PART A

1. INTRODUCTION

1.1 Location of the Thukela WMA

The Thukela WMA fully corresponds to the catchment area of the Thukela River, and lies predominantly in the KwaZulu-Natal province. It is a funnel shaped catchment, with several tributaries draining from the Drakensberg escarpment towards the Indian Ocean. The location of the Thukela WMA is indicated in **Figure 1.1** and a more detailed locality map is provided in **Figure 2.1**.

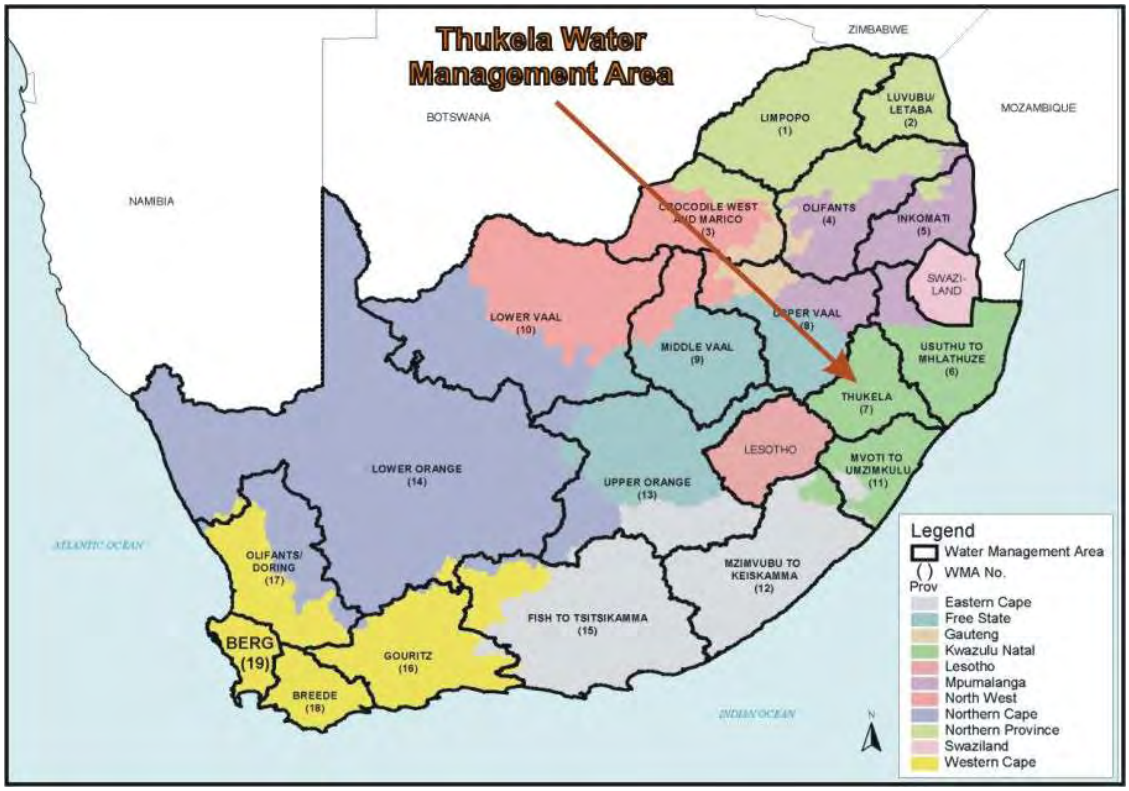

Figure 1.1: Location of the Thukela WMA

1.2 Water Legislation Management

Water is one of the most fundamental and indispensable of all natural resources. It is fundamental to life and the quality of life, to the environment, food production, hygiene, industry, and power generation. The availability of affordable water can be a limiting factor for economic growth and social development, especially in South Africa where water is a relatively scarce resource that is distributed unevenly, both geographically and through time, as well as socio-politically.

Prosperity for South Africa depends upon sound management and utilisation of our many natural and other resources, with water playing a pivotal role. South Africa needs to manage its water resources optimally in order to further the aims and aspirations of its people. Current government objectives for managing water resources in South Africa are set out in the National Water Resource Strategy (NWRS) as follows:

- To achieve equitable access to water, that is, equity of access to water services, to the use of water resources, and to the benefits from the use of water resources.

- To achieve sustainable use of water, by making progressive adjustments to water use to achieve a balance between water availability and legitimate water requirements, and by implementing measures to protect water resources and the natural environment.

- To achieve efficient and effective water use **for optimum social and economic benefit.**

The NWRS also lists important proposals to facilitate achievement of these policy objectives, such as:

- Water will be regarded as an indivisible national asset. The Government will act as the custodian of the nation's water resources, and its powers in this regard will be exercised as a public trust.

- Water is required to meet basic human needs and to maintain environmental sustainability will be guaranteed as a right, whilst water use for all other purposes will be subject to a system of administrative authorisations.

- The responsibility and authority for water resource management will be progressively decentralised by the establishment of suitable regional and local institutions, with appropriate community, racial and gender representation, to enable all interested persons to participate.

1.2.1 The National Water Act (NWA)

The NWA of 1998 is the principal legal instrument relating to water resource management in South Africa. The Act is now being implemented incrementally. Other recent legislation which supports the NWA includes the Water Services Act (Act 108 of 1997) and the National Environmental Management Act (Act 107 of 1998).

1.2.2 The National Water Resource Strategy (NWRS

The NWRS is the implementation strategy for the NWA and provides the framework within which the water resources of South Africa will be managed in the future. All authorities and institutions exercising powers or performing duties under the NWA must give effect to the NWRS. This strategy sets out policies, strategies, objectives, plans, guidelines, procedures and institutional arrangements for the protection, use, development, conservation, management and control of the country's water resources. The purpose of the NWRS is to provide the following:

- The National framework for managing water resources;

- The framework for preparation of catchment management strategies in a nationally consistent way;

- Information, in line with current legislation, regarding transparent and accountable public administration; and

- The identification of development opportunities and constraints with respect to water availability (quantity and quality).

1.2.3 Catchment Management Strategies (CMS)

The country has been divided into 19 Water Management Areas (WMAs). The delegation of water resource management from central government to catchment level will be achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA will

progressively develop a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA.

The Department's eventual aim is to hand over certain water resource management functions to CMAs. Until such time as the CMAs are established and are fully operational, the Regional Offices (ROs) of DWAF will continue managing the water resources in their areas of jurisdiction.

1.3 Internal Strategic Perspectives (ISPs)

1.3.1 The Objectives of the ISP Process

The objective of the ISP will be to provide a framework for DWAF's management of the water resources in each Water Management Area, until such time as the relevant Regional Office can hand over the management functions to the established CMA. This will ensure consistency when answering requests for new water licences, and informing existing water users (including authorities) on how the Department will manage the water resource within the area of concern. Stakeholders must be made aware of the bigger picture as well as the management detail associated with each specific water resource management unit.

1.3.2 Approach Adopted in Developing the ISP

The ISP for the Thukela WMA was developed in five stages as follows:

1. Determining the current status of water resource management and relevant water resource management issues and concerns in the Thukela WMA. This was achieved through interviews with individual members of DWAF's KwaZulu-Natal Regional Office and by collating information from the NWRS, WMA reports, Water Resource Situation Assessment (WRSA) reports and other catchment study reports. The following topics were discussed with Regional Office staff and their issues and concerns documented:

    - Current water situation
    - Resource protection
    - Water Uses
    - Water reconciliation
    - Water infrastructure
    - Monitoring and information
    - Water management institutions
    - Co-operative governance
    - Planning responsibilities.

A starter document of the identified issues and concerns was produced as a discussion document for the first workshop arranged for the development of this ISP.

2. The first workshop was held with attendees from the Regional Office, the Integrated Water Resource Planning (IWRP) Chief Directorate of the Department as well as the consulting team. The workshop focussed on the list of general issues in the WMA as well as area-specific issues. The issues were clarified and refined during the workshop. Strategies were discussed and developed to address the issues.

3. The third stage involved the preparation of the second draft document to be used for refining strategies to address the various issues and concerns, during a second workshop.

4. The fourth stage was the second workshop. During this workshop the overall management of the water resources in the catchment was discussed along with the management strategies and the relevant issues and concerns. The priorities and

responsibilities for carrying out the strategies were identified. First workshop attendees were again involved, as were representatives of several DWAF Head Office directorates.

5. The fifth stage was the finalisation of the ISP document.

As can be deduced from the above this Thukela ISP was prepared internally within the Department, and captures the Department's perspectives. Once approved by DWAF Management, it is intended that the Regional Office will make the ISP available to Water User Associations (WUAs), Water Service Providers (WSPs), Water Service Authorities (WSAs) and other forums for discussion and comment. These comments will be considered and worked into later versions of the ISP. By adopting this procedure this ISP becomes a working document, which will be progressively updated and revised by DWAF. Public participation forms part of the CMS process, for which the ISP serves as a foundation (see Section 1.6).

The ISP does not formulate all the details pertaining to every strategy but provides a suggested framework for each strategy around which the details will be developed by the responsible authority. Where relevant and readily available, certain details have been included in the strategies. The responsible authority for the further development of each strategy is indicated. This is predominantly the Regional Office, which remains responsible for involving the relevant DWAF directorates.

1.3.3 Updating of the ISP Report

The ISP will be regularly reviewed by keeping abreast of changes in national legislation and policy changes or refinements by keeping a list of all relevant legislation and supporting documents relevant to the ISP by:

- Ensuring consistency between the ISP strategies and national strategies through a regular review-and-update procedure;
- Annually reviewing and ensuring consistency and agreement regarding trans-boundary ISP management issues by liaising with the responsible managers of other areas and updating relevant ISP strategies if necessary;
- Annually reviewing the priorities of required management actions and aligning budgets accordingly;
- Monitoring the implementation of the ISP (review actions, progress, implementation and stumbling blocks);
- Incorporating feedback from stakeholders;
- Rigorously applying ISP version control.

Updating and Version Control
The actual frequency of ISP revision will be determined by the number and extent of revisions to management approaches as reflected in strategy amendments. All updates to this report, particularly with respect to amendment to the Strategies, need to be passed on to and vetted by the Catchment Manager for the Thukela WMA. Comments to be sent to:

The Water Resources Manager
Department of Water Affairs and Forestry
KwaZulu-Natal Regional Office
P O Box 1018
DURBAN
4000

1.3.4 The Authority of Information Contained in the ISP

The NWRS is a statutory document, subject to a high level of public scrutiny and input, and signed off by the Minister. The information contained in the NWRS is the best information and

knowledge available at the time. The information in **Chapter 2** and **Appendix D** of the draft NWRS Strategy on water requirements, availability and reconciliation was updated with comments received from the public participation process in the second half of 2002. To enable the finalisation of the draft NWRS, these figures were "closed" for changes in February 2003.

Underlying the figures in **Chapter 2** and **Appendix D** is a set of 19 reports on the "Overview of Water Resources Availability and Utilisation", one for each WMA. These reports contain more detailed information on each WMA than was summarised for the NWRS and are referred to, in short, as "WMA Reports". The WMA reports were also finalised with the February 2003 information.

Still deeper in the background lies another set of reports (one per WMA), the so-called Water Resource Situation Assessment Reports. These reports contain a wealth of information on each WMA, but the figures on requirements, availability and reconciliation have been superceded by the WMA report and the NWRS.

The ISPs for all WMAs used the information contained in the NWRS and WMA reports as the point of departure. However, an inevitable result of the ISP process has been that better information has emerged in some cases. The reason is that the level of study is more detailed and intense for the ISP. This included very close scrutiny of the numbers used in the NWRS, and in some cases a reworking of base data and some re-modelling. Where the ISPs contain yield balance data which differs from the NWRS, these discrepancies are carefully explained. Where other differences from the NWRS are necessary these are also detailed in the ISP, with accompanying explanations.

It is required that the Department work with the best possible data so that the best possible decisions can be taken. Where the ISPs have improved upon the NWRS then this is the data that should be used. The new data contained in the ISP will also be open to public scrutiny as the ISP reports will be published on the Internet and in hardcopy, and will be presented and discussed at WMA forums. Comments received will be considered and worked into subsequent versions of the ISP on a regular (yearly) basis. The NWRS will be updated to reflect the latest understanding in each new edition.

1.4 Integrated Water Resource Management (IWRM)

It is imperative that the natural, social, economic, political and other environments and their various components are adequately considered when conducting water resources planning and management. Water as a strategic component also interacts with other components in all environments. For example, human activities such as the use of land, the disposal of waste, and air pollution can have major impacts on the quantity and quality of water which is available for human use and for proper life support to natural biota.

Taking an even broader view, water must also be managed in full understanding of its importance for social and economic development. It is important to ensure that there is conformity between the water-related plans and programmes of the CMAs, and the plans and programmes of all other role players in their management areas. The CMAs must therefore establish co-operative relationships with a wide range of stakeholders, including other water management institutions, water services institutions, provincial and local government authorities, communities, water users ranging from large industries to individual irrigators, and other interested persons.

This integrated planning and management approach is intended, through co-operative governance and public participation, to enable water managers to meet the needs of all people for water, employment, and economic growth in a manner that also allows protection and, where necessary, rehabilitation of aquatic ecosystems. Above all, Integrated Water Resource Management (IWRM) will enable water managers to use precious water resources to assist in poverty eradication and removal of inequity.

One of the big opportunities to formally integrate a large number of actions in water resource management presents itself during the so-called compulsory licensing process. Compulsory licensing is identified in the NWRS as a very important action for implementing the NWA. However, it is not a simple action of issuing licences but a complex process of closely related and interdependent activities that will in itself formalise IWRM to a great extent. The elements contained in the process of IWRM is diagrammatically depicted in **Figure 1.2**.

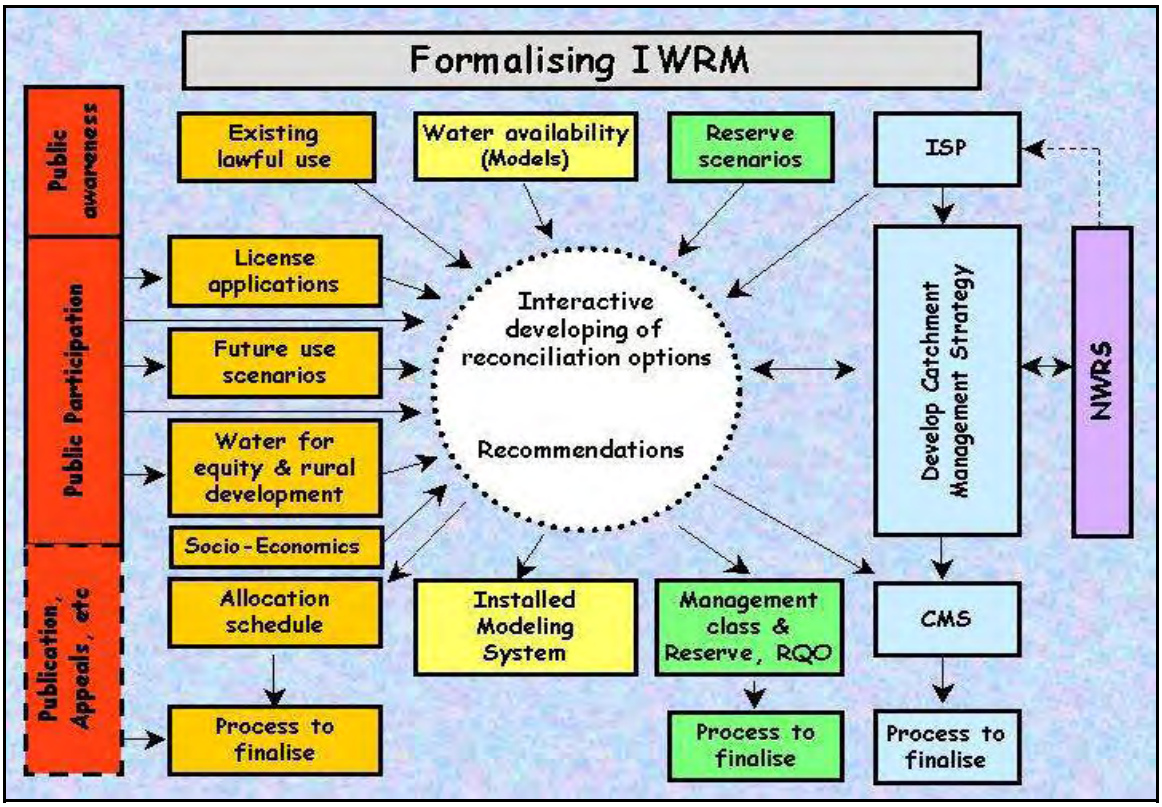

Figure 1.2: Diagram showing DWAF's Integrated Water Resource Management approach

Before an allocation schedule can be determined and the legal steps followed to finalise compulsory licensing (through the issuing of licences to all users), many other aspects must be addressed:

- Existing use and the lawfulness of that use must be verified, all users (existing and new) must apply for licences, a good understanding of future use scenarios must be developed and water required for equity purposes and rural development must be clearly understood.

