. Availability charges are fixed charges levied monthly, irrespective of the actual volume of water supplied or amount of effluent discharged or disposed of. Availability charges account for 2% of total income of the reference municipalities.

Of the operating costs the purchase of bulk water accounts for 15%, repairs and maintenance for 9%, administration and service costs for 16%, contributions from the public and donations 4% and relief to the poor 8%. Variable costs account for 25% of total operating costs and fixed costs for 54%. The cost of transfers accounts for 21% of total operating costs.

The consolidated financial data of the eighteen reference municipalities (3 Eastern Cape plus 15 Other) reflects that both the water and sanitation services cross-subsidise rate and general services (Table 3.3). The reference municipalities employ a mixture of operating strategies (trading, economic or subsidised). The consolidated result financial data reflects that water is an economic service and that sanitation is a trading service. The aforementioned is determined by considering the planned financial result for the financial year and in addition the difference between operation expenditure and income. Tables 3.4-3.6 indicate the financial data of the separate categories of municipality. The metropolitan municipalities operate water as a subsidised service and sanitation a trading service. The local municipalities operate both services as a trading service and the district municipalities operate water as a subsidised service and sanitation as an economic service. The strategies are of minor financial significance. They provide for an accumulated 1%.

Table 3.3: Consolidated result of 18 reference municipalities

2008/09 FINANCIAL YEAR			
	All reference muns.		% of
Operating Costs	**Water**	**Sanitation**	**Total**
Variable Costs	**1,106,504,195**	**689,544,980**	**25%**
Repairs and maintenance of infrastructure and other fixed assets	326,193,501	291,579,552	**9%**
Administrative and service costs, including but not limited to:	-	-	
Interdepartmental costs	780,310,694	397,965,428	**16%**
	-	-	
Fixed Costs	**3,053,763,876**	**857,921,977**	**54%**
Bulk Water costs	1,094,265,671	-	**15%**
Contribution to the capital replacement reserve	294,682,246	49,377,985	**5%**
Administrative overheads	1,219,508,993	502,375,884	**24%**
Finance charge costs	125,491,628	117,020,050	**3%**
Depreciation costs	319,815,338	189,148,059	**7%**
Cost of transfers	**704,106,690**	**800,818,455**	**21%**
ATTP cost of relief - varies according to consumption	403,856,251	205,867,599	**8%**
Assets as a result of public contributions and donations	78,803,000	217,176,000	**4%**
Provision for non-payment of services by consumers	275,476,108	186,094,531	**6%**
Cross-subsidisation [Rate and General or other service]	69,352,447	20,838,000	**1%**
Planned result [surplus/loss/break even]	-123,381,116	170,842,325	**1%**
TOTAL OPERATING EXPENDITURE [A]	**4,864,374,761**	**2,348,285,413**	**100%**
Operating Income			
Consumptive Income			
Availability Charges	78,082,380	39,064,263	**2%**
Metered when not categorised	1,501,016,148	627,444,929	**28%**
Metered Charges Within - Commercial	368,806,079	206,611,179	**8%**
Metered Charges Within - Industrial	138,383,800	70,139,530	**3%**
Metered Charges Within - Residential	1,682,889,390	858,533,166	**34%**
Reclaimed Water	1,462,690	-	**0%**
	3,761,517,127	**1,801,793,067**	**74%**
Interest Earned - Outstanding Debtors	**123,184,789**	**48,478,688**	**2%**
	-	-	
Government Grants and Subsidies	**709,571,121**	**233,055,903**	**12%**
	-	-	
Other Income	-	-	
Sundry Income	81,959,612	56,994,171	**2%**
Public contrib. & Donations Revenue	135,108,375	264,319,873	**5%**
Internal charges Distribution Statements	116,195,086	35,923,218	**2%**
Future Depreciation -CR & DPC	64,133,330	55,790,430	**2%**
Pail Service	-	16,202,840	**0%**
Trade Effluent	-	47,308,256	**1%**
	397,396,402	**476,538,787**	**12%**
TOTAL OPERATING INCOME [B]	**4,991,669,440**	**2,559,866,446**	**100%**
Equitable Share as a proportion of total income	**14%**	**9%**	
Consumptive Income as a proportion of total income	**75%**	**69%**	

3.3 VARIATIONS IN FINANCIAL DATA OF THE THREE DIFFERENT CATEGORIES OF MUNICIPALITIES

The financial data collected and represented per category of municipality is part of Tables 3.4-3.6. The total operating budgets for the water and sanitation services of the metropolitan municipalities amount to R2,546 billion and R1,628 billion, respectively. The local municipalities operating budgets amounted to R1,837 billion for the water service and R620 million for sanitation service. The total operating budgets for the district municipalities amounted to R481 million for the water service and R109 million for the sanitation service. The two reference district municipalities render the water and sanitation services on behalf of the local municipalities in the respective districts.

Consumptive income introduced in section 3.1 above accounts for 74% of the operating income of the metropolitan municipalities operating income, 78% of the local municipalities operating income and 53% of the district municipalities. Government Grants account for 4% of the operating income for the metropolitan municipalities, 18% of the operating income of local municipalities and a material 45% of the operating income of district municipalities.

District municipalities are reliant to a larger degree on government grants to finance their operations than metropolitan and local municipalities. The latter are able to generate the majority of their operating income and are therefore less reliant than district municipalities on government grants. District municipalities are representative of smaller less urban municipalities. This has an impact on the operating strategies related to the water and sanitation services. (Refer comments regarding operating strategies below.)

Availability charges account for 1% of the total operating income of the metropolitan municipalities, 1% of total operating income of local municipalities and 6% of the district municipalities operating income for the water and sanitation services.

The metropolitan and local municipalities recover a large portion of the operation costs using metered charges instead of availability charges (which are fixed charges levied monthly, irrespective of the actual volume of water supplied or amount of effluent discharged or disposed of).

The variation in the percentage of availability charges compared to total operating income is analysed further when reviewing the tariff structures used by each of the reference municipalities. Typically the cost per kilolitre of water in district municipalities is lower than that charged by metropolitan and local municipalities; this being as a result of the larger availability charges being levied by district municipalities.

Of the operating costs of metropolitan municipalities, the purchase of bulk water accounts 7%, repairs and maintenance for 8%, administration and service costs for 11%, contributions from the public and donations 7% and relief to the poor 14%. Variable costs account for 19% of total operating costs and fixed costs for 53%. The cost of transfers accounts for 28% of total operating costs.

The purchase of bulk water accounts for 31% of the operating costs for the local municipalities and 8% of operating costs for the district municipalities. The provision of bulk water from various sources is partly responsible for the variation in costs. Municipalities are charged for extracting raw water from bulk sources managed by the DWA. There are also cheaper municipal owned sources of bulk water.

Repairs and maintenance account for 10% of the operating costs of the local municipalities and 6% of the operating costs of district municipalities. The water and sanitation service is dependent on large scale infrastructure. The metropolitan and local municipalities allocate a greater percentage of operating costs to repairs and maintenance than district municipalities. This could be as a result of new infrastructure not requiring maintenance or the operating strategy adopted to provide the water and sanitation services and funding availability. The district municipalities are dependent on government grants to maintain the infrastructure, and these do not increase as usage of the infrastructure increases.

The administration and service costs of the local and district municipalities are larger than the administration costs for the metropolitan municipalities. As a percentage of operating costs, administration and service costs are 23% and 28% respectively.

Only the metropolitan municipalities benefit from public contributions and donations. This could primarily be due to the nature of the development taking place in the various reference categories. It is dependent on development strategies of the municipalities.

Relief to the poor costs are inconsistently applied by the reference municipalities. The metropolitan municipalities provide 14% of total operating cost for relief, the local municipalities 0,6% and the district municipalities 3%. This category of relief to the poor is typically covered by government grant funding.

Variable costs account for 19% of the metropolitan municipalities operating costs, 33% of the local municipalities operating costs and 34% of the district municipalities operating costs. Fixed costs account for 53% of the metropolitan municipalities operating costs, 55% of the local municipalities operating costs and 61% of the district municipalities operating costs. The cost of transfers account for 28% of the metropolitan municipalities operating costs, 12% of the local municipalities operating costs and 6% of the district municipalities operating costs.

The variations between variable and fixed costs and the cost of transfer are typically influenced by the service strategies adopted by the various municipalities. The metropolitan municipalities operate water as a subsidised service and sanitation a trading service. The local municipalities operate both services as a trading service and the district municipalities operate water as a subsidised service and sanitation as an economic service.

Only the metropolitan and local municipalities have provided for cross-subsidisation service strategies. The cost of this strategy compared to the operating cost amounts to 3% for the local municipalities and 1% for metropolitan municipalities. The actual profit or loss incurred in providing any service within a municipality has cross-subsidisation implications. If for example the water service is run at a loss, the loss is carried by other services rendered by the municipality.

Table 3.4: Consolidated result of the Category A municipalities

2008/09 FINANCIAL YEAR

Operating Costs	TOTAL Water	TOTAL Sanitation	% of Total
Variable Costs	**391,662,020**	**393,416,550**	**19%**
Repairs and maintenance of infrastructure and other fixed assets	163,881,000	179,333,850	**8%**
Administrative and service costs, including but not limited to:	-	-	
Interdepartmental costs	227,781,020	214,082,700	**11%**
	-	-	
Fixed Costs	**1,647,534,400**	**559,437,960**	**53%**
Bulk Water costs	295,338,000	-	**7%**
Contribution to the capital replacement reserve	253,003,050	32,899,440	**7%**
Administrative overheads	869,195,380	338,475,020	**29%**
Finance charge costs	82,076,830	88,844,500	**4%**
Depreciation costs	147,921,140	99,219,000	**6%**
Cost of transfers	**506,774,730**	**674,714,090**	**28%**
ATTP cost of relief - varies according to consumption	390,946,500	196,840,640	**14%**
Assets as a result of public contributions and donations	78,803,000	217,176,000	**7%**
Provision for non-payment of services by consumers	163,798,230	108,580,450	**7%**
Cross-subsidisation [Rate and General or other service]	20,000,000	-	**0%**
Planned result [surplus/loss/break even]	-146,773,000	152,117,000	**0%**
TOTAL OPERATING EXPENDITURE [A]	**2,545,971,150**	**1,627,568,600**	**100%**
Operating Income			
Consumptive Income			
Availability Charges	44,269,590	9,506,000	**1%**
Metered when not categorised	-	-	**0%**
Metered Charges Within - Commercial	273,902,260	185,419,800	**11%**
Metered Charges Within - Industrial	130,183,800	70,139,530	**5%**
Metered Charges Within - Residential	1,532,643,650	832,303,220	**57%**
Reclaimed Water	882,690	-	**0%**
	1,972,758,630	**1,097,368,550**	**74%**
Interest Earned - Outstanding Debtors	**121,346,000**	**46,663,130**	**4%**
	-	-	
Government Grants and Subsidies	**116,545,400**	**63,050,640**	**4%**
	-	-	
Other Income	-	-	
Sundry Income	44,640,910	29,655,010	**2%**
Public contrib. & Donations Revenue	122,429,000	257,247,000	**9%**
Internal charges Distribution Statements	90,863,000	33,850,910	**3%**
Future Depreciation -CR & DPC	59,141,490	50,635,800	**3%**
Pail Service	-	16,202,840	**0%**
Trade Effluent	-	32,894,720	**1%**
	317,074,400	**420,486,280**	**18%**
TOTAL OPERATING INCOME [B]	**2,527,724,430**	**1,627,568,600**	**100%**
Equitable Share as a proportion of total income	**5%**	**4%**	
Consumptive Income as a proportion of total income	**78%**	**67%**	

Table 3.5: Consolidated result of the Category B municipalities

2008/09 FINANCIAL YEAR			
	TOTAL		% of
Operating Costs	**Water**	**Sanitation**	**Total**
Variable Costs	**549,071,972**	**265,231,722**	**33%**
Repairs and maintenance of infrastructure and other fixed assets	137,617,266	103,390,460	**10%**
Administrative and service costs, including but not limited to:	-	-	
Interdepartmental costs	411,454,707	161,841,262	**23%**
	-	-	
Fixed Costs	**1,101,907,701**	**249,504,363**	**55%**
Bulk Water costs	754,305,178	-	**31%**
Contribution to the capital replacement reserve	21,163,196	16,478,545	**2%**
Administrative overheads	167,543,165	135,515,432	**12%**
Finance charge costs	38,930,151	22,998,653	**3%**
Depreciation costs	119,966,011	74,511,734	**8%**
	-	0	
Cost of transfers	**186,421,676**	**104,950,813**	**12%**
ATTP cost of relief - varies according to consumption	4,197,440	2,617,420	**0%**
Assets as a result of public contributions and donations	-	-	**0%**
Provision for non-payment of services by consumers	92,015,571	63,830,582	**6%**
Cross-subsidisation [Rate and General or other service]	49,352,447	20,838,000	**3%**
Planned result [surplus/loss/break even]	40,856,218	17,664,811	**2%**
TOTAL OPERATING EXPENDITURE [A]	**1,837,401,349**	**619,686,899**	**100%**
Operating Income			
Consumptive Income			
Availability Charges	15,724,093	10,619,715	**1%**
Metered when not categorised	1,406,262,904	561,570,577	**70%**
Metered Charges Within - Commercial	68,368,802	21,191,379	**3%**
Metered Charges Within - Industrial	8,200,000	-	**0%**
Metered Charges Within - Residential	62,537,510	26,229,946	**3%**
Reclaimed Water	580,000	-	**0%**
	1,561,673,309	**619,611,617**	**78%**
Interest Earned - Outstanding Debtors	**1,838,789**	**1,815,558**	**0%**
	-	-	
Government Grants and Subsidies	**344,912,789**	**155,428,495**	**18%**
	-	-	
Other Income	-	-	
Sundry Income	27,142,241	26,073,603	**2%**
Public contrib. & Donations Revenue	12,389,375	7,072,873	**1%**
Internal charges Distribution Statements	23,864,086	2,072,308	**1%**
Future Depreciation -CR & DPC	4,991,840	5,154,630	**0%**
Pail Service	-	-	**0%**
Trade Effluent	-	14,038,848	**0%**
	68,387,542	**54,412,261**	**4%**
TOTAL OPERATING INCOME [B]	**1,976,812,429**	**831,267,932**	**100%**
Equitable Share as a proportion of total income	**17%**	**19%**	
Consumptive Income as a proportion of total income	**79%**	**73%**	

Table 3.6: Consolidated result of the Category C municipalities

2008/09 FINANCIAL YEAR

Operating Costs	GRAND TOTAL Water	GRAND TOTAL Sanitation	% of Total
Variable Costs	**165,770,203**	**30,896,708**	**34%**
Repairs and maintenance of infrastructure and other fixed assets	24,695,236	8,855,242	**6%**
Administrative and service costs, including but not limited to:	-	-	
Interdepartmental costs	141,074,967	22,041,466	**28%**
	-	-	
Fixed Costs	**304,321,775**	**48,979,654**	**61%**
Bulk Water costs	44,622,493	-	**8%**
Contribution to the capital replacement reserve	20,516,000	-	**4%**
Administrative overheads	182,770,448	28,385,432	**36%**
Finance charge costs	4,484,647	5,176,897	**2%**
Depreciation costs	51,928,187	15,417,325	**12%**
Cost of transfers	**10,910,284**	**21,153,552**	**6%**
ATTP cost of relief - varies according to consumption	8,712,311	6,409,539	**3%**
Assets as a result of public contributions and donations	-	-	**0%**
Provision for non-payment of services by consumers	19,662,307	13,683,499	**6%**
Cross-subsidisation [Rate and General or other service]	-	-	**0%**
Planned result [surplus/loss/break even]	-17,464,334	1,060,514	**-3%**
TOTAL OPERATING EXPENDITURE [A]	**481,002,262**	**101,029,914**	**100%**
Operating Income			
Consumptive Income			
Availability Charges	18,088,697	18,938,548	**6%**
Metered when not categorised	94,753,244	65,874,352	**27%**
Metered Charges Within - Commercial	26,535,017	-	**5%**
Metered Charges Within - Industrial	-	-	**0%**
Metered Charges Within - Residential	87,708,230	-	**15%**
Reclaimed Water	-	-	**0%**
	227,085,188	**84,812,900**	**53%**
	-	0	
Interest Earned - Outstanding Debtors	**-**	**-**	**0%**
	-	-	
Government Grants and Subsidies	**248,112,932**	**14,576,768**	**45%**
	-	-	
Other Income	-	-	
Sundry Income	10,176,460	1,265,558	**2%**
Public contrib. & Donations Revenue	290,000	-	**0%**
Internal charges Distribution Statements	1,468,000	-	**0%**
Future Depreciation -CR & DPC	-	-	**0%**
Pail Service	-	-	**0%**
Trade Effluent	-	374,688	**0%**
	11,934,460	**1,640,246**	**2%**
TOTAL OPERATING INCOME [B]	**487,132,580**	**101,029,914**	**100%**
Equitable Share as a proportion of total income	**51%**	**14%**	
Consumptive Income as a proportion of total income	**47%**	**65%**	

3.4 VARIATIONS IN FINANCIAL DATA OF THE DIFFERENT PROVINCES

Tables 3.7-3.12 provide the consolidations of the financial data per province. The total operating budgets of the reference municipalities for the water service of the Western Cape, Gauteng, Limpopo, Eastern Cape, Free State, KwaZulu-Natal, Mpumalanga, North West and Northern Cape Provinces respectively, amounted to R2,138 billion, R482 million, R180 million, R772 million, R316 million, R568 million, R47 million, R238 million and R124 million. The sanitation service budgeted costs for the nine provinces amounted to R1,307 billion, R168 million, R47 million, R477 million, R88 million, R158 million, R34 million, R29 million and R41 million, respectively.

Consumptive income varies from 99% of total operating income in the Northern Cape to as little as 52% in the Eastern Cape. Municipalities with lower consumptive income compared to total operating income typically have a higher government grant allocation to the services. The Eastern Cape municipalities allocate 24% of government grants to the services to compensate for the lower consumptive income.

The variable costs of the reference municipalities vary from 8% of total operating costs for the water and sanitation services in the Free State Province to 61% in the KwaZulu-Natal Province. These varying percentages are influenced by the amount of budget allocated to administrative and service costs and repairs and maintenance costs. The provinces with the higher variable costs have allocated a greater portion of the costs to repairs and maintenance. The KwaZulu-Natal Province municipalities allocate 51% of total operating costs to administration and service costs.

Fixed costs as a percentage of total operating costs vary from 81% (Free State Province) to 36% (Northern Cape). Average fixed costs are 54% for all the reference municipalities. The fixed costs are primarily as a result of high raw water and overhead costs. In the Free State Province a total of 42% of the water service is allocated to the purchase of bulk water. The allocation for the purchase of bulk water compared to the operating costs amounts to 49% in Gauteng Province and 36% in the Limpopo Province. The bulk purchase of raw water is influenced by the ease of access to raw water supplies. The contribution to the capital replacement reserve (to finance new capital and to rehabilitate existing capital) is reflective of the decay in water and sanitation services infrastructure. These contributions range from as low as 0% (North West Province) to as high as 9% of total operating cost. The average contribution for all the reference municipalities was 5% of total operating cost.

There is uncertainty among municipalities over the most desirable method of providing for replacement of capital (infrastructure). If provision is made at replacement value the cost of the depreciation provision would be much higher in almost all cases, and would require much higher water tariffs to be set in order to cover the costs. For this reason municipal water service tariffs currently under recover the costs of providing water services.

The cost of transfers for the various provinces ranges from 1% in the Limpopo Province to 29% in the Gauteng Province. In the Eastern Cape public contribution and donations make up 10% of total operating costs, cross-subsidisation of the Rate and General Service 2% and relief provided to the poor 12%.

The water and sanitation service strategies vary from province to province. The service strategies also typically differ from municipality to municipality. Stellenbosch and George municipalities operate the water service and sanitation services as a trading service and the Cape Town municipality operates the

water service as a subsided service and the sanitation service as a trading service. Similar variation in method are to be found in each of the provinces which has more than one reference municipality.

Table 3.7: Western Cape 3 reference municipalities and total

2008/09 FINANCIAL YEAR	WESTERN CAPE								
	Cape Town		Stellenbosch		George		TOTAL		% of
Operating Costs	Water	Sanitation	Water	Sanitation	Water	Sanitation	Water	Sanitation	Total
Variable Costs	**274,093,000**	**246,884,000**	**19,652,232**	**11,999,317**	**7,803,000**	**8,065,000**	**301,548,232**	**266,948,317**	**16%**
Repairs and maintenance of infrastructure and other fixed assets	85,676,000	81,750,000	8,847,338	4,728,505	7,803,000	8,065,000	102,326,338	94,543,505	**6%**
Administrative and service costs, including but not limited to:							-	-	
Interdepartmental costs	188,417,000	165,134,000	10,804,895	7,270,812			199,221,895	172,404,812	**11%**
Fixed Costs	**1,398,467,000**	**415,980,000**	**26,214,766**	**14,846,016**	**31,782,000**	**30,212,000**	**1,456,463,766**	**461,038,016**	**56%**
Bulk Water costs	259,178,000		10,072,821	-			269,250,821	-	**8%**
Contribution to the capital replacement reserve	190,013,000	6,018,000	-	-	3,060,000	5,100,000	193,073,000	11,118,000	**6%**
Administrative overheads	753,036,000	263,392,000	11,367,811	10,743,682	12,126,000	10,759,000	776,529,811	284,894,682	**31%**
Finance charge costs	73,597,000	78,052,000	7,177	103,948	6,831,000	6,611,000	80,435,177	84,766,948	**5%**
Depreciation costs	122,643,000	68,518,000	4,766,957	3,998,387	9,765,000	7,742,000	137,174,957	80,258,387	**6%**
Cost of transfers	**339,010,000**	**560,313,000**	**6,719**	**-**	**41,278,000**	**18,873,000**	**380,294,719**	**579,186,000**	**28%**
ATTP cost of relief - varies according to consumption	325,429,000	133,790,000					325,429,000	133,790,000	**13%**
Assets as a result of public contributions and donations	1,203,000	169,376,000					1,203,000	169,376,000	**5%**
Provision for non-payment of services by consumers	159,151,000	105,030,000	6,719		2,000,000	1,200,000	161,157,719	106,230,000	**8%**
Cross-subsidisation [Rate and General or other service]	-				23,839,000	9,638,000	23,839,000	9,638,000	**1%**
Planned result [surplus/loss/break even]	-146,773,000	152,117,000			15,439,000	8,035,000	-131,334,000	160,152,000	**1%**
TOTAL OPERATING EXPENDITURE [A]	**2,011,570,000**	**1,223,177,000**	**45,873,717**	**26,845,334**	**80,863,000**	**57,150,000**	**2,138,306,717**	**1,307,172,334**	**100%**
Operating Income									
Consumptive Income									
Availability Charges	4,125,000	9,506,000	283,893	544,165	6,200,000		10,608,893	10,050,165	**1%**
Metered when not categorised			58,123,858	24,213,134	65,500,000	46,000,000	123,623,858	70,213,134	**6%**
Metered Charges Within - Commercial	224,755,000	137,025,000	-	-			224,755,000	137,025,000	**10%**
Metered Charges Within - Industrial	83,550,000	41,381,000		-			83,550,000	41,381,000	**4%**
Metered Charges Within - Residential	1,363,546,000	699,885,000		-			1,363,546,000	699,885,000	**59%**
Reclaimed Water							-	-	
	1,675,976,000	**887,797,000**	**58,407,751**	**24,757,299**	**71,700,000**	**46,000,000**	**1,806,083,751**	**958,554,299**	**79%**
Interest Earned - Outstanding Debtors	**100,000,000**	**36,000,000**	**-**	**481,769**	**1,550,000**	**1,150,000**	**101,550,000**	**37,631,769**	**4%**
							-	-	
Government Grants and Subsidies	**42,500,000**	**-**	**1,656,940**	**2,833,301**			**44,156,940**	**2,833,301**	**1%**
							-	-	
Other Income							-	-	
Sundry Income	20,738,000	19,619,000	2,459,938	8,246,612	4,642,000	8,505,000	27,839,938	36,370,612	**2%**
Public contrib. & Donations Revenue	44,829,000	209,447,000	-	-			44,829,000	209,447,000	**7%**
Internal charges Distribution Statements	89,162,000	26,924,000	2,440,502	794,970	1,000,000	-	92,602,502	27,718,970	**3%**
Future Depreciation -CR & DPC	38,365,000	24,445,000	-	-	1,971,000	1,495,000	40,336,000	25,940,000	**2%**
Pail Service			-	-			-	-	
Trade Effluent		18,945,000	-	5,533,348			-	24,478,348	**1%**
	193,094,000	**299,380,000**	**4,900,440**	**14,574,929**	**7,613,000**	**10,000,000**	**205,607,440**	**323,954,929**	**15%**
TOTAL OPERATING INCOME [B]	**2,011,570,000**	**1,223,177,000**	**64,965,131**	**42,647,299**	**80,863,000**	**57,150,000**	**2,157,398,131**	**1,322,974,299**	**100%**
Equitable Share as a proportion of total income	**2%**	**0%**	**3%**	**7%**	**0%**	**0%**	**2%**	**0%**	
Consumptive Income as a proportion of total income	**83%**	**72%**	**90%**	**57%**	**89%**	**80%**	**84%**	**72%**	

