NATURAL RESOURCE ACCOUNTING: WATER ACCOUNTS OF THE UPPER VAAL WATER MANAGEMENT AREA 1991-2000

Discussion Document

Interpretative summary

Statistics South Africa (Stats SA) implemented the 1993 System of National Accounts (SNA) in June 1999 in conjunction with rebasing and benchmarking of Gross Domestic Product (GDP) estimates. In addition, Stats SA also published the first set of supply and use tables (SU-tables). These tables were developed to include all the transactions in goods and services in the South African economy for a specific year in matrix format. The first set of these tables with 1993 as reference year were published in 1999. Subsequent tables were published for 1998 and 1999. As a next step towards implementing the 1993 SNA, Stats SA has now compiled Natural Resource Accounts (NRA) (satellite accounts) for minerals and water. Satellite accounts or systems (e.g. NRA) as presented in the 1993 SNA, generally stress the need to expand the analytical capacity of national accounting for selected areas of social concern in a flexible manner, without overburdening or disrupting the central system.

In this discussion document, the methodology (techniques and method used) with an example for the compilation of the water accounts is discussed. The actual accounts for the upper Vaal Water Management Area (WMA) form the basis for the discussion and these include supply, use as well as asset accounts. In future Stats SA aims to compile a full set (19 catchment areas) of water accounts for South Africa with an update every five years.

The most important conclusion to be drawn from this study is that it was possible to compile water resource accounts for the Upper Vaal WMA using the framework proposed by the United Nations. From the analysis of this WMA the following conclusions can be drawn with regard to the physical account.

Although many studies of the WMA have been done, some detailed data on the use of water remain unavailable or unreliable. In the case of the main water distributors, such as Rand Water Board, the data are reliable but where the distributors depend on local authorities to provide detailed user patterns, the data are unreliable. Specifically, data on groundwater use are also difficult to obtain and are not reliable.

As far as information on the supply of water is concerned, the Department of Water Affairs and Forestry's (DWAF) Data Management Unit has very reliable data available on the level of dams, outflow from dams and transfers in and out. These data are available on a daily or weekly basis.

If the erratic transfers to the Lower Vaal WMA are ignored, total use of water in the Upper Vaal WMA over the 10 year period 1991-2000 has increased from 1629,2 Mm³ in 1991 to 2105,7 Mm³ in 2000 with an average annual growth rate of 2,7 %. These calculations include the amount transferred to the Crocodile Catchment where the water was mostly used in the Tshwane Metropole and other urban areas.

Regarding the Surface Water Resources data a project is now underway to update the data from 1990 to 2000. The data used in these Water Research Commission of South Africa reports for annual runoff are therefore probably not the final figures and will be adapted by the project team consisting of a group of engineering firms.

The availability of the Lesotho Highlands Scheme since 1988 has pushed the total storage capacity of the Upper Vaal WMA up from 5618 to 8505 million m^3 and the potential annual transfer in from this scheme to the WMA up to 1500 million m^3 .

In a water-scarce country, the provision of water should always be considered in terms of the socio-economic benefits accruing from contributions by specific users. Two macroeconomic variables were used as indicators of these benefits namely value added and employment opportunities. The total contribution to value added of water used per sector in 2000 amounted to R113,7 billion (in 2000 prices), while approximately 1,2 million employment opportunities are sustained by water use from the Upper Vaal River WMA for the same year.

According to the figures generated in this study, the cost to supply raw water was approximately R1 billion in 2000 while the revenue from water tariffs amounted to R1,6 billion. These figures translate into negative subsidies or overrecoveries of R544 million.

The compilation of water accounts requires extensive data. It is therefore very important that data should be available on a regular basis in order to facilitate analysis of supply and use trends. DWAF is the main supplier of data on water resource development and management. It is therefore of paramount importance that Stats SA and DWAF jointly plan and manage the collection and processing of water data to ensure that the data are available timeously and in the right format. The water resource accounts framework as proposed by the UN is very comprehensive and it requires very highly skilled people to compile reliable accounts. It is therefore important that the people who deal with these accounts in DWAF and Stats SA should be fully *au fait* with the nature and magnitude of water accounts.

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ABBREVIATIONS AND ACRONYMS

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1. Introduction

Given the increasing international and local support for good environmental management based on sound economic principles, the need for Natural Resource Accounting (NRA) has become necessary. Over the past three to four decades the conventional System of National Accounts (SNA) has been the source of information about production and disposition of economic goods and services between intermediate use, final consumption and savings, about employment of primary factors of production (land, capital and labour) and the creation and distribution of income and wealth in national economies.

The central framework of the SNA presents a number of characteristics, which give it the advantage of an integrated accounting structure. It is exhaustive and consistent within the boundary of the economic activities it covers; that is, each unit, transaction, product and purpose is given a place, and only one, in the classifications and accounts of the System. Moreover, the set of concepts adopted by the System is fully coherent. The counterpart of these benefits is that there are certain limitations as to what may be accommodated directly in the central framework. Among the major shortcomings of the SNA is its focus on the production and the use of manufactured goods and assets that are bought and sold on the market. Excluding the values of environmental amenities, human capital and non-produced natural assets renders conventional measures of national income and wealth inappropriate for evaluating long-term welfa re aspects and sustainability.

Satellite accounts or systems (e.g. NRA) as presented in the 1993 SNA, generally stress the need to expand the analytical capacity of national accounting for selected areas of social concern in a flexible manner, without overburdening or disrupting the central system. On the one hand, satellite accounts are linked with the central framework of national accounts and through them to the main body of integrated economic statistics. On the other hand, as they are more specific to a given field or topic, they are also linked to the information system specific to this field or topic. They also call for better integration of monetary and physical data. Because they preserve close connections with the central accounts, they facilitate analyses of specific fields in the context of macro-economic accounts and analyses. Satellite accounts in various fields may, in addition, help to connect analyses between some of those fields. They are thus able to play a dual role, as tool for analyses and for statistical coordination.

Typically satellite accounts or systems allow for -

- The provision of additional information on particular social concerns of a functional or crosssector nature;
- The use of complementary or alternative concepts, including the use of complementary and alternative classifications and accounting frameworks, when needed to introduce additional dimensions to the conceptual framework of national accounts;
- Extended coverage of costs and benefits of human activities;
- Further analysis of data by means of relevant indicators and aggregates; and
- Linkage of physical data sources and analysis to the monetary accounting system.

Statistics South Africa (Stats SA) has implemented the 1993 SNA in June 1999 in conjunction with rebasing and benchmarking of Gross Domestic Product (GDP) estimates. In addition, Stats SA also published the first set of supply and use tables (SU-tables), which intended to include all the transactions in goods and services in the South African economy for a specific year in matrix format, for the 1993 reference year in 1999. Subsequent tables were published for 1998 and 1999.

As a next step towards implementing the 1993 SNA, Stats SA has now compiled NRA (satellite accounts) for minerals and water.