- Water availability must be understood as thoroughly as possible with "best available" existing information used to model all possible reconciliation options.

- Reserve scenarios must be developed for all significant resources in the catchment, for instance, the river flow requirements for all possible classes that may be considered.

- The development of strategies for implementing the licensing (abstraction controls, for example), the Reserve and Resource Quality Objectives (i.e. incrementally over time) must go hand in hand with the rest of the processes to ensure that practical, workable solutions are found.

- The processes will then enter a very intensive, interactive phase of developing realistic reconciliation options. This will entail, for example, the selection of a specific management

class to be scrutinised for its impact on the number of licences that could be issued for use, with its concomitant impacts on the social and economic structure of the catchment.

- The active participation of stakeholders in this process will then hopefully crystallise clear recommendations on an allocation schedule, management classes for the various reaches of the rivers and the resultant ecological Reserve and Resource Quality Objectives, as well as strategies for the implementation thereof.

Although the Department will play a very strong role in guiding this process, it is extremely important to have the CMA actively involved. Preferably, at least the Board of the CMA must be in place to drive the public participation for the process.

1.5 Caring for the Environment

DWAF is responsible for water resource development and management in terms of the NWA, and within the broader framework of other environmental legislation. The Department also strongly reflects the will to make sound decisions which ensure the development of society and the economy whilst maintaining, and where possible enhancing, ecological integrity. The concept of management of the environment has evolved from the exclusivity of protection of plants and animals to balancing the complex interaction of society, the economy, and ecology. "Environmental management is the integration of social, economic and ecological factors into planning, implementation and decision-making so as to ensure that development serves present and future generations" (NEMA).

The key legislative Acts to which DWAF is required to refer are the National Environmental Management Act (NEMA, Act 107 of 1998) and the Environment Conservation Act (ECA, Act 73 of 1989). DWAF has prepared a Consolidated Environmental Implementation and Management Plan (CEIMP) as a requirement of NEMA. This describes the Department's functions, policies, plans and programmes, and states how these comply with environmental legislation. Through the CEIMP the Department has committed itself to developing and implementing an integrated Environmental Management Framework (EMF) to ensure that its approach is aligned with the principles prescribed in NEMA and the ECA. The EMF will inform the Department at a strategic decision-making level, bring about environmental legal compliance, and help in achieving environmental sustainability through the promotion of sound environmental management practices. Integrated Environmental Management is a co-operative governance effort with DWAF as a full partner in the process.

This ISP has the responsibility of raising and maintaining the environmental consciousness of the Department's water resource planners and managers. The control over water has a very broad range of influences and impacts for which strategies and planning need to account. Impacts come from many different angles.

Some of these angles of impact which are considered through this ISP are noted below:

- The direct impact of physical structures (environmental constraints to construction e.g. of weirs or dams).

- The implications of allocating and licensing water for use. Forestry and irrigation are examples of users where development based on water can mean the transformation of extensive areas of otherwise 'natural' environments.

- The allocation of water for equity. Here we can include approaches towards the application of Schedule 1 use, general authorisations, the revitalisation of irrigation schemes, etc.

- Failure to support equity, or appropriate development – noting the consequential impacts of poverty.

- Sanitation systems and the impacts on groundwater quality.
- The implementation of the Reserve.
- The ability to monitor and manage compliance, thus protecting the resource and with it the environment.

All decisions regarding water are critical to the environment. Decisions must be made on a balance of social, economic and ecological costs and benefits, considering both the immediate and the long-term, and always with an eye out for the unintended consequence. It is the intention of the ISP to provide the basis for integrated decision-making. The principles of environmental management underpin every strategy developed in this document.

There are a number of strategic areas with a particularly strong biophysical/ecological emphasis. These include:

- the Reserve (groundwater, rivers, wetlands and estuaries)
- water quality - surface and groundwater
- the approach towards the clearing of invasive alien plants
- the management of wetlands
- land degradation, erosion and sedimentation (land care)
- land use and especially how this is impacted by land reform and the re-allocation of water.

The roles of co-operative governance and the need for awareness raising and capacity building are key strategic elements of many strategies.

In reality all strategies and all aspects of management have a strong interaction with the biophysical environment. This ISP endeavours to capture all of these concerns in discussion and through a strategic approach which emphasises the will of the Department to manage the environment to the best benefit of the country and its people.

The approach set out above applies to all Water Management Areas and associated ISPs, and is not repeated within the Strategy Tables (Part B of this ISP). It reflects the way the Department views Integrated Water Resource Management and the importance of the biophysical aspects of decision-making. There may nevertheless be specific ecological and biophysical aspects of management which require specific attention and which may not be captured in the above-mentioned or other strategies. The ISP therefore still includes an Environmental Strategy which serves to make pertinent those issues of the environment which might not otherwise be covered.

1.6 The Social Environment

The utilisation of water resources is aimed at the benefit of society, and at society through the economy. As noted in Section 1.5 this should not be at undue cost to ecological integrity.

Impacts on society are a core element of this ISP, and decisions are often complicated by the risk of unintended consequence. As a typical example the over-zealous implementation of the ecological Reserve may benefit the river, to the intended benefit of society, but the cost of lack of use of that water to employment and to livelihoods may lead to other strains on natural resources that undo the benefits.

The implementation of the NWA requires that society be kept at the forefront of all decision-making. This principle is now deep-seated within the Department and is integral to all strategies. Water resource allocation and use has critical social impacts, as does water quality management. But pivotal to the social component is the question of equity. What can be done and what is being done to redress past inequities? Within this, strategies have been developed to consider the provision of water to Resource Poor Farmers, the use of water under Schedule 1, Licensing and General Authorisations, etc. Whilst water supply and sanitation are not part of the brief of the ISP, the provision of water to meet these needs most certainly is. The urban poor, and the poor in rural villages, are as important in the consideration of the distribution and use of water resources as are the rural subsistence poor, and this should not be forgotten in the urgencies of land reform and the enthusiasm to establish a substantial class of farmers from amongst the previously disadvantaged.

This ISP aims to see water benefiting society. This can be through access to water in livelihood strategies, through small-farmer development programmes, through water supply and sanitation and especially the provision of good quality drinking water, and through the maintenance and growth of income-producing, job-creating, and tax-paying agricultural, commercial and industrial strategies.

Consultation and public participation are cornerstones of the social component of any strategic document. These requirements are repeatedly stressed throughout the National Water Act. This ISP has been prepared as DWAF's position statement with respect to the management of water resources and, although strategies and plans have been captured without consultation with the stakeholders, it remains an open and transparent document where the understanding of the Department, its visions and its principles are made clear for all to see and to interact with. This is amplified in the Implementation (**Strategy 8**) of this ISP.

1.7 Water Quality Management

Much of the emphasis in water resource management has revolved around ensuring that users have sufficient quantities of water. However, as more water gets used and re-used, as quantities get scarce and feedback loops get even tighter, it is quality that begins to take on a dominant role.

Water availability is only as good as the quality of that water. Both quantity and quality need to be considered at the correct level of detail, and this can mean that at times they should be considered with similar emphasis and with similar expenditure of resources. Too often we have failed to integrate the issues of quantity and quality – both with regard to surface water and groundwater. The concept of Available Assimilative Capacity, the ability of the water resource to absorb a level of pollution and remain 'serviceable', is as important in water resource management as is the concept of System Yield.

Quantity and quality can no longer be managed in isolation of each other. Not that this isolation has ever been total. The importance of releasing better quality water from the Spioenkop Dam for flushing out the Thukela River Mouth and the addition of freshening releases from the Vaal Barrage to bring water back to an acceptable quality has, *inter alia*, long been standard practice. The consequences of irrigation, the leaching of fertilisers, and more importantly the leaching of salts from deeper soil horizons can render both the lands themselves and the receiving rivers unsuitable for use. Diffuse agricultural 'effluent' may be less visible than direct discharges of sewage or industrial effluent, but are no less pernicious.

Direct discharges to rivers are licensed and managed on the basis of assimilative capacities of those rivers, and on Receiving Water Quality. Where these limits are exceeded, often through the cumulative impact of diffuse discharges, water becomes unavailable to some, or even all, users downstream. DWAF will licence users to take water, and again to discharge it in recognition that there is generally a cost to the resource in terms of a reduction in quality and a reduction in its further assimilative capacity. It is for this reason, and in order to bring about additional management and a strong incentive, that the Waste Discharge Charge System is

being developed. Dischargers will be obliged to pay, depending on the quantity and quality of their discharge.

Surface water quality is affected by many things including sediment and erosion, the diffuse discharges from irrigated farmland (both fertilisers and salinity through leaching), domestic and urban runoff, industrial waste, and sewage discharges. Of these, industrial waste and sewage discharges are the easiest to licence and control, but this does not mean that this is problem-free. The Department has found that the situation with regard to sewage discharges often far exceeds the standards and conditions demanded by licences. There is a problem of compliance with regard to Local Authorities and private operators responsible for waste management systems. Diffuse discharges only compound the problem by reducing the assimilative capacity until the water becomes unfit for use, very expensive to purify, and a danger to human health.

Groundwater quality requires equal attention, and more so as we recognise the importance of groundwater in supplementing our meagre resources, and providing water to remote communities. Although our groundwater resources are for the most part to be found at a relatively deep level (50-100 m is quite typical) this water can easily be polluted by surface activity. The leaching of fertilisers is one such problem but of greater concern is the influx of nitrates, primarily a consequence of human habitation and sanitation. Pit latrines are on the one hand so necessary, and have the huge advantage of not requiring volumes of water, but disposal is 'on-site', and often responsible for the longer-term pollution of the underlying aquifers which feed and water the communities above.

Water quality is a very important aspect of strategy within this ISP – considered primarily within the Water Quality Strategy and also under Groundwater. Industrial wastewater discharge, diffuse agricultural discharges, wastewater treatment works, the location and management of solid waste disposal sites, the siting of new developments, informal settlements and the impacts of sanitation systems, are all elements considered with great concern in this and other ISPs. Despite this attention it may be that water quality has still not taken its rightful place in the integrated management of the water resource. But the Department is moving towards IWRM and the integration of quantity and quality issues. Managers have now been given crosscutting responsibilities that will ensure a far more integrated approach in future.

Actions recommended within the Department include:

- The need to actively workshop the integration process. Resource Management, Planning and Allocations of Groundwater and Surface Water quantity and quality.
- The review and incorporation of knowledge from recent Water Research Commission studies on both radioactivity and nitrates (groundwater quality issues).
- A review of all water quality literature reflecting situational knowledge and understanding within this WMA (and each and every WMA).

Ensuring that Water Quality monitoring is fully integrated into WMA water resources monitoring.

1.8 GROUNDWATER

The ISP process in all of the Water Management Areas of South Africa has highlighted the role and importance of groundwater as part of the total water resource. Although groundwater has always been important in some areas this overall vision is a significant advance on our previous understanding of the potential for groundwater use. With the surface water resources in many WMAs now fully utilised, almost the only opportunity left for further development lies in the exploitation of groundwater. More particularly it is recognised that many of the more remote towns and villages, far from surface supplies, can in fact supply or supplement existing sources through groundwater, and that this must become a priority option. So, too, many small communities and subsistence farmers can avail themselves of groundwater when it would otherwise be impossible or impractical to lay on piped supplies. This can also reduce the pressure on existing users and perhaps even circumvent the need for compulsory licensing.

The Department will be developing its capacity to explore and encourage the use of groundwater.

Of obvious concern is the likelihood of an interaction between groundwater and surface water. If the interaction is strong then additional use of groundwater may simply be reducing the surface water resource already allocated to someone else. In some instances (such as in the case of dolomitic aquifers) this interaction can indeed be very strong, whilst across many areas of the country it is so weak as to be negligible. In these circumstances groundwater comprises a huge pool of available water which is only of benefit if it is utilised. Care must always be taken with the issuing of licenses to ensure that both the Groundwater Reserve and other downstream users do not end up being the losers.

The realisation in this and other ISPs is that groundwater offers a huge resource of water which can be tapped, and that this can be a very significant supplement to the national water resource.

1.9 Public Recreation – the use of dams and rivers

The use of water for recreational purposes is one of the 11 water uses regulated in terms of the NWA (Section 21 j). The Department is developing a national policy towards 'Recreation on Dams and Rivers' and this should, in the first instance, be adhered to. Recreational use can take many forms and only occasionally has any direct impact on the water resource. Most obvious are activities such as power-boating, sailing and swimming which can have quality / pollution impacts. These activities can bring very significant economic benefits to the WMAs concerned, and where water releases can be accommodated, particularly through alignment with the needs of the ecological Reserve or other downstream users, then so much the better.

It is noted in this ISP that water resources offer a very significant recreational outlet and that recreation is an important public and social asset necessary for national health and productivity. A central philosophy is that recreational opportunity should not be unreasonably and unnecessarily denied to users, and that the implementation of policy should ensure that disadvantaged and poor people should also be able to avail themselves of opportunities.

The Department has already transferred responsibility for the management of many public waters to Local Authorities and will continue with this process. Responsibility will therefore devolve upon these Authorities, but within the broad principles as laid down by the Department.

1.10 Co-operative Governance – the place of the ISP

The ISP is DWAF's approach to the management of water resources within the WMA. This will, in the longer term, be replaced by a fully consultative Catchment Management Agency. What is important in the medium term is that the ISP has a good fit with the Provincial Growth and Development Plan, with regional and other Environmental Management Plans, with plans and expectations of the Departments of Agriculture, Land Affairs, the Environment and others. It must also be aligned with the Integrated Development Plans and Water Services Development Plans now required for each District Municipality. Water is very often a constraining feature in development and co-operative governance planning and implementation is essential in matching what is wanted with what is possible.

2. OVERVIEW OF THE THUKELA WMA

2.1 SOURCES OF INFORMATION

In this chapter summarised information from the National Water Resource Strategy (NWRS) (DWAF, 2003b) and the "Overview of Water Resources Availability and Utilisation" reports for the Thukela WMA (DWAF, 2003a) is included to provide the reader with the required background of the water situation in the Thukela WMA. When more detailed background information is required the reader is referred to the NWRS document and secondly to the "Overview of Water Resources Availability and Utilisation" reports for each WMA. These reports should in general provide sufficient detail for most readers. Even more detail can be obtained from the "Water Resources Situation Assessment Study" as prepared for each Water Management Area (DWAF, 2002b).

In addition to the above references, the reader is also referred to a list of policy documentation, legislation, regional planning, departmental guidelines and previous water resources related studies for detailed information. A list of these information sources is provided in **Annexure A.**

2.2 LOCALITY AND PHYSICAL CHARACTERISTICS

2.2.1 Geographic subdivision

The Thukela River originates in the Drakensberg Mountain Range along the border between Lesotho and the KwaZulu-Natal Province of South Africa. The river meanders through central KwaZulu-Natal and discharges into the Indian Ocean (see **Figure 2.1**). The Little Thukela, Klip, Bloukrans, Bushmans, Sundays, Mooi and Buffalo rivers are the major tributaries of the Thukela, which together make up the 'V' Hydrological Drainage with its 88 quaternary catchments. The total area of the Thukela River catchment is approximately 30 000 km^2 in extent.

2.2.2 Topography

The Thukela River and some of its main tributaries rise in the west of the catchment in the high lying Drakensberg Mountain Range. The headwaters of the main stem Thukela River originates at an elevation of some 3 000 m.a.s.l. The river then winds its way through gently rolling hills before entering steep sided gorges below Colenso. This rugged topography continues down to the river mouth only broken occasionally by flatter, more densely populated floodplains (e.g. Tugela Estates and Tugela Ferry). The Little Thukela, Bushmans, Sundays and Mooi Rivers meander down through the mountains through relatively undulating terrain before joining the Thukela River. The source of the Buffalo River is also reasonably high lying but flows through more rugged topography and gorges in the lower half of its trajectory.