Table 3.8: Gauteng 3 reference municipalities and total

2008/09 FINANCIAL YEAR	GAUTENG								
	Emfuleni		Randfontein		Midvaal		TOTAL		% of
Operating Costs	Water	Sanitation	Water	Sanitation	Water	Sanitation	Water	Sanitation	Total
Variable Costs	**65,382,361**	**57,842,761**	**13,813,000**	**23,315,000**	**6,711,400**	**6,447,573**	**85,906,761**	**87,605,334**	**27%**
Repairs and maintenance of infrastructure and other fixed assets	28,013,416	38,508,545	1,185,000	783,000	2,108,000	1,623,000	31,306,416	40,914,545	**11%**
Administrative and service costs, including but not limited to:							-	-	
Interdepartmental costs	37,368,945	19,334,216	12,628,000	22,532,000	4,603,400	4,824,573	54,600,345	46,690,789	**16%**
							-	-	
Fixed Costs	**256,951,138**	**3,134,813**	**31,484,000**	**825,000**	**44,773,138**	**9,319,252**	**333,208,276**	**13,279,065**	**53%**
Bulk Water costs	255,000,000		28,674,000		35,970,000		319,644,000	-	**49%**
Contribution to the capital replacement reserve					-		-	-	
Administrative overheads					4,978,843	5,952,997	4,978,843	5,952,997	**2%**
Finance charge costs					2,905,821	1,715,752	2,905,821	1,715,752	**1%**
Depreciation costs	1,951,138	3,134,813	2,810,000	825,000	918,474	1,650,503	5,679,612	5,610,316	**2%**
Cost of transfers	**41,881,619**	**60,901,961**			**20,491,138**	**5,793,831**	**62,372,757**	**66,695,792**	**20%**
ATTP cost of relief - varies according to consumption							-	-	
Assets as a result of public contributions and donations							-	-	
Provision for non-payment of services by consumers	41,881,619	60,901,961			-	150,000	41,881,619	61,051,961	**16%**
Cross-subsidisation [Rate and General or other service]							-	-	
Planned result [surplus/loss/break even]					20,491,138	5,643,831	20,491,138	5,643,831	**4%**
TOTAL OPERATING EXPENDITURE [A]	**364,215,118**	**121,879,535**	**45,297,000**	**24,140,000**	**71,975,676**	**21,560,656**	**481,487,794**	**167,580,191**	**100%**
Operating Income									
Consumptive Income									
Availability Charges					6,800,000	8,400,000	6,800,000	8,400,000	**2%**
Metered when not categorised	371,533,480	165,043,648	48,915,000	15,894,000		9,332,700	420,448,480	190,270,348	**80%**
Metered Charges Within - Commercial					8,500,000		8,500,000	-	**1%**
Metered Charges Within - Industrial					8,200,000		8,200,000	-	**1%**
Metered Charges Within - Residential					36,875,500		36,875,500	-	**5%**
Reclaimed Water					580,000		580,000	-	
	371,533,480	**165,043,648**	**48,915,000**	**15,894,000**	**60,955,500**	**17,732,700**	**481,403,980**	**198,670,348**	**89%**
Interest Earned - Outstanding Debtors							-	-	
							-	-	
Government Grants and Subsidies	**36,041,480**	**10,285,256**	**4,259,000**	**3,228,000**	**8,827,175**	**2,077,956**	**49,127,655**	**15,591,212**	**9%**
							-	-	
Other Income							-	-	
Sundry Income					1,372,720	50,000	1,372,720	50,000	**0%**
Public contrib. & Donations Revenue					795,000		795,000	-	**0%**
Internal charges Distribution Statements	12,051,740		110,000	400,000	25,281		12,187,021	400,000	**2%**
Future Depreciation -CR & DPC							-	-	
Pail Service							-	-	
Trade Effluent						1,700,000	-	1,700,000	
	12,051,740	**-**	**110,000**	**400,000**	**2,193,001**	**1,750,000**	**14,354,741**	**2,150,000**	**3%**
TOTAL OPERATING INCOME [B]	**419,626,700**	**175,328,904**	**53,284,000**	**19,522,000**	**71,975,676**	**21,560,656**	**544,886,376**	**216,411,560**	**100%**
Equitable Share as a proportion of total income	**9%**	**6%**	**8%**	**17%**	**12%**	**10%**	**9%**	**7%**	
Consumptive Income as a proportion of total income	**89%**	**94%**	**92%**	**81%**	**84%**	**43%**	**88%**	**88%**	

Table 3.9: Limpopo 3 reference municipalities and total

2008/09 FINANCIAL YEAR	LIMPOPO								
	Greater Tzaneen		Musina		Polokwane		TOTAL		% of
Operating Costs	Water	Sanitation	Water	Sanitation	Water	Sanitation	Water	Sanitation	Total
Variable Costs	**18,229,000**	**9,829,000**	**4,589,354**	**3,195,732**	**36,361,175**	**10,487,110**	**59,179,529**	**23,511,842**	**36%**
Repairs and maintenance of infrastructure and other fixed assets	3,968,000	3,668,000	1,686,983	647,156	20,325,015	5,885,610	25,979,998	10,200,766	**16%**
Administrative and service costs, including but not limited to:							-	-	
Interdepartmental costs	14,261,000	6,161,000	2,902,371	2,548,576	16,036,160	4,601,500	33,199,531	13,311,076	**20%**
Fixed Costs	**3,995,000**	**793,000**	**8,754,529**	**-**	**106,566,685**	**22,591,695**	**119,316,214**	**23,384,695**	**63%**
Bulk Water costs	880,000				80,000,000		80,880,000	-	**36%**
Contribution to the capital replacement reserve			725,166			10,843,125	725,166	10,843,125	**5%**
Administrative overheads			7,416,339		24,369,215	10,948,110	31,785,554	10,948,110	**19%**
Finance charge costs			613,024				613,024	-	
Depreciation costs	3,115,000	793,000			2,197,470	800,460	5,312,470	1,593,460	**3%**
							-	-	
Cost of transfers	**-**	**-**	**1,500,000**	**-**	**-**	**-**	**1,500,000**	**-**	**1%**
ATTP cost of relief - varies according to consumption							-	-	
Assets as a result of public contributions and donations							-	-	
Provision for non-payment of services by consumers							-	-	
Cross-subsidisation [Rate and General or other service]			1,500,000				1,500,000	-	**1%**
Planned result [surplus/loss/break even]							-	-	
TOTAL OPERATING EXPENDITURE [A]	**22,224,000**	**10,622,000**	**14,843,883**	**3,195,732**	**142,927,860**	**33,078,805**	**179,995,743**	**46,896,537**	**100%**
Operating Income									
Consumptive Income									
Availability Charges							-	-	
Metered when not categorised	17,886,000	5,091,000	12,215,649	3,148,700	87,471,000	24,466,830	117,572,649	32,706,530	**67%**
Metered Charges Within - Commercial							-	-	
Metered Charges Within - Industrial							-	-	
Metered Charges Within - Residential							-	-	
Reclaimed Water							-	-	
	17,886,000	**5,091,000**	**12,215,649**	**3,148,700**	**87,471,000**	**24,466,830**	**117,572,649**	**32,706,530**	**67%**
Interest Earned - Outstanding Debtors							-	-	
							-	-	
Government Grants and Subsidies	**8,612,000**		**2,702,265**		**42,299,755**		**53,614,020**	-	**24%**
							-	-	
Other Income							-	-	
Sundry Income		142,000			5,315,200	1,087,420	5,315,200	1,229,420	**3%**
Public contrib. & Donations Revenue							-	-	
Internal charges Distribution Statements					7,841,905	719,055	7,841,905	719,055	**4%**
Future Depreciation -CR & DPC							-	-	
Pail Service							-	-	
Trade Effluent						6,805,500	-	6,805,500	**3%**
	-	**142,000**	**-**	**-**	**13,157,105**	**8,611,975**	**13,157,105**	**8,753,975**	**10%**
TOTAL OPERATING INCOME [B]	**26,498,000**	**5,233,000**	**14,917,914**	**3,148,700**	**142,927,860**	**33,078,805**	**184,343,774**	**41,460,505**	**100%**
Equitable Share as a proportion of total income	**33%**	**0%**	**18%**	**0%**	**30%**	**0%**	**29%**	**0%**	
Consumptive Income as a proportion of total income	**67%**	**97%**	**82%**	**100%**	**61%**	**74%**	**64%**	**79%**	

Table 3.10: Eastern Cape 3 reference municipalities and total

2008/09 FINANCIAL YEAR	EASTERN CAPE								
	Nelson Mandela Bay		Amathole DM		Kouga		TOTAL		% of
Operating Costs	Water	Sanitation	Water	Sanitation	Water	Sanitation	Water	Sanitation	Total
Variable Costs	**117,569,020**	**146,532,550**	**8,527,586**	**1,563,242**	**5,096,370**	**2,839,170**	**131,192,976**	**150,934,962**	**23%**
Repairs and maintenance of infrastructure and other fixed assets	78,205,000	97,583,850	8,527,586	1,563,242	2,525,840	1,763,260	89,258,426	100,910,352	**15%**
Administrative and service costs, including but not limited to:			-	-			-	-	
Interdepartmental costs	39,364,020	48,948,700	-	-	2,570,530	1,075,910	41,934,550	50,024,610	**7%**
Fixed Costs	**249,067,400**	**143,457,960**	**178,320,990**	**23,501,389**	**25,512,300**	**16,660,960**	**452,900,690**	**183,620,309**	**51%**
Bulk Water costs	36,160,000		28,872,493	-	8,850,890		73,883,383	-	**6%**
Contribution to the capital replacement reserve	62,990,050	26,881,440	20,516,000	-	2,004,800	81,820	85,510,850	26,963,260	**9%**
Administrative overheads	116,159,380	75,083,020	100,298,116	11,998,172	8,749,030	8,744,950	225,206,526	95,826,142	**26%**
Finance charge costs	8,479,830	10,792,500	1,706,338	300,000	2,865,320	3,494,360	13,051,488	14,586,860	**2%**
Depreciation costs	25,278,140	30,701,000	26,928,043	11,203,217	3,042,260	4,339,830	55,248,443	46,244,047	**8%**
Cost of transfers	**167,764,730**	**114,401,090**	**8,910,284**	**19,853,552**	**11,117,540**	**7,648,600**	**187,792,554**	**141,903,242**	**26%**
ATTP cost of relief - varies according to consumption	65,517,500	63,050,640	8,712,311	6,409,539	4,197,440	2,617,420	78,427,251	72,077,599	**12%**
Assets as a result of public contributions and donations	77,600,000	47,800,000	-	-			77,600,000	47,800,000	**10%**
Provision for non-payment of services by consumers	4,647,230	3,550,450	17,662,307	12,383,499	1,994,020	1,045,200	24,303,557	16,979,149	**3%**
Cross-subsidisation [Rate and General or other service]	20,000,000		-	-			20,000,000	-	**2%**
Planned result [surplus/loss/break even]	-		-17,464,334	1,060,514	4,926,080	3,985,980	-12,538,254	5,046,494	**-1%**
TOTAL OPERATING EXPENDITURE [A]	**534,401,150**	**404,391,600**	**195,758,860**	**44,918,183**	**41,726,210**	**27,148,730**	**771,886,220**	**476,458,513**	**100%**
Operating Income									
Consumptive Income									
Availability Charges	40,144,590		18,088,697	18,938,548	2,440,200	1,675,550	60,673,487	20,614,098	**7%**
Metered when not categorised			36,108,351	12,587,999	30,793,530	15,185,490	66,901,881	27,773,489	**8%**
Metered Charges Within - Commercial	49,147,260	48,394,800					49,147,260	48,394,800	**8%**
Metered Charges Within - Industrial	46,633,800	28,758,530	-	-			46,633,800	28,758,530	**6%**
Metered Charges Within - Residential	169,097,650	132,418,220	-	-			169,097,650	132,418,220	**25%**
Reclaimed Water	882,690						882,690	-	**0%**
	296,782,630	**209,571,550**	**54,197,048**	**31,526,547**	**33,233,730**	**16,861,040**	**384,213,408**	**257,959,137**	**52%**
Interest Earned - Outstanding Debtors	**21,346,000**	**10,663,130**	**-**	**-**			**21,346,000**	**10,663,130**	**3%**
Government Grants and Subsidies	**74,045,400**	**63,050,640**	**139,496,876**	**13,376,768**	**4,671,640**	**6,044,020**	**218,213,916**	**82,471,428**	**24%**
Other Income									
Sundry Income	23,902,910	10,036,010	306,935	14,868	800,000	584,040	25,009,845	10,634,918	**3%**
Public contrib. & Donations Revenue	77,600,000	47,800,000	290,000	-			77,890,000	47,800,000	**10%**
Internal charges Distribution Statements	1,701,000	6,926,910	1,468,000	-			3,169,000	6,926,910	**1%**
Future Depreciation -CR & DPC	20,776,490	26,190,800	-	-	3,020,840	3,659,630	23,797,330	29,850,430	**4%**
Pail Service		16,202,840	-	-			-	16,202,840	**1%**
Trade Effluent		13,949,720					-	13,949,720	**1%**
	123,980,400	**121,106,280**	**2,064,935**	**14,868**	**3,820,840**	**4,243,670**	**129,866,175**	**125,364,818**	**20%**
TOTAL OPERATING INCOME [B]	**516,154,430**	**404,391,600**	**195,758,859**	**44,918,183**	**41,726,210**	**27,148,730**	**753,639,499**	**476,458,513**	**100%**
Equitable Share as a proportion of total income	**14%**	**16%**	**71%**	**30%**	**11%**	**22%**	**29%**	**17%**	
Consumptive Income as a proportion of total income	**57%**	**52%**	**28%**	**28%**	**80%**	**56%**	**51%**	**50%**	

Table 3.11: Free State and KwaZulu-Natal, 3 reference municipalities

2008/09 FINANCIAL YEAR	TOTAL FREE STATE			KWAZULU NATAL						
	Mangaung		% of	uMhlathuze		Ugu (district)		TOTAL		% of
Operating Costs	Water	Sanitation	Total	Water	Sanitation	Water	Sanitation	Water	Sanitation	Total
Variable Costs	**20,820,763**	**10,305,052**	**8%**	**191,986,520**	**66,413,792**	**157,242,617**	**29,333,466**	**349,229,137**	**95,747,258**	**61%**
Repairs and maintenance of infrastructure and other fixed assets	10,847,893	10,305,052	**5%**	31,527,718	20,847,332	16,167,650	7,292,000	47,695,368	28,139,332	**10%**
Administrative and service costs, including but not limited to:								-	-	
Interdepartmental costs	9,972,870	-	**2%**	160,458,802	45,566,460	141,074,967	22,041,466	301,533,769	67,607,926	**51%**
Fixed Costs	**249,539,068**	**78,103,612**	**81%**	**81,487,595**	**35,457,723**	**126,000,785**	**25,478,265**	**207,488,380**	**60,935,988**	**37%**
Bulk Water costs	170,799,693		**42%**	25,711,000		15,750,000	-	41,461,000	-	**6%**
Contribution to the capital replacement reserve	-					-	-	-	-	
Administrative overheads	66,206,169	49,190,288	**29%**	19,106,808	25,050,631	82,472,332	16,387,260	101,579,140	41,437,891	**20%**
Finance charge costs	797,171	1,459,488	**1%**	17,273,561	6,107,576	2,778,309	4,876,897	20,051,870	10,984,473	**4%**
Depreciation costs	11,736,035	27,453,836	**10%**	19,396,226	4,299,516	25,000,144	4,214,108	44,396,370	8,513,624	**7%**
Cost of transfers	**45,566,240**	**-**	**11%**	**9,013,447**	**-**	**2,000,000**	**1,300,000**	**11,013,447**	**1,300,000**	**2%**
ATTP cost of relief - varies according to consumption								-	-	
Assets as a result of public contributions and donations								-	-	
Provision for non-payment of services by consumers	45,566,240		**11%**			2,000,000	1,300,000	2,000,000	1,300,000	
Cross-subsidisation [Rate and General or other service]				9,013,447				9,013,447	-	**1%**
Planned result [surplus/loss/break even]								-	-	
TOTAL OPERATING EXPENDITURE [A]	**315,926,071**	**88,408,664**	**100%**	**282,487,562**	**101,871,515**	**285,243,402**	**56,111,731**	**567,730,964**	**157,983,246**	**100%**
Operating Income										
Consumptive Income										
Availability Charges							-	-	-	
Metered when not categorised	285,953,701	106,554,681	**70%**	96,010,270	47,455,839	58,644,893	53,286,353	154,655,163	100,742,192	**33%**
Metered Charges Within - Commercial				59,868,802	21,191,379	26,535,017	-	86,403,819	21,191,379	**14%**
Metered Charges Within - Industrial						-		-	-	
Metered Charges Within - Residential				25,662,010	26,229,946	87,708,230	-	113,370,240	26,229,946	**18%**
Reclaimed Water								-	-	
	285,953,701	**106,554,681**	**70%**	**181,541,082**	**94,877,164**	**172,888,140**	**53,286,353**	**354,429,222**	**148,163,517**	**65%**
Interest Earned - Outstanding Debtors								-	-	
								-	-	
Government Grants and Subsidies	**75,832,018**	**85,209,425**	**29%**	**102,630,296**	**23,848,225**	**108,616,056**	**1,200,000**	**211,246,352**	**25,048,225**	**31%**
								-	-	
Other Income								-	-	
Sundry Income	1,800,676	1,851,595	**1%**	7,646,091	3,968,895	9,869,525	1,250,690	17,515,616	5,219,585	**3%**
Public contrib. & Donations Revenue				5,749,049				5,749,049	-	**1%**
Internal charges Distribution Statements								-	-	
Future Depreciation -CR & DPC								-	-	
Pail Service								-	-	
Trade Effluent						-	374,688	-	374,688	**0%**
	1,800,676	**1,851,595**	**1%**	**13,395,140**	**3,968,895**	**9,869,525**	**1,625,378**	**23,264,665**	**5,594,273**	**4%**
TOTAL OPERATING INCOME [B]	**363,586,395**	**193,615,701**	**100%**	**297,566,518**	**122,694,284**	**291,373,721**	**56,111,731**	**588,940,239**	**178,806,015**	**100%**
Equitable Share as a proportion of total income	**21%**	**44%**		**34%**	**19%**	**37%**	**2%**	**36%**	**14%**	
Consumptive Income as a proportion of total income	**79%**	**55%**		**61%**	**77%**	**59%**	**95%**	**60%**	**83%**	

Table 3.12: Mpumalanga, North West and Northern Cape, 3 reference municipalities

2008/09 FINANCIAL YEAR	MPUMALANGA			NORTH WEST			NORTHRN CAPE		
	Steve Tshwete		% of	Rustenburg		% of	Sol Plaatjie		% of
Operating Costs	**Water**	**Sanitation**	**Total**	**Water**	**Sanitation**	**Total**	**Water**	**Sanitation**	**Total**
Variable Costs	**9,010,286**	**6,710,668**	**19%**	**93,836,000**	**24,159,000**	**44%**	**55,780,511**	**23,622,547**	**48%**
Repairs and maintenance of infrastructure and other fixed assets	1,743,770	2,587,485	**5%**	3,533,000	71,000	**1%**	13,502,293	3,907,515	**11%**
Administrative and service costs, including but not limited to:									
Interdepartmental costs	7,266,516	4,123,183	**14%**	90,303,000	24,088,000	**43%**	42,278,218	19,715,032	**38%**
			0%						
Fixed Costs	**37,140,122**	**27,012,794**	**79%**	**144,345,000**	**4,769,000**	**56%**	**53,362,360**	**5,778,498**	**36%**
Bulk Water costs	2,620,774		**3%**	107,726,000		**40%**	28,000,000		**17%**
Contribution to the capital replacement reserve	1,373,230	453,600	**2%**				14,000,000		**8%**
Administrative overheads	13,222,950	14,125,774	**34%**						
Finance charge costs	1,003,893	851,865	**2%**				6,633,184	2,654,664	**6%**
Depreciation costs	18,919,275	11,581,555	**38%**	36,619,000	4,769,000	**15%**	4,729,176	3,123,834	**5%**
Cost of transfers	**566,973**	**533,421**	**1%**	-	-		**15,000,000**	**11,200,000**	**16%**
ATTP cost of relief - varies according to consumption									
Assets as a result of public contributions and donations									
Provision for non-payment of services by consumers	566,973	533,421	**1%**						
Cross-subsidisation [Rate and General or other service]							15,000,000	11,200,000	**16%**
Planned result [surplus/loss/break even]									
TOTAL OPERATING EXPENDITURE [A]	**46,717,381**	**34,256,883**	**100%**	**238,181,000**	**28,928,000**	**100%**	**124,142,871**	**40,601,045**	**100%**
Operating Income									
Consumptive Income									
Availability Charges									
Metered when not categorised	34,920,310	21,164,430	**71%**	172,811,000	38,370,000	**74%**	124,129,106	39,650,125	**99%**
Metered Charges Within - Commercial									
Metered Charges Within - Industrial									
Metered Charges Within - Residential									
Reclaimed Water									
	34,920,310	**21,164,430**	**71%**	**172,811,000**	**38,370,000**	**74%**	**124,129,106**	**39,650,125**	**99%**
Interest Earned - Outstanding Debtors	**288,789**	**183,789**	**1%**						
Government Grants and Subsidies	**856,220**	**5,607,312**	**8%**	**56,524,000**	**16,295,000**	**26%**			
Other Income									
Sundry Income	1,866,851	440,121	**3%**	1,225,000	247,000	**1%**	13,765	950,920	**1%**
Public contrib. & Donations Revenue	5,845,326	7,072,873	**16%**						
Internal charges Distribution Statements	394,658	158,283	**1%**						
Future Depreciation -CR & DPC									
Pail Service									
Trade Effluent									
	8,106,835	**7,671,277**	**19%**	**1,225,000**	**247,000**	**1%**	**13,765**	**950,920**	**1%**
TOTAL OPERATING INCOME [B]	**44,172,154**	**34,626,808**	**99%**	**230,560,000**	**54,912,000**	**100%**	**124,142,871**	**40,601,045**	**100%**
Equitable Share as a proportion of total income	**2%**	**16%**		**25%**	**30%**		**0%**	**0%**	
Consumptive Income as a proportion of total income	**79%**	**61%**		**75%**	**70%**		**100%**	**98%**	

3.5 SURVEY RESULTS ON CHARGING THE MUNICIPAL WATER SERVICE USERS

Surveys requesting information on various aspects of the tariff setting process were sent out to 30 municipalities selected outside of the Eastern Cape Province – 8 were returned. An analysis of these returns is shown in Tables 3.13 to 3.20 below.

The main legal requirements municipalities perceive facing them in setting water service tariffs are the Water Services Act (1977), the Municipal Financial Management Act (2003) and municipal by-laws (see Table 4.13), but a wide range of other Law and policy is also referred to, including the National Water Act (1998), DWA Framework for Water Services (2003), SALGA documents and Treasury directives.

Table 3.13: Main legal requirements and other policy guiding municipalities in water service tariff setting

Municipality	Legal Requirements	Other Policy
Cape Town (Western Cape)	(1)Water Services Act (1997) (2) Municipal Systems Act (2000 and as amended 2003) (3) Municipal Financial Management Act (2003) Section 62 – Accounting control, Risk Management and Audit requirements	(1) DWA Framework for Water Services 2003
Stellenbosch (Western Cape)	(1) Water Services Act (1997) (2) Municipal Financial Management Act (2003) (3) Constitution (1996) (4) Municipal Structures Act (1998)	(1) Tariff Policy (2) SALGA (3) SAAWU (4) Change in CPIX (5) MFMA Circular 48 requires that increases above 6% be motivated and explained
Emfuleni (Gauteng)	(1) Water Services Act (1997)	(1) Local government financial best practice
Richards Bay (KwaZulu-Natal)	(1)Water Services Act (1997)	
Musina (Limpopo)	(1) Water Services Act (1997) (2) Municipal Financial Management Act (2003)	(1) National Treasury guidelines (2) Credit control policy (annually reviewed)
Steve Tshwete (Mpumalanga)	(1) Water Services Act (1997)	(1) Tariff policy (2) Water by laws (3) MFMA circulars (4) Budget circulars
Sol Plaatjie (Northern Cape)	(1) Water Services Act (1997) (2) MFMA (2003)	(1) Policy and law requiring statistical information on water use and loss, as well as future capital development
Potchefstroom (North West)	(1) Water Services Act (1997) (2) Municipal Financial Management Act (2003) (3) Constitution (1996) (4) Municipal Structures Act (1998) (5) Municipal System Act (6) National Water Act (1998) (7) National Water Amendment Act (1999) (8) Standard Water By-Laws (Administrator's notice 21 of 5 January 1977)	

Securing future water supplies for the municipalities is a shared responsibility – between the municipalities and DWA. The municipalities do not maintain schedules of supply options (cost of production and time frame for bringing into action) for the sources of their potable water or receiving and sanitising used water (Table 3.14). Each water service infrastructural development scheme is considered on a case by case basis.

Table 3.14: The existence of a schedule of water service supply schemes

Municipality	Schedule of schemes for new water supplies (Yes/No)	Schedule of schemes for improving treatment and disposal of used water
Cape Town (Western Cape)	No – each proposal evaluated in a prefeasibility analysis based on various factors, including unit cost. Responsibility shared with DWA	No – each proposal evaluated in a prefeasibility analysis based on various factors, including unit cost
Stellenbosch (Western Cape)	Yes – generate about 50-65% of own water	Not yet
Emfuleni (Gauteng)	No – all water supplied by Rand Water	Yes
Richards Bay (KwaZulu-Natal)	No	No
Musina (Limpopo)	No, but do make use of own water (Limpopo River)	No
Steve Tshwete (Mpumalanga)	Not necessary until recently, when reduced quota from Middelburg dam led to investigations to reclaim mine water	No
Sol Plaatjie (Northern Cape)	Yes – feasibility studies and capital requirement estimates, plus investigation of recycling of mine water	
Potchefstroom (North West)	No	No

Some municipalities participate fully with the DWA in the determination of the bulk water supply costs, but most do not (Table 3.15). The rate the DWA charges municipalities for raw water varies. It is as low as 30c/kl for some (like Stellenbosch) and above 70c/kl for others (like Potchefstroom). Some municipal officials responded that were unaware of what they paid for water, which was unfortunate, as they must have been paying for their water.