The System for integrated Environmental and Economic Accounting (SEEA) was developed by the United Nations to provide a conceptual basis for implementing a 1993 SNA (satellite) system for integrated environmental and economic accounting. The SEEA describes the interrelationships between the natural environment and the economy. This is achieved by linking the conventional economic accounts with environmental and natural resource accounts. The main purpose of integrated environmental and economic accounting is to support integrated social, economic and environmental policy by means of an integrated information system. This facilitates policy-making and analysis of the interaction between environmentally sound and sustainable economic growth and development.

In this discussion document, the methodology (techniques and method used) with an example for the compilation of the water accounts is discussed. The actual accounts for the upper Vaal Water Management Area will form the basis for the discussion and these will include supply, use as well as the asset accounts. In future Stats SA aims to compile a full set (19 catchment areas) of water accounts for South Africa with an update every five years.

2. Methodology

2.1 Physical Accounts

The framework for water resource accounts in physical units is made up of the following components:

- Water supply accounts.
- Water use accounts
- Water asset account.

The basis of these accounts is formed by the structures as proposed in Chapter 7 of the Handbook on Integrated Environmental and Economic Accounting.

2.1.1 Water Supply Accounts

Table 1 on page 3 gives a schematic representation of the supply of water in terms of industries, final consumers, rest of the world and the environment.

Table 1 - Schematic water supply table (millions of cubic metres)

	Sources	Agriculture	Energy	Industries	Final Consumer	Rest of the World	Environment	Total
Ecosystem	S1 – Rain							
Inputs								
Natural	S2 –Total water abstracted							
Resources								
	Water abstracted for own use of which: for irrigation							
	Water abstracted for delivery							
Products	S3 – Water supplied to other sectors of which: Wastewater							
Residuals	S4 -Water returned							
	Irrigation water							
	Cooling water							
	Wastewater treated							
	Wastewater untreated							
	Losses/leakages in distribution							
	Other returns							
S-Total Supply	V(S3 + S4)							

Source: United Nations Statistical Division

The following supply sources are used to compile the water supply table:

- Ecosystem Inputs (S1);
- Natural Resources (S2);
- Products (S3); and
- Residuals (S4).

Ecosystem Inputs (S1)

The rainwater is supplied to the environment.

Natural Resources (S2)

In this section all abstracted water is shown as coming from the environment. It is then disaggregated between ground, perennial or ephemeral surface water.

Products (S3)

This section shows the main industries supplying water as a product. In addition, some industries may supply water which has already been used in the production process to other industries and as such has lower quality water in their production process. The supply of water as a product is net of the leakages during transportation. These losses/leakages are considered as returns from the industry supplying the water.

Residuals (S4)

The entries under residuals cover the returns of water to the environment and include all the flows of water that are supplied by the industries and used by the environment. In South Africa, the term *return flows* is commonly used to indicate this water.

2.1.2 Water use accounts

Table 2 on page 4 gives a schematic representation of the use of the water by the different water using sectors. The users of water as a natural resource are shown by industry.

Table 2 - Schematic use table for water (millions of cubic metres)

	Sources	Agriculture	Energy	Industries	Final Consumer	Rest of the World	Environment	Total
Ecosystem Inputs	U1 – Rain							
Natural Resources	U2 –Total water abstracted							
	Water abstracted for own use of which: for irrigation							
Water abstracted for delivery Products U3 – Water delivered through mains of which: wastewater								
Residuals	U4 - Water returned							
	Irrigation water Cooling water							
	Wastewater Treated							
	Wastewater Untreated							
	Losses/leakages In distribution							
U-Total Wa	Other returns ter Use (U1 +U2 + U3)							
CONSUMP	TION (U-S)							

Source: United Nations Statistical Division

The use of water can also be disaggregated by purpose depending on data availability and specific country needs. It can also be distinguished according to whether the water is reused in the production process, after having been treated to some extent, or whether it is directly supplied through mains. In some instances, other countries classify the use of water according to whether it is provided by bulk systems or rural systems.

Table 2 makes provision for the different sources from which users will draw water for consumption or distribution namely:

- Ecosystem inputs (U1);
- Natural resources (U2);
- Products (U3);
- Residual (U4)

Ecosystem inputs (U1)

These will be the activities that use rainwater or reduce run off. In South Africa at present, only three activities are seen as reducing runoff namely, Forestry; Alien plants and Dryland Sugar Cane.

Natural Resources (U2)

These sources will include water abstracted from rivers, lakes, dams and groundwater for own use or distribution. For instance in the case of irrigation, the user can himself abstract from the source or there could be an irrigation scheme which abstracts water and distributes it.

Products (U3)

This water is received from distributors.

Residuals (U4)

Water that is returned to the system by the different sectors (Return flows).

Total water consumption can be calculated from the Supply and Use Table for water. Water consumption is defined as the part of abstracted water which is no longer available for use because it has evaporated, transpired, been incorporated into products and crops, consumed by man or livestock, or otherwise removed from freshwater resources. Water consumption is calculated for each sector as the difference between water use and water supply.

2.1.3 Water asset account

Asset accounts for water reflect how the stocks of water at the beginning of the accounting period are affected by transfers of water between the environment and internal hydrological systems to make up the stocks of water at the end of an accounting period.

Before embarking on the compilation of asset accounts for water, the definition of water stocks has to be clarified. For groundwater, reservoirs and lakes it is conceptually simple to measure such stocks. For rivers, the stock of water is not well defined due to the "flowing" nature of the resource. In order to maintain consistency with the other water resources, the stock of water in a river is measured as the volume of the riverbed. However, the volume of a riverbed is not a quantity of water in itself and is not a good measure of water stocks for ephemeral rivers in particular. Alternative measures are the annual runoff (AR) into the river or the mean annual runoff (MAR) in a country subject to a very large annual variation.

AR is the total volume of water that flows during a year, usually referring to the outflow of a drainage area or river basin. For perennial rivers, runoff is measured at the lowest point (downstream sometimes close to the estuary). Hence it represents the balance of all the flows which took place upstream in the river catchment. For rivers crossing national borders, the runoff may take place entirely or mainly outside the relevant country in which case it is the runoff at the point of entry to that country or exit from that country which is of interest.

MAR is defined as the average annual flow under natural conditions. This definition is dependent on the runoff regime for each river basin. Where the flow increases downstream, (it is at its highest level at the mouth of the river basin), MAR is defined at the river basin. Where the flow in the rivers decreases downstream (often with little or no outflow from the river basin), MAR is defined as the combined MAR of each of the major catchments in the river basin, calculated at the point where the flow is at its highest level and excluding runoff from upstream basins.

The use of AR or MAR as a measure of stock, however, presents problems in the compilation of the asset accounts as some of the flows in the table may already be included, depending on where the river flow is measured. In such a case, the flows in the asset account should be modified accordingly to avoid double counting.

It is important to note that the classification of water assets does not include water in the soil, vegetation, snow or ice. Thus, the asset accounts will measure the precipitation, which falls directly on rivers, lakes and reservoirs, and the part of the precipitation, which reaches surface and ground water. The runoffs to surface water and infiltration to groundwater are therefore net of evapotranspiration.