2.2.3 Geology and Soils

A broad map of the geology of the Thukela River Catchment is shown in **Figure 2.2** while **Figure 2.3** provides a generalised soil map of the catchment. The upper and middle Thukela River flows eastwards through a succession of sedimentary strata of the Karoo Supergroup, ranging from the younger rocks of the Triassic System (situated just below the Drakensburg volcanics) to the base of the Karoo succession in the Tugela Ferry area. The geomorphology of the Thukela River is strongly associated with the underlying geology and the erosion resistance of the various formations on a regional scale is reflected by these characteristics. Parts of the catchment are quite densely populated. The arid and often erosive landscape, coupled with overgrazing and extreme pressure on natural resources has led to the loss of vegetative cover, erosion, and sedimentation. Land reform projects are sometimes resulting in too many people being settled on the land, with consequent unsustainable use. This should be

taken up with both the Department of Agriculture (DA) and the Department of Land Affairs (DLA) (see **Strategy 2.2** in **Part B** of this document).

The average annual sediment load at the Thukela Mouth has been estimated at 5.5 million tons (Midgley et al, 1994). Marine biologists also maintain that the marine environment in the vicinity of the mouth (known as the Thukela Marine Banks) is maintained by sediment deposited on the continental shelf.

2.2.4 Climate

The Thukela River catchment experiences a wide variety of weather conditions ranging from generally wet and cold in the Drakensberg Mountains, to dry and hot in the Thukela Valley from Colenso down towards the coast, and hot and humid and reasonably well watered at the coast. The region receives most of its rainfall in summer between September and April. Snow falls are common in winter along the Drakensberg Mountain peaks, which melt fairly quickly. The average rainfall ranges from about 1 500 mm per annum in the mountains to about 650 mm per annum in the central parts of the catchment. There is a slight increase in rainfall towards the coast as is shown on the isohyetal map in **Figure 2.4**.

Annual runoff varies from 600 mm in the Drakensberg to as little as 50 mm in the dry bushveld areas with an estimated natural Mean Annual Runoff (MAR) of 3799 million m^3/a at the river mouth. Rainfall is however erratic and years of prolonged drought in the central and lower catchment alternate with very wet periods.

The generalised Mean Annual (gross Symon's Pan) Evaporation (MAE) varies from about 1300 mm in the higher lying western areas to around 1500 mm in the lower lying central parts of the catchment.

2.2.5 Vegetation

As would be expected, natural vegetation types of the Thukela River Catchment follow a similar pattern to its geology. Montane grasslands covers the higher lying areas giving way to Southern Tall Grassveld interspersed with invading Acacia sieberiana savanna and tilled agriculture in the lower parts of the Upper Thukela Sub-catchment between Bergville and Colenso.

Moving downstream past Colenso, vegetation slowly changes to Valley Bushveld. Coastal grasslands and sugar cane farming characterise the lower part of the catchment. The Mooi River system is mainly modified by pastural farming practices with areas of indigenous sub-tropical forests along the steeper parts of this sub-catchment. Cattle farming bushveld dominates the Buffalo River Sub-catchment with the exception of montane grasslands in the upper part of this sub-catchment.

Active intervention of the National Working for Water Programme and local resident organisations have been very successful in controlling invasive alien vegetation in parts of this catchment. The Upper Thukela River Catchment has been cleared of much of the Black and Silver Wattle infestations. Aquatic weeds have not been noted as a problem in the Thukela River Catchment.

2.2.6 Indigenous Fauna

The upper Drakensberg area along the border with Lesotho is a conservation area and much of the fauna is protected. The environment in the upper parts of the catchment still has naturally occurring small game and their predators, reptiles and a wealth of bird species. Commercial game and stock farming has proliferated in the central catchment where there is a trend towards the former. There are also large tracts of fairly densely settled communities which rely on subsistence agriculture. The resultant human pressure on the environment has had a

negative impact on the animal and bird populations. The aquatic riverine environment has been significantly modified in certain areas by development pressure on the river system. A number of indigenous fish species still remain along with exotic fish species (including trout and bass) dominating the various dams along these watercourses.

2.2.7 Environmentally Sensitive Areas

The Ecological Reserve has recently been determined for the Thukela River Catchment. Implementation of the Reserve and conservation of the aquatic riparian habitats of this river system will need due consideration in future.

The following aspects and issues may need specific attention:

- More knowledge regarding the status of all the natural habitats in the Thukela River Catchment is required.

- Soils in the Drakensberg Mountain Range is relatively shallow. Pressure from human activities outside of the protected areas, particularly in the subsistence agriculture areas, is resulting in soil erosion with the consequent loss of habitat and siltation of dams in the upper catchment. The lower Drakensberg areas and specifically the Mweni Valley are the most effected.

- Severe overgrazing and soil erosion problems are being experienced in the Driefontein Block and Matiwaneskop areas to the north west and north of Ladysmith. Similar problems are being experienced on the land reform projects around Weenen and Estcourt.

- The wetlands and sponges in the upper and middle Drakensberg are at present not under major threat of destruction due to their remoteness and the fact that this is a protected area. These resources need to be preserved as far as possible due to their critical role in supplying baseflows in all the rivers.

These issues have been referenced in **Strategies 2.1** and **2.2** in **Part B** of this document.

2.3 Demography, land use and development

2.3.1 Population and Domestic Water Supply

Current population estimates as recorded in the Thukela WMA Report (DWAF, 2003) indicate that there was a total population of about 1 537 000 people in 1995. The population distribution is shown on the map provided in **Figure 2.5**. The largest concentrations of this population occur around Newcastle in the north of the catchment, Ladysmith (including Roosboom, Driefontein, Matiwaneskop, Elandslaagte and Ekuvukeni/Tholeni) and the upper Thukela area (Okahlamba Tribal areas), Estcourt, Tugela Ferry, and along the lower Thukela River. The Newcastle area accounts for over 280 000 people alone.

The most sparsely populated areas are located in the south-west and in the north-east of the WMA, the Mooi River catchment and Utrecht. Population densities are lower in the interior of the WMA and increase in a west and south-east direction.

The dominant population group is the Black race (92%), followed by the White (4%) and Indian/Asian (3%) race groups. On average, the number of females is higher than that of the males (54%: 46%). The dominant age group in the WMA is the 0 - 15 years group (43%), followed by 16 – 30 years group (28%), then the 31 – 60 years group (23%) and greater than 60 years group (6%).

Population growth in the rural areas is likely to be influenced by the impacts of HIV/AIDS and migration to urban areas. It is likely that there will be little change in the demography in the

foreseeable future and there may even be a decline in the rural population. Population growth in the urban areas is likely to be driven by the above-mentioned migration as well as economic opportunities and potential. Small to moderate growth in the urban population is anticipated as job-seekers are attracted by opportunities associated with the potential growth in industrial activity.

Estimates of the unemployment rate have been quoted at around 60% in this catchment with high levels of poverty and high incidences of HIV/AIDS infections being reported. Poverty-stricken areas within the Thukela WMA are mainly in the central and lower areas of the WMA, where only a small percentage of the population are employed and of this percentage the bigger portion do not earn income but are paid in kind. Although employment in the upstream catchments of the WMA is moderately high, the level of individual income is very low. Living standards are reasonably good when compared with other parts of South Africa due to traditional houses that people build and their ability to harvest natural resources for food and the production of commercial products (e.g. selling reed sleeping mats and the African Potato in the bigger metropolitan areas).

It should be noted that development planning in the various spheres of local government is fairly advanced, particularly with both Integrated Development Plans (IDP) and Water Services Development Plans (WSDP). Government policies regarding free basic water have been very successfully implemented in the Umzinyathi and uThukela District Municipal areas.

The following may also need to be considered by DWAF :

- Planning data, particularly population statistics and projections, needs to be correlated with District and Local Municipalities to arrive at uniform planning data.

- A lack of adequate (and appropriate) sanitation still remains a problem.

2.3.2 Land use

From a water resources point of view, irrigation is a significant land use. According to the Thukela WMA Report (DWAF, 2003), the estimated irrigated area is some 276 km^2. The irrigation requirements according to various references are listed in **Table 2.1**. A direct comparison between these requirements is not appropriate since the values reflect development levels in different years and the assurance of supply related to these requirements may not be the same. It should be noted that there is more variation at a tertiary catchment level. It is therefore concluded that the irrigation areas need to be reviewed.

Table 2.1: Comparison of irrigation water requirements from different sources.

Source of data	Irrigation requirement (million m^3/a)	Assurance of supply
TWP Feasibility Study	323	Average requirement
DWAF Registration Database (WARMS)	209	Average requirement
Water Resources Situation Assessment	229	1:50 years
NWRS	230	1:50 years
VAPS	231	1:50 years

It is thought that the registered water use underestimates the actual water use in the catchment. The implication of this is that much of the irrigation water use in the Thukela WMA is now illegal. A case in point is the Sundays River Key Area where the estimated irrigation requirement is 34 million m^3/a (DWAF, 2004a) while the registered water use is only 3,7 million m^3/a. **Strategy 1.2** in **Part B** of this report deals with this problem.

Another important land-use that has an impact on the water resources of the Thukela River catchment is commercial timber. The afforestation data acquired from different sources is listed in **Table 2.2**, which reveals a significant difference in the areas of commercial timber.

Table 2.2: Estimates of the extent of commercial forestry in the Thukela WMA.

Source of data	Extent of afforestation (km^2)
Water Resources Situation Assessment Report (DWAF, 2002)	226.3
Vaal Augmentation Planning Study (DWAF, 1996)	340.0
Thukela WMA Report (DWAF, 2003)	226.8
DWAF registration database (2003)	947.8
Timber Handy Reference Manual (DWAF, 1997)	226.3

The WRSA report (DWAF, 2002), the WMA report (DWAF, 2003) and the Handy Reference Manual (DWAF, 1997) are all based on the CSIR Landsat imagery of 1995 and, not surprisingly, all quote the same area. The large difference between the registered forestry and all other sources is a cause for concern and this will need to be verified at some point. This is dealt with in **Strategy 1.2** in **Part B** of this report.

Mining activities in the Thukela WMA do not use significant amounts of water, but do impact on the water quality, especially in the Buffalo River and Sundays River catchments. The coal mines scattered all over the northern parts of the Thukela River catchment have either been closed for a number of years or are in the process of closing down. Many of the older mines were never rehabilitated adequately. Consequently, these mines produce acid mine decant that enters the Thukela River system. The worst affected areas are around Newcastle (Buffalo and Ngagane rivers).

Industry as a land-use is not significant in the Thukela WMA. Small to medium-sized industries are situated in the peripheral industrial zones in and around Newcastle, Ladysmith and Estcourt. No major future growth in industry is expected unless active Government intervention is brought to bear on the region.

2.3.3 Existing water related infrastructure

There are a number of large dams in the Thukela WMA, some of which make up the Thukela-Vaal Transfer Scheme. The largest of these is Woodstock Dam, from which water is released to the Driel Barrage near Bergville. Water is then pumped into a canal that conveys this water to the Kilburn Dam, from which it is pumped over the escarpment from the Kilburn Dam into the Driekloof Dam (at the upper end of the Sterkfontein Dam).

Spioenkop Dam supplies the downstream requirements of Ladysmith and irrigated agriculture. In future the dam could be used to supplement flows in the lower Thukela to ensure that the water requirements of the Fairbreeze Mine, the Sappi mill at Mandini and the ecology are met.

Other significant infrastructure is Zaaihoek Dam on the Slang River (a tributary of the Buffalo River) with its related pump station and pipeline. This scheme, situated in the northern part of

the WMA, was constructed primarily to transfer water to the Eastern Vaal sub-system. Some water is also released to local users.

Ntshingwayo Dam (formerly Chelmsford Dam) in the Buffalo River in the northern part of the WMA supplies water to Newcastle, while Wagendrift Dam in the Bushmans River near Escourt supplies water to irrigators and the town of Escourt.

A list of all dams in the WMA is attached as **Annexure B**.

2.4 Regional Economy

This section was sourced from the Thukela WMA report (DWAF, 2003).

Less than 2% of the Gross Domestic Product (GDP) of South Africa originated from the Thukela WMA in 1997. Compared to other WMAs, the Thukela WMA has one of the smallest economies in the country. The largest economic sectors (in 1997) in the WMA, in terms of GGP, were:

- Manufacturing: 27,9%
- Government: 14,3%
- Trade: 11,2%
- Transport: 9,8%

Geographically, over 30% of the GGP is derived from the Newcastle area, followed by Ladysmith, Escourt and Dundee in descending order, with about 30% produced over the remainder of the WMA.

The main manufacturing centres in the Thukela WMA are Newcastle, Escourt and Ladysmith, which also corresponds to the geographic distribution of contributions to the GGP. The importance of the manufacturing sector is to a large extent attributable to the influence of the Iscor iron and steel plant at Newcastle. The manufacturing sector in the water management area has also undergone structural change from heavy to light industries, such as for the manufacturing of textiles, clothing, footwear and leather products.

Activities in the government sector in the WMA include items such as local government and related services, law and order, education, public health care and conservation services.

The trade and tourism sector is also an important contributor to the regional economy. Trade activities are well diversified with close linkages to the other economic sectors. Tourism in the WMA mainly relates to eco-tourism because of the natural beauty and historical sites.

The importance of the transportation sector can be contributed to export and primary products and other manufacturing commodities as well as to the main transportation routes through the area.

Many people in the WMA are dependent on agriculture for their livelihood. Agriculture is most productive in the Dundee and Escourt districts. Subsistence farming is practised on communal land, which cover much of the WMA (see **Figure 2.6**). Of the work force of 254 000 people in 1994, 50% were active in the formal economy, 35% were unemployed (compared to the national average of 29%), with the remaining 15% in the informal economy. Of those formally employed, 31% were in the government sector, 20% in agriculture (and forestry) and 16% in manufacturing.

Attributable to a favourable climate and good transportation infrastructure, the economy of the Thukela WMA has relatively good potential with respect to the agriculture and forestry, transport and manufacturing sectors. The comparative advantage of the agricultural sector can be attributed to the diversity of products in the WMA as well as the potential for further forestry developments. The manufacturing sector's comparative advantage is mainly as a result of the numerous large manufacturing activities together with small inter-linked concerns currently operational in the WMA, and which provide opportunity for the broader resurgence of manufacturing in the region. There is a lack of strong economic drivers, however, such as new mining developments or the immediate proximity of export facilities.

Although a fairly strong sector in the regional economy, trade and tourism in the WMA do not have a comparative advantage in the national context.

2.5 National and regional water plans and other legislation

The NWA, the NWRS and the CMS will form the guiding principles in preparing further water policy and plans in managing the water resources of the catchment. This legislation and the strategy documents are inextricably linked to national policies (e.g. poverty eradication and socio-economic development), other legislation (e.g. environmental laws and regulations), as well as regional integrated development planning. The NWRS has been published for public comment and will be ratified in due course. The CMS will be developed once the CMA is fully functional.

Water Service Development Plans (WSDP) have recently been prepared by all the local and district authorities. It has been noticed that water resource planning has not been sufficiently included into these WSDPs and it is intended that this ISP inform these planning processes in future.

A proposal for the development of the Thukela CMA has been developed and has been submitted to the Minister for consideration. In the interim, this ISP will serve as DWAF's strategy to manage the water resources in the Thukela River catchment. This ISP is also intended to provide a portion of DWAFs input to the development of the CMS.

Co-operative governance (co-ordinated planning and co-operation with other national, provincial, district and local authorities) and other legal requirements need to be co-ordinated. Innovative communication strategies need to be developed to encourage this synergy, which is intended to streamline public service inputs into the provision of an enabling environment that can encourage equitable and sustainable social and economic development. The Directorate of Social and Environmental Services in DWAF have recently gazetted a Consolidated Environmental Implementation and Management Plan (CEIMP) which spells out how the Department will incorporate all relevant environmental and other legislation into its water resources management and other responsibilities. This CEIMP forms the backbone of the Environmental Strategy presented in this ISP.

2.6 Institutions

There are five types of water-related institutions, which play a role in the Thukela WMA. These are:

- District Municipalities;
- Local Municipalities;
- Irrigation Boards (and Water User Associations);
- Water Boards, and
- DWAF's Regional Office (in lieu of the CMA).