Table 3.15: Municipal costs of bulk raw water (excl VAT)

Municipality	Participation in setting DWA tariffs	Rate DWA charges you for water	Rate you are able to supply own water
Cape Town (Western Cape)*	Provincial Steering Committee Cooperation and partnership Local office interaction Comprehensive WSDP	Not available	Not available (total cost per kl = R6.80)
Stellenbosch (Western Cape)*	None	30.3c/kl	R0.50 per kl (50-65% of supply)
Emfuleni (Gauteng)	None	Operation and Maintenance 6.53c/kl Depreciation 10.73c/kl Return on assets 49.13c/kl	Do not supply self
Richards Bay (KwaZulu-Natal)	None	Do not purchase	Do not supply self
Musina (Limpopo)	Do not purchase from DWA – extract from Limpopo	Do not purchase	Not known
Steve Tshwete (Mpumalanga)	Mainly discussion on quota extracted from Komati Scheme	R2.64/kl	Less than R2/kl
Sol Plaatjie (Northern Cape)	None	Rate varies with consumption	Not readily available
Potchefstroom (North West)	None	Consumption = 66.39c/kl Catchment Management Authority = 1.55c/kl Research (WRC) = 3.36c/kl	R2.66/kl

Most municipalities find it useful to the distinguish charges for access (availability) and use. These municipalities believe fixed costs are an appropriate reference for determining the availability charge and variable costs an appropriate reference for determining the use charge (Table 3.16). No municipalities applied marginal cost principles as a guide for setting water service tariffs. The main tariff setting aim of municipalities is to administer a tariff structure that raises sufficient revenue to recover the financial costs of supply. The supply of service is a fixed variable in this model.

Table 3.16: Calculation of availability and use charges

Municipality	Method calculate availability charge	Method calculate use charge
Cape Town (Western Cape)	Initially connection size, after that by annual adjustment, subject to total availability income = total fixed costs (balance check)	Variable cost divided by quantity of chargeable reticulated water
Stellenbosch (Western Cape)	Fixed cost divided by number of users	Variable cost divided by quantity of chargeable reticulated water
Emfuleni (Gauteng)	Fixed cost divided by number of users initially then fixed percentage per annum	Fixed percentage per annum
Richards Bay (KwaZulu-Natal)	Do not set	Do not set
Musina (Limpopo)	Fixed cost divided by number of users	Variable cost scale of tariff according to consumption
Steve Tshwete (Mpumalanga)	Not separated – combined charge – chargeable water divided by total cost	Not separated – combined charge – chargeable water divided by total cost
Sol Plaatjie (Northern Cape)	Fixed cost divided by number of users plus annual adjustments	Total costs – tariff is stepped, based on consumption
Potchefstroom (North West)	Do not set	Variable cost divided by quantity of chargeable reticulated water

There is widespread acceptance of the practice of charging different groups different tariffs for their water services, and there were very few problems encountered in implementing this type of price discrimination (Table 3.17). The overwhelming majority of municipalities employ an increasing block structure, but one (Potchefstroom) also employed a declining block structure for its industrial consumers (Table 3.18). Among the more important groups identified are: full paying residents, part paying residents and business/government. The business and government consumers are typically charged flat rates approximately equal to the average cost of production or tariff level (Table 3.18). In all cases free basic water is provided to the resident group called the indigents (usually 6 kl per household per month), but this allowance is also often extended to full paying tariff groups as well. To belong to the indigent group documentary proof has to be supplied and these documents verified. The cost of administering the admission to indigent group process was not cited as onerous or excessive by any of the municipalities that responded.

Within the resident group as a whole, the most generally applied method for distinguishing different consumer groups is in the volume of water they are supplied, with those households who are supplied more, paying progressively more for the additional water they are metered to have been supplied (Table 3.17). The highest stepped tariff reported in this survey was for the residents of the City of Cape Town. Its residents pay R17.14 plus VAT per kl potable water consumed over 50 kl; an amount approximately three times higher than the average cost of capturing, treating and reticulating the water supplied to them (Table 3.17).

Table 3.17: Price discrimination between user groups

Municipality	Identified different user groups	Method used to allocate people to a group	Problems encountered in group jumping	Method by which amount of inter-group cross-subsidisation is set
Cape Town (Western Cape)	Domestic full Domestic cluster Industrial/Commercial Homeless people Vulnerable Groups of subsistence farmers Government Municipal Miscellaneous Schools/Community Bulk water (to other municipalities) Quantity Water consumed	Land use From homeless – annual affidavit with validation Water consumption	No	Test whole model with anticipated sales per tariff group to make balance with costs
Stellenbosch (Western Cape)	Domestic Domestic Cluster Commercial/Industrial Municipal/Leakages Miscellaneous/other	Demographics of town	Indigent have to go through an application process	Only the indigent users are subsidised – by Equitable share from govt
Emfuleni (Gauteng)	Normal groups	Indigent registration process	None	So long as balance achieved
Richards Bay (KwaZulu-Natal)	Residential Business/Commercial Clarified water Individual special business agreement, e.g. Exarro Sands	Land use indication	None	So long as balance achieved
Musina (Limpopo)	Business Industrial Government/Churches Residential	Indigent to state under oath their income	No – Indigent application process system	Only for indigents
Steve Tshwete (Mpumalanga)	Indigents Residential Business/Industry Departmental	Land use/zoning of property Indigent policy	Only registered indigent receive 4 kl free. All residential users receive 6 kl free	Increasing stepped tariff system
Sol Plaatjie (Northern Cape)	Residential Business Indigent	Land use Indigent policy	No	Only for indigents
Potchefstroom (North West)	By water quantity consumed	Quantity consumed	No	Rising block tariffs

Cape Town and Stellenbosch have multiple structures of water service tariffs, with higher structures applying to higher aggregate savings (demand constraint) targets, e.g. 10% or 20% aggregate savings. While all the municipalities surveyed found it desirable and feasible to charging different water service customers different tariffs, none employed a scientific method or formula or democratic approach by which to determine a scale of intergroup redistributive income transfer. The scale of cross

subsidisation was arbitrarily determined in all cases, within the constraint that total water services revenue raised should cover the costs of providing the water services.

Table 3.18: Nature of normal increasing block tariff structure applied (excl VAT)

Municipality	Residential per kl	Other per kl
Cape Town (Western Cape)*	R0-R17.14 (+50 kl/m)	Flat R6.59-R8.60
Stellenbosch (Western Cape)*	R3.11-R11.91 (+71 kl/m)	Flat R8.26
Emfuleni (Gauteng)	Yes – no details (max at 31 kl/m)	No detail
Richards Bay (KwaZulu-Natal)	R0-R4.54 (+30 kl)	Flat R1.27
Musina (Limpopo)	No details	No details
Steve Tshwete (Mpumalanga)	R0-R4.54 (+40 kl)	No details
Sol Plaatjie (Northern Cape)	Flat structure	Flat structure
Potchefstroom (North West)	R0-R4.40 (+80 kl)	Declining structure for industrial R4.00 for first 5000 kl and R3.60 per kl thereafter For other business R3.80/kl

Note * Higher scales relate to different water restriction/saving periods, e.g. 10%, or 20% or 30% saving targets, e.g. max rate at Stellenbosch for a 10% saving goes up to R15.94.

The municipalities find the increasing block tariff structure for residents appealing (Table 3.19) – it works well as a mechanism by which to limit increasing residential demand for water services (and so postpone the need to invest in additional water service infrastructure), it benefits the households with low water service demand (assumed to be the poor) at the cost of the high water service users (assumed to be the rich). Problems encountered in applying the system are minimal. They occur when payment for service is not directly linked to demand, for instance, where domestic clusters made up of many of households (formal and informal), are served by one meter and the bill paid by one entity. Some members making up formally recognised domestic clusters have expressed dissatisfaction that they are unable to take advantage of the low initial rates for individual household consumption. On a similar tack, some owners of informal domestic clusters (multiple households on one premise, e.g. owner plus other people renting plus workers) have expressed unhappiness that they are forced to pay high marginal tariffs because the number of users is high that makes up their cluster.

None of the municipalities surveyed made any provision in setting their tariff level for the environmental costs they imposed through their (inadequate) disposal of waste water (Table 3.19).

Table 3.19: Self-assessment of tariff structure

Municipality	Reason for tariff structure	Good aspects	Poor aspects	Are environmental costs of disposed used water built into tariffs?
Cape Town (Western Cape)*	City council adopted Water Conservation and Water Demand management strategy	Works a demand management strategy – postponing need for new water infrastructure	Domestic clusters – how introduce stepped tariff with 1 site meter and 1 account to body corporate	No, only actual payments made
Stellenbosch (Western Cape)*	Water conservation (high marginal tariffs discourage consumption)	Sustainability of service	Lack of community participation and knowledge	No
Emfuleni (Gauteng)	No		Scale is too wide – proposed reduced number of categories	No
Richards Bay (KwaZulu-Natal)	Curtail consumption Consumers pay more when using more	Tariffs are an easy way to limit consumption to supply Allows free water Analysis easy	None	No
Musina (Limpopo)	Operates well	Rich subsidise poor	Water services authority was transferred to the district	No
Steve Tshwete (Mpumalanga)	Adopted to subsidise poor residents and free basic water for all.	Cost of free water recovered in stepped tariffs Cost easily compared to income received No illegal connections	None	No – but as a result of blue drop requirements, this will be linked to tariffs in the future
Sol Plaatjie (Northern Cape)	Reduce water consumption	No consumer complaints have been received	Failures to prevent water losses	No
Potchefstroom (North West)	Free basic water	Whole structure	None	No

There is very little information gathered by the municipalities on the demand for water services by the users of their services (Table 3.20) and there is little evidence that demand informs the administered price structure in any way, other than incidentally. Municipalities are insensitive to losses of consumer surplus or in water demand or the rent on water resource exploitation, but are sensitive to losses of producer surplus by commerce and industry resulting from their water service tariff policy, e.g. the case of Exarro Sands at Richards Bay. Municipal demand analysis of water service provision is primarily:

- forecasting demand with a given tariff structure, based on what was demanded under a previous tariff structure
- setting tariffs that limit demand to what is immediately available.

Table 3.20: How information of the demand for water services is gathered

Municipality	How demand information is gathered
Cape Town (Western Cape)	Detailed analysis of one or two years actual consumption. Long term overall demand studies
Stellenbosch (Western Cape)	Past trends
Emfuleni (Gauteng)	Venus financial system
Richards Bay (KwaZulu-Natal)	Past consumption figures
Musina (Limpopo)	None
Steve Tshwete (Mpumalanga)	Not done
Sol Plaatjie (Northern Cape)	Done by trial and error – reaction to annual increase
Potchefstroom (North West)	Not done

3.6 CONCLUSION

Chapter 3 deduces the features and practices of municipal water service tariff setting within South Africa, based upon:
- 15 responses received from municipalities outside of the Eastern Cape and 3 within (18 in total), covering the financial information relevant to tariff setting and
- 8 responses relating to the thinking that underlay their water service tariff setting.

It is evident that:
- the financial information is available to set water service tariffs that reflect the financial costs of provision,
- there is widespread support for the increasing block structure – as an easy to apply mechanism to cross-subsidise the poor and curtail demand for water new water infrastructure, and
- there is little knowledge about the characteristics of water demand of the users within the municipal boundaries.

As is the case for the three Eastern Cape municipalities, the tariff arrangement is followed by the municipalities in the other provinces of South Africa effectively classes the water it supplies into three categories – **non-tariff water, water charged at average financial cost and water charged to balance total revenue with total financial cost:**
- non-tariff water relates to all water losses and water supplied at no charge or without national government subsidy support
- water charged at its average financial cost of production, e.g. to government, selected business firms, other municipalities and residents whose tariffs are paid out of equitable share on their behalf by National Government
- water charged to balance total revenue with total cost is the residual, and paid by residents and businesses not qualifying for average cost tariffs. Revenue is maximised from this group by means of price discrimination (and the capture of the consumer surplus), with those who are prepared to pay more for their water being charged more.

The good thing about this tariff and water classification system is that it works for the municipalities. **It is a system that enables municipalities to adjust to the different circumstances they face**, it is feasible to administer and can be made compatible with the constraints they face. However, there are three obvious economic concerns that these tariff arrangements also give rise to:

- whether the responsiveness of supply to demand is thereby undermined. Several municipalities reported an advantage of the system being that they could solve the problem of excess demand through a tariff hike rather than an increase supply; the former being cheaper
- whether this system is accommodative to water wastage/loss (and high non-tariff water levels) because the supplier (municipality) does not bear the burden of this loss – it is simply captured from consumers (transferred consumer surplus) using monopolistic power
- how to raise tariff revenue to cover for the full cost of water services, including depreciation provision for replacement of capital and environmental damage. Currently, tariffs are typically set at levels that under-recover costs.

Chapter 3 finds that municipalities set water service tariffs per level of household consumption that bring in enough revenue to match their financial costs, and that they typically employ increasing block tariffs in pursuing this objective. The latter is thought to have advantages as a tool of demand management and as a means to cross subsidise the demand of low water using residents by taxing the demand of high water using residents.

Chapter 4 analyzes the process of municipal tariff setting in South Africa by modelling it as a response to the circumstances they face.

CHAPTER 4

MODELLING THE SETTING OF MUNICPAL WATER SERVICE TARIFFS IN SOUTH AFRICA

4.1 MUNICIPAL MOTIVES IN SETTING WATER TARIFFS

There are undoubtedly many different goals that the different relevant municipal personnel are pursuing when they set their water service tariffs, but, as concluded in Chapter 1, a common and critically important element is compliance with national policy, directives and rules and with the integrated development plan. Underlying this objective (compliance) may be the goals of the provision for efficient provision water services and promoting the welfare of the water users (see also Appendix 5), but the links to what these municipalities do and the efficiency of provision and welfare of their water service consumers are indirect and imprecise.[3]

For this reason South African municipal tariff setting processes are not best modelled as ones aimed at optimising the wellbeing of water users, so much as ones conditioned by constraints and precedent. They face a challenging set of constraints:

- Compliance with legal requirements;
- Cost-recovery – a tariff must generate sufficient revenue to cover the costs of service provision;
- Accommodating (appeasement of) socio-political pressure for intra-water-service-provision income transfers;
- Not exceeding water availability – the short-run supply constraint;
- Affordability – there must be sufficient demand;
- Allowance for environmental opportunity cost.

These constraints define the feasible options ('space') for South African municipal tariff setting. Their choices within this space are inspired by past choices they have made, or legal rulings in this connection (precedent) and the reported experience and influence that choices of other municipalities have on them (peer guidance and mentoring).

4.2 THE LEGAL CONSTRAINT

4.2.1 STANDARDS

There are standards in water service delivery which municipalities are expected to attempt to attain, but the exact nature of these has become blurred in the light of Constitutional Court decisions. Until recently the courts had argued South African municipalities must provide the infrastructure necessary to supply 25 litres of potable water per person per day within 200 metres of where the person resides and at a rate of flow of at least 10 litres per minute. The key features are listed below.

Inflows:

- Quality potable water – grade 1 potable;
- Pressure – 10 litres per minute flow from a tap;
- Distribution: distance from residence – 200 metres;

[3] The concept of wellbeing employed here is a broad one, including sustainability of service, promotion of economic development within the relevant municipal region, poverty alleviation, positive liberty and fairness. Such thinking may well be present and underlie the national policy and development plans.

- Distribution: times available per day – 'reasonable time' (duration and time) and by which to access water every day;
- Quantity delivered per person/household – 25 litres per person per day.

However, meeting these requirements is subject to municipal discretion.[4] There are a number of guidelines that are laid down for the various types of water. For potable water the primary reference is the South African National Standards (SANS, 2008). These standards identify two classes of potable water: classes 1 and 2, with class 1 being the required standard. Specific health risks to consumers are identified for the reticulation of class 2 or lower quality potable water. A higher class 0 quality, similar to the World Health Organisation (WHO) standard for potable water, used to be identified by SANS, but is no longer so. In this sense the class 1 standard could be considered a lenient standard. Quality of water is classed in terms of the presence of other substances in the water, such solids and total dissolvable salts. This presence is measured by means of tests such as of the electrical conductivity of the water. More general quality standards for water service – potable, industrial and outflow (sewerage) disposed are laid down in the *DWAF Water Quality Guidelines* (2009). There is municipal discretion permitted in improving the quality of water above a class 1 standard and adding chemicals such as fluoride, but discretion to produce lower than class 2 water quality is excluded. There are also guidelines laid down for the receipt of waste water and effluent and the sanitation and disposal of the treated waste water.

The relevance of these requirements to tariff setting is that the standards set play a major role in determining the cost of water service provision. Decreased quality, reticulation flow (pressure size of piping) and the extent of distribution network reduce costs, while increased quality, reticulation pressure and extent of distribution network increase costs, BUT to a large extent this discretion is excluded by a combination of policy and Law.

4.2.2 REVENUE RAISING SCOPE

In raising revenue to recover the costs of providing water services a municipality may differentiate between different categories (tariff groups) of users and consumers in regard to tariffs that it levies (Local Government Financial Best Practice Manual, SALGA).

[4] The project team argued that there were two water allocation systems operating in South Africa – an individual rights based one and a tariff based one, and that the municipalities could only influence allocation through the tariff based one. The Constitution of South Africa (1996) requires the state to provide access to sufficient water to its residents. Members of the reference group of this study dispute the Project Team argument that municipalities do not also have discretion with respect to the (so-called) rights based allocation, citing the Constitutional ruling on the Phiri Residents vs. City of Johannesburg Case (8 October 2009). The court ruled, *inter alia*, (a) that the state has a constitutional obligation to progressively realize the right of access, but that the scope of this right was what was reasonable under the circumstances prevailing, (b) that means testing was consistent with the constitution, because it sought to ensure those who are most in need benefit (c) that determining basic allocations per stand rather than per person was consistent with the constitution because it was administratively too burdensome to determine the number of persons per stand (d) that cutting off water supplies to the poor after the free basic allocation per month had been provided was not a 'discontinuation' of service but a 'suspension' and that the latter was consistent with the constitution. The reference group view this ruling, in effect, as meaning that the municipalities had considerable discretion in allocating water service – providing they could justify their provision as 'reasonable progression' under the circumstances, i.e. that the provision of access to water services was really only a discretionary right (not something that all South African could or should expect to enjoy). The project team argued that the Constitutional Court's interpretation of the right of South Africans to be provided with access to sufficient water was confusing and speculated that there may not be consensus among academic legal authorities on this interpretation of the government's obligation. The main bone of contention in this case was over the legality of the City of Johannesburg installing pre-paid water meters.

Section 74 (3) of the MSA (2000:81) provides for a tariff policy to differentiate between different categories of users, debtors, service providers, services, service standards, geographical areas and other matters, as long as the differentiation does not amount to unfair discrimination.

The categories and levels of water services provided for in terms of the DWA guidelines for norms and standards for water services tariffs and the regulations are listed under Section 10 of the Water Services Act (Act 108, 1997):

a) A water service institution must, when setting tariffs for water services provided to consumers and other users within its area of jurisdiction, differentiate, where applicable, between at least the following categories –
    i. water supply services to households;
    ii. industrial use of water supplied through a water services work;
    iii. water supply services other than those specified in paragraphs (i) and (ii);
    iv. sanitation services to households;
    v. discharge of industrial effluent to a sewage treatment plant; and
    vi. sanitation services other than those specified in paragraphs (iv) and (v).

b) A water services institution must, when setting tariffs for providing water services to households, differentiate, where applicable, between at least the following levels of service –
    i. the supply of water to a household through a communal water services work;
    ii. the supply of water to a household through a water services work or consumer installation designed to provide a controlled volume of water;
    iii. the supply of water to a household through a water services work or consumer installation designed to provide an uncontrolled volume of water;
    iv. the provision of sanitation services to a household not connected to a sewer; and
    v. the provision of sanitation services to a household connected to a sewer.

c) A tariff structure may use additional categories to those stipulated above and the same tariff may also be set for two or more categories.

4.3 THE COST RECOVERY CONSTRAINT

There are four costs that should be covered or considered in setting water service tariffs. They are:

- Potable water production cost. This is often expressed as a per unit cost (unit reference value). The unit reference value cost equals the total cost (TC) divided by the total volume of water supplied in cubic metres (Q). This cost includes infrastructure cost (per scheme) and treatment of water to potable standard;
- Distribution (reticulation) of water and collection of fees from users cost;
- Treatment (sanitation) and disposal of waste water cost;
- External costs (environmental).

Typically only the first three (the financial costs) are provided for in municipal accounting frameworks (see Chapter 3 for further comment on the last listed one). The processes that precede the calculation of the financial cost are:

- Water service demand must be forecast (see Figure 4.1 below);
- Water source supply, treatment schemes, and plants must be selected;
- The total financial cost of water service provision must be calculated;
- If fixed and variable costs are to inform the setting of availability and use tariffs, these components of the total financial cost must be identified

and finally

- Individual user tariffs must be set so as to raise enough revenue to cover the sum of these costs.

The first step in the process is forecasting demand (Q_1) for the target period (t_0t_1) – as shown in Figure 4.1 below.

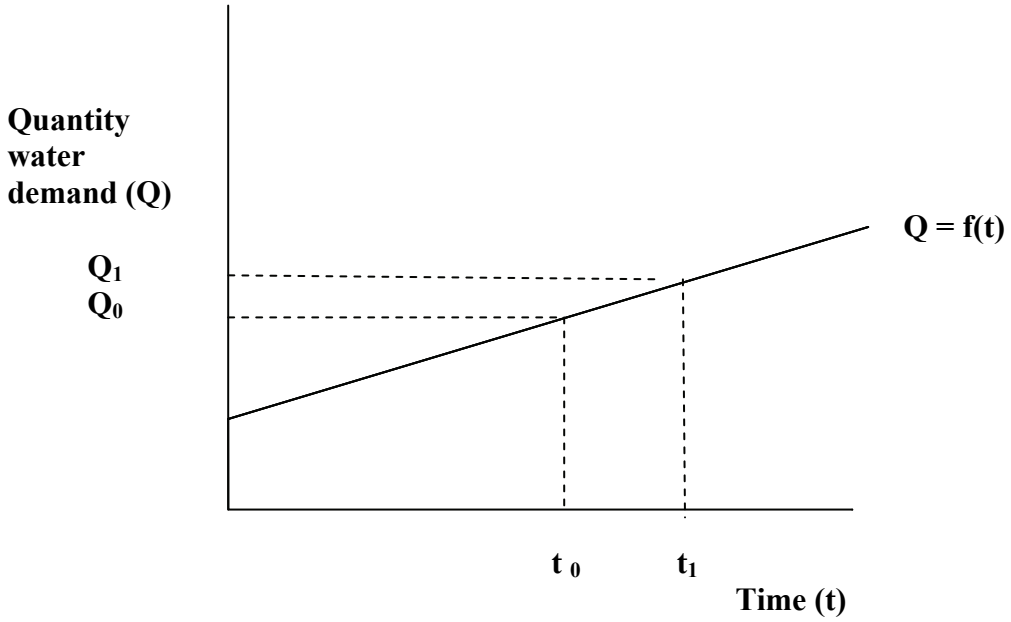

Figure 4.1: Forecasting demand for potable water

The total willingness to pay is aggregate water demand. This aggregate is forecast on the basis of past demand, given rates of water service tariff, forecast economic and population growth rates and anticipated future developments, *inter alia*. If user groups are relevant to this demand forecast (they usually are) then the demand forecast will be disaggregated into these sub-groups, e.g. industrial demand, demand by the poor (who cannot pay for service) and demand by those who can pay for service. The relevant forecast time horizon is that which is required to plan and bring into being the new potable water supplies. For a time horizon of t_0 the water demand forecast is Q_0, where $Q = f(t)$, and for time horizon t_1 it is Q_1 (see Figure 4.1). Once demand is forecast the municipality has defined its target water service supply.

The second step in the process is choosing the investment in water service infrastructure. Municipal water service supply includes five aspects:

- the impoundment, transfer and treatment infrastructure for producing potable water (not provided by DWA)
- the distribution network for potable water
- outflow receiving, sanitation (re-treatment) and disposal infrastructure for waste water
- reticulation (lumping) of potable and industrial water and receipt and pumping of waste water
- metering and customer management arrangements

The costs of providing water service are a composite of the costs of these five aspects. The long-run investment decisions made about infrastructure (planning choices) mainly relate to the first and third listed aspects and the short-run choices relate to the second fourth and fifth listed aspects.

There are a number of features municipalities need to take into account when optimizing investment in water service infrastructure:

- Exploiting (choosing) lower cost infrastructure options (lower unit reference values) before the higher cost ones. There are economies of scale in choice of water supply scheme and there are declining marginal costs of output per scheme (the short run marginal costs are typically lower than the short run average costs);
- Exploiting higher quality sources of water for treatment before lower quality sources (because the latter are more costly to treat);
- In the disposal and sanitation of wastewater there are both economies of scale plus high external diseconomies.

For these reasons most municipalities find themselves on the upward sloping sections of their long-run average cost (LAC) curves (see Figure 4.2 below). The subscript of the MC curve indicates the water supply scheme to which it is relevant. If Q_1 water is required it makes no sense for a municipality to choose scheme 0 only because this scheme yields insufficient water. Nor does it make sense to choose scheme 2 in addition because it would incur costs needlessly.

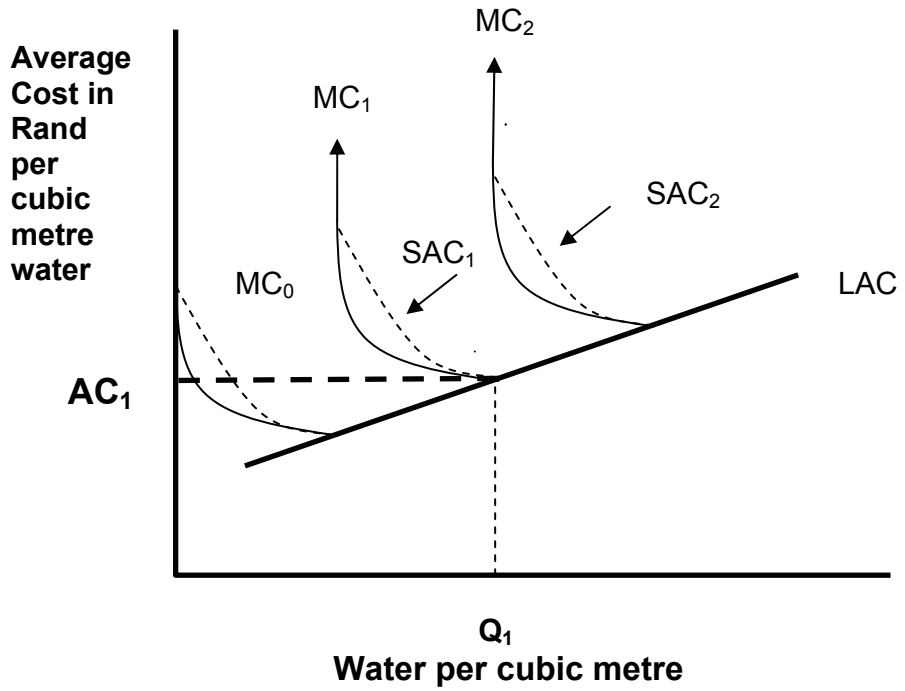

Figure 4.2: Choosing the investment/scale in supply infrastructure

When lower infrastructure cost options are exploited before the higher cost ones (the usual case), the structure of marginal costs of water impoundment and transfer will be higher for incremental water supply schemes. For this reason, even with economies of scale in choice of water supply scheme and with the associated declining marginal costs, the long-run average costs of water supply will increase (see Figure 4.2 above). The short run marginal costs are lower than the short run average costs at all levels of potable water production except when the new water service scheme is introduced (then there is a discontinuity). The costs of treating water up to potable standard reinforce the increasing long-run

cost trend because higher quality sources of water are selected for treatment before lower quality sources; and the latter are more costly to treat.