The opening and closing stocks represent the quantity of water, in cubic meters, at the beginning and end respectively of the accounting period. The changes in stocks during the accounting period can be caused by human activities (abstraction and return of water to the environment) and by natural processes (precipitation, evapotranspiration, natural inflows and outflows to other rivers, etc.).

Table 3 gives a schematic representation of the asset account for water for surface water, groundwater and other resources.

Table 3 - Schematic asset account for water (millions of cubic metres)

	Source	?S		Surface Water		Ground	Other	Total
			Dams	Rivers	Lakes			
Open	ing Stocks							
A1	Abstraction (-)	Sustainable use						
		Runoff reduced						
A2	Residuals (+)	Irrigation						
A3	Wastewater Precipitation (+)							
A4	Inflows (+)							
A5	Net natural transfe	ers ()						
A6	Evapotranspiratio	n (-)						
A7		To other regions To the sea						
A8	Other Volume changes	Due to natural disaster						
		Discovery (+)						
		Others						
Closi	ng Stocks							

Source: United Nations Statistical Division

The detailed description of the table entries is as follows:

Abstraction (row A1) is the total volume of water abstracted in a year. A distinction is made between water abstracted and water that is used by runoff reducing agricultural activities.

Residuals (row A2) represent the total volume of water in the accounting period returned to the environment. The total return of water; (A2), has to be equal to the part of the supply (S5) in the supply table, which returns to surface and groundwater. When data are available, the returns of water can be disaggregated by type of water returned and represented by annual runoff.

Precipitation (row A3) is composed of all wet precipitation. When the category "water in soil" is not included in the table, the figures for precipitations are net of evapotranspiration. They represent the part of the total annual precipitation that reaches the lakes (directly), rivers (via runoff), reservoirs (directly), and groundwater (infiltration) but include the water that was used by alien plants, forestation and dry land sugar cane.

Inflows (row A4) represent the total volume of water in the accounting period that enters the relevant territory. For a river that enters that territory, the inflow is the total quantity at its entry point.

Net natural transfers (row A5) for a water resource is defined as the difference between the inflows to one type of water resource from all the others and the outflows from the same water resource to all the others.

Evapotranspiration (row A6) is the loss (in cubic metres) during the accounting period of the water resources due to the process of evapotranspiration.

Outflows (row A7) represent the volume of water that leaves the relevant territory during the accounting period. This flow could be disaggregated depending on whether the flow is to other territories or to the sea.

Other changes in volume (row A8) include all the changes in the stocks of water that are not specified elsewhere in table 3. This item can either be estimated or calculated directly. It is usually calculated as a difference between the closing and opening stocks and the entries in the table and is therefore a balancing item.

2.2 Example of the compilation of physical accounts for water

This section provides an example of a relatively easy system to highlight the principles involved in compiling supply, use and asset accounts for water.

2.2.1 Supply account for water

Table 4 on page 8 and table 5 on page 9 provide an example of water supply account.

iple of a water supply account

Sources		Total agri-culture	Irrigation	Afforestation	Energy	Collection and distribution of water	Sewerage	Urban requirement	Rest of the World	Environn
		A + B	A	В	С	D	E	F	G	Н
S1	Rain	0								
S2	Total Water Abstracted	0	0	0	0	0	0	0	0	
	 Water for own use 	0	1							
	 Water for irrigation 									
	- Water abstracted for delivery									
S3	Water supplied to other sectors	8.0	8.0			247.0		60.0		_
	of which is waste water	0.0				60.0				
S4	Water returned	18.5	18.5	0.0	12.0	12.0	130.0	0.0	0.0	
	- Irrigation water	11.4	11.4							
	- Cooling Water	0.0			1.2					
	- Waste water treated	0.0					60.0			
	- Waste water untreated	0.0					70.0			
	- Losses/Leakages	7.1	7.1			12.0				
supply	S3+S4	26.5	26.5	0.0	12.0	259.0	130.0	60.0	0.0	

Table 5 - Explanation of table 4

Cell (Row/	Amount of water in physical units (million	Description
Column)	m^3)	
1Н	110	This number is drawn from the use table row 1: Total, representing the total rainwater used by the system.
2Н	125	This number is drawn from the use table representing the water abstracted from the natural resource.
2.1H	55	Ditto
3Н	259	Ditto
4A	8	Water abstracted with irrigation water and supplied to another sector.
4D	247	Water delivered through mains to the different sectors.
4.1D	60	Water delivered through mains that end up in the sewerage treating system.
4F	60	This is the water flowing from Urban requirements into the sewerage system.
5A	11.4	Irrigation water discharged into the system.
6C	1.2	Water from the energy sector discharged into the system.
6E		This is the treated water discharged by the sewerage system, either into the environment or available for recycling.
8E		This is the water from the paved urban areas into the stormwater system and discharged untreated.
9A	7.1	Irrigation water conveyance losses.
9D	12	Losses/Leakages in the distribution system.

2.2.2 Use account for water

Table 6 on page 10 and table 7 on page 11 provide an example of water use account.

le of a water use account

	Sources	Total agriculture	Irrigation	Afforestation	Energy	Collection and distribution of water	Sewerage	Urban requirement	Rest of the World	Env
		A + B	A	В	С	D	Е	F	G	
U1	Rain	40		40			70			
U2	Total Water Abstracted Water for own use of which for irrigation :Water abstracted for delivery	63 63 55	63		62 62			0	0	
U3	Water delivered through mains of which is waste water	8	8				60	182 60	65	
U4	Water returned Irrigation water Cooling Water Waste water treated Waste water untreated Losses/Leakages									
U	1+U2+U3	111	71	40	62	259	130	182	65	
;		84.5	44.5	40.0	50.0	0.0	0.0	122.0	65.0	

Table 7 - Explanation of table 6

Cell (Row/ Column)	Amount of water in physical units (million m ³)	Description
1B	40	Water reduction/use by afforestation. South Africa at this stage only accepts afforestation, alien plants and dry land sugar cane as water reduction agriculture practices.
1E	70	Rain water falling on paved urban areas and flowing into the stormwater system.
2A	63	Water abstracted for irrigation (includes losses).
2.1A	55	The portion of the water abstracted and effectively used for irrigation.
2C	62	Water abstracted for electricity plants.
3D	259	Water abstracted by water boards for further distribution.
4A	8	Water abstracted by the irrigation system but delivered to another sector.
4E	60	The water in the sewerage system delivered by the urban users.
4F	182	Water delivered to the urban users.
4G	65	Water delivered to users in another WMA.
4.1F	60	Water used by urban users which ultimately flows into sewerage system
5H	11.4	
6Н	1.2	These numbers came from the same categories in the supply table
7H	60	and represents water discharged by the sectors into the environment.
8H	70	
9Н	19.1	J

2.2.3 Asset Account for Water

The following table 8 represents a water asset account which is compiled only for water storage facilities.