District Municipalities (see **Figure 2.7**) are defined as Water Services Authorities (WSA) in terms of the Water Services Act (Act 108 of 1997), and are responsible for preparing Integrated

Development Plans (IDP). It is important to bear in mind though, that a Local Municipality (see below) can also become a Water Services Authority. An IDP is a principal strategic planning instrument, which guides and informs all planning, budgeting, management and decision-making in a municipality. The Water Services Act states that a Water Services Development Plan (see Local Municipalities below) must be part of the process of developing an IDP, and this is an important link between District Municipalities and the water sector. Water Services Authorities are also responsible for sanitation services and therefore play an important role in maintaining the water quality of the catchment at an acceptable level.

Local Municipalities (see **Figure 2.8**) are responsible for the preparation of a Water Services Development Plan (WSDP). The essential difference between an IDP and a WSDP is that a WSDP deals with water services while an IDP deals with all services. A WSDP must contain a water balance component which provides a point of reference for what is possible and what is not possible in terms of integrated development planning which impacts upon water resources. As the name indicates, this plan deals with water services, but in preparing a WSDP Local Municipalities must take cognisance of water related planning initiatives such as:

- Catchment Management Strategies
- Business plans of water boards
- Business plans of other water services providers.

This ISP forms an important step towards preparing a CMS and it is therefore essential that all IDPs and WSDPs in the Thukela WMA are in harmony with this ISP, especially with regard to sources of raw water, to ensure co-ordinated planning.

Irrigation Boards were established under the old Water Act to administer the bulk distribution of water to irrigators within a defined area. Under the National Water Act, Irrigation Boards must be transformed to form Water User Associations, which will fulfil a similar function to an irrigation board but need not necessarily be limited only to irrigation practices.

Water Boards are classified in terms of the Water Services Act as Water Services Providers and in this respect fulfil a similar role to Local Municipalities. The difference is that a Water Board deals only with water matters, usually bulk water distribution, and not any other services. There are no water boards in the Thukela WMA.

Although not an institution *per se,* the so-called Provincial Liaison Committee (PLC) also plays a role in water matters as does its sub-committee, the Water Resources Planning sub-committee. The purpose of the PLC is to foster communication and co-operation with Provincial Government, Water Boards and important stakeholders such as the Forestry Industry Association and Sugar Association. This committee currently serves the whole of KwaZulu-Natal and is not limited to only the Thukela WMA. This committee meets about twice a year. The Water Resources Planning sub-committee co-ordinates water related planning activities in the Province while the Co-ordinating Committee for Agricultural Water (CCAW) (formerly the Irrigation Action Committee) deals with matters related to irrigation, and the Department of Local Government's Water and Sanitation sub-committee deals with water services matters.

The Department of Water Affairs and Forestry is the custodian of the water resources of South Africa. Under the National Water Act, DWAF's Regional Office will fulfil the role of the Catchment Management Agency until such time as the CMA is in place and fully functional.

2.7 International

The eastern boundary of the Thukela WMA borders on the Kingdom of Lesotho. The watershed of the Thukela Catchment also runs along this border. As such, the water resources of the Thukela Catchment are fully contained within the WMA and Lesotho has no interest in these resources.

3. GROUNDWATER

3.1 INTRODUCTION

The geohydrogeological conditions prevailing in this WMA are well understood as a result of the DWAF 1995 KwaZulu-Natal Groundwater Resources Mapping and Characterisation Project, the reports of which in respect of Units 1, 6 (very minor coverage), 8, 9 and 11, with related maps, cover the area of the Thukela WMA. Since the publication of these reports, the situation in respect of the groundwater conditions in the WMA have not changed to any significant extent.

Physiographically the WMA comprises a number of low-standing valley sub-basins of the major tributary rivers, the orientation of which changes from southwest-northeast to the south of the main Thukela River in the centre of the main basin (Mooi, Bushmans) to northwest-southeast to its north (Klip, Sundays and Buffalo). These sub-basins are separated by intervening high-standing influve ridges, the margins of the main basin likewise being bounded by elevated interfluve ridges. Whereas topography in the interior portions of the sub-basin bottoms is relatively flat, eastwards and seawards the topography becomes increasingly steep and strongly dissected.

3.2 GEOLOGY

Geologically the WMA comprises two structurally different portions. These comprise the unfaulted major interior portion of the WMA wherein the bedding of the sedimentary Karoo rocks is either sub-horizontal or it has a very gentle inland dip to the west, and a minor eastern coastal and coastal hinterland portion wherein the structure comprises numerous south easterly or seaward tilted fault blocks. The latter area is characterised by numerous major faults of Gondwana breakup, late Jurassic age, the presence of which gives rise to complex geological conditions here. The major west-east Tugela Fault extends into the major western portion of the basin.

In the low standing east central portion of the basin, and extending east to within about 20 km of the coast - 'Basement' rocks are exposed, these comprising granite-gneiss, schists and amphibolites. Except along the northern margin of this portion of the basin and where much the same but much older rock-types are exposed, these comprising the southern limit of the much older Kaapvaal craton, these rocks comprise part of the considerably younger Nama-Natal Structural and Metamorphic Province. All the 'Basement' rocks are generally strongly foliated and jointed.

These 'Basement' rocks are unconformably overlain in the east by sandstones of the Natal Group which are in turn overlain unconformably by the basal tillite of the Dwyka Formation of the Karoo Supergroup and the sandstones and shales of the Ecca Group which are much intruded by subaccordant sheets of Karoo dolerite. Along the short coastal portion of the WMA, unconsolidated dune deposits of variously *in situ*-weathered sediments overlie the bedrock formations (Berea-type red sand). The lower courses of the rivers in this region are underlain by considerable (up to 60 m) thicknesses of alluvial and estuarine sediments, those of the former type generally being sandy, and those of the latter clayey.

By contrast the major and extensive interior portion of the WMA comprises gently westwards-dipping shales, mudstones and sandstones of the Ecca and Beaufort Groups (Karoo Supergroup). In the eastern portion of the basin the Dwyka tillite rests unconformably on 'Basement' rocks, without the intervention of the Natal Group sandstone. In the Ladysmith-Dundee-Newcastle portion of the basin, coal occurs and has been long-term mined, this occurring in the Vryheid Formation of the Ecca Group. The Karoo sediments in this portion of the WMA are much intruded by subaccordant sheets, and to a lesser extent by near-vertical dykes of Karoo dolerite. The major high Drakensberg escarpment that occurs along the southern portion of the western boundary of the WMA comprises flat-lying extrusive basalt.

On account of its relative resistence to erosion, the Karoo dolerite sheets, especially the thicker ones, generally give rise to very prominent high-standing topographic features in the interior basin portion of the WMA. Also of extensive occurrence in the interior basin portion of the WMA is the highly erodible unconsolidated Late Pleistocene sandy clay colluvial surficial deposit of the Masotcheni Formation that can be up to 15 to 20 m thick in places, it resting unconformably on the bedrock. It is characterised by the extensive occurrence of erosion dongas of various sizes.

Virtually all the WMA comprises 'hard rock' secondary porosity aquifers of the 'weathered and fractured' and 'fractured' aquifer classes. Faults, joints and intrusive Karoo dolerite contacts in the regional 'hard rocks', are zones usually of increased groundwater presence. In the coastal zone, sandy alluvium, that is a primary porosity groundwater aquifer of the 'intergranular' class and up to about 30 to 50 m in thickness, is generally present. By contrast, the depth of sandy alluvium in the river beds in the interior portion of the WMA seldom exceeds about 5 m. The poorest groundwater aquifer in the region is without doubt the Dwyka tillite. In the interior the best aquifer is sandstones of the Vryheid Formation, in the coastal zone sandstones of the Natal Group being the best aquifer. Overall the highest yielding aquifers are faults and joints in the coastal region, and in the interior intrusive Karoo dolerite contact zones, both sheets and dykes, in the Karoo Supergroup sedimentary rocks which are of very extensive occurrence here.

Except in one instance where water for the village of Nqutu is abstracted from the primary porosity intergranular sand aquifer in the river bed of the Buffalo River at Vant's Drift by means of a system of lateral screen caisson wells, which actually draw down surface water flowing on the river bed, all groundwater abstraction in the WMA is by means of 'hard rock' boreholes located in the secondary porosity 'hard rock' aquifers. Natural springs and seepages, although their flows are markedly seasonally affected, are extensively exploited as domestic water supply sources in the rural residential and agricultural portions of the WMA. With the provision of piped domestic water supply to a considerable proportion of such areas in recent years, dependence on this types of water resource for domestic use is now declining markedly in the WMA.

Groundwater yields from 'hard-rock' boreholes in the WMA are generally low and in the range 0,1 to 0,6 l/s, although significantly higher yields (3 /s) can be obtained in hydrogeologically favourable situations, such as intrusive Karoo dolerite contact zones. There is little difference in yield between the various geological formations present. Median depth to the water table in the WMA is 20 m.

Groundwater quality in the WMA is generally good, with the best quality groundwater found in the higher rainfall portions and the poorest quality found in the lower rainfall areas. The total Dissolved Solid (TDS) content of the groundwater is generally in the range 90 to 200 mg/l, but it can rise to very considerably more than 500 mg/l in the lower rainfall portions of the WMA. Groundwater pollution in the WMA is generally not of significant proportions and, where present, it is very localised. Significant pollution of the groundwater can be present (although also localised) in the northwest portion of the WMA (Ladysmith-Dundee-Newcastle) where underground coal mining and the dumping of mine discard material has taken place over the last 100 years or more.

Groundwater recharge over the WMA varies from 1 to 5 per cent of the MAP, with an average of about 3 per cent of the MAP. Overall, average annual recharge over the WMA is some 25000 m^3/km^2, varying from about 40 000 m^3/km^2 in the higher rainfall portions of the area, to about 15 000 m^3/km^2 in the portions of the area of lower rainfall.

The WARMS data indicates that present groundwater usage in the Thukela WMA is about 2,75 million m^3/a. This converts to a usage of only 100 $m^3/km^2/a$ over the WMA as a whole, which is only some 0,4 per cent of the mean annual recharge over the area. Usage is lowest in the areas of low-density population and highest in its more densely populated rural areas. It is evident that present groundwater usage in the WMA is in the low to very low range in terms

of the sustainability of the available resource. Groundwater usage in the WMA can thus be safely increased very considerably without detrimental impact on the resource.

The interaction between groundwater abstraction and surface water flow is thought to be very low in the Thukela WMA due to the generally low porosity of the rock in the WMA. Increased groundwater use should therefore not impact significantly on the surface water resource.

3.3 Conclusion

From the above it is evident that current exploitation of the groundwater resource available in the WMA is at a very low level in terms of its potential. In terms of the prevailing hydrogeological conditions in the WMA, this potential can be most usefully and effectively exploited in the relatively sparsely inhabited portions of the area for the provision of domestic water supply. In general, the nature of the 'hard-rock' aquifers present is appropriate for this type of water supply. Very considerable exploitation of the available resource for this purpose is possible with no long-term depletion of the resource being likely to occur as a result thereof. Such usage can best be provided by the relevant Local Authorities. The involvement of local communities in any such rural domestic water supply projects is imperative.

4. WATER RESOURCES MANAGEMENT PERSPECTIVES OF THE THUKELA WMA

4.1 INTRODUCTION

The broad water resources and water quality perspectives of the Thukela WMA are provided in this chapter, from which the key issues have been identified and broad strategies developed. The details of the various strategies are attached in the strategy tables provided in **Part B** of this report.

This chapter outlines the details of the water resources, water requirements and water quality of the catchment as obtained through the ISP process. Much of the data relating to the water availability and water requirements have been obtained from the Thukela Reserve Determination Study (DWAF, 2004b).

The Water Resources Yield Model (WRYM) was used to simulate the Thukela River System for a number of Ecological Reserve Scenarios for the Thukela Reserve Determination Study (DWAF, 2004a). The original WRYM that was set up for the Thukela Water Project (TWP), Feasibility Study (DWAF, 2002a) was used and modified during this assignment. A water accounts exercise was undertaken to determine the impacts of selected Ecological Reserve scenarios on the local economy of the Thukela catchment. The main objective was to determine the current and projected impact on water allocations that could be expected with the implementation of the ecological Reserve under different scenarios. The analyses were undertaken for the seven catchment areas (or Key Areas) listed below using the final recommended Reserve scenario:

- Upper Thukela (tertiary catchments V11, V12, V14 and quaternaries, V60G, H and J);
- Little Thukela (tertiary catchment V13);
- Bushmans (tertiary catchment V70);
- Sundays (quaternary catchments V60A, B, C, D, E and F);
- Mooi (tertiary catchment V20);
- Buffalo (tertiary catchments V31, V32 and quaternaries, V33A and B);
- Lower Thukela (tertiary catchments V40, V50 and quaternaries, V33C, D and V60K);

The locations of the various Key Areas are shown **Figure 3.1**. This figure also shows the four sub-areas as defined and used for the balance calculations in the NWRS.

The water resource evaluations undertaken in each of the above-mentioned Key Areas for the Thukela Reserve Determination Study (DWAF, 2004b) have been summarised in the following sections of this report and form the basis of this ISP. Due to the much higher level of detail afforded to the Thukela Reserve Determination Study than the NWRS, the situation portrayed in this ISP offers important (and significant) improvements on the NWRS. The main differences between the situation portrayed in this ISP and the NWRS are discussed in detail in **Section 4.13**.

4.2 WATER RESOURCE EVALUATION METHODOLOGY

This section briefly describes the methodology that was applied to derive the water balance figures presented in the remainder of this chapter.

4.2.1 Source of information

The results on which the water balance calculations are based were derived from the WRYM system analysis which was set up for the Thukela Reserve Determination Study (DWAF, 2004b). This is the latest available system but required a re-evaluation for the purposes of this ISP. The reason for this is that the analysis carried out for the Thukela Reserve Determination Study was focused on determining the economic impacts of the Reserve and not on determining the currently available allocable resource.

4.2.2 Ecological Reserve Scenario

The final recommended Reserve (Scenario 9/10), as determined in the Thukela Reserve Determination Study (DWAF, 2004b), was used as the basis for determining the available water resources in the Thukela WMA. However, it has been assumed in this ISP that the Reserve will not be implemented immediately in the stressed catchments of the Little Thukela and Sundays Key Areas. The implication of this is that additional releases are required from the Spioenkop and Wagendrift dams to meet the Reserve on the main stem of the Thukela River, and hence reducing the currently available surplus in these dams.

4.2.3 Simulation record

The systems analysis was undertaken using the historical record period only.

4.2.4 User requirements

The final analyses undertaken in the Reserve Determination Study (DWAF, 2004b) to determine the impact of implementing the Reserve was based on the projected water requirements as at 2005. These user requirements were accepted for use in the ISP water balance procedure. It was assumed that urban/industrial sectors receive their water at a 1:50 year assurance while irrigators receive their water at an 80% assurance.

4.3 Reconciliation methodology

The reconciliation of the water requirements and the available yield in the system was carried out by firstly determining excess yield at the most downstream point of each of the seven Key Areas. This was done with the Water Resources Yield Model set up for the Thukela Reserve Determination Study (DWAF, 2004b). The excess yield was determined by allowing support from the major dams in the system but farm dams were only allowed to support the water requirements that are directly imposed on them. Excess yield from farm dams, if any, is therefore not reflected in the water balances of this ISP. The assurance of the excess yield was assumed to be at a recurrence interval of 1:50 years (i.e. the same as that for the urban/industrial sector).

While the excess yield or balance of each Key Area was determined using the rigorous techniques described above, a simple reconciliation of water requirements and the water resource is useful for reporting purposes. This was done by expressing water requirements at an equivalent 1:50 year assurance. Urban and industrial water requirements were assumed to be at a 1:50 year assurance while irrigation requirements were reduced to a 80% assurance by multiplying by a factor of 0.85. The water resource as given in the various tables in this report were then calculated by adding the surplus yield to the water requirements at equivalent assurance. The important point that the reader must bear in mind is that while the water requirements and the water resource (expressed at a 1:50 year assurance) are approximations, the water balance has been determined using rigorous techniques.

4.3.1 Water resource

The surface water resource could, in most cases, be inferred from the water balance. However, in those catchments where there is a deficit, the available yield is zero and it is not possible to infer the resource from the balance. In these cases (Little Thukela, Sundays and the Mooi Key Areas), the surface water resources were determined by means of an incremental yield analysis using Version 2 of the Rapid Simulation Model (Mallory, 2003).