Another significant municipal water service cost is the receipt, sanitation and disposal of waste water. If left to private provision, the management, sanitation (re-treatment) and disposal of water outflows would typically be under-supplied within metropolitan areas because the negative external costs of inadequate private water outflow treatment are too difficult to exclude. Typical external costs of supplying sanitation water services are spillages (leakages) of outflows (particularly during rainstorms) and disposal of under-treated outflows back into the environment (which may have a negative recreational impact). An aggravating factor is that the incentive to continue to adequately sanitise one's own outflows diminishes once an area is already contaminated with untreated outflows of others. A municipality is a sensible choice of firm to manage outflows because there are strong economies of scale in providing this service, making it a natural monopoly. As a result of municipality being responsible for managing all the waste water costs associated with water service, the external costs associated with outflow management are captured into the cost calculations (the municipality's cost calculations).

In addition to taking into account the infrastructure costs of impounding fresh water and transferring it to locations from which municipalities can treat and distribute it, they also should take into account other external costs and benefits of the impounding infrastructure and bulk water transfer arrangements. Environmental costs are imposed by dams and recreational opportunities and benefits are created by dams and water transfer arrangements. Dams also create the scope for developing electrical power generating balancing services.

The third step determining the nature of the cost constraint is total cost determination. Given the choice of Q_1 water supply, total costs are the sum of the treatment, distribution and external costs to the production cost:

TC = potable water production cost + waste treatment cost + distribution cost + external cost

where,

distribution cost = reticulation + metering + receipt of waste water + management costs (4.1)

A significant component of the transfer of bulk water, reticulation of potable water and receipt of waste water cost is that for electrical power (pumping).

Two other important costs in water service supply are metering and customer management (including the collection of tariffs). In order to implement the tariff system it is necessary to have a system for collecting the water service charges and managing those who do not pay (bad debts). In order to sustain collections it is necessary to be able to exclude users who refuse to pay for that part of the service they are charged. Making such arrangements is part of the customer management service.

The statutory principle guiding for water tariff setting in South Africa is that the tariff collections should recover the total explicit costs of providing the water service. This cost is expressed per cubic metre of potable water delivered (frequently termed the unit (cost) reference value). It is the rental value of water service infrastructure, as calculated from capital consumption cost (depreciation) plus the operating cost of delivering per cubic metre of potable water generated per production scheme.

Implicit costs, such as the opportunity cost of water and environmental costs of water use are not taken into account.

The fourth step is to determine what dual tariff structures will be adopted. There are two distinctions relevant in this connection:
- separate tariffs for access and use
- separate tariffs for potable water supplied and waste water received

In principle an access cost could only be levied once – when a new user is provided with access (availability) cost (tariff) to the water service; the cost being the extra cost of connecting the user to the distribution network. It is efficient to charge separately for access and use, when it is very costly to provide access to particular users because this cost will be signalled to them through a high access charge. When access costs are levied on all users, the access cost charge aims at capturing the fixed costs of supply and distinguishing it from the variable cost charge. It is not efficient to calculate and distinguish fixed and variable costs when the extra accounting cost of distinguishing the two types of cost exceeds the benefit (revenue or cost saving) that can be achieved in levying separate tariffs for access and use.

Not all water service users receive both potable water and waste water receiving and sanitation services, and for this reason it is useful to calculate separate tariffs for potable water supply and waster received. For those receiving both components of the municipal water service, the distinction has little significance as they are linked to each other.

The fifth element defining the cost constraint is structuring the tariffs to recover costs. It entails setting total costs equal to total revenue:

$TC = TR$ (tariff payments by users for water services) (4.2)

$TC/Q = TR/Q = T$ (4.3)

where,

T is the tariff per cubic metre of water paid by the users.

In the simple model considered below this tariff covers the sum of both the costs of reticulating potable water and receiving the return flows, treating and disposing of them.

If fixed and variable costs are used in tariff setting then:

$TFC = TR_A = N.TA$; where N is number of houses and firms and TA is the availability charge (for access) and TR_A is the revenue raised from access charges. (4.4)

$TVC = TR_U = Q.TU$; where TU is the use tariff per cubic metre of potable water supplied and TR_U is the revenue raised from use charges (4.5)

and

$TFC + TVC = N.TA + Q.TU$ (4.6)

4.4 THE SOCIO-POLITICAL CONSTRAINT

The socio-political constraint on municipalities is that the political leadership support tariff arrangements that cross-subsidise the water service provision from the politically weak to the politically strong (the poor majority). It is a political requirement of staying in office, the so-called re-election constraint (winning the support of the median voter). The implementation of this requirement has three elements: identifying of the relevant political groups, setting up a structure that can enable the

separation of payment by members of these groups and the determination of an 'appeasement transfer' that leaves the political leadership in office.

4.4.1 IDENTIFICATION OF THE RELEVANT POLITICAL GROUPS

There are a number of political groups that exist within South African municipalities; the membership of which is defined by many things, like race, ethnic group, wealth, income and area/region in which reside. Below we will model tariff setting with three political groupings based on a combination of wealth and land use activity:

- Group h (politically weak households): Those who can afford to pay and are vulnerable to having transfers imposed upon them;
- Group f (firms and government): Those using the water service as an input into production, government and those users whose water services are paid for on their behalf by the government (linked to the tariff level, that is average cost of production);
- Group p (politically strong households): Those who seek appeasement transfers to reduce their costs of water service supplied.

Corresponding with the tariff level is Tf; one of three groups for which tariffs per m^3 of water are set:

$$(Th; Tf; Tp) \quad (4.7)$$

Within this context, two arrangements can be identified:

(a) Tariff setting without differentiating between FC (access) and VC (use) and without cross-subsidy (Th = Tf = Tp) would be given by:

$$TC/Q = TR/Q = whTh + wfTf + wpTp \quad (4.8)$$

it follows that,

$$TC = TR = (wh.Q)Th + (wf.Q)Tf + (wp.Q)Tp \quad (4.9)$$

where,

$$1 = wh + wf + wp = \text{proportions (weights) of TC contributed by each group} \quad (4.10)$$

Q = total quantity of potable water reticulated.

(b) Tariff setting where a differentiation between FC (access) and VC (use) is made but not cross-subsidisation (TAh = TAf = TAp and TUh = TUf = TUp)

- Where an access charge is levied:

$$TFC = \text{Access or Availability Revenue (TA)} = Nh.TAh + Nf.TAf + Np.Tap \quad (4.11)$$

where,
N indicates the number of households and firms provided with access and
TA the access tariff for the relevant group (h, f or p)

- The use charge is set with reference to volume of water use:

$$TVC/Q = (\text{Use revenue})/Q = (wh.Q)TUh + (wf.Q)TUf + (wp.Q)TUp \quad (4.12)$$

where,
TU indicates use tariff of the relevant group (h, f or p)

4.4.2 SELECTING A VARIABLE BY WHICH TO SEPARATE PAYMENTS FROM THE RICH FROM POOR FOR THE SAME GOOD

The government and firm group (f) are identified by their declared (official) primary land use, but the implementation of such a tariff structure is a challenge because an effective way has to be found to separate the group favoured (p group) from the group discriminated against (h group). The auditing (verifying) costs of maintaining the intended separation must not be prohibitively high. There are a number of feasible variables that may be used that correlate with wealth, for instance:

- total household income earned
- market value of property
- typical socio-economic status of residents in the location where the users resides
- volume of water used.

All have problems associated with them. Some have high audit costs (like total household income). Others distort behaviour, for instance, creating a disincentive to invest in property and relocation to lower tariff locations. In order to minimise the distortion to the incentives to do business, firms may need to be exempted from the stepped structure, but there are many cases of mixed use in municipal areas (residential and business). Arguably the first two listed are the most appropriate, and indeed the first listed one is applied by many municipalities as a means to determine special tariff dispensation, e.g. zero tariff.

The option of separating markets by volume of water consumed has the merit of being easy to implement, but the link to wealth is contentious. It is premised on the basis that the members of the group that can afford to pay more for their water service will consume more, even at higher tariffs for the additional units of water they consume and this revenue will be used to cross-subsidise the consumption of those people consuming less (the poor). Under this structure of separating groups, the spread of the burden of the appeasement transfer is determined by the number of volumetric tariff brackets and by the rate of increase between tariff brackets. Membership of each volumetric user group is determined by the maximum WTP of the users. The more user group brackets that are introduced the greater the total WTP that may be collected. Tariff revenue is maximised under perfect price discrimination.

The Ramsey pricing rule is also relevant in this connection – that in order to maximise revenue, tariff setting mark ups should be inversely related to elasticity of demand. Under the assumption that the rich have a lower price elasticity of demand than the poor, it is argued that their tariff should be set higher. There are two obvious problems in applying this rule to water tariff setting – there is no empirical basis for the relevant elasticity assumption and it remains unclear why maximising tariff revenue is superior to maximising consumer surplus.

Ultimately, what tips the scale in favour of the volumetric variable as the preferred one among South African municipalities on which to base a price discriminatory water service tariff structure is that the resultant structure also helps solve another constraint at the same time – overcoming the short-run supply constraint.

4.5 THE SHORT-RUN SUPPLY CONSTRAINT

4.5.1 REINFORCING THE CASE FOR AN INCREASING BLOCK TARIFF

Added to the above political appeasement constraint, there may also be a short-run supply constraint facing the municipality. The short-run supply constraint is where the available infrastructure to supply water service is inadequate to satisfy demand; a situation that many municipalities appear to find themselves in. When the municipality faces a short-run supply constraint it has little option but to ration or discourage household demand. Discouragement entails extending the same type of tariff structure as required to appease the politically powerful, but with the goal of limiting individual user demand to the short-run water supply available, i.e. when the short-run supply constraint is binding it reinforces the case for utilising an increasing block tariff structure. The poor do not have the means to compete (so need help) and the firms may have limited short-run flexibility in choice of water use in production (so may need to be exempted).

4.5.2 SIMULTANEOUSLY SETTING AN APPEASEMENT TRANSFER ARRANGEMENT AND DISCOURAGING THE DEMAND FOR WATER

The scale of appeasement transfer that can be effected depends on maximum WTP of the paying group (h) and the scope for translating political pressure into political transfers of income by the receiving group (p) from the other group (h).[5] Let us define this sum as R. The intra group transfer should balance, assuming audit and implementation costs are trivial:

$$(wp.Q)[(Tf - R/(wp.Q)] = (wh.Q)[Tf + R/(wh.Q)] \quad (4.13)$$

where

$$R = f(WTPh, PPp.h) \quad (4.14)$$

and
WTPh is the willingness to pay of the members of group h
PPp.h is the political pressure influence of group p vs. group h.

The water service tariffs can easily be adjusted to incorporate the short-run supply constraint and appeasement constraint:

$$Tp = Tf - R/(wp.Q) \quad (4.15)$$

and increase for the politically weak group to:

$$Th = Tf + R/(wh.Q) \quad (4.16)$$

A similar adjustment is valid for the use tariff structure:

$$TUp = TUf - R/(wp.Q) \quad (4.17)$$

$$TUh = TUf + R/(wh.Q) \quad (4.18)$$

The higher is R the greater the increase in tariff above the tariff level paid by the wealthy and the lesser the proportion of the tariff level paid by the poor.

[5] An income transfer can be arranged in many other ways as well: through the national budget or cross subsidisation between services within the local government budget.

4.6 THE AFFORDABILITY CONSTRAINT

Yet another important constraint on municipalities is that there must be sufficient community willingness (ability) to pay for the water service provided. In this connection the viability of the structure is vulnerable to there being enough voluntary premium tariff paying community members and firms staying within the municipality.

Adding in the affordability constraint to the other equations:

$$Nh.TAh + (wh.Q)[TUf + R/(wh.Q)] \leq Nh.WTPh.(wh.Q) \quad (4.19)$$
$$Nf.TAf + (wf.Q)TUf \leq Nf.WTPf.(wf.Q) \quad (4.20)$$
$$Np.TAp + (wp.Q)[TUf + R/(wh.Q)] \leq Np.WTPp.(wp.Q) \quad (4.21)$$

where
WTP is willingness to pay by the respective group (h, f and p).
and

$$TFC + TVC = Nh.TAh + (wh.Q)[TUf + R/(wh.Q)] + Nf.TAf + (wf.Q)TUf + Np.TAp + (wp.Q)[TUf + R/(wh.Q)] \quad (4.22)$$

Meeting Constraint 4.22 requires that there must be sufficient numbers and willingness to pay. If within a particular municipality the number of premium tariff paying households (Nh) decline or the willingness to pay of premium tariff paying households declines, the revenue that can be collected from this group declines accordingly. If the constraints for groups h and f are disregarded by the municipality, the following behaviours could be predicted from premium tariff paying (high income earning) households and from firms:

- Increased political pressure for reduced tariffs from high income earning households and firms
- Tariff becoming a barrier to the entry of new firms and high income earners into the municipal area
- Migration of existing firms and high-income earners from the municipal area.

4.7 THE ENVIRONMENTAL USE (RESERVE) OPPORTUNITY COST CONSTRAINT AND CONSIDERATION OF THE COMPETING CLAIMS OF AGRICULTURE

In addition to all the other law the National Water Act (1998) specifies that catchment management agencies prioritise the allocation of sufficient water for the environment, and that the needs of agriculture should also be taken into account and balanced against urban demand. An economic interpretation of this Act is that water services tariffs should incorporate the opportunity cost of water that would otherwise be left to sustain the natural environment and that allocations between urban and agricultural use should be guided by the respective marginal values of the water in the alternative uses.

The opportunity costs of urban water use to the natural environment is the value of this water if left to maintain natural habitats. When this opportunity cost is incorporated as a constraint in tariff level (Tf) setting:

$$Tf - TC/Q \geq TO \quad \text{or} \quad Tf > TC/Q + TO \tag{4.23}$$

where,
TO is opportunity cost of water (*in situ*) and TC/Q is urban water service production cost.

Taking environmental opportunity cost into account in tariff setting means that they must be added to the average cost of producing water for human use (Tf).

The scope for opportunity cost inspired reallocations of bulk water between urban and agricultural users depends on the relevant marginal values at any given point in time of the water (*in situ*) as consumed in the different agricultural and urban locations.

4.8 CONCLUSION

South African municipalities face a challenging set of constraints in their provision of water services. What is feasible is constrained by: legal standard of delivery requirements, the need for cost recovery, accommodation of socio-political pressures, short-run water service infrastructure capability, water availability, water service affordability and environmental opportunity costs. In pursuing their goals (as outlined in their IDPs and WSDPs) within these constraints they will often have little discretionary space.

There are many water service tariffs that may be set – for potable water, for waste water management, for access and for use. The economic case is not an overwhelming one for separately levying for potable water provision and for waste water receipt and sanitisation, where both services are provided and not optional. There is a case for distinguishing access from use charges as there may be important costs that should be taken into account in access (that would not be if the two tariffs were combined). In order to implement transfers between socio-political groups there is also a need for different tariffs being charged to different groups; a case reinforced where there is a short-run inadequacy in the available water service supply infrastructure.

The use increasing stepped tariffs to satisfy the political need for transfers and the short-run supply constraints is an obvious choice. However, these tariffs may not impact in the expected way because the link between greater use and transferring income from the rich to the poor is imprecise and complicated by other factors. While it appears true that on average higher income households use more water:

- households with more inhabitants in them (including workers) also use more water,
- the poor who have water supply connections frequently supply water to other unconnected poor families
- progressive tax on water use may give rise to unintended negative consequences for production (for poor subsistence crop growers and household based businesses and formal businesses).

SECTION B: AN ANALYSIS OF THE DEMAND FOR WATER SERVICES

CHAPTER 5

THE DESIGNING OF THE CHOICE EXPERIMENT FOR THE MUNICIPAL WATER SERVICE USERS AT THE THREE SELECTED MUNICIPALITIES

5.1 INTRODUCTION

Given that municipalities do not know very much about the nature of demand for the water service they provide, there is an information gap that needs filling. One of the main aims of this study was to assess customer demand (willingness to pay) from water service delivery at 3 selected municipalities in the Eastern Cape: the Nelson Mandela Bay Municipality, the Kouga Municipality and the Amathole Municipality.

In the field of marketing, where choice modelling was originally applied, it is called conjoint analysis. Conjoint analysis, or the choice experiment method, is a survey based method that models preferences for goods and services, where potential buyers of these goods and services are asked to make hypothetical choices between different combinations of levels of the attributes (characteristics) in these goods and services. Its conceptual roots may be traced back to Lancaster's (1966) characteristics theory of value. In this random utility maximizing theory of choice, where the utility from consuming goods is modelled in terms of selected (specified) utilities from the attributes of the good, and those attributes that are omitted are captured in the error term.

Choice modelling is applied to 5 groups of current consumers within the 3 selected Eastern Cape municipalities. Randomly selected consumers were presented with alternative packages of attributes and levels and requested to indicate a preference. Their responses are described, modelled and analyzed (Chapter 6). Following the standard approach to estimation maximum likelihood estimation procedures were applied to generate predictive models of choice and of marginal values of choices from the tariffs associated with those choices (Kuhfeld, 2002; Haab and McConnel, 2003; Henscher et al, 2005). The price of the composite good was included as one of the attributes, so that willingness to pay (welfare) values could be determined for the component attributes.

5.2 THE DESIGN TASKS IN A CHOICE EXPERIMENT

An application of a choice experiment may be divided up into four stages (Shen, 2005):

- questionnaire design (selection of attributes, assignments of levels, experimental design and presentation of questionnaires)
- data collection (sample frame and sampling strategy determination, setting of sample size and method of response collection)
- model estimation and assessment
- application of model results.

Designing a choice experiment questionnaire can be subdivided as follows: the selection of attributes, assignment of levels, experimental design and presentation of questionnaires (Shen, 2005).

The first step in a choice experiment consists of developing an understanding what the study aims to achieve and listing the alternatives, attributes and attribute levels in which one is interested and considers relevant (Hensher et al., 2005). This step includes:
- determining the feasibility and validity of a set of attributes as management options. Literature reviews, focus groups and expert consultations are all useful aids in the identification of feasible and important attributes. In order to allow for the estimation of marginal willingness to pay (WTP) one of the attributes should be a monetary cost (Hanley *et al., 2001)*.
- administering a pilot test to determine the respondent feedback on the validity of the choices (Louviere et al., 2000; Shen, 2005). Respondents can be helped with tasks by introducing attributes and levels in questions prior to the choice task, the use of glossaries, providing detailed explanatory text, and/or providing visual representations (Carson et al., 1994).
- balancing the objectives of introducing as many essential attributes as possible into the experiment against placing an excessive cognitive burden on the respondent (as a result of having too many attributes from which to choose). Respondents have limited ability to process information. If tasks are too long and too difficult or lack realism and credibility, the choice experiment will be compromised (Carson et al., 1994). Respondent comprehension is improved by phrasing the survey instruments in as simple and straight forward manner as possible. As a rule of thumb the number of attributes included in a choice experiment questionnaire should not exceed seven and the number of choice sets presented not exceed four and the number of alternatives per choice set should not exceed four (Carson et al., 1994).

The range and measurement of attributes are important issues in the selection of attribute levels. The current range experienced by the respondents and high and low extreme ends are important considerations with respect to range. It improves relevance when the choices presented are benchmarked against the *status quo* (Hanley et al., 2001). In this regard it is not only important to include the latter as an option for choice, but set the alternatives so that they are realistic and accepted as feasible by the respondents (Shen, 2005). It is also suggested that the attribute levels should be non-linearly spaced and extend over the expected range of respondents' preferences (Hanley *et al.,* 2001).

The measurement of attributes is differentiated by subjective and objective attributes. Objective attributes can be objectively defined, such as monetary cost, time or distance, while subjective attributes are more difficult to be define, such as environmental quality and conservation (Shen, 2005)

As is the case for attribute identification, focus groups, pilot surveys, literature reviews and consultations with experts are useful elements to research into what levels of attribute are most relevant (Hanley *et al., 2001)*. Focus groups, may be very effectively used to test draft questionnaires on cognitive issues and identifying the most relevant attributes and levels (Shen, 2005).

A choice experiment is a testing of hypotheses about user interest based upon the observation of the effect upon one variable, called the response variable, in response to manipulated changes in the levels of other variables (Louviere et al., 2000). The response variable may be choice and the manipulated variables attributes, when they are related to characteristics of a good or service (Hensher et al., 2005). An attribute level is sometimes referred to as a 'treatment', and a combination of attribute levels, a 'treatment combination' or choice set (Louviere et al., 2000).

After the alternatives, attributes and their levels are identified and defined, the type of design to be utilized needs to be selected, the model to be estimated needs to be specified and the scale (size) of the experiment needs to be set (in terms of the requirements for estimation).

This chapter describes how the Choice experiment (CE) was designed for the municipal water service users at the three selected municipalities in the Eastern Cape, the NMBM, the KLM and ADM.

5.3 SELECTION OF THE ATTRIBUTES

The selection of attributes and assignment of levels entailed two processes: the identification of what attributes were found to be relevant in similar work undertaken elsewhere (internationally) and within South Africa and the use of focus groups to determine which attributes and levels were of most local relevance.

5.3.1 INTERNATIONAL PERSPECTIVES

In a choice experiment to value household water supply attributes in Canberra, Australia Hensher et al. (2005) selected the following attributes for valuation:
- service interruption frequency
- service interruption duration
- service interruption time of day
- service interruption notification
- service interruption information provided
- price of service
- waste water services frequency of disruption and "overflows"
- waste water services source of the overflow – inside, outside, in the street
- waste water services information services
- price of service.

They found that respondents were willing (WTP) to pay to reduce the number and frequency of interruptions and overflows, preferred to have interruptions later in the day on weekdays and valued both notice and in-person information services. They also found that as the number of interruptions rose, households were willing to pay less to avoid the interruptions.

In another Australian study conducted in Adelaide (MacDonald et al. 2005), in which similar options were presented as well as:
- notification options (letter, phone call, in-person visit)
- alternative water supplies during the interruption (none, from a central location, delivery of bottled water)
- a status quo and
- "don't know" option.

They found that the only attributes that were statistically significant in all models were the frequency of interruptions and the price. The goodness of fit was improved by including interaction terms with socio economic variables (age and income) and previous experience of the respondent with disruptions.

Willis et al (2005) used a choice experiment to conduct a cost-benefit study in the UK (Yorkshire Water). The study included 14 service factors. In order to make the number of choices manageable, the service factors were divided into three sets:
- supply and quality of household water (like security of supply, interruptions to supply, the biological quality of drinking water, water discoloration)
- external negative benefits of wastewater disposal (like sewage flooding and odour from sewage works)

- environmental factors related to waste water disposal (like the ecological quality of rivers and bathing beach water quality).
These sets were divided in five "blocks" of three or four attributes each.

As was the case with the Australian studies, they found that customers were WTP to reduce the number and frequency of interruptions to supply, but that the WTP amount did depend on the number of interruptions. Respondents were also found to value security of supply during drought conditions, improvements in biological and chemical water quality and a reduction in the number of households complaining about water discolouration.

Nam and Son (2005) compared the choice experiment and contingent valuation methods for valuing domestic water quality and pressure in Ho Chi Min City in Vietnam. This city is the largest in Vietnam, with a population of about 5.5 million people. The water supply to households is poor in some areas, with only about 322 000 households being connected directly to the piped water system. Their sample was divided into those households already connected and those not currently connected. The former were asked their willingness to pay for good water quality and high pressure while the latter were asked, if they had a connection, to choose between the status quo and one other option (choice experiment).

The choice experiment had only three attributes:
- water quality (low, medium, high),
- water pressure (low, medium and high)
- price (monthly bill with five levels including the status quo).
They found that in households not yet connected to piped water, water quality was by far the most important attribute compared to water pressure.

While no estimate of the costs involved in improving water quality and pressure were available, Nam and Son (2005) found that the amount that households were willing to pay to improve water supply attributes was greater than their current water bill, plus the costs of various coping strategies (like collecting water, treating it by boiling and filtering, storing it in household tanks, or buying it from vendors).

5.3.2 A SIMILAR SOUTH AFRICAN STUDY

There has been only one South African application of a choice experiment to the users of water services of which we are aware, that of Snowball, Willis and Jeurissen (2009). It was administered in Grahamstown West, Eastern Cape, to determine household willingness to pay for water service improvements. This pilot study speculated that following list of attributes/problems were the ones water service users thought important:
Bacterial count in drinking water
Water discoloration
Low water pressure
Interrupted supply
Water meter problems
Price.
The authors assigned five of the attributes four levels of service and one attribute three levels.

Utilizing the conventional orthogonal design, they only investigated the main effects. They justified this restricted focus of attention with the argument that these effects accounted for 80-90% of the variation in the data (Willis et al., 2005). They also did not include the status quo as an option in the choice cards (it normally is) on the grounds that many households did not report water problems, although they experienced them, and as a strategy for reducing 'status quo bias' (Adamowicz et al., 1998).