Table 8 - Example of a water asset account (millions of cubic metres)

			Surface water, dams and other storage facilities	Groundwater	Total
			A	В	C
1	Opening stock (as at 1 st of October 1999)	+	480		480
2	Abstraction	-	384		384
	Total return flows	+	153.4		153.4
3	Return flows:- Irrigation water		11.4		11.4
4	Cooling water		12		12
	Waste water				
5	Treated		60		60
	Waste water				
6	Untreated		70		70
7	Other returns				0
8	Precipitation (Annual run off)	+	700		700
	Total transfers in	+	32		32
	Transfers in:Lesotho				
9	Highlands		20		
10	Tugela		12		
11	Net natural transfers	(+\-)			0
12	Evapotranspiration	-	51		51
	Total transfers out	-	66		66
13	Transfers out: Olifants		29		
14	Flood releases		37		
	Total volume change	+	-65		-65
	Other volume changes				
	Due to natural disasters				
	Other (balancing item)				
15			-65		-65
	Closing stock (30 September 2000)		799.4	(+

Table 9 - Explanation of table 8

Cell (Row/	Amount of water in physical units (million	Description
Column)	m^3)	
1 A	480	Measured opening volumes in the water storage facilities.
2A	384	Water abstracted from Natural Resources Use Accounts.
3A	11.4	Irrigation water return flows from the Supply Account.
4A	12	Cooling water return flows from the Supply Account.
5A	60	Treated waste water returned from the Supply Account.
6A	70	Untreated waste water from the stormwater system – from the Supply Account.
7A	_	Other return flows from the Supply Account.
8A	700	Annual nett runoff in the rivers actually reaching the storage facilities.
9A	20	Water transferred in from the Lesotho Highlands.
10A	12	Water transferred in from the Tugela pump scheme.
11A	-	This represents water that flows into the storage facilities and flows out. If there is a residual it is refl ected.
12A	51	Evaporation and storage losses.
13A	29	Transfers to the Olifants WMA.
14A	37	The storage facilities/dams were full and the water flowed to the sea or another WMA.
15A	65	Water volumes are difficult to balance. This is therefore used to balance the calculated closing stock with actual measured closing stock. This is done to ensure that at the beginning of every year/period, the asset account starts with the correct volumes.

3. Physical Water Accounts for the Upper Vaal River

Catchment Area

The supply, use and asset accounts for the Upper Vaal River Catchment are founded on a comprehensive database from which the appropriate figures are entered into the accounts.

The database combines data from three main sources namely:

- Department of Water Affairs and Forestry The National Water Resources Strategy Proposed First Edition, October 2001.
- BKS (Pty) Ltd Upper Vaal Management Area: Water Resources Situation assessment Main Report (Volume 1 of 3)
- Department of Water Affairs and Forestry Comprehensive unpublished data received from the Hydrological Data Management Unit

Data from the Department of Water Affairs and Forestry could only be obtained for 1995, the average growth rate between 1995 and 2000 was therefore calculated and extrapolated to the years preceding 1995

3.1 Water supply accounts: 1991 - 2000

This section contains annual water supply accounts for the Upper Vaal WMA for 1991 to 2000. The accounts will be followed by a summary table with a short discussion.

ıpp		TOTAL	IRRIGA	LIVEST	AFFORS	FISHERI	ENERG	MINING	OF IRRIGA	COLLE	SEWER	HOUSE	URBAN	RURA
		AGRICUL TURE	TION AGRICU LTURE	оск	TATION & ALIEN PLANTS	ES	Y		DISTR TION IBUTI WATER ON	CTION DISTRIE AND UTION OF WATER	AGE	HOLDS	REQUIR EMENT S	
		A+B +C	A	В	С	D	Е	F	G	Н	l i	J	К	L
1	RAIN (S1)													
	TOTAL WATER ABSTRACTED (S2)													
	PERENNIAL SURFACE WATER													
2	- Water abstracted for own use													
2.1	- of which for irrigation													
3	- Water abstracted for delivery	1												
	GROUNDWATER													
4	- Water abstracted for own use													
4.1	- of which for irrigation													
5	- Water abstracted for delivery	1												
6	WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	938.2	0.0	160.2	121.0	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	160.2	121.0	0.0
	WATER RETURNED (WATER DISCHARGED)(S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	113.7	392.7	0.0	0.0	0.0
7	- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	281.3	0.0	0.0	0.0
10	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0	111.4	0.0	0.0	0.0
11	- Losses/leakages	14.6	14.6	0.0	0.0	0.0	0.0	0.0	0.0	113.7	0.0	0.0	0.0	0.0
12	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(S3 + S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1051.9	392.7	160.2	121.0	0.0
use re	presents users such as Iscor, Sappi, Sasol and	l other large ir	idustries o	utside the	municipal	areas.								

		TOTAL	IRRIG	LIVES	AFFORE	FISHE	ENER	MINING	DISTRIB	COLLE D	ISTRIB	SEWE	HOUSE	URBA	RURAL
				тоск	STATIO N & ALIEN PLANTS		GΥ	AND	UTION IRRIGA OF TION WATER	CTION U			HOLDS	N	REQUII EMENT
		A+B+C	A	В	С	D	E	F	G	Н		I	J	K	L
1	RAIN (S1)														
	TOTAL WATER ABSTRACTED (S2)														
	PERENNIAL SURFACE WATER														
2	- Water abstracted for own use														
2.1	- of which for irrigation													1	1
3	- Water abstracted for delivery														
	GROUNDWATER														-
4	- Water abstracted for own use														-
.1	- of which for irrigation														
5	- Water abstracted for delivery														
6	WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	980.7		0.0	164.8	124.4	0.0
i. 1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	164.8	124.4	0.0
	WATER RETURNED (WATER DISCHARGED) (S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	117.0		400.8	0.0	0.0	0.0
7	- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
8	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
9	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		289.3	0.0	0.0	0.0
0	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0		111.4	0.0	0.0	0.0
1	- Losses/leakages	14.6	14.6	0.0	0.0	0.0	0.0	0.0	0.0	117.0		0.0	0.0	0.0	0.0
12	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
_	(S3+S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1097.7		400.8	164.8	124.4	0.0

sents water used in urban areas for light industries and parks but excludes domestic requirements

ents domestic use and stock watering.

			IRRIGA TION AGRICU LTURE	TOCK	AFFORES TATION & ALIEN PLANTS	RIES	GY	AND	DISTR IRRIGA IBUTI TION ON OF WATER	CTION DISTRIB	SEWER AGE		URBAN REQUIR EMENT S	REQUIE
		A+B+C	A	В	С	D	E	F	G	Н	I	J	K	L
1	RAIN (S1)													
	TOTAL WATER ABSTRACTED (S2)													
	PERENNIAL SURFACE WATER													
2	- Water abstracted for own use													
2.1	- of which for irrigation - Water abstracted for delivery													
	·													
	GROUNDWATER													
4	- Water abstracted for own use													
4.1	- of which for irrigation													
5	- Water abstracted for delivery													
6	WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1025.6	0.0	169.6	128.0	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	169.6	128.0	0.0
	WATER RETURNED (WATER DISCHARGED)(S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	120.3	409.0	0.0	0.0	0.0
7	- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	297.6	0.0	0.0	0.0
10	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0	111.4	0.0	0.0	0.0
11	- Losses/leakages	14.6	14.6	0.0	0.0	0.0	0.0	0.0	0.0	120.3	0.0	0.0	0.0	0.0
12	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(S3 + S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1145.9	409.0	169.6	128.0	0.0
epre	esents users such as Iscor,Sappi,Sasol and	other large indu	stri e s outs	ide the	municipal ar	eas.								