4.3.2 Analysis of the transfers

In the water resources analyses, the Thukela-Vaal and Mooi-Mgeni transfers were assumed to be operated at their maximum capacities while water is available at their respective abstraction points, but taking into account the downstream ecological Reserve requirements. The transfer volume from Zaaihoek Dam was determined from the capacity of the pumping station and assuming continuous pumping. The Middeldrift and Fairbreeze transfers (located in the Lower Thukela Key Area) were assumed to be supported by releases from Spioenkop and Wagendrift dams.

4.3.4 Impact of the Ecological Reserve

The impact of the ecological Reserve (as presented in the resource availability table of each Key Area) was calculated to be the difference in the availability between two scenarios, one with and the other without the ecological Reserve being implemented.

4.4 Overall Perspective

Sections 4.5 to **4.11** give a description of the water requirements, water resource and the reconciliation of the two for each Key Area in the Thukela WMA. However, in order to understand the arguments put forward, it is necessary to understand the overall water resource perspective of the whole WMA and the proposed water resource management strategy for the whole WMA. This overall perspective is therefore provided here as an introduction and elaborated on after the detailed discussion of each Key Area.

As part of the Thukela Reserve Determination Study (DWAF, 2004b), a comprehensive water resource evaluation assessment was undertaken in order to understand and quantify the economic impact of the ecological Reserve on the economy of the WMA. This evaluation indicated substantial surpluses in the Thukela WMA even after meeting the Reserve requirements, and the intention was to use these same results for this ISP. However, after careful review and consideration of the Reserve Study results, it became clear that assumptions made for the Reserve Study, while valid for Reserve determination, are not valid for the allocation of water in the Thukela WMA today or in the short term. The reasons for this are as follows:

- The Thukela Reserve water resource analysis assumed that the Reserve will ultimately be met, and in order to achieve this, curtailments were applied within the model to users throughout the catchment. This curtailment results in surplus water becoming available in the lower reaches of the Thukela River.
- The Thukela Reserve water resource analysis assumed that the Spioenkop, Ntshingwayo and Wagendrift dams will all contribute to the users and the Reserve in the Lower Thukela. This conjunctive use of these three dams results in large theoretical surpluses in the Lower Thukela.
- The methodology used in the Thukela Reserve analysis, whereby the excess yield is determined at the bottom of each key area, represents the best-case scenario. If the yield is required further upstream in the catchment then the excess yield is less. The reason for this is that releases are only made from the large dams to meet the users' shortfalls after they have made use of run-of-river yields. The further downstream a user is situated, the more

run-of-river yield becomes available, with the result that less water needs to be released from the dams and hence more surplus is available.

This ISP, while not disputing the validity or correctness of the Reserve Determination Study, has taken a more conservative approach based on the current situation. This, together with the following assumptions, results in a different view of the water resource availability in the WMA:

- Any surplus in the Buffalo Key Area will be retained for use in this area and will not be used to support users in the Lower Thukela.
- The ecological Reserve will not be implemented immediately in the Little Thukela or Sundays River Key areas because this would require compulsory licensing. In the interim, the Reserve in the main stem of the River will need to be met from the Spioenkop and Wagendrift dams. Given that the Little Thukela and Sundays Key Areas cannot contribute fully to the Reserve, this reduces the yield available from these two dams.
- The surplus yield available in the other Key Areas, where applicable, has been expressed in two forms; the maximum surplus if abstracted at the outlet of the Key Area, and the minimum if abstracted from the relevant dam (Spioenkop, Wagendrift and Ntshingwayo Dam).

Given the assumptions made for this ISP, the surplus yield which can be allocated now from the Thukela WMA is less than the surplus indicated in the Reserve Determination study.

4.5 Upper Thukela Key Area

4.5.1 Introduction

The Upper Thukela lies in the upper reaches of the Thukela River, upstream of the confluence with the Bushmans River, and includes the towns of Bergville, Ladysmith, Colenso and Weenen. The Thukela and Klip Rivers are the main rivers in this catchment. This area is the source of water for the Thukela-Vaal Transfer Scheme, which, *inter alia*, transfers water to the Vaal River System. The transfer capacity of this scheme represents a large portion (about 30%) of the water resources available in the Upper Vaal WMA, which is the economic heart of South Africa.

Over the last few years, the transfer has operated below capacity due to the implementation of the Lesotho Highlands Water Project and the preferred utilisation of this gravity feed resource as opposed to the pumping of water through the Thukela-Vaal Transfer Scheme. It is expected that the transfer volume will increase over time to match the growth in the water requirements in the Vaal River system and to supplement the water resources during periods of drought. During droughts, when water is released from the Sterkfontein Dam to the Vaal Dam, the scheme will also be operated at maximum capacity.

The Thukela-Vaal Transfer Scheme consists of the following infrastructure :

- **Woodstock Dam,** located on the upper reaches of the Thukela River, is the main source of water for the scheme. The net storage capacity of the dam is 373 million m^3;

- **Driel Barrage,** situated on the Thukela River 7 km downstream of the Woodstock Dam. Water is released from Woodstock Dam to Driel Barrage, from where it is pumped to a transfer canal that feeds the Jagersrust Balancing Dam. The net storage capacity of Driel Barrage is 8.7 million m^3;

- **a transfer canal,** which allows transferred water to gravitate to the Jagersrust Balancing Dam before it is pumped to Kilburn and over the catchment divide to Sterkfontein Dam. The canal has a maximum capacity of some 20 m^3/s;

- **diversion weirs** in the Upper Thukela River which divert run-of-river flows upstream of Woodstock Dam into the above-mentioned transfer canal. The estimated capacity of these

diversions is some 4 m^3/s, which is additional to the total canal capacity of 20 m^3/s mentioned above;

- **Jagersrust Balancing Dam,** provides balancing storage at the end of the transfer canal from where water is pumped to Kilburn Dam;

- **Kilburn Dam**, the lower reservoir in the Eskom pump storage scheme, with an active storage capacity of 27 million m^3. Kilburn Dam provides both the storage for the transferred water and is a sump for the water discharged after electricity generation;

- **Sterkfontein Dam,** located in the headwaters of the Wilge River, a main tributary of the Vaal River, provides storage for water transferred over the escarpment. This dam, with a capacity of 2 617 million m^3, is the 4th largest dam in South Africa. Water is released from Sterkfontein Dam to Vaal Dam when required;

- **Driekloof Dam** is the upper reservoir of the Eskom pump storage scheme and is situated in the upper reaches of the Sterkfontein Dam catchment. Water can only be transferred from Driekloof Dam to Sterkfontein Dam when Driekloof Dam is spilling;

- **Spioenkop Dam** was constructed to regulate flow downstream of the Driel Barrage to mitigate the effect of the transfer scheme. This dam has a capacity of 280 million m^3. The dam also supplies water to Ladysmith and supports water requirements for the farmers between the dam and the confluence of the Little Thukela River. Releases are also occasionally called for to dilute the effluent discharged by Sappi into the lower Thukela near the river mouth. It should be noted, however, that SAPPI does not have a formal allocation from the dam. The Tugela-Mhlathuze Water Transfer Scheme at Middeldrift can also be supported from Spioenkop Dam if necessary.

The proposed **Jana Dam**, which forms part of the Thukela Water Project, will also be located in this area on the Thukela River should this project proceed. It is important that the optimal long-term benefits be derived from the development of the Thukela River, and that both the national and local interests be considered.

4.5.2 Water availability

The MAR of the Upper Thukela Key Area is 1 256 million m^3/a.

The gross available surface water resource in the Upper Thukela Key Area based on current development levels is estimated to be between 553 and 570 million m^3/a deperning on where in the Key Area the water is supplied to (see **Table 4.1**) The available water is derived mainly from the Woodstock/Driel system and Spioenkop Dam. Groundwater, irrigation and urban return flows contribute about 5% to the total. A substantial proportion of the undeveloped water resource potential of the Thukela WMA lies in this area, with the proposed Jana Dam, a component of the Thukela Water Project (DWAF, 2002a) with the purpose of transferring water to the Vaal River System. The construction of Jana Dam could increase the gross available water resource by some 380 million m^3/a according to a yield analysis that was undertaken as part of the Thukela Reserve Determination Study (DWAF, 2004b).

It should be noted that the reduction in streamflow as a result of invasive alien plants (see **Table 4.1**) was not taken into account in the Thukela Rserve Determination Study. According to the Thukela WMA Report (DWAF, 2003), the extent of alien plant infestation in the Upper Thukela sub-area is some 180 km^2, which is more than six times that of afforestation. While this seems unlikely, the impact of invasive alien plants on the available yield (as estimated for the NWRS) has been used in this ISP. The reason for this is to rather present a slightly conservative picture than to over-estimate the available water resource. The implication is that if the extent and/or impact of invasive alien plants is not as severe as indicated in the Thukela

WMA Report (DWAF, 2003), there will be slightly more water available than indicated in this ISP. This aspect is dealt with in more detail in **Strategy 4** in **Part B** of this report.

The NWRS gives the highest priority to water for the ecological Reserve. The estimated requirements of the Reserve as determined in the Thukela Reserve Determination Study (DWAF, 2004a) is 71 million m^3/a, expressed as impact on the historical yield. This is shown in **Table 4.1** to provide an estimate of the net water availability.

Table 4.1: Overview of the water availability in the Upper Thukela Key Area (year 2005)

Resource category	Water available at a 1:50 year assurance (million m^3/a)	
	At outlet of Key Area	At Spioenkop Dam
Gross surface water resource	570	555
Subtract : Ecological Reserve	71	71
Invasivealien plants	6	6
Dryland sugarcane	0	0
Net surface water resource	493	478
Groundwater resource	5	5
Return flows	23	23
Total local yield	521	506
Transfer In	0	0
Grand Total	**521**	**506**

4.5.3 Water requirements

A summary of the water requirements in the upper Thukela Key Area is provided in **Table 4.2**.

Table 4.2: Water requirements in the Upper Thukela Key Area in 2005

User sector	Water requirement at a 1:50 equivalent assurance (million m^3/a)
Irrigation	87
Urban	17
Rural	9
Industrial	0
Afforestation	1
Total local requirements	114
Transfers Out	**377**
Grand Total	**491**

Transfers out of the Upper Thukela to the Vaal system are quoted in the Thukela WMA Report as 377 million m^3/a. This figure reflects the impact of the yield on the Upper Thukela rather than the average transfer or the impact on the receiving system. On average it is possible to transfer 530 million m^3/a, the limitation being on the availability of water in the Upper Thukela Key Area. The maximum capacity of the transfer infrastructure (pumps, pipelines, etc) is 630 million m^3/a. This transfer has been reserved in the NWRS up to a maximum of 630 million m^3/a. In practice the year-to-year transfer volumes will vary depending on the water balance in the Vaal River System which is, amongst other things, influenced by naturally occurring wet and dry periods. For example, if the storage in the Vaal system is low and Woodstock Dam is full, it would be possible to transfer up to 630 million m^3 in one year. The WRYM setup used to model

the upper Thukela River assumed the Vaal system always required water and therefore the impact on yield is for some future situation when the Vaal system relies more heavily on the Thukela transfer than at present. In future, if the Jana and/or Mielietuin dams are constructed, the transfer capacity will increase substantially.

Irrigation is by far the largest user sector accounting for 78% of the requirements of the Key Area. Despite the relatively high rainfall, irrigation is still required to ensure crop security. At this stage no major new commercial irrigation expansions are envisaged in the Upper Thukela Key Area. As noted in **Section 2.3.2,** there is conflicting information on the level of irrigation development in the whole WMA, and this is especially the case in this Key Area. This issue has been taken up in **Strategy 1.2** in **Part B**.

4.5.4 Water balance

A reconciliation of the requirements and available resource based on the information provided in **Sections 4.5.2** and **4.5.3** is shown in **Table 4.3**. The water balance indicates that the Upper Thukela Key Area has a surplus of between 15 and 30 million m^3/a, depending on where the water is sourced. This surplus is only available downstream of the Driel Barrage.

Table 4.3: Water balance in the Upper Thukela Key Area in 2005 (million m^3/a)

		At outlet of Key Area	At Spioenkop Dam
Available water	Local yield	521	506
	Transfers in	0	0
	Total	521	506
Water requirements	Local requirements	114	114
	Transfers out	377	377
	Total	491	491
Balance		**30**	**15**

4.5.5 Reconciliation perspective

There will be an increasing dependency of the Vaal River System on the Thukela-Vaal Transfer Scheme, thereby necessitating the need to reserve the current transfer volumes (see **Strategy 3.1** in **Part B**). New allocations that are dependent on the same water resource as the transfer (ie Woodstock Dam and Driel Barrage) should therefore only be allocated to supply Basic Human Needs. The NWRS reserves a maximum of 630 million m^3/a for transfer to the Vaal River System and makes provision for the development of new large water resources infrastructure in the Thukela WMA.

Any new allocations (except for Basic Human Needs) which are considered upstream of the Driel Barrage must be implemented in such a way so as not to have a negative impact on the Thukela-Vaal Transfer Scheme or existing lawful water use in the Key Area. This can only be achieved through the construction of farm dams coupled with stringently applied operating rules to release part of the yield to the Driel Barrage. Such farm dams will require the approval of the Minister of Water Affairs and Forestry because the water in this area (upstream of Driel Barrage) is reserved for transfer to the Vaal. In general, new allocations and the construction of farm dams should be discouraged upstream of Driel Barrage. There is, however, between 15 and 30 million m^3/a available for allocation downstream of Driel Barrage, depending on where in the Key Area it is abstracted. If abstracted entirely at the outlet of the Key Area (ie at the proposed Jana Dam site), there is 30 million m^3/a available while if abstracted directly from the Spioenkop Dam (or upstream of the dam, but downstream of the Driel Barrage), there is approximately 15 million m^3/a available.

The Upper Thukela Key Area is well-suited to commercial irrigated agriculture. New allocations for irrigation can be considered provided these are downstream of Driel Barrage. Water for irrigation can be sourced from Spioenkop Dam, run-of-river, or new farm dams may be constructed (downstream of Driel Barrage). Within these constraints, emerging farmers should receive priority when allocating water in this Key Area. New farm dams upstream of Spioenkop Dam will reduce the available surplus in Spioenkop Dam and the financial implications of this will need to be taken into consideration when issuing licenses for new dams in this region.

The towns or settlements in the Upper Thukela Key Area (and in the rest of the Thukela WMA for that matter) do not have serious water availability problems. Where problems do exist they are usually associated with poor infrastructure and water resource development. It is also believed that groundwater is not being optimally utilised due to the perceived abundance of surface water resources. Better conjunctive use and planning for future water requirements must receive more attention. There is insignificant water being used by the communal sector and water use allocations to this sector should focus on poverty eradication and inequity redress.

4.5.6 Water quality

The following water quality issues have been noted :

- The effluent from the industrial area and untreated sewerage from the Ezakheni complex outside of Ladysmith has resulted in very poor quality water flowing down the Klip River into the Thukela River.

- Severe overgrazing and soil erosion problems are being experienced in the Driefontein Block and Matiwaneskop areas to the north-west and north of Ladysmith.

- Soils in the Drakensberg Mountain Range are relatively shallow and highly dispersive. Pressure from human activities is resulting in soil erosion with the consequent loss of habitat and siltation of dams in the upper catchment. This has long-term consequences for the Thukela-Vaal Transfer Scheme. These lower Drakensberg areas and specifically the Mweni Valley are the most effected. Intervention and mitigation measures are required to deal with this.

4.5.7 Summary, key issues and strategies

The Upper Thukela catchment is well endowed with water resources which are mostly derived from the large Woodstock Dam and the Driel Barrage. These dams together with canal systems and pump stations transfer much of the available resource out of the WMA to the Vaal River System while the Spioenkop Dam provides for local requirements. Due to the fact that local requirements are less than the available yield from Spioenkop Dam, there is surplus yield available from this source of between 15 and 30 million m^3/a.

While the Upper Thukela Key Area is geared primarily for transfers to the Vaal River System, the transfer scheme is currently being under-utilised. The planning for this sub-area, however, must be based on the maximum possible transfer, which is reserved in the NWRS up to 630 million m^3/a, which, expressed as impact on the yield of the Thukela system is 377 million m^3/a.

Implementation of the ecological Reserve will reduce the amount that can be transferred to the Vaal River System using the current infrastructure. However, the construction of the proposed Jana Dam could add as much as 380 million m^3/a to the transferable yield of this sub-area.