This study contained 25 randomly generated question sets with differing attribute-level combinations. These question sets were paired and numbered into 13 choice cards. Each questionnaire contained three choice cards (3x2 choice sets in all). Respondents were instructed to choose their most preferred alternative out of each pair.

The attributes found to be significant were:
Bacteria count (most significant attribute)
Discoloration
Interruptions to supply
Price.

It was also calculated that for a decrease in bacteria count of one level, Grahamstown West residents were willing to pay 15,72% more for water, and it was concluded that bacteria counts should be kept in check and information shared with users on how to reduce bacteria levels (to the public to improve water service consumer utility). McFadden's (1973) likelihood ratio index was calculated as 0.27, i.e. the model had an adequate goodness of fit measure.

5.3.3 FOCUS GROUP FINDINGS

The process followed in selecting the attributes and levels was also guided by running a series of focus groups with relevant authorities and interested agents. The first series of meetings were held with water engineers who advise and build infrastructure for the selected municipalities. These meetings aimed at generating a set of water service options to consider. The second series of meetings was held with representatives of the selected municipalities. The main purpose was to determine the scope and a priority ordering of water service options from the engineering and management perspectives.

(A) THE FOCUS GROUP WITH THE WATER ENGINEERS

An engineering firm was consulted that regularly undertook water infrastructure work for the municipality. Table 5.1 summarises their estimates of some of the potential water service options that could be offered to the customers of the Nelson Mandela Bay Municipality.

Table 5.1: Some water service options for NMBM consumers

Attribute – study	Benefit of study	KL proportion People/firms Benefiting	Estimated Cost of Study (year)	Number of kl affected
Level of treatment of reticulated water – make softer	Better tasting water (less chlorine plus salts), kettle's last longer, etc.	90 ml/d (eastern section of metro)	R400m ((2008)	90 ml/d
Increased water supply assurance	Increase capacity to last 1 in 50 year drought up from present 1 in 20 years. In agric they operate on 1 in 20 capacity – postponement of implementing water use restrictions in droughts	240 ml/d (whole metro)	R480m (2008/9)	24 ml/d
Reduce outflow leakages into the environment – Baakens, Papenkruis and Swartkops systems	Upgrade/Extend infrastructure of sewerage to cope with floods		Too difficult to say	
Reduce smell at Swartkops water treatment plant	Visitor to PE and residents in area. But still problem of Algorax	0	R28m	0
Water tariff incentives to new businesses in the NMB metropolitan area located at the Coega IDZ	Level 1: Below AC tariff – attract new business to NMB location Level 2:AC tariff Level 3: Above AC tariff	Level 1: jobs and business income generated through the extra new businesses Less jobs and business income generated through the extra new businesses No extra jobs and income generated	R2bil (extra infrastructure 70 ml/d plus extra 40 ml/d sewerage treatment and disposal via new sea outfall)	Level 1: Substantial extra tariff Level 2: Lesser extra tariff (as move up AC curve) Level 3: Zero extra tariff
Increase treatment of outflows (sewerage) before disposal into sea	Extra treatment plus disposal further out to sea (in compliance with the Law)	Small improvement in recreation experience at New Brighton Beach, Port Elizabeth	R300m (new design req)	
Increased enforcement of compliance with regulations on permissible outflows	e.g. Increased effort to catch cheaters – by appointment of 6 new monitoring staff plus purchase of R100 000 extra monitoring equipment			
Increase the network of consumers to whom reticulate potable water and receive outflows	e.g. Increase of 2000 dwellings to be covered by water service network			
Steeply escalating/progressive tariff structure governing residential demand				

References: McGilvray (2009) and Van Renen (2009)

(B) THE FOCUS GROUPS WITH THE MUNICIPALITIES

A series of focus group meetings was also held with selected management personnel of the three selected municipalities. These meetings took place during February and March 2009.

The staff attending the NMBM focus group meeting were:
Kevin Jacoby, CFO – Facilitator
Stan Groenewalt – Infrastructure and Engineering Assistant Director responsible for water distribution

Selwyn Thys – Director Budgeting and Financial Management
Barbara de Scande, Director Expenditure Management and Financial Control – hands on involvement during the research
Charmaine Von Berg, Chief Accountant – responsible for the budget of water and sanitation services
Kevin Gillmer, Chief Accountant – National Treasury reporting and general co-ordination of information
Herman Vosloo, Principal Chief Accounts Officer – responsible tariff analysis and liaison officer and major consumers

The staff attending the Amathole focus group meeting were:
Stephen Nash – Engineering, for Distribution element
Sharon Kalis – Budget and Treasury, Budget element
Zingi Dlova – Budget and Treasury, Customer Interface element

The staff attending the Kouga focus group meeting were:
Ridwaan Abdullah, Accounting and Financial Control, Kouga Municipality
Kevin Jacoby – CFO, NMBM
Barbara de Scande, Director Expenditure Management and Financial Control – hands on involvement during the research
Kevin Gillmer, Chief Accountant – National Treasury reporting and general co-ordination of information

At these meetings the respective staff were asked to rank the importance they attached to what their water service users felt about elements of this service. Table 5.2 shows their ranking from highest to lowest.

Table 5.2: Municipal ranking of attributes of water services

Rank	Attribute
1	User preference for increase security of supply (coverage of 1 in 20, 1 in 50 or 1 in 100 year droughts)
2	Reduced incidence per month of higher than class 1 specified bacterial/*ecoli* counts (is this a serious problem on the demand side)
3	Reduced sewerage flooding/leaks overflows (Swartkops, Baakens) and presence at bathing beaches (cost versus benefit)
4	Increased interruptions in supply among different user groups (is it worth the cost savings?)
5	Reduced water pressure (is it worth the cost savings?)
6	Response to extra effort to identify water service user use. Options: metering 100% per household/firm or more per small community or more per large community or not at all (old New York style)
7	Responsiveness to tariff increases per water service user group
8	Reduced odour from sewage works (cost versus benefit)
9	Willingness to pay for water services to other users (external health and charity benefit)
10	Response to extra effort (investment) in communications (notifications) to users
11	Reduced/increased dissolved salt concentration (would the cost be justified to improve the taste)
12	Reduced water discolouration incidents per month (is the cost justified?)
13	Fixing of Fluoride concentration at 0,7 mg/l (cost versus benefit)
14	Increased effort in monitoring compliance with the regulations relating to trade effluent

The municipalities also identified two different types of full tariff paying user: residents and firms which use water as an input into production. They favoured an experimental design with 3 levels per attribute analysis, the *status quo* plus two other levels.

5.3.4 EXPERIMENTAL DESIGN CONSIDERATIONS

The translation of this information into a choice experiment was influenced by literature on choice experiments which argue for reduced numbers of attributes and levels and reducing the complexity of the decision making task facing the respondent. The options had to be translated into a format the user could follow. This resulted in the following decisions:

- limiting the number of attributes to six and the number of levels to three

- setting questionnaires for the two groups of users, full tariff paying residents and firms

- presenting both user groups at the three municipalities with the same water service options excluding the tariffs (because their range differs)

- putting the choices in simple language and translating the questionnaires from English into Afrikaans and Xhosa

The result was two types of questionnaire – one for residential users and another for firms, with minor differences for the three Municipalities. In total 5 versions of the questionnaire were administered: two each at NMBM and ADM and one at KLM. The questionnaires included questions eliciting respondent information, household socio-economic information, household water use information, views on method of payment, a choice experiment and a debriefing question. The former was gathered to enable the research team to describe who supplied them the information. The socio-economic and water use information was gathered for the purpose of modelling choice in terms of these variables. The two basic types of survey questionnaire administered are shown in Appendix 5.

5.4 CHOICE SET CONSTRUCTION AND PREFERENCE MEASUREMENT

The experiment used in this study was an unlabelled choice modelling experiment which included the six attributes: sewerage disposal, water quality, water security, interruption of provision, rate of flow and service charges. The questionnaire was constructed to provide three levels for each attribute yielding a total of $3^6 = 729$ treatments (or level combinations). To reduce the number of treatment levels to a manageable number, the experiment employed a fractional factorial design (using the statistical software package, SPSS) with 3^{k-p} treatments where $k = 6$ and $p = 2$. The 3^{6-2} design reduced the number of treatments from 729 to 81, a reasonable number given the financial backing provided for the choice experiment survey. The experimental design followed Montgomery (2009: 251) with the 81 choice cards randomised using the random number generator in Excel 2003, and the borrowing from the approach of Snowball *et al.* (2007). The respondents were asked to choose four times between two alternatives.

The unlabeled choice modelling experiment was estimated for the sites using NLogit 4.0, software developed for the estimation of multinomial logit (MNL) models. The analysis follows the methodology advocated by Hensher, Rose and Greene (2005: 308-373).

5.5 SAMPLE DESIGN

A multistage sampling technique was used for the purposes of this research study. Multistage sampling is a complex form of cluster sampling in which two or more levels of units are embedded one in the other. The first stage consists of constructing the clusters that will be used to sample from. In the second stage, a sample of primary units is randomly selected from each cluster, rather than using all units contained in all selected clusters. In each of those selected clusters additional samples of units were selected, and so on. All ultimate units (individuals, for instance) selected at the last step of this procedure are surveyed. Multistage sampling is a good option when a complete list of all members of the population does not exist or is inappropriate to use (the survey would become too difficult and expensive to administer).

Within the multistage sample, 3 methods of sampling were used, namely, systematic sampling, cluster sampling and simple random sampling. Systematic sampling was used to select the suburbs where most of the people residing in that suburb paid for their water services. This was achieved by randomly selecting 30 suburbs from the municipal data base. Within the selected suburb sample the cluster sampling technique was used to select 10 suburbs (within the original suburb sample) where all 10 of the suburbs were within 15 km radius of the CBD. A simple random sampling method was used to select the households that were surveyed within the cluster sample of suburbs within a 15 km radius from the CBD.

Sample size was determined with reference to experimental design requirements. Two groups of 75 businesses were targeted for the businesses water service users, one group for the NMB municipality and another group for the Amathole municipality. Each survey within the group of 75 was identical except for the choice experiment section of the survey, which was unique. The same set of surveys with the same set of 75 unique choice experiments was used to survey the NMB and Amathole municipalities.

Following a similar process, three groups of 100 residents were targeted in the NMB, Amathole and Kouga municipalities. These surveys were identical except for the choice experiment section which was unique for each 100 surveys. As a result the same choice experiment for residential water service users was repeated 3 times, once in each municipality.

All the surveys were comprised on two sections. The first section comprised personal and general information type questions. The second section comprised water service related questions. The second section also contained the choice experiment.

5.6 CONCLUSION

The design of a choice experiment is a fundamentally important one. The attribute and levels selected have to be important and realistic to those who are being asked to choose. In order to identify the relevant attributes and levels a combination of international literature and focus groups were consulted. Following this phase, the number of options and complexity was reduced in order to yield better experimental design features. The two basic types of choice experiment questionnaires that resulted from this process are shown in Appendix 5. The sample design features were determined with reference to the requirements for estimation of the choice models.

CHAPTER 6

THE CHOICE EXPERIMENT SURVEY ADMINISTRATION, RESULTS AND ANALYSIS

6.1 ADMINISTRATION

Chapter 6 summarises the results of a choice modelling questionnaire administered at three locations in the Eastern Cape of Southern Africa: the Nelson Mandela Bay Municipality (NMBM), Amathole Municipality and the Kouga Municipality. The questionnaire for this choice experiment was presented as a hard copy to respondents. The respondents were approached, provided with the background to the survey, after which they completed it immediately or were left with the survey over night, and it was collected from the household the following morning. As a thank you for their effort each respondent was given a present on completion of the questionnaire. Table 6.1 summarises the numbers of water services users surveyed at each municipality.

Table 6.1: Respondents surveyed per study site

Study site	Residential	No. Questionnaires	Business	No. Questionnaires
NMBM	Yes	100	Yes	75
Kouga	Yes	100	No	0
Amathole	Yes	100	Yes	75

The decision was made not to include businesses in the Kouga municipality did not reflect a belief that business users were unimportant here, but rather with the view to increasing the effort devoted within the NMB and the Amathole municipalities. Initially 450 responses were targeted.

6.2 THE BUSINESSES SURVEYED IN AMATHOLE AND NMB MUNICIPALITIES

The data collected from the surveys administered to the businesses and the residents was assessed separately. The general and question specific results were tabulated accordingly. Each municipality was assessed as well as the overall results from all municipalities.

The information gathered from the 150 surveys administered to businesses is presented in Table 6.2.

Table 6.2: Size of the firms surveyed

Municipality	Average number of employees	Average Asset Worth	Average Yearly Turnover
Amatola	13.80	R 2 535 333.33	R 3 539 608.00
NMB	14.09	R 3110 967.74	R 13 713 333.33
Total	13.95	R 2 770 131.58	R 6 839 194.59

The businesses surveyed in both the Amathole and NMB municipalities employed an average of approximately 14 people (Table 6.2). The businesses surveyed in the NMB municipality had a higher

asset worth and average yearly turnover than the businesses surveyed in the Amathole municipality. The total average yearly turnover for both municipalities is approximately R6, 839,194.54.

Businesses in the Amathole and NMB municipalities were asked a series of questions relating to the businesses water usage and importance of the municipal water services for the functioning of their respective businesses (see Table 6.3).

Table 6.3: A summary of the findings from the questions related to water services

		Amathole	NMBM	Both Total
Average business payment for water per month		R 1 432.79	R 1 759.44	R 1 577.38
Importance of cost of water for business location	Unimportant	17	10	27
	Relevant but not a deciding factor	37	45	82
	Very	20	18	38
What does the business mainly use the water for	Garden	13	7	20
	Cleaning	61	68	129
	Cooling production	1	23	24
Is Industrial Water Offered/Available	No	51	70	121
	Yes	4	1	5
	Do not know	24	0	24
If Industry water was provided at a low price would the business use it	Yes	52	68	120
	No	23	3	26

The average monthly cost of water services for businesses in the Amathole and NMB municipalities is approximately R1 577.38. In the NMB municipality firms pay a higher price for water services than they do in the Amathole municipality (Table 6.3).

Most businesses found the water prices relevant to the location of the business in the municipality but maintained that this was not currently the critical influence in their location decisions (there were other more critical cost issues, *inter alia*). The businesses in both municipalities indicated that they mainly use water for cleaning/dust reduction and cooling in production. In both municipalities most firms had no option of using industrial quality of water as an alternative to potable water, but the provision for industrial water at a low cost would be supported by businesses in both municipalities.

The importance of different aspects of water services was assessed by the businesses surveyed (see Figure 6.1).

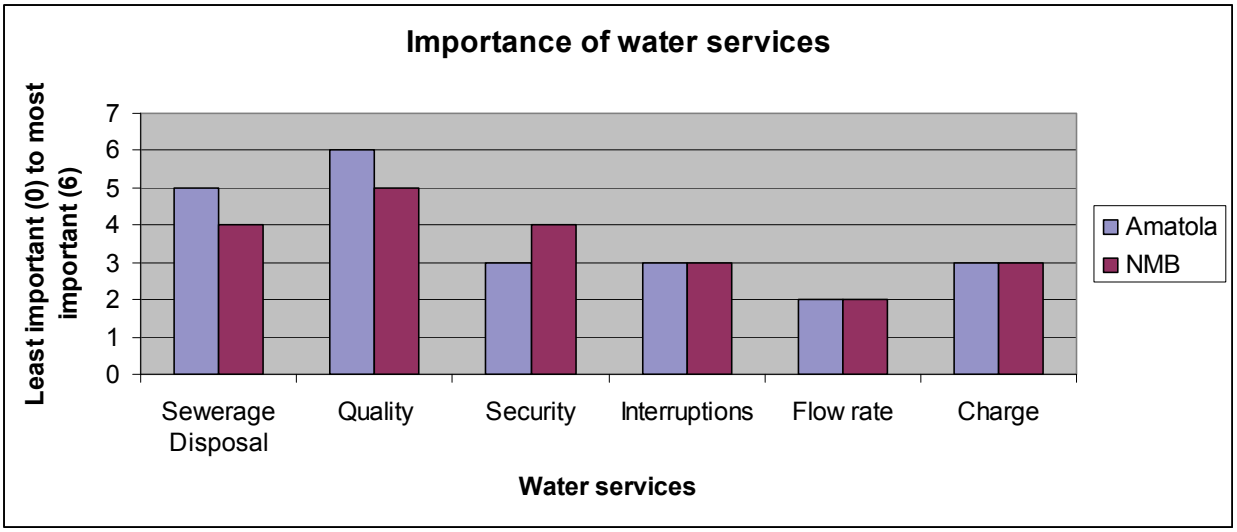

Figure 6.1: Importance of water services to businesses

The most important aspects of water services for businesses in both the Amathole and NMB municipalities were "quality of water" and "sewerage disposal into water" (Figure 6.1). "Security of the water", "interruptions in flow" and "service charge" were considered to be of average importance to the businesses. The least important attribute was thought to be "rate of flow of water" (water pressure).

6.3 THE RESIDENTS

The residents from all three municipalities were presented with surveys that were different from the business surveys. A total of three hundred surveys were presented to residents.

Table 6.4: A summary of the residents characteristics and responses

		NMB	Kouga	Amathole
Gender	Female	62	49	40
	Male	38	51	58
Non response		0	0	2
Average Age (yrs)		48.52	47.32	57.53
Average Income		R26 001-R34 000	R13 001-R19 000	R13 001-R19 000
Race	Black	2	4	2
	White	2	89	96
	Coloured	94	6	0
	Other	1	0	0
Non response		1	1	2
Own/Rent	Own	85	73	80
	Rent	15	25	20
Non response		0	2	0
Pay for water	Yes	94	87	85
	No	6	12	15
Non response		0	1	0
Average Payment for water		R390.47	R198.86	R191.89
Total Number surveyed		100	100	100

The gender of the respondents surveyed was evenly matched within the ADM and KM, but in the NMB municipality where the majority of the respondents were female. The race of the respondents differed for each municipality. In the NMB municipality the majority of respondents were Coloured whereas in the Amathole and Kouga municipalities the majority of respondents were White. The average age for the respondents was 51.

The majority of the respondents in all municipalities owned their properties (houses) and the majority paid for their usage of water services. The average payment for water services in NMB, Amathole and Kouga municipalities respectively was R390.47, R198.86 and R191.89. The NMB municipality charged the most for water services.

The residents were asked several questions relating to their usage of water services and the importance which they attach to different elements of the service. The percentage of respondents in each municipality who indicated that they used the municipal water services ranged from 12% in the Amathole municipality to 30.67% in the Kouga municipality and 31.33% in the NMB municipality.

Residents from the Amathole municipality used the municipal water services substantially less than the residents in the other municipalities; with most making use of water tanks and septic toilet systems as an alternative.

The residents from each municipality were asked to indicate which water services they deemed to be most important in meeting their water service needs. Table 6.5 displays the results from this question. The water services were ordered from most to least important in each municipality. This ordering was determined by the number of respondents which selected the water service to be important.

Table 6.5: Attributes of water service that residents rate as important

	Ordered from most to least important	Number of respondents selecting this service as most important
NMB	Quality of water	57
	Security of water	25
	Sewerage disposal	14
	Per 10 KL (kilolitre) water service charge	6
	Interruptions in water services	3
	Rate of flow of water from tap	1
Kouga	Quality of water	64
	Sewerage disposal	23
	Security of water	23
	Per 10 KL (kilolitre) water service charge	8
	Interruptions in water services	1
	Rate of flow of water from tap	1
Amatola	Quality of water	39
	Security of water	31
	Sewerage disposal	26
	Interruptions in water services	4
	Per 10 KL (kilolitre) water service charge	2
	Rate of flow of water from tap	0

There is some consistency between the respondents ranking of importance of water services in each municipality (Table 6.5). In all three municipalities respondents indicated that the "quality of water" was the most important attribute. Furthermore, respondents in all three municipalities indicated that "rate of flow of water" was the least important attribute. "Security of water" and "sewerage disposal" were also consistently in the top three rated attributes.

6.4 THE CHOICES MADE FOR WATER SERVICE

The choice experiment involved presenting each participant in the survey with a four sets of two options for water services. Each option contained six attributes. These six attributes were:

1. Sewerage disposal into water
2. Quality of water
3. Security of the water
4. Interruptions in the flow of water
5. Rate of flow of the water
6. Per 10 KL (kilolitre) water Service Charge

Each of these six attributes had three levels. As there are multiple ways to combine these attributes and levels and present them to one individual, a fractional factorial design was used to create unique option sets on each questionnaire (also see Chapter 5). Each option was numbered, representing a unique combination of levels of the six attributes. For example, option 1 has the combination of levels of attributes shown in Table 6.5. Level 1 of an attribute indicates the lowest/poorest form of the attribute. Level 2 indicates a moderate form of the attribute and Level 3 the highest/greatest form of the attribute. In Table 6.6 level 3 for sewerage disposal indicates limited pollution of the water whereas Level 1 for charge indicates a low service charge for water.

Table 6.6: Description of the levels of attributes for option 1

Option 1	Sewerage	Quality	Security	Interruptions	Rate	Charge
Level	3	2	3	1	1	1

The number of times a specific option was selected and the number of times the option was presented in the surveys are shown in Figure 6.2. The blue part of the bar chart represents the number of times that option was selected by individuals. The red part indicated the excess number of times the option was presented but not selected. Figure 6.2 can be seen as a ranking of the options according to the ratio of selections to non-selections. The best options would be the options at the bottom of the figure with the best ratio of selections to non-selections.

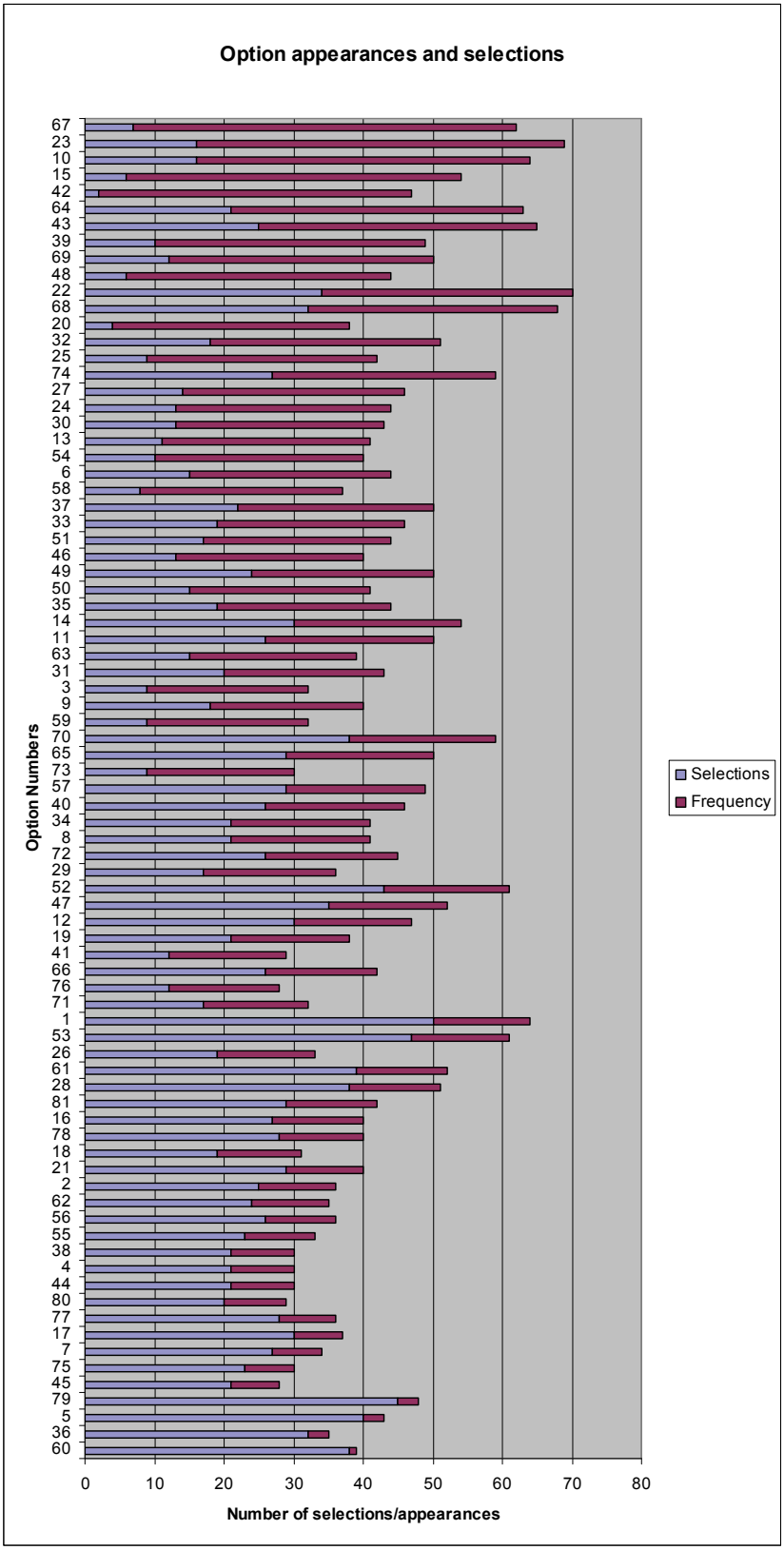

Figure 6.2: Option appearances in choice experiment and selections

Option 60 was determined to be the best choice overall having the largest number of selections to non-selections (Figure 6.2). The worst option was determined to be Option 67, as it had the smallest selection to non-selection ratio.

The five best and worst options and each of the options attribute level combinations are presented in Table 6.7.