		TOTAL	IRRIG	LIVEST			ENER	MINING	DISTR IRRIG	COLLE DISTRII	3 SEWE	HOUS	URBAN	RURA
		AGRICUL TURE	ATIO N AGRI CULT URE	OCK	STATIO N & ALIEN PLANTS	RIES	GY	AND HEAVY INDUST RIES	ON N	CTION UTION AND OF WATER			REQUIR EMENT S	
		A+B+C	A	В	С	D	E	F	G	Н	I	J	K	L
	RAIN (S1)													
	TOTAL WATER ABSTRACTED (S2)													
	PERENNIAL SURFACE WATER													
	- Water abstracted for own use										+			\vdash
	- of which for irrigation													1
	- Water abstracted for delivery													
	GROUNDWATER													
	- Water abstracted for own use										+		1	
	- of which for irrigation											1		
	- Water abstracted for delivery										<u> </u>	-		-
	WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1073.0	0.0	174.4	131.7	0
	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	174.4	131.7	0
	WATER RETURNED (WATER DISCHARGED)(S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	123.7	417.5	0.0	0.0	0
	- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
_	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	306.1	0.0	0.0	0
	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0	111.4	0.0	0.0	0
	- Losses/leakages	14.6	14.6	0.0	0.0	0.0	0.0	0.0	0.0	123.7	0.0	0.0	0.0	0
	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
	(S3+S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1196.8	417.5	174.4	131.7	0

presents domestic use and stock watering.

	in the Upper Vaal Water Manageme	TOTAL		LIVEST					DISTR IRRIC	COLLE	DISTR	SEWER	HOUSE	URBAN	RUI
			ATIO N AGRI CULT URE		STATIO N & ALIEN PLANTS		GΥ	AND	IBUTI ATIO ON N	CTION AND		AGE	HOLDS	REQUIR EMENT S	L
		A+B+C	A	В	С	D	E	F	G	Н		I	J	K	1
1	RAIN (S1)														
	TOTAL WATER ABSTRACTED (S2)	<u> </u>								-				├─	╁
	PERENNIAL SURFACE WATER														
2	- Water abstracted for own use														
2.1	- of which for irrigation														
3	- Water abstracted for delivery														1
	GROUNDWATER														
4	- Water abstracted for own use														1
4.1	- of which for irrigation														
5	- Water abstracted for delivery														_
6	WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1123.2		0.0	179.4	135.4	0.
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	179.4	135.4	0.
	WATER RETURNED (WATER DISCHARGED)(S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	127.2		426.3	0.0	0.0	0.
7	- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.
8	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.
9	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		314.9	0.0	0.0	0.
10	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0		111.4	0.0	0.0	0.
11	- Losses/leakages	14.6	14.6	0.0	0.0	0.0	0.0	0.0	0.0	127.2		0.0	0.0	0.0	0.
12	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.
	(83+84)`	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1250.4		426.3	179.4	135.4	0.

 $\hbox{${\rm e}$ represents users such as Iscor, Sappi, Sasol and other large industries outside the municipal areas.}$

 $resents\ water\ used\ in\ urban\ areas\ for\ light\ industries\ and\ parks\ but\ excludes\ domestic\ requirements$

resents domestic use and stock watering.

		TOTAL	IRRIG	LIVES	AFFORE	FISHERI	ENER	MINING	DISTR IRRIG	COLLE DISTRI	BSEWE	HOUSE	URBAN	RURAL
		AGRICUL TURE	ATIO N AGRI CULT URE	TOCK	STATIO N & ALIEN PLANTS	ES	GY		ON N	CTION UTION AND OF WATER		HOLDS	REQUIR EMENT S	REQUIE
	D. 101 (74)	A+B+C	A	В	С	D	E	F	G	Н	I	J	K	L
1	RAIN (S1)												 	
	TOTAL WATER ABSTRACTED (S2)													
	PERENNIAL SURFACE WATER													
2	- Water abstracted for own use													
2.1	- of which for irrigation - Water abstracted for delivery													
	GROUNDWATER													
4	- Water abstracted for own use													
i.1 5	- of which for irrigation - Water abstracted for delivery													
6	WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1173.3	0.0	184.4	139.2	0.0
5.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	184.4	139.2	0.0
	WATER RETURNED (WATER DISCHARGED)(S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	130.8	435.0	0.0	0.0	0.0
7	- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	323.6	0.0	0.0	0.0
0	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0	111.4	0.0	0.0	0.0
2	- Losses/leakages - Other returns	14.6 0.0	14.6 0.0	0.0	0.0	0.0	0.0	0.0	0.0	130.8	0.0	0.0	0.0	0.0
	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	(S3+S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1304.1	435.0	184.4	139.2	0.0

represents domestic use and stock watering.

		TOTAL	IRRIG	LIVES	AFFORE	FISHE	ENER	MINING	DISTR IRRIG	COLLE I	DISTR SE	WER	HOUSE	URBAN	RURAL
		AGRICUL TURE	ATIO N AGRI CULT URE	тоск	STATIO N & ALIEN PLANTS	RIES	GY	AND HEAVY INDUST RIES		AND (IBUTI AC ON OF WATE R	GE	HOLDS	REQUIR EMENT S	REQUIF EMENT S
		A+ B + C	A	В	С	D	E	F	G	Н		I	J	K	L
1	RAIN (S1)												<u> </u>	├	<u> </u>
	TOTAL WATER ABSTRACTED (S2)														
	PERENNIAL SURFACE WATER														
2	- Water abstracted for own use														-
2.1	- of which for irrigation														
3	- Water abstracted for delivery														
	GROUNDWATER														
4	- Water abstracted for own use													-	-
4.1	- of which for irrigation														
5	- Water abstracted for delivery														
6	WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1226.1		0. 0	189.5	143.0	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	189.5	143.0	0.0
	WATER RETURNED (WATER DISCHARGED)(S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	134.4	4	444.0	0.0	0.0	0.0
7	- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
8	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
9	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3	332.6	0.0	0.0	0.0
10	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0	1	111.4	0.0	0.0	0.0
11	- Losses/leakages	14.6	14.6	0.0	0.0	0.0	0.0	0.0	0.0	134.4		0.0	0.0	0.0	0.0
12	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	(\$3+\$4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1360.5		444.0	189.5	143.0	0.0

er use represents users such as Iscor, Sappi, Sasol and other large industries outside the municipal areas.

s represents water used in urban areas for light industries and parks but excludes domestic requirements

s represents domestic use and stock watering.