In summary, the key issues in the Upper Thukela Catchment are :

- The resources of the Thukela River are predominantly used to support requirements for water in other parts of the country, with large transfers of water to all three neighbouring WMAs. The need for increased and additional transfers in future have been identified and investigated in detail although no decision on this has as yet been made.

- Implementation of the Reserve will have an impact on the water reconciliation and the availability of water for transfer out of the WMA. This impact is now well understood given the completion of the Thukela Reserve Determination Study (DWAF, 2004b).

- Potential for further development of surface water resources exists. However, it is important that the optimal long-term benefits be derived from the development of these resources, and that both the national and local interests be considered.

The key strategy identified in the NWRS relating to this sub-area is :

- Additional water for Ladysmith may be obtained from the proposed Thukela Water Project, or from Spioenkop Dam. Jana Dam, which will be the main structure of the Thukela Water Project, is planned for construction on the Thukela River just below the confluence with the Little Thukela River.

In addition to the above, this ISP suggests the following strategies :

- New water use licences may be issued in this Key Area. Upstream of Driel Barrage these should be limited to licences for domestic or high-value use but must be accompanied by the creation of additional yield provided by storage, while downstream of the Barrage additional licences for irrigation may be issued up to 30 million m^3/a.

- Additional afforestation may be permitted downstream of the Driel Barrage.

- Groundwater should be considered as the first option for rural domestic use. Conjunctive use of ground and surface water should receive more attention.

- Catchment management plans are required to maintain and/or rehabilitate the land cover in the foothills of the Drakensberg mountains.

4.6 Little Thukela Key Area

4.6.1 Introduction

Other than commercial agriculture, much of which requires irrigation, there is little development in the Little Thukela River Catchment. The upper areas of the catchment are located in a nature reserve with the implication that no development in this area is likely. Areas adjacent to the nature reserve have however developed rapidly into popular tourist resorts in recent years with the concomitant pressures of human habitation.

4.6.2 Water availability

The MAR of the Little Thukela Key Area is 307 million m^3/a. The gross available surface water resource in the Little Thukela is estimated to be 15 million m^3/a, as is summarised in **Table 4.4**.

The available water is derived mainly from run-of-river and numerous small farm dams. The Bell Park Dam, with a capacity of 7,5 million m^3 is situated in the upper reaches of this key area and has an estimated yield of 6,2 million m^3/a (DWAF, 1999). However, this dam appears to be used mostly for recreational purposes and its potential yield is not fully utilised.

Table 4.4: Overview of the water availability in the Little Thukela Key Area

Resource category	Water available at a 1:50 year assurance (million m^3/a)
Gross surface water resource	15
Subtract : Ecological Reserve	7
Invasive alien plants	2
Dryland sugarcane	0
Net surface water resource	6
Groundwater resource	1
Return flows	1
Total local yield	8
Transfer In	0
Grand Total	**8**

4.6.3 Water requirements

There are no transfers out of the Little Thukela catchment and irrigation is by far the dominant water use. The irrigation water requirements listed in **Table 4.5** may appear unlikely given the limited water resource in the Key Area but this estimate was verified against the registered water use which is given as 44,1 million m^3/a. In order to understand the water use better in the catchment, the registered water use has been broken down into quaternary catchment and source of supply (see **Table 4.5).**

Table 4.5: Registered water use and source of supply in the Little Thukela Key Area

Quaternary catchment	Source of supply	
	Dams	Run-of-river
V13A	0	0
V13B	2.2	8.0
V13C	1.8	8.2
V13D	7.8	3.8
V13E	4.1	8.2
Total	**15.9**	**28.2**

A summary of the present day water requirements in the Little Thukela catchment is provided in **Table 4.6**. The urban requirements are those of the town of Winterton.

Table 4.6: Water requirements in the Little Thukela Key Area in 2005

User sector	Water requirement at a 1:50 equivalent assurance (million m^3/a)
Irrigation	36
Urban	1
Rural	1
Industrial	0
Afforestation	0
Total local requirements	38
Transfers Out	0
Grand Total	**38**

4.6.4 Water balance

A reconciliation of the water requirements and water resource is given in **Table 4.7**. The water balance, based on the WRYM analysis, indicates that the Little Thukela Key Area has a deficit of some 30 million m^3/a.

Table 4.7: Water balance in the Little Thukela Key Area in 2005 (million m^3/a).

Available water	Local yield	8
	Transfers in	0
	Total	8
Water requirements	Local requirements	38
	Transfers out	0
	Total	38
Balance		**-30**

The above simplistic approach of reconciling water requirements with the available resource does not portray the reality of the situation, and a more detailed analysis of this Key Area using the Rapid Simulation Model (Mallory, 2003) was carried out. The results of this analysis are given in **Table 4.8** and this confirms that the assurances of supply are low, especially in the lower reaches of the Key Area. However, the assurance of supply is not so low as to make the current irrigation practices uneconomical but they are unsustainable in terms of the ecological Reserve.

Table 4.8: Assurance of supply to irrigators in the Little Thukela Key Area

Quaternary catchment	Assurance of supply	
	Farm Dams	Run-of-river
V13B	100%	64%
V13C	100%	81%
V13D	60%	69%
V13E	67%	73%

4.6.5 Reconciliation perspective

The water supply to irrigators in the Little Thukela Key Area is low in most cases and questions have been raised as to whether the large area of irrigation really exists in this Key Area. However, the registered water use seems to confirm the large irrigation requirement although this will need to be verified. It is surmised that due to the relatively high rainfall in this Key Area (ranging from 700 mm/a to over 1 000 mm/a), the crops that are irrigated are still viable at relatively low assurances of irrigation i.e. irrigation is only supplementary.

Irrigation seems to have expanded to the limit of what is financially viable and irrigators are using all available water in this Key Area. This holds serious implications for the ecological Reserve which will be difficult to implement without compulsory licencing. As an interim measure, no further water allocations from run-of-river should be considered in the Little Thukela catchment. Further licences for storage of water could be accepted to improve the assurance of water supply, subject to proper analysis of impact.

4.6.6 Water quality

The naturally good water quality in the Little Thukela Key Area is threatened by large concentrations of tourism activities (e.g. Champagne Valley), agro-chemicals and fertilisers as a diffuse source of pollution. These problems need to be better understood before they can be adequately addressed.

4.6.7 Summary, key issues and strategies

In summary, the key issues in the Little Thukela Catchment Key Area are:

- Irrigation in the Key Area has expanded to the point where it is utilising all the available water in the Key Area and irrigators experience frequent water shortages. The implementation of the ecological Reserve will therefore be problematic and it is recommended that this be done in a phased manner. Compulsory licencing may be required in order to fully implement the Reserve.

- There is no surplus water available for additional water-use licences.

- Significant diffuse source pollution occurs and the long-term impacts are not known.

The following key strategies have been formulated to address the above issues:

- No additional water-use licences to be issued for irrigation. The construction of farm dams will be permitted, however, should farmers wish to improve their security of supply. New farm dams will have to be shown to increase the system yield and contribute to the ecological Reserve.

- Allocations for other water use cannot be considered unless significant storage is created.

- Additional afforestation should be prohibited (unless additional storage to compensate for the loss of yield can be provided).

- The impacts of the diffuse pollution need to be investigated.

4.7 Bushmans River Key Area

4.7.1 Introduction

The Bushmans River rises in the Drakensberg Mountain range and flows in a north-easterly direction past the town of Estcourt to join the Thukela River near the town of Weenen. The Wagendrift Dam, with a full supply capacity of 56 million m^3, was constructed in 1963 on the Bushmans River to supply approximately 3 000 ha of irrigation between the dam and the Thukela River. This irrigation scheme is managed by the Weenen Water User Association. Up to 2 m^3/s is released from the dam for environmental and irrigation requirements if the dam is not spilling.

Estcourt obtains water for domestic and local industrial purposes directly from the Wagendrift Dam and discharges treated effluent back into the river downstream of the dam. There are significant tribal / communal areas between Estcourt and Weenen.

The site of the proposed Mielietuin Dam, which will be part of the Thukela Water Project if constructed, is located in the lower reaches of the Bushmans River, downstream of the Wagendrift Dam.

4.7.2 Water availability

The MAR of the Bushmans River Key Area is 358 million m^3/a.

The gross available water resource of the Bushmans River Key Area, based on current development levels, is estimated to be 115 million m^3/a, as is summarised in **Table 4.9**. The available water resource is derived mainly from the Wagendrift Dam, which is currently under-utilised. After accounting for the ecological Reserve and allowing for return flows and groundwater resources, there is an estimated 80 million m^3/a which can be used consumptively in the Bushmans River Key Area or in the Lower Thukela Key Area.

Table 4.9: Overview of the water availability in the Bushmans River Key Area

Resource category	Water available at a 1:50 year assurance (million m^3/a)
Gross surface water resource	115
Subtract : Ecological Reserve	36
Invasive alien plants	5
Dryland sugarcane	0
Net surface water resource	74
Groundwater resource	2
Return flows	4
Total local yield	80
Transfer In	0
Grand Total	**80**

4.7.3 Water requirements

A summary of the water requirements in the Bushmans River Key Area is provided in **Table 4.10**. Irrigation, situated mostly downstream of the Wagendrift Dam, is by far the dominant water use. The only other significant use is the domestic and industrial use of the town of Escourt. There are no transfers out of the Bushmans River Key Area.

Table 4.10: Water requirements in the Bushmans River Key Area in 2005

User sector	Water requirements at a 1:50 equivalent assurance (million m^3/a)
Irrigation	31
Urban	4
Rural	3
Industrial	1
Afforestation	1
Total local requirements	40
Transfers Out	0
Grand Total	**40**

4.7.4 Water balance

A reconciliation of the water requirements and available resource is given in **Table 4.11** and indicates that there is currently a large surplus in the Bushmans River Key Area.

Table 4.11: Water balance in the Bushmans River Key Area in 2005 (million m^3/a)

Available water	Local yield	80
	Transfers in	0
	Total	80
Water requirements	Local requirements	40
	Transfers out	0
	Total	40
Balance		**40**

4.7.5 Reconciliation perspective

Under current operating conditions there is a surplus of about 40 million m^3/a available in the Wagendrift Dam. The surplrus could be allocated to emerging farmers, but this decision will need to be carefully analysed in the light of the new allocations to the Fairbreeze mine and the ecological Reserve of the lower Thukela, which will require support from either the Wagendrift or the Spioenkop Dam, or both. Construction of farm dams in the upper reaches of the catchment could also be allowed although operating rules for these dams will need to be established in order that they do not reduce the yield of the Wagendrift Dam.

4.7.6 Water quality

In the Bushmans River below Estcourt, water quality problems are experienced due to the leaching of fertilisers and agro-chemicals from the soil and the discharge of industrial waste from the various factories in the town. This pollution impacts on the Weenen Nature Reserve and irrigators in the Weenen area.

4.7.7 Summary, key issues and strategies

In summary, the key issues in the Bushmans River Key Area are :

- There is currently surplus water available in this Key Area but the allocation of this needs to be carefully considered in the light of the requirements of the Lower Thukela Key Area (the Reserve and the new allocation to the Fairbreeze mine and irrigators).

- Potential for further development of surface water resources exists (i.e. Mielietuin Dam), however, it is important that both national and local interests be considered, since the Mielietuin Dam has been identified as a possible source for further water transfer to the Vaal River System.

- Significant diffuse source pollution occurs and the long-term impacts are not known.

To address the above identified issues, the following strategies are proposed:

- Future water use applications for irrigation can still be considered but must be accompanied with the creation of storage.

- Any growth in water requirement for Escourt will be supplied from the Wagendrift Dam. In future, water may also be obtained from the proposed Mielietuin Dam.

- Additional afforestation is possible in this Key Area from a water resources point of view.

- Groundwater should be considered as the first option for rural domestic use. Conjunctive use of ground and surface water in the more formal areas should receive more attention.

- The impacts of the diffuse pollution needs to be investigated.

4.8 SUNDAYS RIVER KEY AREA

4.8.1 Introduction

The Sundays River flows in a south-easterly direction from the Eastern Escarpment to its confluence with the Thukela River near the Bushmans River confluence. Commercial dryland agriculture dominates the area and there are also fairly large tracts of tribal / communal land in the lower reaches of the catchment (see **Figure 2.6**). Other than the Slangdraai Dam, which has a full supply capacity of 10,3 million m^3, there is no significant storage in this Key Area. Irrigation within the Key Area is supplied from farm dams or from run-of-river flows. Coal mining abounds in the upper areas of the catchment which contributes both to water quality problems and is a source of return flows.

4.8.2 Water availability

The MAR of the Sundays River Key Area is 220 million m^3/a. The gross available water in the Sundays River, based on current development levels, is estimated to be 12 million m^3/a, as is summarised in **Table 4.12**. The available water was determined at the bottom of the catchment and is derived mainly from the natural runoff. There are significant return flows from both irrigation and the mining activities in the catchment. The water availability after accounting for the ecological Reserve and allowing for return flows and groundwater resources is some 8 million m^3/a.

Table 4.12: Overview of the water availability in the Sundays River Key Area

Resource category	Water available at a 1:50 year assurance (million m^3/a)
Gross surface water resource	12
Subtract : Ecological Reserve	5
Invasive alien plants	1
Dryland sugarcane	0
Net surface water resource	6
Groundwater resource	1
Return flows	1
Total local yield	8
Transfer In	0
Grand Total	**8**

4.8.3 Water requirements

A summary of the water requirements in the Sundays River Key Area catchment is provided in **Table 4.13**. Again, irrigation is the dominant water use.

Similar to the Little Thukela Key Area, there appears to be a large amount of irrigation in this Key Area with insufficient water resources to support this. In contrast to the Little Thukela, however, the large irrigation requirement is not confirmed by the registered water use in this Key Area, which is only 3,7 million m^3/a. This large discrepancy needs to be resolved before any new allocations can be made from this Key Area.

Table 4.13: Water requirements in the Sundays River Key Area in 2005

User sector	Water requirements at a 1:50 equivalent assurance (million m^3/a)
Irrigation	26
Urban	1
Rural	4
Industrial/Mining	1
Afforestation	0
Total local requirements	32
Transfers Out	0
Grand Total	**32**

4.8.4 Water balance

A reconciliation of the water requirements and available water resource is given in **Table 4.14**. The water balance indicates that the Sundays River Key Area has a deficit of some 24 million m^3/a. As with the Little Thukela River catchment, much of the irrigation is from run-of-river flows and shortfalls in supply occur frequently.

Table 4.14: Water balance in the Sundays River Key Area in 2005 (million m^3/a)

Available water	Local yield	8
	Transfers in	0
	Total	8
Water requirements	Local requirements	32
	Transfers out	0
	Total	32
Balance		**-24**

4.8.5 Reconciliation perspective

There is some doubt as to the balance in this Key Area due to the huge discrepancy between the registered irrigation water use and the irrigation water use estimated in other studies. This issue must be resolved before any further water allocations can be considered to the irrigation sector. If the situation proves to be as dire as indicated in this ISP, compulsory licencing might be required to reduce irrigation to acceptable levels in order that the ecological Reserve can be met.

4.8.6 Water quality

The following water quality issues have been noted :

- The high rural population density in many of the tribal / communal areas (in the region of 56 people/km^2) contributes to the occasional high phosphate concentrations observed in the Sundays River (up to 450 mg/l) and the Wasbankspruit (1320 mg/l).

- The natural drainage from geological formations but especially from coal mine workings also contain appreciable amounts of nitrates and phosphate. There are two dormant and six closed coal mines that are located in the Sundays River Key Area.

- There is evidence of salt deposition in the Upper Sundays River at gauging point V6H004 with sulphate concentrations reaching 214 mg/l (compared with 18 mg/l further upstream at V6H006).

4.8.7 Summary, key issues and strategies

In summary, the key issues in the Sundays River Key Area are :

- Irrigation appears to have over-developed in this catchment and there is no surplus water available for other development. However, there is uncertainty relating to the actual amount of irrigation in the Key Area and this must be investigated as a matter of priority.

- Significant pollution occurs as a result of the mining activities and the relatively dense rural settlements.

In light of the above, the ISP suggests the following strategies :

- DWAF should take a precautionary approach and not make any new allocations to the irrigation sector from this Key Area until it can be clearly shown that the registered irrigation water use accurately reflects the actual lawful use in the area. Water for poverty eradication is available elsewhere in the WMA and this catchment should not be targeted for such initiatives, at least until such time as the irrigation water use has been accurately determined.

- The construction of farm dams should be allowed, subject to strict operating rules, if irrigation farmers wish to improve their assurance of supply.