Table 6.7: The five best and worst options

	Options	Sewerage disposal	Quality of water	Security	Interruptions	Rate of flow	Service charge
5 Best Options	60	3	3	2	2	3	2
	36	2	3	3	3	1	2
	5	3	3	3	1	2	2
	79	3	3	2	2	2	1
	45	1	3	3	2	2	1
Average		**2.4**	**3**	**2.6**	**2**	**2**	**1.6**
5 Worst Options	42	1	1	1	1	2	2
	15	1	1	2	3	2	3
	10	2	1	2	1	1	1
	23	1	1	3	2	1	3
	67	1	1	1	1	1	1
Average		**1.2**	**1**	**1.8**	**1.6**	**1.4**	**2**

The best options have relatively high levels of the attributes and the worst options have relatively low levels of the attributes (Table 6.7), as one would expect. The attribute which is most consistent with what is expected is "quality of water" because the five best options have all got the highest level and the five worst options the lowest level. This selection implies that this attribute is very important to water users. "Sewerage disposal" and "Security of water" have also been rated as relatively important attributes where the best options have high levels of these attributes and the worst options have low levels.

The attributes: "Service charge", "rate of flow" and "interruptions in the flow of water" are all of average importance to the individuals surveyed, suggesting that these the respondents were currently less concerned with the costs levied on water and unconcerned with interruptions and rate of flow.

6.5 ADEQUACY OF SAMPLE SIZE FROM THE DESIGN PERSPECTIVE

The summarised descriptive results in this section cover the responses to the 400 choices made by the NMBM residents only. The attribute levels of the 81 choice cards were approximately equally distributed for the 400 choices, as shown by the summarised frequencies in Table 6.8. Each attribute was allocated three levels, the lowest level (-1), a middle level (0) and the highest level (+1). Given that there were 400 choice cards, each with two choices, this yields a total of 800 selections per attribute (i.e. $800/3 \approx 267$ selections per level). The summary in Table 6.8 shows The number of times each attribute level was used in the experiment was round about 267, which is an acceptable number and an indication that the allocation of levels within the design process were acceptable.

Table 6. 8: Frequency of attribute level use in the questionnaire

Coded level	Sewerage disposal	Water quality	Security	Interruptions	Rate of flow	Service charge
Lowest (-1)	278	277	247	287	269	262
Middle (0)	247	246	291	264	242	256
Highest (+1)	275	277	262	249	289	282

6.6 CROSS-TABULATION SUMMARIES

Tables 6.9 to 6.13 summarise the respondents' choices in bivariate tables. The bivariate tables include the service charge (or cost) variable, using an effects coding as follows:

$$X_1 = \begin{cases} -1 & \text{if cost is lower value } (R86.76) \\ 0 & \text{if cost is middle value } (R96.40) \\ 1 & \text{if cost is upper value } (R125.32). \end{cases}$$

As the service charge variable is important for the interpretation of the estimated consumer marginal willingness-to-pay $\left(\widehat{WTP}\right)$, the variable is included in each table with one of the attribute variables, sewerage disposal (Table 6.9), water quality (Table 6.10), water security (Table 6.11), interruption of provision (Table 6.12) and rate of flow (Table 6.13).

The attribute variable was effects coded as follows:

$$X_i = \begin{cases} -1 & \text{if attribute is lower level} \\ 0 & \text{if attribute is middle value} \\ 1 & \text{if attribute is upper value,} \end{cases} \qquad \text{for } i = 2\,(\text{sew. dis.}), 3\,(\text{water qual.}), ..., 6\,(\text{flow rate}).$$

Assuming the theory that respondents would choose to pay as little as possible, whilst simultaneously selecting the best attribute option, we expected that these combinations would be selected more often than others. Tables 6.9 to 6.13 have been sorted to examine this theory by ordering the more favourable service charge in ascending order and with the attribute levels in descending order.

Table 6.9: Response counts of NMBM residents – Sewerage disposal

Service charge	Sew disposal	Counts	Row total	Percentage
-1	1	59	90	65.6
-1	0	40	84	47.6
-1	-1	33	88	37.5
0	1	64	93	68.8
0	0	43	74	58.1
0	-1	26	89	29.2
1	1	57	92	62.0
1	0	44	89	49.4
1	-1	34	101	33.7

The last column in Table 6.9 shows the percentage of selection of the combination, as opposed to not having selected the combination. The results indicate preference for the sewerage disposal level,

"*virtually no area affected by disposal and spills of sewerage into the environment*" as observed by the high percentage preference (> 60%) for this level. There was also support shown for the lowest service charge, although this preference was not significant in all cases.

Table 6.10: Response counts of NMBM residents – water quality

Service charge	Quality water	Counts	Row total	Percentage
-1	1	56	90	62.2
-1	0	43	84	51.2
-1	-1	33	88	37.5
0	1	53	80	66.3
0	0	49	81	60.5
0	-1	31	95	32.6
1	1	59	107	55.1
1	0	46	81	56.8
1	-1	30	94	31.9

The observational results from Table 6.9, have many of the same features as those reported in Table 6.10. They reveal strong support for high quality water, such as, "*water is an excellent quality, improved life of kettles, etc.*" and "*water is clear, no smell, pleasant taste*". The option of a low water quality level, "*water is unclear, chlorine smell, sour taste*", was infrequently selected (< 40%).

Table 6.11: Response counts of NMBM residents – Security

Service charge	Security	Counts	Row total	Percentage
-1	1	47	85	55.3
-1	0	51	100	51.0
-1	-1	34	77	44.2
0	1	51	86	59.3
0	0	50	92	54.3
0	-1	32	78	41.0
1	1	49	91	53.8
1	0	46	99	46.5
1	-1	40	92	43.5

Table 6.12: Response counts of NMBM residents – Interrupted service

Service charge	Interruptions	Counts	Row total	Percentage
-1	1	49	90	54.4
-1	0	41	72	56.9
-1	-1	42	100	42.0
0	1	36	74	48.6
0	0	55	97	56.7
0	-1	42	85	49.4
1	1	43	85	50.6
1	0	42	95	44.2
1	-1	50	102	49.0

Table 6.13: Response counts of NMBM residents – rate of flow

Service charge	Rate of flow	Counts	Row total	Percentage
-1	1	49	90	54.4
-1	0	41	72	56.9
-1	-1	42	100	42.0
0	1	55	97	56.7
0	0	42	85	49.4
0	-1	36	74	48.6
1	1	50	102	49.0
1	0	43	85	50.6
1	-1	42	95	44.2

The results reported in Tables 6.11 to 6.13 are less conclusive than those in Tables 6.9 and 6.10. There is limited support indicating low preferences for the lowest level of the respective attributes. The lowest level of the security attribute was selected less frequently than the upper two levels (Table 6.11). For the attributes, interruptions of provision and rate of flow, similar preference patterns were found (Tables 6.12 and 6.13). These results lend support to the theory that respondents select the best attribute option, whilst choosing to pay as little as possible.

6.7 MODEL ESTIMATION RESULTS

Tables 6.14 to 6.18 summarise the results of the fitted models for the discrete choice multinomial logit estimation for each experiment. The similarities in the results of the fitted models include the following:

- The coefficient for the service charge (cost) variable is negative for all five experiments, as would be expected. As the service charge for water provision increases, so the water service package offered becomes less attractive and preference decreases (a negative relation). Respondents were less willing to pay a higher tariff for the provision of water, but for some of the models (surprisingly) the results were inconclusive on the tariff level; the *p*-value showed this variable (tariff) not significant for three of the five models.
- The coefficients for the variables, sewerage disposal, water quality, security and interrupted supply were all found to be positive, as one would expect.

Table 6.14: MNL model summary for NMBM residents

Variable	Coeff	Std error	*p*-value	$\widehat{WTP}$
Sew disposal	0.8427	0.1136	0.0000	252.94
Quality of water	0.7723	0.1155	0.0000	231.81
Security	0.3897	0.1092	0.0004	116.98
Interruptions	0.1842	0.1037	0.0756	55.28
Rate of flow	0.1528	0.0901	0.1115	45.86
Cost	-0.0033	0.0049	0.4935	

Table 6.15: MNL summary for Kouga residents

Variable	Coeff	Std error	*p*-value	$\overline{WTP}$
Sew disposal	1.0227	0.1306	0.0000	57.29
Quality of water	1.1614	0.1396	0.0000	65.05
Security	0.3910	0.1180	0.0009	21.90
Interruptions	0.1754	0.1119	0.1170	9.83
Rate of flow	-0.0495	0.1043	0.6355	-2.77
Cost	-0.0179	0.0053	0.0008	

Table 6.16: MNL summary for Amathole residents

Variable	Coeff	Std error	*p*-value	$\overline{WTP}$
Sew disposal	1.0770	0.1282	0.0000	114.99
Quality of water	0.8412	-0.1216	0.0000	89.81
Security	0.3785	0.1141	0.0009	40.41
Interruptions	0.1918	0.1081	0.0761	20.47
Rate of flow	0.0521	0.1009	0.6058	5.56
Cost	-0.0094	0.0080	0.2395	

Table 6.17: MNL summary for NMBM business owners

Variable	Coeff	Std error	*p*-value	$\overline{WTP}$
Sew disposal	0.9725	0.1637	0.0000	35.93
Quality of water	1.6851	0.2191	0.0000	62.26
Security	0.9657	0.1630	0.0000	35.68
Interruptions	0.1491	0.1415	0.2920	5.51
Rate of flow	0.2413	0.1325	0.0686	8.92
Cost	-0.0271	0.0075	0.0003	

Table 6.18: MNL summary for Amathole business owners

Variable	Coeff	Std error	*p*-value	$\overline{WTP}$
Sew disposal	0.7343	0.1415	0.0000	194.46
Quality of water	1.4662	0.1833	0.0000	388.28
Security	0.5945	0.1403	0.0000	157.45
Interruptions	0.3923	0.1354	0.0038	103.89
Rate of flow	-0.0451	0.1234	0.7146	-11.95
Cost	-0.0038	0.0098	0.7002	

The coefficients for the variable, rate of flow were not significant in all five experiments (*p*-value of the coefficient is greater than the 5% level) and inconsistent, being positive for three experiments and negative for two experiments. It was deduced that rate of flow did not have a major influence on the choice among users among municipal water service packages provided.

6.8 MODELLING MARGINAL WILLINGNESS-TO-PAY (WTP)

In order to determine the marginal WTP for the choice modelling experiments, it is necessary that the coefficient for the attributes in the model is statistically significant (Hensher, Rose & Greene, 2005: 359). The estimated marginal WTP, is a ratio of the attribute and the price variable and is defined as $\overline{WTP} = \left(\frac{\beta_{attribute\,i}}{\beta_{price\,\mathrm{var}}} \right)$. In the choice modelling experiments, the direction of the attribute level and the

service charge variable have been defined as diametric opposites. To simplify the interpretations of the estimate, the function is adjusted accordingly as $WTP = \left(\frac{\beta_{attribute\ i}}{-\beta_{price\ \mathrm{var}}} \right)$. An outline of the theory underlying this definition is provided in Appendix 6.

In the experiment reported in Tables 6.14, 6.16 and 6.18 the service charge (cost) variable is statistically insignificant at the 5% level of significance, and for this reason there is little interpretative value in determining the marginal WTP in these cases (Hensher et. al., 2005). Accordingly, the marginal willingness to pay was only calculated for Tables 6.15 and 6.17, the fitted choice models for the Kouga residents and the NMBM business owners. The marginal WTP for these two study sites are summarised in Table 6.19.

Table 6.19: Estimated WTP per month for Kouga residents and NMBM business owners

Variable	WTP per month (R) per increase in attribute level	
	Kouga residents	NMBM business owners
Sew disposal	57.29	35.93
Quality of water	65.05	62.26
Security	21.90	35.68
Interruptions	9.83	5.51
Rate of flow	-2.77	8.92

The summarised results in Table 6.19 provide an estimate of the Rand value that respondents are WTP per month for a level improvement in the attribute.

The willingness to pay for a marginal improvement in sewerage disposal within the Kouga municipality was R57.29 per month; the relevant marginal improvement being from
"*many areas affected by disposal and spills of sewerage into the environment*",
to
"*only isolated areas affected by disposal and spills into the environment*".
By way of contrast, the NMBM business owners were willing to pay R35.93 per month for the same marginal improvement.

The quality of water was an attribute both the Kouga residents and NMBM business owners were prepared to pay even higher amounts than this for marginal improvements. Both groups were willing to pay over R60 per month.

Improved security of supply was also an attribute that both sets of users were willing to pay highly for per month, R21.90 in the case of the Kouga residents and R35.68 in the case of the NMBM businesses.

The experiment yielded inconclusive values for the rate of flow and interrupted flow attributes. The results shown in the shaded cells are statistically insignificant and included for completion rather than interpretive purposes. There was a positive willingness to pay found for less interruptions in water flow, but the values were low and findings statistically insignificant. Businesses within the NMBM do value rate of flow (water pressure) but not as much as they do the other attributes, but nothing could be

concluded in connection with this attribute from the responses of the residents of the Kouga municipality.

6.9 SELECTED DESIGN PROBLEMS REFLECTED IN THE FINDINGS

(1)Order of listing
The fact that the first three listed attributes were found to be significant in all three, but the last three were not significant in all cases, raises the possibility that order of attribute may have played a role in determining the choices. In terms of this theory, the respondents fatigued and paid less attention to lower listed attributes, or alternatively, found the choice problem of six overwhelming and so focused their attention on a smaller set, the top three only.

(2) Tariff level bands were too narrow
In the light of the sharp increases in public utility tariffs currently being proposed in South Africa, the tariff bands considered may have been too narrow – leading to this variable being insufficiently differentiated and it not influencing choice as much as one would have expected, *a priori*.
(3) Linear estimation models used

One of the limitations of the model used in this analysis is that the changes between attribute levels were assumed to be linear and no consideration was made for the interaction of terms.

6.10 CONCLUSION

Chapter 6 reports the results of five choice modelling experiments. There were 450 respondents surveyed. They made 1800 choices between alternative water service packages. An acceptable number of selections were made per attribute level from the experimental design and estimation perspectives (about 267). An appropriate statistical model was fitted to the data, namely a discrete choice multinomial logit model, and the programme used for this purpose was the one recommended by leading authorities in the application of CEs, the NLogit 4.0 programme.

The results of the estimation were largely consistent with *a priori* expectations, although tariffs were not significant in three of the 5 experiments. The latter may have been the consequence of an error in design; with the tariff level bands being too narrow. Users were found to be willing to pay significant amounts for improvements in water quality, proper management of used water and security in supply of water, between R20 and R70 more per month per level of improvement.

Reduced interruption of water service and improved water pressure, were not valued as highly as the above three mentioned attributes, and there was little positive willingness to pay found for improvements in these aspects of the water service package municipalities provide to their users.

The usage of water services was found to be similar for both the Kouga and NMB municipality residents. The Amathole residents were found not to use municipal water services as intensively as the residents in the other two municipalities.

Water service charges in the NMB municipality were found to be higher than the water service charges for other two municipalities.

Both business firms and residents in all municipalities were found to value “quality of water” as the most important attribute in water service delivery, and “security of water” and “sewerage disposal into water” were found to be important concerns. “Service charges” and “Interruptions in flow” were found to be of less importance to users, and both groups were found to be least concerned with the “rate of flow of water”.

SECTION C:CONCLUSIONS

CHAPTER 7

KEY FINDINGS AND RECOMMENDATIONS TOWARDS MUNICIPAL WATER SERVICE TARIFF SETTING

7.1 KEY FINDINGS

(1) The primary current influence on municipal tariff design is compliance with water and municipal governance law and policy. The water service provided by South African municipalities and the tariffs set for this service are principally influenced by their quest to comply with National Law and Policy and local user political pressure (Chapter 1, 2,3 and 4). There are a number of influential national laws; arguably the most important being the Constitution (1996), Water Services Act (1997), Municipal Structures Act (1997), National Water Act (1998) and Local Government Municipal Systems Act (2000) and Municipal Financial Management Act (2003). The Water Services Act makes the provision of water services a municipal monopoly. The tariff policy that has emerged under the compliance goal distinguishes three water service classes: water charged in increasing steps based on volume demanded, water charged a flat rate (average financial cost) and water not charged for (free or wasted). The indigent (very poor) receive water that is typically charged for and paid for by government in the form of the equitable share grant.

(2) For many of South Africa's municipalities meeting the compliance goals are challenging, to the point of being almost overwhelming.

(a) A challenge facing South Africa's poor municipalities seeking to improve their level of water service is to attract sufficient 'full paying members' to sustain the target standard of service provision (what Chapter 4 described as the affordability constraint). The less such people there are, the greater the tariff needed to be imposed on these few and the greater their incentive to exit the municipality. The links between cross-subsidisation within municipalities and inducement to exit over the long run have yet to be explored.

(b) Regulating uniform standards of water service probably most hurt poor communities because the affordability constraint is binding in these communities. When the affordability constraint cannot be met, the alternative to a reduced standard of service may be no service (fetch water from the river, etc., see Chapter 2, with respect to Amathole municipality).

(3) Net external cost is not included in the calculation of South African municipal water service tariffs. Given the widespread reports of waste water spills the negative external cost of municipal water service provision is positive in many cases. In these cases the average cost tariff is an undercharge.

Net external costs = External costs – External benefits

External costs

(a) Water transfer impacts
(b) Dam impacts
(c) Spills + under-treatment of waste water

MINUS

External benefits

(a) Electricity generating opportunities
(b) New recreation opportunities

(4) Many municipalities use limited (if any) accounting information to determine the availability tariff. Using the selected Eastern Cape municipalities as a reference suggests that the financial accounting information is only partially used to determine the cost of service recovery requirement, and that tariffs may be set in some cases by reference to precedent (historical rates levied). The accounting methods of the reference municipalities do distinguish FC and VC and for this reason do provide a basis for setting access (availability) and use tariffs that reflect the relevant economic costs, and thereby efficiently ration the investment in water service structure.

(5) There is uncertainty within South African municipalities as to the underlying economic rationale of the water service tariff (price) structure.
Water tariffs are an integral mechanism by which water is allocated within the economy, not only within urban settings but between all users. The environmental and agricultural values of water should not be seen as not having a price. **What makes a golf course a more or less worthy type of demand than a farmer or a home gardener or an industry? If** one can answer this question with certainty, then one can draw up a tariff structure that is consistent with this ranking, but we do not think that this question can be answered with certainty. For this reason, there remains merit in letting the market have more of a say in these allocations – in identifying the right prices (average cost) and allocating water accordingly, not only for allocations between urban users but all users (including agriculture and environmental).

(6) Increasing block tariff structures may redistribute income in unintended ways. The use of increasing block tariff structures is appropriate for curtailing individual user demand, but other more targeted instruments may be superior for the pursuit of other goals, such as cross-subsidising to cost of providing water services to the poor. Increasing block tariff structures may redistribute income in unintended ways.

Increasing block tariff structure have economic merit as a tool of demand management in drought situations. They also may have merit as a means to cross subsidise the demand of low water using residents by taxing the demand of high water using residents. To the extent that the low water using residents are poor people and high water using residents are rich people this structure may be consistent with redistribution goals.

However, they may also punish households with more users of water simply because they have more users or value water services relatively higher than other households, and there may be better ways to organise the water service tariff structure so that there is redistribution from rich to poor. For instance, a flat water service rate with a structure of (government subsidised rebates, calculated on the basis of income, has been shown to be a more efficiently targeted redistributive arrangement (Boland and Whittington, 2009). The popularity of increasing block structure among South African municipalities is not well explained by the need to manage droughts or cross-subsidise the poor.

An alternative explanation for their popularity is that during the last decade South African municipalities discovered that demand management is a cheap substitute for increasing the supply of

water services in meeting their mandates to comply with Law, policy and political pressure, and is very easy to apply. Municipalities set water service tariffs per level of household consumption that bring in enough revenue to match their financial costs (Chapters 2 and 3). The consequences of this approach have been:

- a loss of domestic residential water service users consumer surplus (Chapter 4)
- disinterest in the underlying characteristics of demand for water services (Chapter 4)

(7) Analysis of choice with respect to the characteristics of municipal demand for water services, show that the most valued improvements in water service are: quality of water, security of supply and sanitisation of waste water. Still valued, but less so, are interruptions in service and rate of flow (water pressure). Eastern Cape municipal water service users are willing to pay significant amounts for water quality, proper management of used water and security in supply of water, but not for reduced interruption of water service and improved water pressure (Chapters 5 and 6).

In the light of the latter finding, there is merit in reconsidering the required standard of service options and hence financial TC (and FC and VC) options municipalities present to their users of water services. For instance, the scope and (legal) permissibility low cost delivery options should be reconsidered, e.g. for Q_0Q_1 water service supply to the poor in Figure 7.1 below.

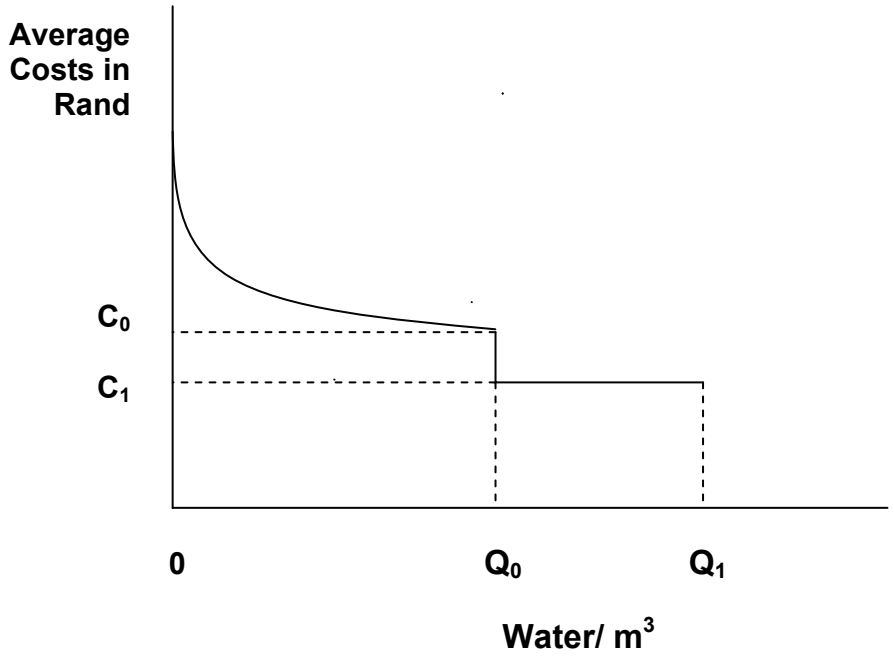

Figure 7.1: Exploring lower cost supply options

7.2 RECOMMENDATIONS TOWARDS SETTING OF MUNICIPAL WATER TARIFFS

7.2.1 CURRENT PRACTICE

The current decision process followed in South African municipal water service tariff setting is a three step one.

- A decision is made on the level of demand for water services that the municipality will aim to accommodate. The less the level of demand accommodated the lower the supply challenge the municipality sets for itself.

- A decision is made on which costs to include. The more costs included the higher the tariff required. Typically there is under-recovery because depreciation is provided for at less than replacement cost, and environmental costs are excluded.

- A decision is made on which users will receive:

- free water (the municipality itself typically being the main recipient)
- water at average cost of production
- water on an increasing block scale

This step is articulated and rationalised in the Water-Service Development Plan.

- A decision is made on the level of the access (availability) charge and the use charge structure. The use charge structure is an increasing block scale that is set in order to cover the cost of the demand managed water supplied under this tariff arrangement, plus the cost of providing free (non-revenue raising) water. Setting the access charge level and use charge structure are primarily an accounting balancing exercise, but the nature of these charges is also influenced by political pressure.

This four step decision process will continue in the future to shape the water service tariff structure set by South African municipalities, but there are a number of guidelines that could improve the economics of the decision making.

7.2.2 PROPOSED GUIDELINE AMENDMENTS FOR FUTURE MUNICIPAL WATER SERVICE TARIFF DECISIONS

(1) The level of demand accommodated

- Free basic water per person.

The Constitution of South Africa defines municipal water service obligations with reference to individuals, so the interests of these individuals must be taken into account in the determination of the tariff structure. There are two important implications of this interest for the way municipalities levy tariffs. Firstly they way they charge domestic clusters (households) must reference to the number of people making up the domestic cluster or household; **something they are not doing**. Secondly, they should not charge anyone for free basic water (such as is done by the NMBM, for instance).

- The need to better link tariff setting with the construction of new water service infrastructure

If the planning horizon is set long enough forward a number of water service infrastructure schemes become economically feasible. When the demand for water services increases in the face of a fixed supply, increasing the tariff is a way to allocate the water service, but at some point the higher tariff makes a new (supplementary) water service supply scheme feasible (with tariff-revenue covering costs). It is an abuse of the monopoly position of municipalities and a government failure if the new water supply schemes are not brought into operation when the tariff level is high enough to justify these. Eliminating excess demand for water services by increasing the tariffs charged does not rectify the problem of inefficient supply.

There are long time horizons in bringing new water supply schemes into operation. A schedule of schemes needs to planned, the various approvals obtained (land-use and financing) and the costs estimated of each scheme, and this has to be done well ahead a schedule of the time these schemes will need to be brought into operation. The costs of each scheme need to be converted into tariffs levels (average cost tariffs at which these schemes become feasible). Given the potential for government failure to provide economically justifiable water service infrastructure, municipalities that practice demand management tariff setting should be made to justify (account for) why they have not commenced with bringing a new supply scheme into operation, or have negotiated with DWA for this to be done on their behalf.

(2) Formulating a policy on how to incorporate excluded costs such as under-depreciation provision and environmental costs. Currently there is typically under-recovery of the costs of providing water services.

(3) The division of the water into tariff groups
There is a good economic rationale for applying flat tariffs to some consumers and stepped tariffs to others but this rationale is not valid under all circumstances.

(4) The distinction between availability and use tariff, the number of steps in the tariff and the size of these steps
The case for charging for access and use separately
The economic rationale for charging for both the provision of access to new users and for the extent of use is the difference between marginal cost of providing access and of service after access is provided. There are fixed costs incurred in providing access, and it is not financially feasible to provide all users with access – because the cost is too high relative to the benefit (what the consumers are willing to pay). It only makes economic sense to provide a user with access to water services when the user's willingness to pay is higher than the cost of providing access. This particular rationale is rendered largely irrelevant in South Africa by the Constitutional right of access to water services. The provision of access is rights determined rather than tariff determined.