		TOTAL AGRICULTU RE		LIVEST OCK	AFFORE STATIO N & ALIEN PLANTS			MINING AND HEAVY INDUSTRIE S	IBUTI ION ON OF WATER	COLLEC DISTR TION IBUTI AND ON OF WATE R		HOUSEH OLDS	REQUIR		
		A+B+C	A	В	С	D	Е	F	G	Н	I	J	K	L	
1	RAIN (S1)														1
	TOTAL WATER ABSTRACTED (S2)														
	PERENNIAL SURFACE WATER														
2	- Water abstracted for own use														
2.1	- of which for irrigation														
3	- Water abstracted for delivery														
	GROUNDWATER														
4	- Water abstracted for own use														-
4.1	- of which for irrigation														i i
5	- Water abstracted for delivery														
6	WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1281.8	0.0	194.8	147.0	0.0	(
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	194.8	147.0	0.0	C
	WATER RE TURNED (WATER DISCHARGED)(S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	138.1	453.3	0.0	0.0	0.0	0
7	- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
8	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
9	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	341.9	0.0	0.0	0.0	0
10	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0	111.4	0.0	0.0	0.0	0
11	- Losses/leakages	14.6	14.6	0.0	0.0	0.0	0.0	0.0	0.0	138.1	0.0	0.0	0.0	0.0	0
12	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
	(S3+S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1419.9	453.3	194.8	147.0	0.0	0

r use represents users such as iscor, sappi, sasoi and other large moustries outside the municipal areas, represents water used in urban areas for light industries and parks but excludes domestic requirements epresents domestic use and stock watering.

		TOTAL	IRRIGA	LIVES	AFFO	FISHE	ENER	MINING	DISTR IRRIG	COLLEC	SEWE	HOUSE	URBAN	RUE
		AGRICUL TURE		тоск			GY	AND	IBUTI ATIO ON N	TION DISTR AND IBUTI	RAGE	HOLDS	REQUIR	L REG IRE EN
					TS									
		A+B+C	A	В	С	D	Е	F	G	Н	I	J	K	
1	RAIN (S1)													
	TOTAL WATER ABSTRACTED (S2)													L
	PERENNIAL SURFACE WATER													
2	- Water abstracted for own use													H
. 1	- of which for irrigation													
3	- Water abstracted for delivery													L
	GROUNDWATER													t
4	- Water abstracted for own use													╁
. 1	- of which for irrigation													1
5	- Water abstracted for delivery													
6	WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1340.5	0.0	200.2	151.1	+
. 1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200.2	151.1	þ
	WATER RETURNED (WATER DISCHARGED)(S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	141.9	462.8	0.0	0.0	(
7	- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
8	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	351.4	0.0	0.0	Ī
10	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0	111.4	0.0	0.0	
1	- Losses/leakages	14.6	14.6	0.0	0.0	0.0	0.0	0.0	0.0	141.9	0.0	0.0	0.0	Ī
12	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	l
	(S3+S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1482.4	462.8	200.2	151.1	╁

er use represents users such as Iscor,Sappi,Sasol and other large industries outside the municipal areas. s represents water used in urban areas for light industries and parks but excludes domestic requirements

s represents domestic use and stock watering.

	TOTAL	IRRIG	LIVEST	AFFO	FISHE	ENERG	MINING	DISTR IRRIG	COLL	DISTRIB	SEWER	HOUSE	URBA	RURAI
	AGRICUL TURE	ATIO N AGRI CULT URE	OCK	REST ATIO N & ALIE N PLAN	RIES	Y	AND HEAVY INDUST RIES	IBUTI ATIO ON N OF WATE R	ECTI ON AND		AGE	HOLDS	REQU IREM ENTS	
			├ ₽	TS										
RAIN (S1)	A+B+C	A	В	С	D	Е	F	G	Н		I	J	K	L
TOTAL WATER ABSTRACTED (S2)														
()														
PERENNIAL SURFACE WATER														
- Water abstracted for own use														
of which for irrigation														
- Water abstracted for delivery														
GROUNDWATER														
- Water abstracted for own use														
of which for irrigation														
- Water abstracted for delivery														
WATER SUPPLIED TO OTHER SECTORS (S3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1402.3		0.0	205.8	155.3	0.0
of which: Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	205.8	155.3	0.0
WATER RETURNED (WATER DISCHARGED)(S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	145.9		472.6	0.0	0.0	0.0
- Irrigation water	11.4	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		361.1	0.0	0.0	0.0
· Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	145.7	0.0	0.0		111.4	0.0	0.0	0.0
- Losses/leakages	14.6	14.6	0.0	0.0	0.0	0.0	0.0	0.0	145.9		0.0	0.0	0.0	0.0
- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.
S3+S4)	26.0	26.0	0.0	0.0	0.0	0.0	145.7	0.0	1548.2		472.6	205.8	155.3	0.0

resents domestic use and stock watering.

Table 20 - Return flows for the Upper Vaal River Catchment area (1991-2000) in Mm^3)

Year	Return flows
1991	678,1
1992	689,4
1993	701,0
1994	712,9
1995	725,2
1996	737,4
1997	750,1
1998	763,0
1999	776,3
2000	790,0

Source: Statistics South Africa

Return flows from paved urban areas remained constant at 111,4 Mm³ between table 21 on page 26 and table 30 on page 35 despite the fact that the size of the paved areas in practice is steadily increasing. Table 20 (p.) indicates that return flows increase in relation to the level of water usage over the study period, 1991-2000.

3.2 Water use accounts: 1991 - 2000

This section contains the annual water use accounts for the Upper Vaal WMA from 1991 to 2000. The accounts are followed by a summary table with a short discussion.

se in the Upper Vaal Water Manager	nent A	rea fo	r 19	91 (mi	llions	of cu	ıbic m	etres)					
	L AGRI	IRRIGA TION AGRICU LTURE	TOCK	AFFORE STATIO N & ALIEN PLANTS	FISHERI ES		AND	DISTRIB IRRIC UTION ATIO OF N WATI R	CTION IBU AND ON	TI AGE	HOUSE HOLDS	URBAN REQUIR EMENT S	
	A+B +C	A	В	С	D	Е	F	G	Н	I	J	К	L
RAIN (U1)	30. 3	0.0	0.0	30.3	0.0	0.0	0.0	0.0	0.0	111.4	0.0	0.0	0.0
TOTAL WATER ABSTRACTED (U2)	150.7	113.8	36.9	0.0	0.0	67.5	173.3	0.0	1045.9	0.0	6.4	0.0	0.0
PERENNIAL SURFACE WATER	113.8	113.8	0.0	0.0	0.0	67.5	173.3	0.0	1042.2	0.0	0.0	0.0	0.0
- Water abstracted for own use	113.8	113.8	0.0	0.0	0.0	67.5	173.3	0.0	0.0	0.0	0.0	0.0	0.0
- of which for irrigation - Water abstracted for delivery	113.8 0.0	113.8 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 1042.2	0.0	0.0	0.0	0.0
GROUNDWATER	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	3.7	0.0	6.4	0.0	0.0
- Water abstracted for own use	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0
- of which for irrigation - Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0. 0 0. 0	0.0	0.0 3.7	0.0	0.0	0.0	0.0
WATER DELIVERED THROUGH MAINS (U3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	281.3	315.6	192.5	3.7
- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	281.3	0	0	0.0
WATER RETURNED (WATER DISCHARGED) (U4)													
- Irrigation water													
- Cooling water - Wastewater treated			-						1		1		_
- Wastewater treated				1							1		+
- Losses/leakages				1					1		1	1	1
- Other returns													1
(U1+U2+U3)	181.0	113.8	36.9	30.3	0.0	67.5	173.3	0.0	1045.9	392.7	322.0	192.5	3.7
	155.0	87.8	36.9	30.3	0.0	67.5	27.7	0.0	-6.0	0.0	161.8	71.5	3.7

 $use\ represents\ users\ such\ as\ Iscor, Sappi, Sasol\ and\ other\ large\ industries\ outside\ the\ municipal\ areas.$

epresents water used in urban areas for light industries and parks but excludes domestic requirements

presents domestic use and stock watering.