- Allocations for water uses other than irrigation cannot be considered unless sufficient storage is created to supply these additional allocations.

- Additional afforestation should be prohibited unless additional storage to compensate for the loss of yield can be provided.

- Groundwater should be considered as the first option for rural domestic use. Conjunctive use of ground and surface water should receive more attention.

- A management plan is required to address the mine pollution problems, particularly with the closure and rehabilitation of the mines.

- A sanitation and solid waste management plan is required to address the human pollution problems.

- The Reserve cannot be implemented in this Key Area under the current stressed conditions. Verification of water use and, probably, compulsory licencing will be required as a prerequisite for the implementation of the Reserve.

4.9 Buffalo River Key Area

4.9.1 Introduction

The Buffalo River is the main northern tributary of the Thukela River and flows in a south-easterly direction from the Eastern Escarpment (Newcastle area) to its confluence with the Thukela River near Nkandla. The area includes the towns of Dundee, Newcastle, Danhauser, Utrecht and Madadeni. The main storage dams in the Buffalo catchment are:

- Ntshingwayo Dam (previously known as Chelmsford Dam) which was completed in 1961 and raised in 1982. It has a capacity of 199 million m^3. The dam was built to supply water

to the town of Newcastle, Eskom's thermal power station and irrigation farmers downstream. Releases are sometimes made to dilute factory spillages that end up in the river system.

- Zaaihoek Dam, which was built in 1988 with an original capacity of 193 million m^3. Zaaihoek Dam is on the Slang River, a tributary of the Buffalo River, and is used to transfer water to the Vaal system and the Majuba Power Station. Zaaihoek Dam can also supplies demands downstream of the dam by releasing water into the Slang River.

4.9.2 Water availability

The MAR of the Buffalo Key Area is 884 million m^3/a. The gross available surface water in the Buffalo River based on current development levels is estimated at between 173 million m^3/a and 205 million m^3/a depending on where in the catchment the water is utilised (see **Table 4.15**). Most of this yield is derived from the Zaaihoek and Ntshingwayo dams with the balance derived from farm dams and run-of-river. It was assumed in this analysis that surplus yield in the Zaaihoek Dam is not available to support requirements in the Thukela WMA.

There are significant return flows from irrigation, the urban and commercial centres as well as the mining and industrial activities in the catchment. In fact, the volume of return flows are similar in magnitude to that of the requirements of the ecological Reserve. There are no transfers into the sub-area.

The Thukela WMA Report (DWAF, 2003a) indicates that afforestation and invasive alien plants reduce the natural runoff by approximately 11 million m^3/a, while having no impact on the available yield. This seems to be an erroneous conclusion which needs to be reviewed. For the purpose of this study an impact of invasive alien plants of 4 million m^3/a has been accepted.

Table 4.15: Overview of the water availability in the Buffalo River Key Area

Resource category	Water available at a 1:50 year assurance (million m^3/a)	
	At outlet of Key Area	At Ntshingwayo Dam
Gross surface water resource	205	173
Subtract : Ecological Reserve	33	33
Invasive alien plants	4	4
Dryland sugarcane	0	0
Net surface water resource	168	136
Groundwater resource	6	6
Return flows	32	32
Total local yield	206	174
Transfer In	0	0
Grand Total	**206**	**174**

4.9.3 Water requirements

A summary of the water requirements in the Buffalo River Key Area is provided in **Table 4.16**. Again, irrigation is the dominant water use. The irrigation estimate used in this ISP (derived from the Thukela Reserve Determination Study) has been verified against the registered water use in the Buffalo Key Area. The urban, rural and mining/industrial requirements are also significant and this is due to the development in and around Newcastle. The WRSA report (DWAF, 2002b) from which the WMA Report sourced its data, indicates the impact of forestry on the water resource to be only 1 million m^3/a.

Transfers out refer to the transfers from Zaaihoek Dam to the Majuba Power Station and the Vaal system.

Table 4.16: Water requirements in the Buffalo River Key Area in 2005

User sector	Water requirement at a 1:50 equivalent assurance (million m^3/a)
Irrigation	50
Urban	24
Rural	9
Industrial	12
Afforestation	1
Total local requirements	96
Transfers Out	55
Grand Total	**151**

4.9.4 Water balance

A reconciliation of the water requirements and available water resource is given in **Table 4.17**.

The water balance indicates that the Buffalo River Key Area has a surplus of between 23 and 55 million m^3/a, depending on where in the catchment it is utilised. It is noted that shortfalls in the supply of irrigation water have been reported occasionally, but this is probably due to over-exploitation of local resources and the lack of storage. Irrigators along the Buffalo River may well experience water shortages because they do not have an allocation from the Ntshingwayo Dam and during drought periods there is insufficient run-of-river to support these irrigators.

Table 4.17: Water balance in the Buffalo Key Area in 2005 (million m^3/a)

		At outlet of Key Area	At Ntshingwayo Dam
Available water	Local yield	206	174
	Transfers in	0	0
	Total	206	174
Water requirements	Local requirements	96	96
	Transfers out	55	55
	Total	151	151
Balance		**55**	**23**

4.9.5 Reconciliation perspective

There is surplus water available in the Buffalo River Key Area that can be allocated. Priority must be given to redressing of inequities and poverty eradication. Allocations must however be dealt with cautiously and the location of the surplus identified before making allocations. New allocations should not be made upstream of the Zaaihoek or Ntshingwayo dams unless accompanied by the provision of additional yield through the construction of farm dams. There is potential for further growth and development in the Newcastle area and allowance should therefore be made to provide for these additional urban and industrial requirements from the currently available surplus before making new allocations in this Key Area to the irrigation sector.

4.9.6 Water quality

The upper Buffalo River is the most severely impacted on (from a water quality perspective) of all the Thukela River's tributaries. Acid mine drainage from numerous old coal mines and industrial pollution from the Newcastle area and the Ngagane River area, requires special intervention. Initiatives by the Regional Office have been underway for a number of years to both understand the extent of the problem and to start rehabilitating this environment. Water quality in the Buffalo River all the way down to its confluence with the Thukela has been described by the Regional Office as being very poor.

4.9.7 Summary, key issues and strategies

In summary, the key issues in the Buffalo River Key Area are :

- The Buffalo River Key Area has substantial available water, some of which is derived from the Ntshingwayo Dam. The water requirements are dominated by irrigation, but there are also large urban and industrial requirements.

- There are substantial transfers out of the Buffalo River to the Vaal system, for which 55 million m^3/a has been reserved in the NWRS.

- A key issue in this area is the water quality, which is very poor in places. Localised water quality problems occur associated with coal mining and pollution resulting from the closure of mines and this is of particular concern.

The strategic perspectives put forward in the NWRS are :

- The small surplus at Ntshingwayo Dam may be used for additional supplies to Newcastle as an interim measure. The implementation of the Reserve together with growth at Newcastle, are likely to result in additional storage being required in the future.

- No additional afforestation in and transfers from the sub-area should be allowed at locations which may have a limiting impact on the options for additional water supply to Newcastle.

In addition to the above, this ISP suggests the following broad strategies :

- Future water use applications for irrigation above Ntshingwayo and Zaaihoek dams that are not accompanied by the provision of additional yield through the construction of new dams should not be approved. There is potential for additional irrigation water downstream of the Ntshingwayo Dam, supported by releases from this dam.

- A management plan is required to address the mine pollution problems, particularly with the closure and rehabilitation of the mines.

- Water is available in the Ntshingwayo Dam to meet the future requirements of the Newcastle and Dundee areas from the surplus still existing in the system and some of the surplus yield of the Ntshingwayo Dam should be reserved for this purpose. The remainder can be allocated to emerging farmers but the allocable amount will need to be carefully determined depending on where in the catchment it is required.

- Given the surplus in this area, it is possible to redress the inequity of water allocations through the development of emerging farmer irrigation schemes and other poverty eradication initiatives. This irrigation should be sourced from the main stem of the Buffalo River downstream of the Newcastle area and supported by releases from the Ntshingwayo Dam when required. The appropriate authorities need to be made aware of this opportunity to address poverty eradication.

- Additional afforestation is a possibility in this Key Area, but not upstream of Ntshingwayo or Zaaihoek Dams.

- Groundwater should be considered as the first option for rural domestic use. Conjunctive use of ground and surface water should receive more attention.

- There is potential to develop the water resource through the construction of new dams in the Key Area.

4.10 Mooi River Key Area

4.10.1 Introduction

The Mooi River rises in the Drakensberg Mountains and flows parallel to the Bushmans River in a north-easterly direction to join the Thukela River near Muden. The only town of any significance in the catchment is Mooi River. The predominant land use in the catchment is commercial agriculture and there is large-scale irrigation of pastures and summer cash crops. Craigieburn Dam was constructed on the Mnyamvubu River in 1963 and has a capacity of 23.5 million m^3. The dam supplements water supplies to approximately 2 000 ha of predominantly citrus farming irrigation downstream of the dam and along the Mooi River at Muden.

A water transfer scheme also exists on the Mooi River at Mearns, which can transfer up to 3.2 m^3/s to the Mgeni River System. The Mooi River has long been recognised as the most feasible resource from which to augment the Mgeni System. The first phase of the two-phase Mooi-Mgeni Transfer Scheme has already been implemented, this being :

- A large weir at Mearns with a capacity of 4,9 million m^3; and

- A pumped transfer from the weir to the upper reaches of the Mgeni catchment.

The proposed second phase of the scheme, possibly to be implemented soon, will entail :

- Construction of a large dam at Spring Grove; and

- Upgrading the transfer capacity from the Mooi to the Mgeni River.

4.10.2 Water availability

The MAR of the Mooi River Key Area is 385 million m^3/a.

The gross available surface water in the Mooi River Key Area, based on current development levels, is estimated at 73 million m^3/a, as is summarised in **Table 4.18**. There are significant return flows from irrigation, but the total local yield after allowing for the ecological Reserve is estimated to be in the order of 64 million m^3/a. There are no transfers into the catchment.

Table 4.18: Water availability in the Mooi River Key Area (prior to the construction of Spring Grove Dam)

Resource category	Water available at a 1:50 year assurance (million m^3/a)
Gross surface water resource	73
Subtract : Ecological Reserve	18
Invasive alien plants	1
Dryland sugarcane	0
Net surface water resource	54
Groundwater resource	2
Return flows	8
Total local yield	64
Transfer In	0
Grand Total	**64**

The construction of the Spring Grove Dam is imminent and this will increase the available resource in the Mooi River Key Area by an estimated 61 million m^3/a (DWAF, 2004c). Table 4.19 shows the revised water resource situation with the Spring Grove Dam in place. Note that with the provision of additional storage at Spring Grove, the impact of the ecological Reserve increases. This is due to the increase in the critical period with the increase in storage within the system with the result that floods and freshets will also need to be released from the dam, resulting in a larger impact on the yield than for a system dominated by run-of-river.

Table 4.19: Water availability in the Mooi River Key Area (after the construction of Spring Grove Dam)

Resource category	Water available at a 1:50 year assurance (million m^3/a)
Gross surface water resource	140
Subtract : Ecological Reserve	24
Invasive alien plants	1
Dryland sugarcane	0
Net surface water resource	115
Groundwater resource	2
Return flows	8
Total local yield	125
Transfer In	0
Grand Total	**125**

4.10.3 Water requirements

A summary of the water requirements in the Mooi River Key Area is provided in **Table 4.20.**

Table 4.20: Water requirements in the Mooi River Key Area in 2005

User sector	Water requirement at a 1:50 equivalent assurance (million m^3/a)
Irrigation	49
Urban	1
Rural	1
Industrial	0
Afforestation	1
Total local requirements	52
Transfers Out	22
Grand Total	**74**

The Spring Grove Dam will be constructed to augment the water resource of the Mgeni System, and, once completed, the available yield of the Spring Grove Dam will be transferred to the Mgeni System when required. **Table 4.21** shows the future situation with the additional transfer made possible by the Spring Grove Dam.

Table 4.21: Water requirements in the Mooi River Key Area after completion of the Spring Grove Dam

User sector	Water requirement at a 1:50 equivalent assurance (million m^3/a)
Irrigation	49
Urban	1
Rural	1
Industrial	0
Afforestation	1
Total local requirements	52
Transfers Out	83
Grand Total	**135**

4.10.4 Water Balance

A reconciliation of the water requirements and available resource for the year 2005 is given in **Table 4.22** while **Table 4.23** gives the reconciliation after the completion of the Spring Grove Dam. The water balance indicates that the Mooi River Key Area has a significant deficit, estimated to be some 10 million m^3/a. However, it must be borne in mind that this deficit relates to the whole Key Area once the ecological Reserve has been implemented. A more detailed analysis of the Mooi River Key Area carried out as part of the ISP using the Rapid Simulation Model (Mallory, 2003), indicates that users in the upper reaches of the Key Area currently enjoy high assurances of supply from the numerous farm dams while the successful implementation of the Reserve will require curtailment of this irrigation.

Table 4.22: Water balance in the Mooi River Key Area in 2005 (million m^3/a)

Available water	Local yield	64
	Transfers in	0
	Total	64
Water requirements	Local requirements	52
	Transfers out	22
	Total	74
Balance		**(10)**

Table 4.23: Water balance in the Mooi River Key Area after completion of the Spring Grove Dam (million m^3/a)

Available water	Local yield	125
	Transfers in	0
	Total	125
Water requirements	Local requirements	52
	Transfers out	83
	Total	135
Balance		**(10)**

There are also surplus summer flows in the Mooi Key Area which could be allocated provided sufficient controls can be put in place to ensure that abstractions only take place once the ecological requirements have been met.

4.10.5 Reconciliation perspective

Under current operating conditions the water resources of the Mooi River are approximately in balance, the deficit indicated in **Table 4.22** arising largely as a result of provision for the Reserve.

The construction of the Spring Grove Dam should not alter the balance in the Mooi River Key Area because the additional yield made available by the Spring Grove Dam is allocated to the Mgeni System.

4.10.6 Water quality

Agro-chemicals from intensive farming activities threaten the quality of the water resource in the Mooi River.

4.10.7 Summary, key issues and strategies

The only key issue identified in the Thukela WMA Report (DWAF, 2002b) is that a quantity of 136 million m^3/a should be reserved for transfer to the Mgeni System. Although additional infrastructure would be required to make this water available (i.e. the construction of Spring Grove Dam), this value is definitely on the high side. The latest analyses of the Mooi-Mgeni transfer indicates that the amount to be reserved, expressed in terms of 1:50 year yield, is about 80 million m^3/a.

Other strategies derived from this ISP are:

- There are possibly limited quantities of water available in the lower reaches of the Key Area, as well as summer use, from November through to March. Each licence application will need to be carefully evaluated, however, to verify the availability of water at the proposed point of abstraction. This water should be reserved for poverty eradication.

- Additional afforestation in low impact areas is a possibility but would require more analysis.

- Groundwater should be considered as the first option for rural domestic use. Conjunctive use of ground and surface water should receive more attention.

- The impact of diffuse agricultural pollution needs to be investigated and a management plan developed.

- The Reserve has been determined and needs to be implemented in this Key Area. This could coincide with the completion of the Spring Grove Dam.

4.11 Lower Thukela Key Area

4.11.1 Introduction

The Lower Thukela Key Area consists of the Thukela River catchment from the Bushmans River confluence down to the river mouth at the Indian Ocean. The area includes the town of Mandini and the Isithebe industrial area, both located close to the river mouth. The existing Middeldrift and proposed Fairbreeze transfer schemes are also located in the lower reaches of this Key Area.

The Middeldrift scheme transfers water to the Mhlathuze catchment upstream of the Goedertrouw Dam. The scheme has a capacity of 1.2 m^3/s and the pumps are operated whenever the water level in this dam drops below 90% of its full supply capacity.

It is proposed that the Fairbreeze transfer will service the proposed Fairbreeze mine and irrigators along the route of the pipeline. Although an abstraction licence has already been issued for this scheme, investigations are still continuing as to whether it would be more cost effective to supply the mine from the Mhlathuze River directly.

4.11.2 Water availability

The MAR of the Lower Thukela Key Area is 434 million m^3/a.