There is a less clear-cut rationale for charging users for both the provision of access and use to long-standing users where connection costs are minimal (have already been provided). The rationale for two separate tariffs under these circumstances is to cover the fixed costs with the access charge and the variable costs with a use charge. The revenue collection and efficiency benefits of this accounting exercise need to outweigh the extra costs of doing so. This study found that most municipalities could and do distinguish fixed from variable costs, and thought that there were net benefits in translating fixed costs into an access (availability) charge and variable costs into a use tariff, but that the levied an availability tariff lower than the fixed cost (because it would otherwise be unacceptably high to the users).

When to use stepped (increasing block) tariffs and when to use flat (average cost) tariffs

(a) Residents
The increasing block tariff for water services used by domestic residents is widely supported by the municipalities of South Africa. The main benefits of the structure are:
- it enables the cost of water not charged for to be recovered
- it facilitates the cross-subsidisation of low water users by high water users
- it discourages the demand for water services among residents and the workers they employ.

However, the rationale for discouraging this particular demand (residential demand) is unclear. One of the consequences of efforts to discourage demand has been the construction of boreholes – leading to the reduction of underground sources of water supply. The rationale for cross-subsidising the water municipalities waste is also unclear.
The least controversial case for the introduction of progressive stepped tariffs is in crisis situations (of government failure) where supply is insufficient and has to be rationed in the short run. It is undesirable that the short-run crisis case should be extended to 'normal' short-run circumstances or the medium and long run.

(b) Business and Government
A flat rate related to average cost is applied to business and government because municipalities do not feel that distorting demand for this segment of the market will serve any purpose.

The size and number of the steps
The volumetric scale and tariff differential, and number of the blocks employed by the various municipalities are key features of the tariff structure. This study found that there was no economic rationale employed in these decisions – the blocks were arbitrarily set and adjusted.

It recommends that only three blocks be employed – the first being the average cost rate (the tariff level), the second being 50% above this and the third 100% or more above the tariff level, and that the size of the blocks (defined by volume) are set to whatever is required to reign in demand to available short-run supply. It is not recommended that a fixed volume block sizes and tariff scale be adopted for all municipalities, because each municipality faces different demand and cost circumstances – the variations in their tariff structure will reflect the particular circumstances of the municipality.

(5) The tariff structure as the appropriate selection of instruments of intervention or regulation

(a) There is a need for better coordination of the water service tariff structure with other water charges.
The different aspects of water policy are linked, but the instruments by which each aspect is addressed are distinct. The primary function of the tariff structure is allocation, but there are many other important related aspects of water services supply policy, for instance, efficiency and environmental sustainability in abstraction, the impact of waste water not adequately sanitised before disposal back into the environment and meeting the water service need of the poor. These problems and challenges are best addressed with other instruments (not tariffs), such as abstraction charges, environmental taxes based on cost of sanitising or pollution load, and redistributive public financial arrangements.

Specifically with respect to abstraction for urban use charges, municipalities must participate in the process of determining the prices they pay DWA for bulk water (in terms of the Municipal Financial Management Act (2003)). The DWA are mainly responsible for bringing the new schemes into operation. The nature of these negotiations should be such that there does not develop a disjoint between water service tariffs and bringing into operation new water supply schemes. Each municipality should know at what tariff levels new supply schemes (DWA or their own) are feasible.

(b) There is little merit of applying VAT to municipal water services.
The gains achieved in the form of revenue raised by levying VAT on municipal water services are increased general revenue, but the impact is to reduce the affordability of the service to the poor and

the sustainability of the service from the municipal perspective. There is little gained in taking this water service income away for the municipalities – it has to be given back (with interest) anyway.

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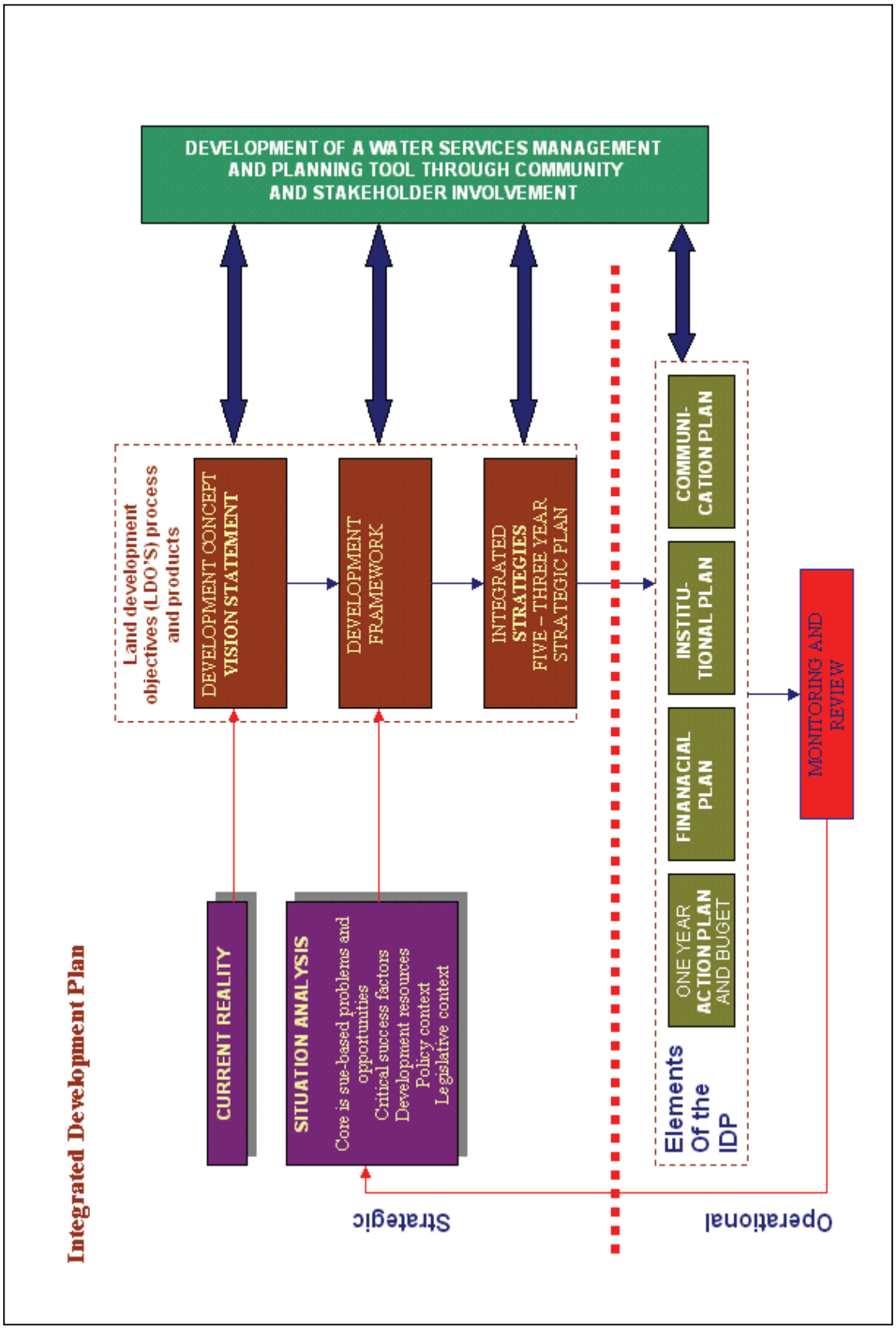
APPENDICES

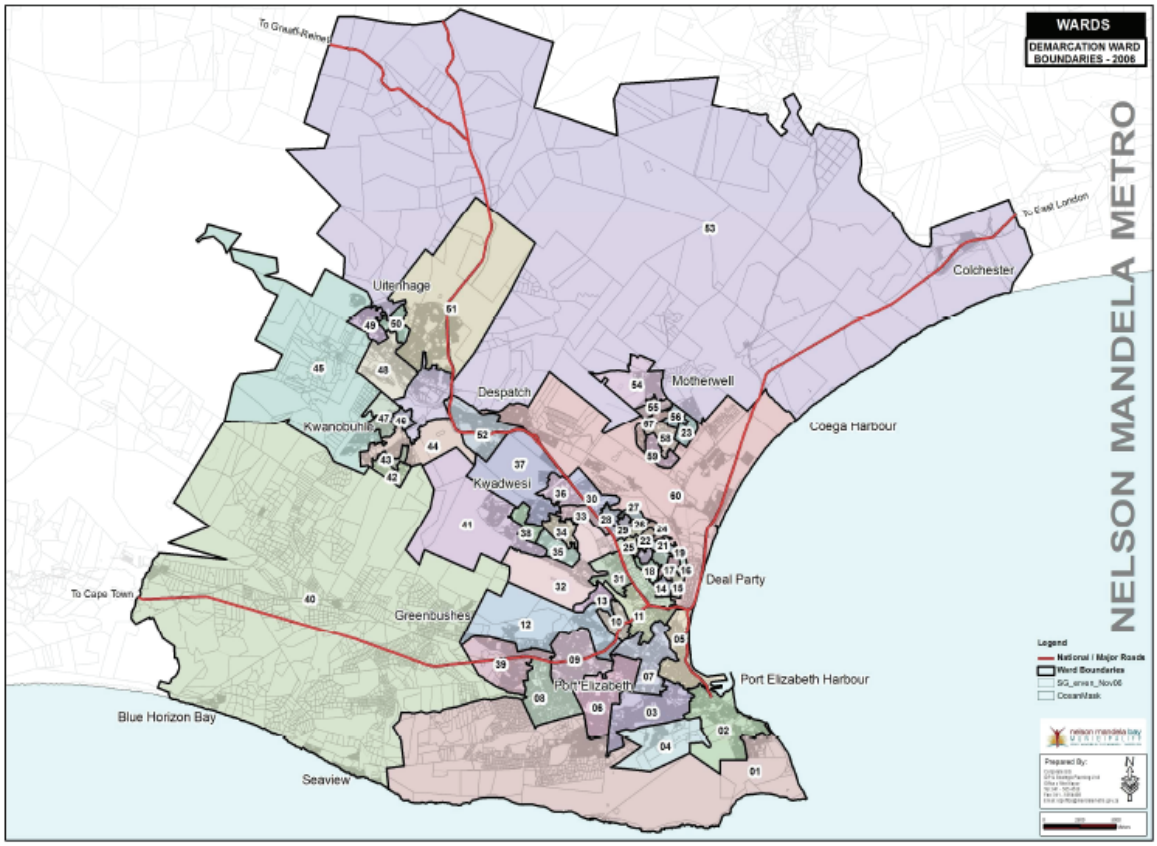
APPENDIX 1: FIGURE A1.1:IDP METHODOLOGY (Source: NMBM Water Service Development Plan (2008)



APPENDIX 2: THE REFERENCE MUNICIPALITIES

LOCATION AND COMPOSITION

The NMBM (NMBM IDP, 2008) has a population of 1.1 million and covers an area of 1 950 km^2. The municipality includes Port Elizabeth, Uitenhage and Despatch.

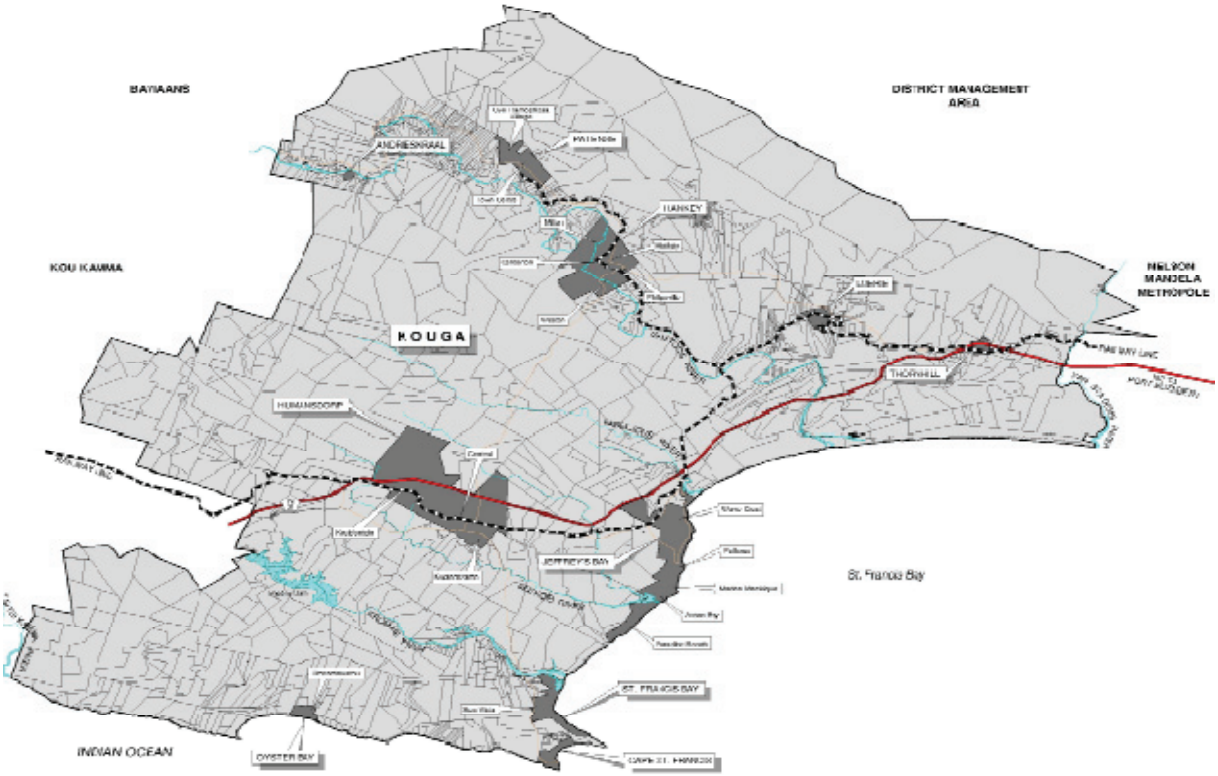


Source: NMBM Water Service Development Plan (2008)

Figure A2.1: Nelson Mandela Bay Municipality

It consists of 289 000 formal households and 35 257 informal households (NMBM WSDP, 2006:40). The municipality in addition has 49 009 back yard shacks.

The KLM (KLM IDP, 2008) is approximately 20 km west of Port Elizabeth. The municipality incorporates Cape St Francis, Hankey, Humansdorp, Jeffreys Bay, Loerie, Oyster Bay, Patensie and Thornhill.



Source: KLM Integrated Development Plan (2008)

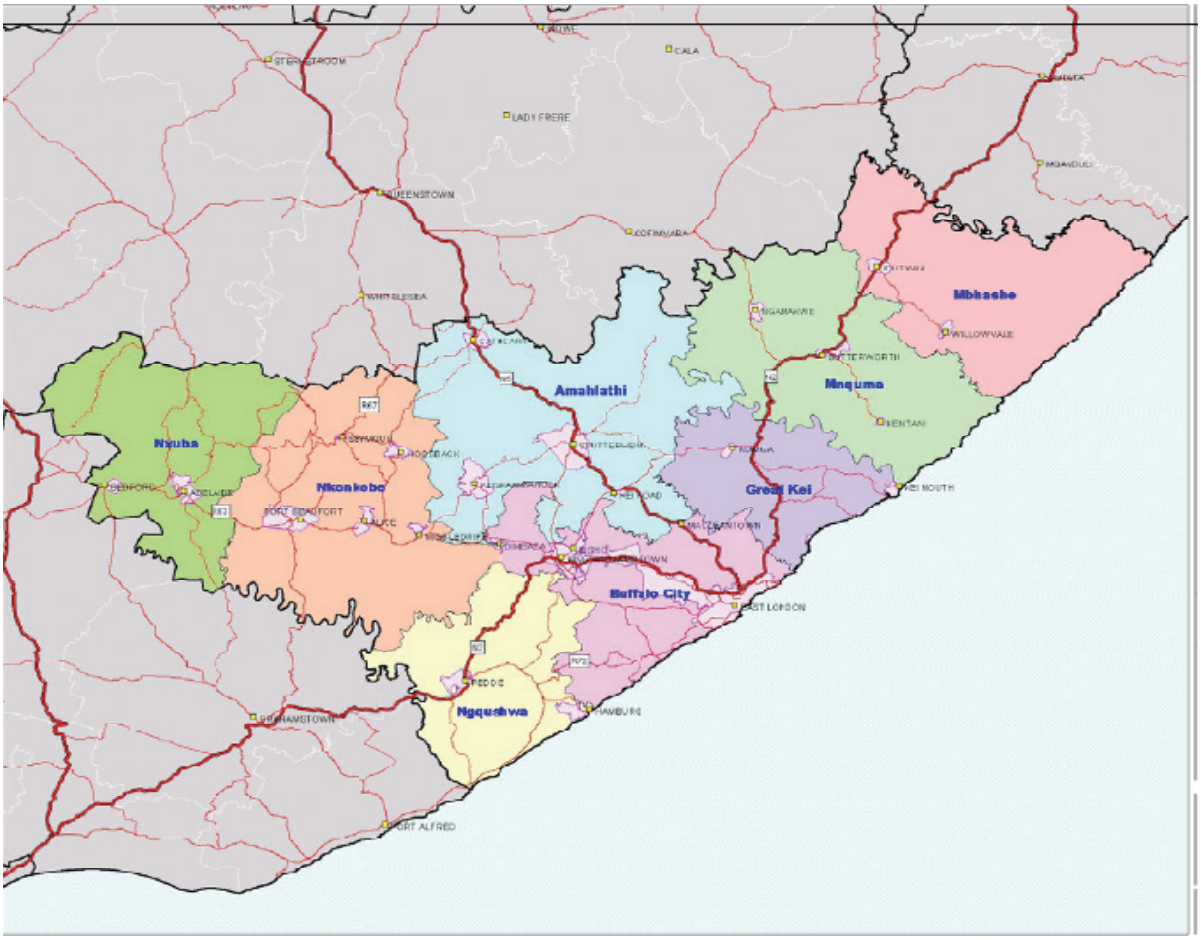
Figure A2.2: The Kouga Local Municipality

It has a permanent population of 70 695 [Census 2001: Statistics of South Africa] and 25 737 households. The population extends to 332 824 during peak holiday migration. Refer to the migration pattern as per KLM WSDP (2006).
45.6% of the permanent population resides in Jeffreys Bay, 27.2% in Humansdorp, 13.3% in Hankey, 4.4% in Patensie, 3.2% in Cape St. Francis/St. Francis, 2.8% in Loerie, 2.5% in Thornhill and 1.2% in Oyster Bay.

The ADM (ADM IDP, 2008) occupies the central coastal portion of the Eastern Cape Province and a land area of 23 576 km^2. The ADM area of jurisdiction, as detailed in Figure A2.3 below, is made up of eight local municipalities, as follows:

- Buffalo City Municipality, comprising East London, King William's Town and surrounding urban centres, a number of coastal towns, numerous peri-urban and rural settlements;
- Amahlathi Municipality, comprising the towns of Stutterheim, Cathcart, Keiskammahoek and Kei Road, numerous peri-urban and rural settlements;
- Nxuba Municipality, comprising the towns of Bedford and Adelaide and surrounding rural areas;

- Nkonkobe Municipality, comprising the towns of Alice, Fort Beaufort and Middeldrift, the smaller towns of Hogsback and Seymour, numerous peri-urban and rural settlements;
- Ngqushwa Municipality, comprising the towns of Peddie, the coastal town of Hamburg, numerous peri-urban and rural settlements;
- Great Kei Municipality, comprising the town of Komga, the small coastal towns of Kei Mouth, Haga Haga, Morgan Bay and Chintsa, and a number of rural settlements;
- Mnquma Municipality, comprising the main town of Butterworth, the small towns of Ngqamakwe and Centani, numerous peri-urban and rural settlements; and
- Mbhashe Municipality, comprising the towns of Dutywa, Elliotdale and Willowvale, and numerous peri-urban and rural settlements.



Source: ADM Integrated Development Plan (2008)

Figure A2.3: The Amathole District Municipality

The districts' total population is 1.664 million (Community Survey carried out by ADM in 2007 and stated in the ADM IDP (2008)) and 458 582 households, the district does not keep statistics on formal or informal households. 43.5% of the population resides in Buffalo City, 17.8% in Mnquma, 15,7% in Mbhashe, 7.8% in Nkonkobe, 6.7% in Amahlathi, 4.9% in Ngqushwa, 2% in Great Kei and finally, 1.2% in Nxuba.

THE ECONOMIES OF THE DIFFERENT REFERENCE MUNICIPALITIES

The NMBM has an unemployment rate among the economically active sector of the community of approximately 38% (NMBM IDP, 2008). The municipality provides relief to impoverished households through the Assistance to the Poor Scheme (ATTP). Approximately 108 000 (37%) households receive 8 kl of water free per month per household registered for ATTP (NMBM Annual Report, 2008). The majority of households (36.1%) have a monthly income of between R0 and R1 600. Approximately 35.1% have a monthly income of between R1 600 and R12 800.

The KLM has 32.9% of the permanent population living in poverty (KLM IDP, 2008). The municipality provides 6 kl of water free per month per household (universal approach). This approach has resulted in 92% of the households receiving free basic services. The municipality administers an indigent register consisting of households with an income of less than R1 500 per month. A total of 3 485 households are listed on this register.

The majority of households (66.29%) have a monthly income of between R0 and R1 600. Approximately 28.91% households have a monthly income of between R1 600 and R 12 800.

The ADM has 1 288 596 people living in poverty spread across the respective local municipal areas (ADM IDP, 2008). The municipality provides relief to the poor but does not provide for a register and verification process at household level. The municipality follows the "area" targeted approach when providing free basic water. About 71% of households (excluding Buffalo City Municipality) receive free basic services. The majority of households (87.5%) have a monthly income of between R0 and R1 600. Approximately 11.5% households have a monthly income of between R1600 and R12 800.

The NMBM contributes 44% of the Eastern Cape GGP (NMBM IDP, 2008). It is the hub of the automotive manufacturing in South Africa. The NMBM is the location of the largest single infrastructure development in South Africa since 1994, the Coega Industrial Zone and the construction of the deep water "Port of Ngura". Manufacturing is the largest sector. It contributes 31% of the GGP of the NMBM, followed by agriculture (27%).

In the KLM (KLM IDP, 2008) economy, agriculture contributes a 9.87% GVA, construction 6.18%, trade 9.03% and community services 6.69%.

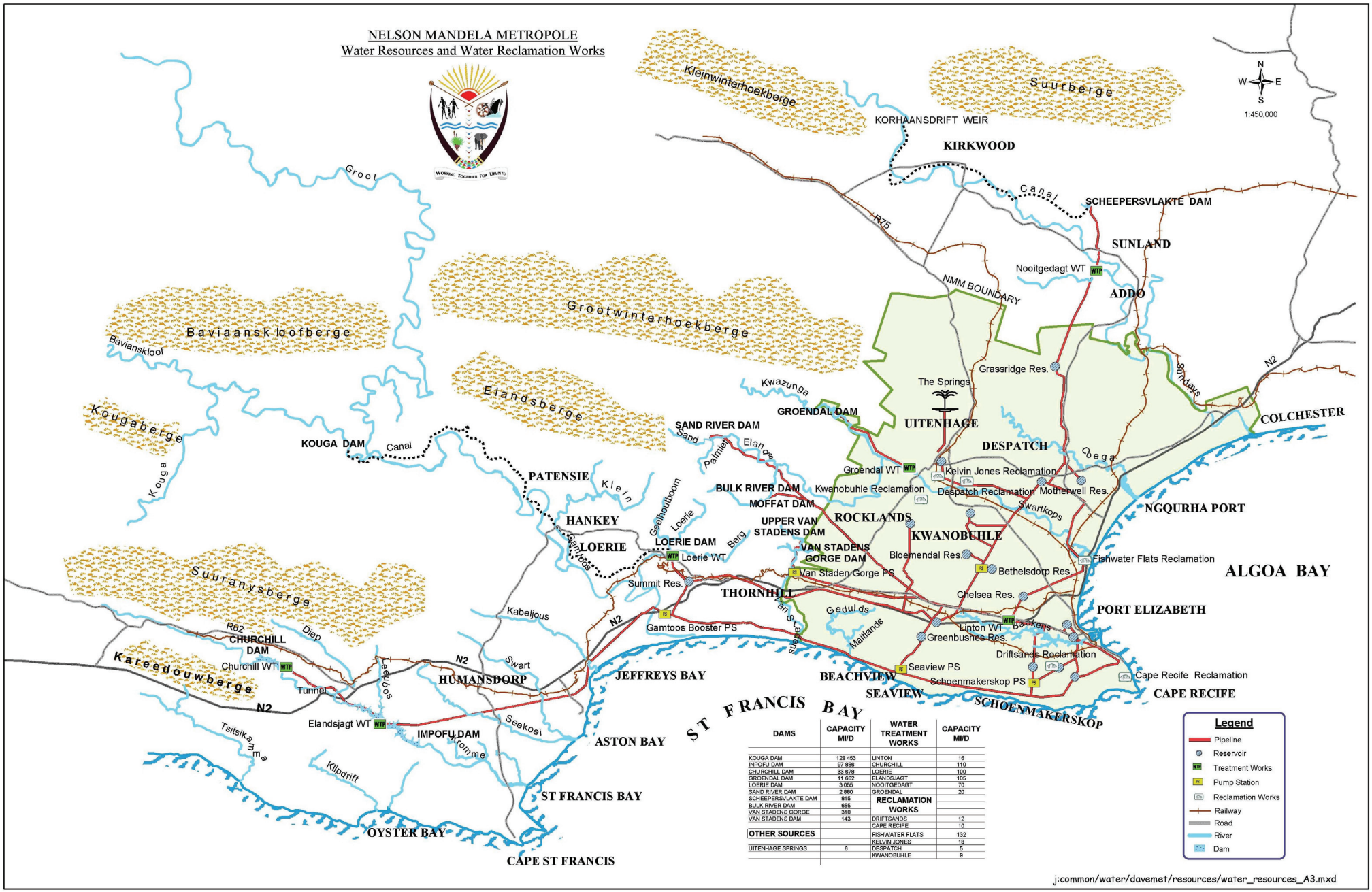
The ADM (ADM IDP, 2008) economy contributes 27% of the provincial GGP. The most economically productive areas are found in East London, Bisho, Butterworth and King William's Town. The most important economic sectors are manufacturing, community services and tourism.