		TOTAL	IRRIG	LIVES	AFFO	FISHE	ENER	MINING	DIS IRRIG	COLLE	DISTR	SEWE	HOUSE	URBAN
			ATIO				GY	AND	TRI ATIO				HOLDS	REQUI
		TURE	N		ATIO			HEAVY		AND	ON			EMENI
			AGRI		N &				TIO WATE		OF			s
			CULT		ALIE			RIES	N R		WATE			
			URE		N				OF		R			
					PLAN TS									
1	RAIN (U1)	A+B+C 30.3	A 0.0	B 0.0	C 30.3	D 0.0	E 0.0	F 0.0	G 0.0	H 0.0		I 111.4	J 0.0	K 0.0
	KAIN (UI)	30.3	0.0	0.0	30.3	0.0	0.0	0.0	0.0	0.0		111.4	0.0	0.0
	TOTAL WATER ABSTRACTED (U2)	150.7	113.8	36.9	0.0	0.0	68.8	173.3	0.0	1093.6		0.0	6.3	0.0
	PERENNIAL SURFACE WATER	113.8	113.8	0.0	0.0	0.0	68.8	173.3	0.0	1089.9		0.0	0.0	0.0
2	- Water abstracted for own use	113.8	113.8	0.0	0.0	0.0	68.8	173.3	0.0	0.0		0.0	0.0	0.0
2.1	- of which for irrigation	113.8	113.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1089.9		0.0	0.0	0.0
	GROUNDWATER	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	3.7		0.0	6.3	0.0
4	- Water abstracted for own use	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	0.0		0.0	6.3	0.0
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7		0.0	0.0	0.0
6	WATER DELIVERED THROUGH MAINS (U3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		289.3	321.0	201.
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		289.3	0	0
	WATER RETURNED (WATER DISCHARGED) (U4)													
7	- Irrigation water													
8	- Cooling water													
9	- Wastewater treated													
10	- Wastewater untreated													
11	- Losses/leakages													
12	- Other returns													
	(U1+U2+U3)	181.0 155.0	113.8 87.8	36.9 36.9	30.3	0.0	68.8 68.8	173.3 27.7	0.0	1093.6 -4.0		400.8 0.0	327.3 162.5	201.0 76.5
					30.3	0.0	00.0	21.1	0.0	-4.0		0.0	102.5	70.5
er use	represents users such as Iscor, Sappi, Sasol and other large indus	tries outside the mu at excludes domest												

ıse i	n the Upper Vaal Water Management Area fo	or 1993	(millio	ons of	cubic	met	res)								
				OCK		FISHE RIES		AND HEAVY	DIS IRRIG TRI ATIO BU N TIO WATE N R OF	CTION AND	DISTR IBUTI ON OF WATE R	RAGE	EHOL DS		RE EN
		A+B+C	A	В	С	D	Е	F	G	Н		I	J	K	┖
1	RAIN (U1)	30.3	0.0	0.0	30.3	0.0	0.0	0.0	0.0	0.0		111.4	0.0	0.0	<u> </u>
	TOTAL WATER ABSTRACTED (U2)	150.7	113.8	36.9	0.0	0.0	70.1	173.3	0.0	1143.5		0.0	6.2	0.0	T
	PERENNIAL SURFACE WATER	113.8	113.8	0.0	0.0	0.0	70.1	173.3	0.0	1139.8		0.0	0.0	0.0	L
2	- Water abstracted for own use	113.8	113.8	0.0	0.0	0.0	70.1	173.3	0.0	0.0		0.0	0.0	0.0	L
2.1	- of which for irrigation	113.8	113.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	▙
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1139.8		0.0	0.0	0.0	-
	GROUNDWATER	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	3.7		0.0	6.2	0.0	
4	- Water abstracted for own use	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	0.0		0.0	6.2	0.0	
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7		0.0	0.0	0.0	-
6	WATER DELIVERED THROUGH MAINS (U3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		297.6	326.5	209.9	T
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		297.6	0	0	
	WATER RETURNED (WATER DISCHARGED) (U4)														
7	- Irrigation water														L
8	- Cooling water														
9	- Wastewater treated														
10	- Wastewater untreated														L
11	- Losses/leakages - Other returns														Ͱ
															H
	(U1+U2+U3)	181.0	113.8	36.9	30.3	0.0	70.1	173.3	0.0	1143.5		409.0	332.7	209.9	
		155.0	87.8	36.9	30.3	0.0	70.1	27.7	0.0	-2.4		0.0	163.2	81.9	

use represents users such as Iscor,Sappi,Sasol and other large industries outside the municipal areas. epresents water used in urban areas for light industries and parks but excludes domestic requirements epresents domestic use and stock watering.

use i	in the Upper Vaal Water Management Aı	rea for 1994													
		TOTAL AGRICUL TURE	IRRIG ATIO N AGRI CULT URE	LIVES TOCK	AFFO REST ATIO N & ALIE N PLAN TS	FISHE RIES	GY	AND HEAVY INDUST	DIS IRRIG TRI ATIO BU N TIO WATE N R OF	CTION AND	DISTROBUTE ON OF WATE R	RAGE	EHOL DS		L R IF
		A+B +C	A	В	C	D	E	F	G	Н		I	J	K	ł
1	RAIN (U1)	30.3	0.0	0.0	30.3	0.0	0.0	0.0	0.0	0.0		111.4	0.0	0.0	İ
	TOTAL WATER ABSTRACTED (U2)	150.7	113.8	36.9	0.0	0.0	71.4	173.3	0.0	1195.7		0.0	6.2	0.0	
	PERENNIAL SURFACE WATER	113.8	113.8	0.0	0.0	0.0	71.4	173.3	0.0	1192.0		0.0	0.0	0.0	l
2	- Water abstracted for own use	113.8	113.8	0.0	0.0	0.0	71.4	173.3	0.0	0.0		0.0	0.0	0.0	
3	- of which for irrigation - Water abstracted for delivery	113.8 0.0	113.8 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 1192.0		0.0	0.0	0.0	l
	GROUNDWATER	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	3.7		0.0	6.2	0.0	l
4	- Water abstracted for own use	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	0.0		0.0	6.2	0.0	
4.1 5	- of which for irrigation - Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 3.7		0.0	0.0	0.0	l
6	WATER DELIVERED THROUGH MAINS (U3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	306.1	332.1	219.2	+
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		306.1	0	0	l
	WATER RETURNED (WATER DISCHARGED) (U4)														ţ
7	- Irrigation water - Cooling water														Ħ
9	- Wastewater treated - Wastewater untreated														ļ
11 12	- Losses/leakages - Other returns														ŧ
	(U1+U2+U3)	181.0	113.8	36.9	30.3	0.0	71.4	173.3	0.0	1195.7		417.5	338.2	219.2	ļ
	ķ·/	155.0	87.8	36.9	30.3	0.0	71.4	27.7	0.0	-1.0		0.0	163.8		+