Table 4.24: Overview of the water availability in the Lower Thukela Key Area

Resource category	Water available at a 1:50 equivalent assurance (million m^3/a)	
	Supported by upstream releases	Not supported by upstream releases
Gross surface water resource	207	122
Subtract : Ecological Reserve	20	20
Invasive alien plants	1	1
Dryland sugarcane	0	0
Net surface water resource	186	101
Groundwater resource	1	1
Return flows	3	3
Total local yield	190	105
Transfer In	0	0
Grand Total	**190**	**105**

The gross available surface water resource in the Lower Thukela Key Area based on current development levels is estimated to be 122 million m^3/a, as is summarised in **Table 4.24**. Although there are significant return flows from the Sappi mill in Mandini, this occurs in the river mouth and has not been taken into account in the water balance. From time to time the quality of the Sappi effluent has been so poor that releases from the Spioenkop Dam have been necessary as a management intervention. This has not been factored into the water resources evaluation carried out for this ISP due to a lack of information on the requirements. This may require more detailed investigation at some point in the future.

4.11.3 Water requirements

A summary of the water requirements in the Lower Thukela Key Area is provided in **Table 4.25**. The largest use of water from the Lower Thukela Key Area is the transfer to the Mhlathuze Catchment. The impact of this transfer on the available resource of the Lower Thukela Key Area is estimated at 38 million m^3/a. There is also a small transfer out of this Key Area of about 2 million m^3/a to meet industrial demands in the Amatikulu River catchment, which forms part of the Usutu to Mhlathuze WMA. The industrial requirements of the Sappi mill at Mandini are also significant with this being the largest single industrial water use in the Thukela WMA. No significant growth is anticipated in the area.

The water requirements of the Fairbreeze mine are included in **Table 4.25** even though this mine is not yet operational. The reason for this is that water has already been allocated with 32 million m^3/a allocated for the mine and a further 15 million m^3/a (at a lower assurance) allocated for proposed new irrigation along the pipeline route. This new irrigation requirement is included in **Table 4.25** under 'Transfers Out'.

Table 4.25: Water requirements in the Lower Thukela Key Area in 2005

User sector	Water requirement at a 1:50 equivalent assurance (million m^3/ a)
Irrigation	22
Urban	2
Rural	10
Industrial	24
Afforestation	0
Total local requirements	58
Transfers Out	87
Grand Total	**145**

4.11.4 Water Balance

A reconciliation of the water requirements and resource availability is given in **Table 4.26**. The water balance indicates that the Lower Thukela Key Area is experiencing a deficit, but it must be borne in mind that this allows for the Ecological Reserve and new allocations to the Fairbreeze transfer which has not yet been taken up.

Table 4.26: Water balance in the Lower Thukela Key Area 2005 (million m^3/a)

		Not supported by upstream releases	Supported by upstream releases
Available water	Local yield	105	190
	Transfers in	0	0
	Total	105	190
Water requirements	Local requirements	58	58
	Transfers out	87	87
	Total	145	145
Balance		**(40)**	**45**

4.11.5 Reconciliation perspective

The above balances refer to two scenarios. In the first scenario, it is assumed that the surpluses are retained (or used locally) in the Spioenkop and Wagendrift dams. Under these circumstances, there will be a large deficit in the Lower Thukela Key Area. This scenario is shown in this report to demonstrate that water must be released from upstream dams to support the Reserve and various users in the Lower Thukela Key Area, as shown in the second scenario. If the entire surplus yield of the Spioenkop and Wagendrift dams are used to supply a hypothetical user at the outlet of the Lower Thukela Key Area, a surplus of 45 million m^3/annum could be made available.

In the water balance for the entire WMA, it is assumed that sufficient water will be released from the upstream dams to ensure a balance in the Lower Thukela Keay Area (see **Table 4.27)**.

4.11.6 Water quality

Large rural settlements and poor sanitation facilities along the Lower Thukela River could cause water quality problems during low-flow conditions. The water quality problems are currently mitigated by the reasonably large volumes of water that flow down this lower section of the Thukela River from the well-watered tributary sub-catchments upstream.

The most significant water quality impact on the river is caused by the Sappi Paper Mill at Mandini, which requires sufficient river flows to dilute its effluent releases. Also, fibres from this industrial process could be affecting the biota downstream to the river mouth.

Releases from the Spioenkop Dam have been made in the past to dilute Sappi's effluent, but if the surplus in the Thukela WMA is to be allocated then this practice must cease or Sappi must apply for a water use licence for the use of this water.

4.11.7 Key issues and strategies

Strategies derived from this ISP are:

- There is scope for additional use in this Key Area, although it must be borne in mind that new allocations in this Key Area will require releases from the Spioenkop or Wagendrift dam (or both). The whole Thukela catchment therefore needs to be considered when allocating water in the Lower Thukela Key Area. Preference should be given to poverty eradication and the redressing of past inequities, but the surpluses are sufficient to consider large-scale commercial irrigation as well.

- Groundwater should be considered as the first option for rural domestic use. Conjunctive use of ground and surface water should receive more attention.

- A management plan for the effluent from Sappi is required.

- An operating rule will need to be established for the Spioenkop Dam and/or the Wagendrift Dam in order to periodically supplement the flow in the Lower Thukela for the Fairbreeze transfer.

4.12 Overall water balance

The overall water balance for the whole Thukela WMA is provided in **Table 4.27.** The overall balance depends very much on how the catchment is operated ie where the surpluses are assumed to be utilised and where they are supplied from. **Table 4.27** presents two possible scenarios in which support for the lower Thukela is provided from the Spieonkop, Wagendrift and Ntshinwayo dams. In both scenarios, support to the Lower Thukela Key Area is assumed in order to maintain the balance in this catchment.

Table 4.27: Reconciliation of allocations and available water for the Thukela WMA for year 2005 assuming support from Wagendrift and Spioenkop (million m^3/a).

Key Area	Available water			Water requirements/allocations			Balance
	Local yield	Transfers In	Total	Local requirements	Transfers out	Total	
Upper Thukela	506	0	506	114	377+11[1]	502	**4**
Little Thukela	8	0	8	38	0	38	**(30)**
Bushmans	80	0	80	40	29[1]	69	**11**
Sundays	8	0	8	32	0	32	**(24)**
Mooi	64	0	64	52	22	74	**(10)**
Buffalo	174	0	174	96	55	151	**23**
Lower Thukela	105	40[2]	145	58	87	145	**0**
Total	**945**	**0**	**945**	430	541	971	**(26)**
Allocable							**38[3]**

Notes:

1. Releases to support the Lower Thukela Key Area.

2. Supplied from Spioenkop and Wagendrift dams.

3. Since it is not feasible to supply the shortages in the Little Thukela, Sundays or Mooi Key Areas from the surpluses in the Upper Thukela, Buffalo or Bushmans Key Areas, there is at least 38 million m^3/a available for allocation in the Thukela WMA.

While Table 4.27 indicates that there is water available for allocation in the Thukela WMA, it is unlikely that these surpluses can be used to supply the deficits in the Little Thukela, Sundays or Mooi River Key Areas because it would be impractical and uneconomical to do so. It would be more cost effective to develop new water resources infrastructure in the catchments where the deficits occur, and even this is unlikely to be economically viable, due to the low economic returns from irrigation, which is the sector experiencing the shortage.

Table 4.27 presents a particular water management scenario, and many other sceanrios can be developed in order to determine the effects of alternative water use patterns or operating rules on the available water resource. In **Table 4.28** two more scenarios are given. In both of these scenarios the Buffallo River Key Area is assumed to contribute to the water requirements

of the Lower Thukela Key Area. In Scearion 1 the surplus water is assumed to be utilised directly from the large dams (Spieonkop, Wagendrift and Ntshingwayo), which is very simlar to the scenario given in **Table 4.27.** In Scenario 2, the surplus water is assumed to be utilised at the outlet of the various Key Areas, which results in more utilsable water than Sceanrio 1.

Table 4.28: Reconciliation of allocations and available water for the Thukela WMA for year 2005 assuming support from Wagendrift, Spioenkop and Ntshingwayo dams (million m^3/a).

Key Area	Scenario 1			Scenario 2		
	Surplus in dams	Release to Lower Thukela	Available in dams	Surplus in catchment	Release to Lower Thukela	Available in catchment
Upper Thukela	15	8	7	30	10	20
Bushmans	40	20	20	40	13	27
Buffalo	23	12	11	55	17	38
Total	**78**	**40**	**38**	**125**	**40**	**85**

4.13 Comparison with the First Edition NWRS

4.13.1 Introduction

In this section, the water balances presented for the various Key Areas are summarised into the Sub-area division used in the first edition of the NWRS so that comparison with this first edition can be made easily and differences explained.

4.13.2 Water requirements

A summary of the water requirements as documented in this ISP is provided in **Table 4.29** while **Table 4.30** contains the water requirements of the NWRS.

Table 4.29: Water requirements/allocations of the Thukela WMA in the year 2005 (million m^3/a). Key Areas as defined in this ISP report.

Key Area/ Sub-area	*Irrigation*	*Urban*	*Rural*	*Mining and bulk industrial*	*Power Generation*	*Afforestation*	*Total local requirements*	*Transfers out*	*Grand Total*
Upper Thukela	87	17	9	0	0	1	114	377	491
Little Thukela	36	1	1	0	0	0	38	0	38
UPPER THUKELA	123	18	10	0	0	1	152	377	529
Bushmans	31	4	3	1	0	1	40	0	40
Sundays	26	1	4	1	0	0	32	0	32
Mooi	49	1	1	0	0	1	52	22	74
MOOI/SUNDAYS	106	6	8	2	0	2	124	22	146
Buffalo	50	24	9	12	0	1	96	55	151
BUFFALO	50	24	9	12	0	1	96	55	151
Lower Thukela	22	2	10	24	0	0	58	87	145
LOWER THUKELA	22	2	10	24	0	0	58	87	145
TOTAL	301	50	37	37	0	4	430	541	971

Note: The shaded rows refer to sub-areas as defined in the NWRS

Table 4.30: Water requirements/allocations of the Thukela WMA in the year 2000 as given in the First Edition NWRS (million m^3/a).

Sub-area	*Irrigation*	*Urban*	*Rural*	*Mining and bulk industrial*	*Power Generation*	*Afforestation*	*Total local requirements*	*Transfers out*	*Grand Total*
UPPER THUKELA	71	11	6	0	0	0	88	377	465
MOOI/SUNDAYS	76	13	9	4	0	0	102	34	136
BUFFALO	38	27	11	14	1	0	91	55	146
LOWER THUKELA	19	1	5	28	0	0	53	40	93
TOTAL	204	52	31	46	0	0	334	506	840

The two significant differences between the water requirements given in this ISP and the NWRS are the irrigation requirements and the transfers out of the WMA. These differences are motivated as follows:

The irrigation requirements in the Thukela WMA, obtained from various sources, are summarised in **Table 4.31**. A direct comparison between these data is not appropriate since the values reflect development levels in different years and the reliability requirements may not be the same. The irrigation requirements used in this ISP were based on the TWP feasibility study and are hence similar. It is clear that the TWP (and hence the ISP) irrigation requirements are significantly higher than those derived from other studies. However, it should be recognised that the TWP erred on the conservative side (high local requirements) in order to make adequate provision for in-basin use and development.

Table 4.31: Comparison of irrigation water requirements from different sources

Sub-area	Requirement (million m^3/a)	Assurance
ISP	353	Average requirement
ISP	301	1:50
TWP Feasibility Study	323	Average requirement
DWAF Registration Database (WARMS)	253	Average requirement
WSAM Version 2	229	1:50
First Edition NWRS	230	1:50
VAPS	231	1:50

The transfers out of the WMA given in this report differ from those of the NWRS for the following reasons:

- The Fairbreeze transfers are included in this report. Even though these transfers have not yet (and might never be) implemented, the licences for the transfers have been issued and hence need to be taken into account.

- The transfer to the Mgeni catchment from the Mooi Key Area is given in the NWRS as 34 million m^3/a. A detailed analysis of this transfer carried out as part of this ISP has determined the impact of this transfer on the availability of the yield in the Mooi Key Area as only 22 million m^3/a, taking the ecological Reserve into account, which does limit these transfers somewhat.

4.13.3 Water resource

A summary of the water resource as documented in this ISP is provided in **Tables 4.32** while **Table 4.33** contains the water resource of the NWRS. Note that the water resource given in **Table 4.32** is based on the conservative scenario given in **Table 4.27**.

Table 4.32: Water resources of the Thukela WMA in the year 2005 (million m³/a) per Key Area (ISP) and per sub-area (NWRS) as determined as part of this ISP report

Key Area/ Sub-area	*Natural resource*		*Usable return flow*	*Total local yield*	*Transfer in*	*Grand total*
	Surface water	Groundwater				
Upper Thukela	478	5	23	506	0	506
Little Thukela	6	1	1	8	0	8
UPPER THUKELA	484	6	24	514	0	514
Bushmans	74	2	4	80	0	80
Sundays	6	1	1	8	0	8
Mooi	54	2	8	64	0	64
MOOI/SUNDAYS	134	5	13	152	0	152
Buffalo	136	6	32	174	0	174
BUFFALO	136	6	32	174	0	174
Lower Thukela	101	1	3	105	0	105
LOWER THUKELA	101	1	3	105	0	105
TOTAL	**855**	**18**	**72**	**945**	**0**	**945**

Note: The shaded rows refer to sub-areas as defined in the NWRS

The water resource of the Thukela WMA, as determined for this ISP using the WRYM setup for the Thukela is substantially higher than given in the NWRS. The main reason for this is that the reduction in yield due to the ecological Reserve, as used in the NWRS (which was based on desktop estimates), is much higher than that recently determined through the Thukela Reserve Determination Study (DWAF, 2004b). The latter Reserve has been approved by DWAF and hence is now the accepted Reserve for the WMA.

Table 4.33: Water resources of the Thukela WMA in the year 2000 (million m³/a) per sub-area (NWRS) as given in the NWRS

Sub-area	*Natural resource*		*Usable return flow*	*Total local yield*	*Transfer in*	*Grand total*
	Surface water	Groundwater				
UPPER THUKELA	376	5	13	394	0	394
MOOI/SUNDAYS	110	3	15	128	0	128
BUFFALO	107	6	22	136	0	136
LOWER THUKELA	73	1	3	79	0	79
TOTAL	**666**	**15**	**56**	**737**	**0**	**737**

4.13.4 Reconciliation of requirements and availability

A reconciliation of the water requirements and available resource as documented in this ISP is provided in **Tables 4.34** while **Table 4.35** contains the reconciliation as given in the First Edition NWRS.

Table 4.34: Reconciliation of requirements and available resource of the Thukela WMA in the year 2005 (million m^3/a).

Key Area	Available water			Water requirements/allocations			Balance
	Local yield	Transfers In	Total	Local requirements	Transfers out	Total	
Upper Thukela	506	0	506	114	377+11	491	**4**
Little Thukela	8	0	8	38	0	38	**(30)**
UPPER THUKELA	514	0	514	152	377+11	529	**4**
Bushmans	80	0	80	40	29	40	**11**
Sundays	8	0	8	32	0	32	**(24)**
Mooi	64	0	64	52	22	74	**(10)**
MOOI/SUNDAYS	152	0	152	124	22	146	**6**
Buffalo	174	0	174	96	55	151	**23**
BUFFALO	174	0	174	96	55	151	**23**
Lower Thukela	105	40	105	58	87	145	**0**
LOWER THUKELA	105	40	145	58	87	145	**0**
Total	**945**	**0**	**945**	430	541	971	**(26)**
Allocable							**38**

Note: The shaded rows refer to sub-areas as defined in the NWRS

Table 4.35: Reconciliation of requirements and available resource of the Thukela WMA in the year 2003 as given in the NWRS (million m^3/a)

Key Area	Available water			Water requirements/allocations			Balance
	Local yield	Transfers In	Total	Local requirements	Transfers out	Total	
UPPER THUKELA	394	0	394	88	377	465	(71)
MOOI/SUNDAYS	128	0	128	102	34	136	(8)
BUFFALO	136	0	136	91	55	146	(10)
LOWER THUKELA	79	0	79	53	40	93	(14)
Total	**737**	**0**	**737**	**334**	**506**	**840**	**(103)**

Considering the WMA as a whole, this ISP shows that the Thukela WMA is in deficit, although the deficit is considerably less than that given in the NWRS. However, as discussed in **Section 4.12**, it is not feasible to supply the shortages in the Little Thukela, Sundays and Mooi Key Areas from the surpluses in the Upper Thukela and the Buffalo Key areas. This ISP shows, through more detailed analyses, that it is possible to allocate at least 38 million m^3/a in the Thukela WMA.

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