APPENDIX 3: THE NMBM WATER RESOURCES INFRASTRUCTURE

All of the reference municipalities draw water from a mix of sources. The example of the NMBM is described below. The NMBM water resources consist of dams owned by the municipality and dams owned by the DWA. The quality of raw water and operational costs vary from source to source. The lower the quality of the raw water the more costly it is to treat before distribution. The more the water has to be pumped to allow for gravitation to the various treatment works the more costly the water is to source, because electricity has to be used to pump the water.

A list of the various dams where water is impounded and extracted is provided in table A4.1, below. The table includes information regarding capacity, ownership, transport and the distribution areas in the NMBM supplied by the resource. There are 6 treatment works used to purify the raw water before distribution. The municipality does not purchase the water from itself but purchases the water from the DWA. The cost related to the purifying of the water is considered when supplying the various treatment works with raw water. The location of water infrastructure use by NMBM is shown in Figure A3.1.

Figure A3.1: The location of NMBM water services infrastructure



DAMS	CAPACITY Ml/D
KOUGA DAM	128 453
INPOFU DAM	97 886
CHURCHILL DAM	33 678
GROENDAL DAM	11 662
LOERIE DAM	3 055
SAND RIVER DAM	2 880
SCHEEPERSVLAKTE DAM	815
BULK RIVER DAM	655
VAN STADENS GORGE	318
VAN STADENS DAM	143
OTHER SOURCES	
UITENHAGE SPRINGS	6

WATER TREATMENT WORKS	CAPACITY Ml/D
LINTON	16
CHURCHILL	110
LOERIE	100
ELANDSJAGT	105
NOOITGEDAGT	70
GROENDAL	20
RECLAMATION WORKS	
DRIFTSANDS	12
CAPE RECIFE	10
FISHWATER FLATS	132
KELVIN JONES	18
DESPATCH	5
KWANOBUHLE	9

Table A3.1: NMBM Water Resources

Dams	Capacity (ML/D)	Ownership	Transport	Distribution area supplied
Kouga	128 453	DWA	Gravitation/open canal	City centre and western supply
Impofu	97 896	DWA	Pumped	Supplement Kouga dam
Churchill	33 678	NMBM	Pumped	Supplement Kouga dam
Groendal	11 662	NMBM	Gravitation	Despatch/Uitenhage
Loerie	3 055	NMBM	Close proximity of treatment works	Western supply
Sand River	2 880	NMBM	Gravitation	Despatch/Uitenhage
Scheepersvlakte	815	DWA	Pumped	North eastern supply
Bulk River	655	NMBM	Pumped	North western supply
Van Stadens Gorge	318	NMBM	Pumped	North western supply
Van Stadens	143	NMBM	Pumped	North western supply

APPENDIX 4: SELECTED FACTORS INFLUENCING THE WELL BEING OF MUNICIPAL USERS OF WATER SERVICE

1. Sustainability.
The level of service provided should be sustainable. By this is meant that the level of provision should not exceed the paying capacity of the population of the municipality and South Africa, and should not undermine the level of economic activity in the municipality and South Africa.

2. Efficiency.
The comparison of welfare measures of alternatives is an efficiency assessment. One of the alternatives should be the status quo because improvements in efficiency use this as the point of reference. Outlays are not necessary welfare reducing, for instance, charity donations may increase a person's welfare, including voluntary payments for water services of others, like the poor, pensioners, etc. In practice efficiency is deduced from comparisons of the total costs with total benefits.

3. Fairness/equity within the whole society.
There are many fairness questions relevant to paying for water. For instance, is it fair to exclude people from receiving the service if they do not or cannot pay for it? Is this not exactly what the market system does? If it is unfair to exclude people from receiving some of a good, how much before it becomes fair? Is it fair to force someone to pay in excess of what they are willing to for a service, or for someone else's services? What if charity is insufficient to cover a minimum supply?

4. Welfare of the poor.
Being a non-substitutable consumer good, one may be less interested in the quantity of it well off people receive than one is in what people who have little income receive. For this reason, one may be more interested in the welfare of the least well off when it comes to water services than anyone else – and a Rawlsian interpretation of fairness (Rawls, 1971). Not only may one wish the least well off to receive a suitable quality of potable water (class 1 grade water) but also receive it with a certain minimum standard of service.

The influence of these criteria on municipal water service tariff setting practice in South Africa may be seen in:
- municipal cost recovery in water service charges
- consistency in tariff setting with declared economic development goals
- the specification nationally of minimum guidelines for standards of service (minimum standard of good and service constraints)
- the constitutional guaranteed basic allocation of a minimum water service as a national citizen 'right' and (by implication) obligation for municipal government to provide (the non-consumer exclusion constraint)

The requirements that there should be cost recovery and that the tariffs should not undermine incentives to local income and national generation and injections (by imposing on production a comparatively high cost of water input) are based on the objectives of sustainability and efficiency. The minimum service standards and basic right guarantees are based on the objectives of fairness and the welfare of the poor. In a representative democracy where the poor make up the largest share of the voter population, they are also predictable political policy outcomes.

No matter which criteria is employed in assessing the merits of alternative tariff structures, both the predicted direct (first round) and indirect (second round) effects (positive economic analyses) need to be considered. By way of example, a direct effect on providing a substantial water service free of charge to the poor may benefit this group directly, but it may be at a cost of lost income earning opportunities to this same group – a second round effect of increased costs imposed on producers and high income households (members of these groups may be induced to leave the municipality).

APPENDIX 5: THE SURVEY QUESTIONNAIRES

A5.1 Survey on the value of water service provision in the Nelson Mandela Bay Municipality and Kouga Municipality

RESPONDENT TO READ

This questionnaire is being administered on behalf of Prof SG Hosking, Department of Economics, Nelson Mandela Metropolitan University. He can be contacted at 041-5042205 or through the e-mail address, Stephen.hosking@nmmu.ac.za or at Nelson Mandela Metropolitan University, PO Box 77000, Port Elizabeth, 6130. The study was initiated (and is supported) by SALGA and the Water Research Commission of South Africa, and it is also supported by your municipality. The answers you supply will be treated as confidential, but will inform public policy on water service provision and tariff setting. It will be greatly appreciated if you will allow us a few minutes of your time to complete this questionnaire.

THE QUESTIONNAIRE

1) Are you able and comfortable answering questions and making hypothetical choices on behalf of the people living in your house about the water services you access from the municipality?

If yes, complete the questionnaire If no, please will you ask the person who can answer these questions to complete this questionnaire and arrange a time with the surveyor to fetch it.

2) Please write the address of your property (including the suburb) in the space below.

QUESTION 3

What gender are you - the respondent? (Tick the correct block).

Male	0
Female	1

QUESTION 4

What is your race? (We are using this information for research purposes.)

Black	0
White	1
Coloured	2
Indian	3
Other	4

QUESTION 5

Do you own or rent a house? (Tick the relevant block)

Own house	0
Rent house	1

QUESTION 6

How many people live in the household? (Indicate the total number, including yourself and people living in out buildings, e.g. 5).

_____(number of people living in your residence)

QUESTION 7

a) Do you pay for water?

Yes	0
No	1

b) Do you know approximately how much you pay per month for water?

R_____(approximate amount you pay for water each month)

QUESTION 8

Which of the following statements apply to your household? (Tick all the correct blocks)

a) I collect rainwater in tank	YES	NO
b) I use borehole water	YES	NO
c) I collect and use untreated dam or river water	YES	NO
d) I own Septic tank and French drain sanitation system	YES	NO
e) I have a pit for sewerage	YES	NO
f) I only use the municipal water services	YES	NO

QUESTION 9

How much would you be willing to pay **every month** towards **subsidising** water services for people who cannot afford to pay for these services?

0	0
0-R10	1
R10-R40	2
R40-R70	3
R70-R100	4
Over R100	5

QUESTION 10

Please tick either YES or NO to the statements that apply to your household.

a) You have a **swimming pool / garden /water features** on your property	YES	NO
b) You grow **vegetables/fruits** on your property	YES	NO
c) You run a **business** on your property. e.g. Renting rooms, or B&B	YES	NO
d) You use water in your home for **drinking, cooking and washing**	YES	NO

QUESTION 11

Does anyone in your household buy bottled water as an alternative to tap water?

YES	0
NO	1

(if you answered yes to the question above, please answer question 12)

QUESTION 12

What reasons do the people in your household buy bottled water?

a) Believe it is safer	YES	NO
b) Prefer the taste of bottled water	YES	NO
c) Believe it is healthier	YES	NO
d) Find it more convenient	YES	NO

QUESTION 13

What is your age?

_____YEARS

QUESTION 14

What is the estimated total household monthly pre-tax income – of all members living on the property added together? (Tick the relevant block)

0	0
0-R1 000	1
R1 001-R4 000	2
R4 001-R7 000	3
R7 000-R10 000	4
R10 000-R13 000	5
R13 001-R19 000	6
R19 001-R26 000	7
R26 001-R34 000	8
R34 001-R43 000	9
R43 001-R80 000	10
Over R80 001	11

QUESTION 15 **The Choice experiment**

- In the next section you are requested to indicate which of the alternative combinations of water services and tariffs you prefer.
- There are four pairs of alternatives presented to you - requiring you to choose 4 times in total.
- Please choose the set that you prefer, even if you don't like either option. There must be one that you prefer over the other, however slightly. (indifference is not an option)

Please consider the options carefully because the results may influence your municipal water service provision and tariff setting.

QUESTION 16

Please mark (with a cross) the attribute you felt was most important in Question 15.

Sewerage spills	0
Quality of water	1
Security of water	2
Interruptions in water services	3
Rate of flow of water from tap	4
Per 10 KL (kilolitre) water service charge	5

QUESTION 17

Did you find the choices hard to make?

YES	0
NO	1

If yes, why?

_____
_____
_____
_____

QUESTION 18

Is there is anything important that you would like to add about water service and the tariffs you pay the municipality for them that has not been already covered in the questionnaire? (Write answer below)

_____
_____

The end – thank you for participating

A5.2: Business survey on the value of water service provision in the Nelson Mandela Bay Municipality and Amathole Municipality

This questionnaire is being administered on behalf of the Prof SG Hosking, Department of Economics, Nelson Mandela Metropolitan University. He can be contacted at 041-5042205 or through the e-mail address, Stephen.hosking@nmmu.ac.za. The study was initiated (and is supported) by SALGA and the Water Research Commission of South Africa, and is supported by your municipality. The answers you supply will be treated as confidential, and will inform public policy on water service provision and tariff setting. It will be appreciated if you give us a few minutes of your time to complete this survey.

Please write the address of the business (including the suburb) in the space below.

QUESTION 1

What products or services does your business mainly produce and sell?

QUESTION 2

How many people are employed by the business (indicate the total number **including yourself**)

_____(number of people employed by business)

QUESTION 3

How important is the cost of water in your decision to locate your firm in this Municipality?

Unimportant	0
Relevant but not a deciding factor or influence	1
Very important and a deciding influence	2

QUESTION 4

What was the **total asset value** and **turnover income** of your business in 2008?

a) Total asset value 2008 R_____

b) Turnover income 2008 R_____

QUESTION 5

How much do you spend approximately per month for water services? R_____

QUESTION 6

Are you happy with this service, and why?

QUESTION 7

What do you use municipal water for in your business?

Watering of garden and for water features	0
Cleaning/dust reducing in production	1
Cooling in production	2
Other (please describe your use for water briefly)	

QUESTION 8

Does the municipality provide industrial quality water to your business (water that is sub-standard and not safe to drink)?

No	0
Yes	1

QUESTION 9

If industrial water was available at a lower price, would you elect to use it instead of better quality (more expensive) water in your business/ production process? (Tick the correct box.)

No	0
Yes	1

QUESTION 10

Rate the following options from 1 to 5, where 1 is strongly agree and 5 is strongly disagree (circle the selected number) with respect to the municipal provision of water services.

It is fair that businesses are charged the same consumption rate as households (increasing step tariff)	1 2 3 4 5
There needs to be more choice and flexibility regarding municipal water service options and tariffs	1 2 3 4 5
The privatisation of water service delivery would improve the quality of the service delivered	1 2 3 4 5
It is better for business to cross-subsidise the services (water and electricity) for the poor through property and business service taxes, rather than through increasing the tariffs firms are charged for water and electricity services	1 2 3 4 5

QUESTION 11

Which of the services does the business provide for itself as alternatives to municipal water services?

Collect rainwater in tank	0
Use borehole water	1
Collect and use untreated dam or river water	2

QUESTION 12: **The Choice experiment**

- Please indicate which alternative combination of water services and tariffs you prefer.
- There are four pairs of alternatives presented to you - requiring you to choose 4 times in total.
- Please choose the set that you prefer, even if you don't like either option. There must be one that you prefer over the other, however slightly. (indifference is not an option)
- Please consider the options carefully because the results may influence your municipal water service provision and tariff setting.

QUESTION 13

Please rate the attributes(from the previous question) that you feel are most important to least important, 1 being most important and 6 being the least important attribute.

Sewerage disposal	
Quality of water	
Rationing	
Interruptions in water services	
Rate of flow of water from tap	
Per 10 KL (kilolitre) water service charge	

QUESTION 14

Did you find the choices hard to make?

YES	0
NO	1

If yes, why?

QUESTION 15

Is there is anything important that you would like to add about water service and the tariffs you pay the municipality that has not been already covered in the questionnaire?

The end – thank you for participating

APPENDIX 6: CHOICE MODEL ESTIMATION AS APPLIED RANDOM UTILITY THEORY

The theoretical basis for applying statistical models to the choices elicited in choice experiments is random utility theory (Willis *et al*., 2005). In terms of this theory respondents make choices according to the utility they derive, and the latter is based on the levels of attributes (an objective component) along with some degree of randomness (random component). A respondent's utility function is deterministic for *him*, but it is not deterministic from the researcher's (choice experimenter) perspective. From the latter perspective the choice experiment only reveals the respondent's preferences with respect to observed attributes (chosen by the researcher). The choices made are also influenced by other unobserved attributes. In choice experiments these other unobserved attributes are treated as random variables (Hanemann, 1984) on the grounds of there being measurement errors, randomness in the preferences of the respondent and incomplete information available to the respondent (Hanemann, 1984; Hanley et al., 2006; Willis et al., 2005). It is a model of choice that combines variation in preference among respondents in a population with the random influence of unobserved variables (Hanemann, 1984; Hanley et al., 2006).

By assigning levels of utility to a respondent's choice that correspond exactly with his or her preference ranking (with higher utility indicating preference), all the information present in the attributes of the alternative may be captured in a single index, utility (Grover and Vriens, 2006).

In a utility model where g and h are the two options, among a set of options C, the underlying utility function for a particular respondent, *i*, may be defined as:

$$U_{ig} = U\left(X_g, P_g\right) \quad (1)$$

$$U_{ih} = U\left(X_h, P_h\right) \quad (2)$$

Where: X_g and X_h are vectors of attributes describing alternatives *g* and *h* and P_g and P_h are the costs associated with the alternatives. If $U_{ig} = U_{ih}$ the respondent is indifferent between the two alternatives, but if $U_{ig} = U_{ih} = 0$ the respondent would not select either alternative (Hanley et al., 2006).

Respondent *i* will choose alternative *g* over alternative *h, if and only if:*

$$U_{ig} > U_{ih} \quad (3)$$

$$U_{ig} > \max_h \in_{Ci, g \neq h} U_{gh} \quad (4)$$

The alternative selected in this case is *g,* implying that the utility of g exceeds that of alternative *h*. This model of choice (utility) is specified for modelling purposes in terms of the observable attributes and the unobservable random component (equations 3 and 4). Following this line of reasoning, the indirect utility function for each respondent 'i' may be broken down into two parts: a deterministic component (V), specified by a linear index of attributes (*X*) of different alternatives in the choice set, and a random error component (ε), representing unobservable influences on individual choice (see Equations 5 and 6).

$$U_{ig} = V_{ig}\left(X_{ig}, P_{ig}\right) + \varepsilon_{ig}\left(X_{ig}, P_{ig}\right) \quad (5)$$

$$U_{ih} = V_{ih}\left(X_{ih}, P_{ih}\right) + \varepsilon_{ih}\left(X_{ih}, P_{ih}\right) \quad (6)$$

The vector $V\left(\cdot\right)$ is assumed to be composed of attributes describing each alternative that are linear in arguments and additive, with a constant term $\left(\theta\right)$, i.e. the relevant indirect utility functions are:

$$V_{ig} = \theta_0 + \alpha P_g + \beta' X_{ig} \quad (7)$$

$$V_{ih} = \theta_0 + \alpha P_h + \beta' X_{ih} \quad (8)$$

The α and β coefficients indicate the contribution of each attribute to the total utility of each alternative (Hanley et al., 2006; Snowball, 2008).

The estimation model

The probability that respondent 'i' prefers option '*g'* over any alternative option '*h'*, can be expressed as the probability that the utility associated with option '*g'* exceeds that associated with all other options, as shown in equation 9.

$$P\left[\left(U_{ig} > U_{ih}\right) \forall h \neq g\right] = P\left[\left(V_{ig} + \varepsilon_{ig}\right) > \left(V_{ih} + \varepsilon_{ih}\right)\right] = P\left[\left(V_{ig} - V_{ih}\right) > \left(\varepsilon_{ih} - \varepsilon_{ig}\right)\right] \quad (9)$$

(Hanley et al., 2001; Hanley et al., 2006)

In order to derive an explicit expression for the above probability, the distribution of error terms (ε_i) should be known.

The typical assumption made in this connection is that the errors are independently and identically distributed with a Type 1 extreme value (Weibull) distribution and the following distribution function:

$$P\left(\varepsilon_{iC} \leq t\right) = F(t) = \exp\left(-\exp\left(-t\right)\right) \quad (10)$$

(Hanley et al., 2001; Willis et al., 2005)

This distribution of the error term implies that the probability of any alternative '*g'* as the most preferred alternative can be expressed as a logistic distribution (McFadden, 1973). The conditional logit model is derived and shown in equation 11, where μ is a scale parameter, inversely proportional to the standard deviation of the error distribution. This parameter is typically assumed to be one, since it is often not separately identifiable (Hanley et al., 2001; Hanley et al., 2006; McFadden, 1973).

$$P\left(U_{ig} > U_{ih}, \forall h \neq g\right) = \frac{\exp(\mu V_{ig})}{\sum_C \exp\left(\mu V_{iC}\right)} = \frac{\exp\left(\mu\left(\theta_0 + \alpha P_g + \beta' X_{ig}\right)\right)}{\sum_C \exp\left(\mu\left(\theta_0 + \alpha P_C + \beta' X_{iC}\right)\right)} \quad (11)$$

(Hanley et al., 2001; Louviere et al., 2000; Willis et al., 2005)

Variables that measure individual specific characteristics that affect utility, such as income, age, education, etc., can also be included in the above specification, but because these characteristics do not vary across the alternatives, such variables cannot be entered into equation 11 as linear arguments. A respondent's income is the same regardless of whether he/she chooses alternative g or h. Socio-economic variables can only be included by interacting them multiplicatively with choice specific attributes or the constant
(Hanley et al., 2001; Hanley et al., 2006; Louviere et al., 2000).

The Independence-from-Irrelevant Alternatives (IIA) axiom is the main selection probability axiom used to develop an operationally compliant individual choice model. The axiom states that "*the ratio of the probabilities of choosing one alternative over another (given that both alternatives have a non-zero probability of choice) is unaffected by the presence or absence of any additional alternatives in the choice set*." The benefit gained when this condition is satisfied is that it provides a computationally convenient choice model, allowing the introduction and/or elimination of alternatives in the choice set without re-estimating the model. The drawback of the IIA condition is that the observed and unobserved attributes of utility may be dependent of one another and/or the unobserved components may be correlated among alternatives. This leads to biased utility parameters and added errors in forecasts (Louviere et al., 2000). This property follows from the independence of the Weibull error terms across the different alternatives in the choice set. If a violation of the IIA hypothesis is observed, then more complex statistical models, including the nested logit, mixed logit, multinomial probit, or Heteroscedastic extreme value models, are necessary to relax some of the assumptions used. The conditional logit model follows the IIA assumption while the nested logit model and mixed logit model partially and fully relaxes the assumption respectively (Christiadi and Cushing, 2007; Hanley et al., 2001; Hanley et al., 2006).

McFadden (1973) introduced the following two additional assumptions:

1. Positivity
   The probability that a particular alternative is choices must be greater than zero for all possible alternative sets, given the respondent's socioeconomic characteristics and the alternatives in the choice set.
2. Irrelevance of alternative effect
   Without replications on each individual, it is impossible to identify an 'alternative choice set effect'; hence, the 'choice alternative effect' has to be isolated.

A maximum likelihood model can be estimated using the log-likelihood function stated in equation 12, where y_{ic} is an indicator variable.

$$\log L = \sum_{i=1}^{N} \sum_{c=1}^{C} y_{ic} \log \left[\frac{\exp(V_{ic})}{\sum_{c=1}^{C} \exp(V_{ic})} \right] \qquad (12)$$

Where: $y_{ic} = \begin{cases} 1 & \text{if respondent i chose option c} \\ 0 & \text{otherwise} \end{cases}$

The assessment of model outputs

Estimation and Statistical significance of utility parameters

Several statistical software packages (SAS, NLogit, Limdep, Stata) may be used to estimate the maximum likelihood parameters, standard errors, p-values and statistical tests for the conditional logit model. The Wald Chi-Square statistic (the square of the parameter estimate divided by its standard error) can be calculated to test statistical significance of utility parameters.

a) *Overall goodness-of-fit tests*

The following three likelihood statistics can be used to test the global null hypothesis that the attributes do not influence choice ($H_0 : \beta = 0$). Each statistic is asymptotically chi-squared distributed with M (the dimension of β) degrees of freedom given the null hypothesis.

i. Likelihood ratio test.

The likelihood ratio is given as:

$$L^* = \max L(\omega) / \max L(\Omega) \qquad (13)$$

Where L^* is the likelihood ratio

$\max L(\omega)$ is the maximum of the likelihood function in which M elements of the parameter space are constrained by the null hypothesis.

$\max L(\Omega)$ is the maximum of the likelihood function in which M elements of the parameter space are constrained by the null hypothesis.

Statistic:

$$-2 \ln L^* \qquad (14)$$

ii. Wald's test

Test Statistic:

$$\chi^2_W = (x-\mu)' \Sigma^{-1} (x-\mu) \tag{15}$$

iii. Score test

This test is also known as the Lagrange multiplier (LM) or efficient score tests.
Test statistic:

$$\chi^2_s = \left[\frac{\partial l(0)}{\partial \beta}\right]' \Gamma^1(0) \left[\frac{\partial l(0)}{\partial \beta}\right] \tag{16}$$

Where

$$\Gamma(0) = \frac{\partial^2 l(0)}{\partial \beta^2}$$

For each of the above tests we reject the null hypothesis if the test statistic is greater than the critical value of χ^2_M at a $\alpha = 0.05$ significance level.

iv. Alternative measures of goodness-of-fit

There are many alternative measures of goodness of fit, roughly analogous to R^2, used in conjunction with dichotomous dependent variables. There is, however, no consensus as to which measures should be reported in empirical studies. The goodness-of-fit measure should be interpreted in a similar way to R^2 in linear regression (Estrella, 1997).

For a goodness-of-fit measure to be desirable in discrete choice:

- The measure must be in the range [0,1], where 0 represents no fit and 1 corresponds to a perfect fit.
- The measure should be directly related to the valid test statistic for the significance of all slope coefficients.
- The derivative of the measure with respect to the test statistic should comply with corresponding derivatives in a linear regression modelling (Estrella, 1997).

Estrella's measure given as:

$$R^2_{E1} = 1 - \left[\ln L / (\ln L_0)\right]^{-(2/N)\ln L_0} \tag{17}$$

Estrella suggests an alternative measure

$$R^2_{E2} = 1 - \left[(\ln L - K)/\ln L_0\right]^{-(2/N)\ln L_0} \tag{18}$$

where lnL_0 is computed with null parameter values
N is the number of observations used
K represents the number of estimated parameters.

A similar goodness-of-fit measure, the likelihood ratio index, was suggested by McFadden(1973). This measure is also analogous to R^2 in the linear regression model.
The likelihood ratio index is defined by the following formula:

$$R^2_M = 1 - \left[\ln L / (\ln L_0)\right] \tag{19}$$

Where L is the maximum of the log-likelihood function

L_0 is the maximum of the log-likelihood function when all coefficients, except for the intercept term, are zero. McFadden's likelihood ratio index is bounded by 0 and 1.

b) *Willingness to Pay*

A WTP compensating variation welfare measure that coincides with demand theory can be derived for each attribute using the following formula:

$$WTP = \alpha^{-1} \ln \left\{ \frac{\sum_i \exp\left(V_i^1\right)}{\sum_i \exp\left(V_i^0\right)} \right\} \quad (20)$$

Where: V_0 represents the utility of the initial state

V_1 represents the utility of the alternative state

α gives the marginal utility of income and is the coefficient of the cost attribute.

(Hanley et al., 2001; Parsons and Kealy, 1992)

The linear utility index, specified in Equation 21 can be simplified to the coefficient of the specific attribute one seeks to value. The ratio of this coefficient to that of the cost attribute is also known as an implicit price or marginal willingness to pay off the respective attribute. If $X = X_1, X_2, \ldots, X_a$ attributes, the implicit price of any individual attribute a is calculated as:

$$WTP = \frac{-\beta_a}{\alpha} \quad (21)$$

where α is the parameter estimate of the price variable P

β_a is the parameter estimate of the specific attribute X_a

It is important to note that both attributes to be used in the calculation need to be statistically significant, otherwise no meaningful WTP measure can be established (Hensher et al., 2005).

APPENDIX 7: CAPACITY BUILDING

The following students were trained in the relevant applications of economics analysis through Study K5/1871/3

Kevin Jacoby – Economics Honours treatise – completed first class at Nelson Mandela Metropolitan University, 2009.

Phillipa Hosking – Masters in Commerce – expected to complete in 2010.

In addition numerous students were trained in the application of choice modelling survey techniques