 $water\ use\ represents\ users\ such\ as\ Iscor, Sappi, Sasol\ and\ other\ large\ industries\ outside\ the\ municipal\ areas.$

ents represents water used in urban areas for light industries and parks but excludes domestic requirements

er use in the Upper Vaal Water Manageme	ent Area	for 1	995	(millio	ns of	f cub	ic met	tres)					
	TOTAL AGRICULT URE	IRRIG	LIVES	AFFORE	FISHE		MINING AND			GE		REQUIR E-	RURAL REQUI E- MENTS
	A+B+C	A	В	С	D	E	F	G	Н	I	J	K	L
1 RAIN (U1)	30.3	0.0	0.0	30.3	0.0	0.0	0.0	0.0	0.0	111.4	0.0	0.0	0.0
TOTAL WATER ABSTRACTED (U2)	150.7	113.8	36.9	0.0	0.0	72.8	173.3	0.0	1250.3	0.0	6.1	0.0	0.0
PERENNIAL SURFACE WATER	113.8	113.8	0.0	0.0	0.0	72.8	173.3	0.0	1246.6	0.0	0.0	0.0	0.0
2 - Water abstracted for own use 2.1 - of which for irrigation 3 - Water abstracted for delivery	113.8 113.8 0.0	113.8 113.8 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	72.8 0.0 0.0	173.3 0.0 0.0	0.0 0.0 0.0	0.0 0.0 1246.6	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0
GROUNDWATER	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	3.7	0.0	6.1	0.0	0.0
4 - Water abstracted for own use 4.1 - of which for irrigation 5 - Water abstracted for delivery	36.9 0.0 0.0	0.0 0.0 0.0	36.9 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 3.7	0.0 0.0 0.0	6.1 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0
6 WATER DELIVERED THROUGH MAINS (U3) 6.1 - of which: Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	314.9 314.9	337.7 0	228.9	3.7
WATER RETURNED (WATER DISCHARGED) (U4)													
7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated													
11 - Losses/leakages 12 - Other returns													
(U1+U2+U3)	181. 0 155. 0	113.8 87.8	36.9 36.9	30.3 30.3	0.0	72.8 72.8	173.3 27.7	0.0	125 0.3 -0.1	426.3 0.0	343.8 164.4	228.9 93.5	3.7 3.7

vater use represents users such as Iscor,Sappi,Sasol and other large industries outside the municipal areas. ents represents water used in urban areas for light industries and parks but excludes domestic requirements nts represents domestic use and stock watering.

		TOTAL			AFFORE		ENERG	MINING	DISTR IRRIG	COLLE DISTR	SEWER	HOUSE	URBA	R
		AGRICUL TURE	ATIO N AGRI CULT URE	TOCK	STATIO N & ALIEN PLANTS	RIES	Y	AND HEAVY INDUST RIES	IBUTI ATIO ON N OF WATE R	AND ON		HOLDS	N REQU IREM ENTS	11
		A+B+C	A	В	С	D	E	F	G	Н	I	J	K	t
1	RAIN (U1)	30.3	0.0	0.0	30.3	0.0	0.0	0.0	0.0	0.0	111.4	0.0	0.0	-
	TOTAL WATER ABSTRACTED (U2)	150.7	113.8	36.9	0.0	0.0	74.2	173.3	0.0	1304.9	0.0	6.0	0.0	t
	PERENNIAL SURFACE WATER	113.8	113.8	0.0	0.0	0.0	74.2	173.3	0.0	1301.2	0.0	0.0	0.0	L
2	- Water abstracted for own use	113.8	113.8	0.0	0.0	0.0	74.2	173.3	0.0	0.0	0.0	0.0	0.0	
2.1	- of which for irrigation	113.8	113.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Ī
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1301.2	0.0	0.0	0.0	l
	GROUNDWATER	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	3.7	0.0	6.0	0.0	L
4	- Water abstracted for own use	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.0	
6	WATER DELIVERED THROUGH MAINS (U3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	323.6	343.4	238.6	t
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	323.6	0	0	L
	WATER RETURNED (WATER DISCHARGED) (U4)													t
7	- Irrigation water													l
8	- Cooling water													
9	- Wastewater treated													
10	- Wastewater untreated													
11	- Losses/leakages													
12	- Other returns													Ł
	(U1 + U2 + U3)	181.0	113.8	36.9	30.3	0.0	74.2	173.3	0.0	1304.9	435.0	349.4	238.6	t
		155.0	87.8	36.9	30.3	0.0	74.2	27.7	0.0	0.8	0.0	165.0	99.5	

water use represents users such as Iscor, Sappi, Sasol and other large industries outside the municipal areas. ents represents water used in urban areas for light industries and parks but excludes domestic requirements

se i	n the Upper Vaal Water Management	Area for 1	.997 (r	nillion	s of o	cubio	: met	res)						
			IRRIGA TION AGRICU LTURE	LIVEST OCK	AFFO REST ATIO N & ALIE N PLAN TS		GY	AND	IBUT: ON		CTION AND	RAGE	EHOL	
		A+B+C	A	В	C	D	E	F	G		Н	I	J	K
1	RAIN (U1)	30.3	0.0	0.0	30.3	0.0	0.0	0.0	0.0		0.0	111.4	0.0	0.0
	TOTAL WATER ABSTRACTED (U2)	150.7	113.8	36.9	0.0	0.0	75.5	173.3	0.0		1361.9	0.0	5.9	0.0
	PERENNIAL SURFACE WATER	113.8	113.8	0.0	0.0	0.0	75.5	173.3	0.0		1358.2	0.0	0.0	0.0
2	- Water abstracted for own use	113.8	113.8	0.0	0.0	0.0	75.5	173.3	0.0		0.0	0.0	0.0	0.0
2.1	- of which for irrigation	113.8	113.8	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		1358.2	0.0	0.0	0.0
	GROUNDWATER	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0		3.7	0.0	5.9	0.0
4	- Water abstracted for own use	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0		0.0	0.0	5.9	0.0
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		3.7	0.0	0.0	0.0
6	WATER DELIVERED THROUGH MAINS (U3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	332.6	349.2	248.8
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	332.6	0	0
	WATER RETURNED (WATER DISCHARGED) (U4)													
7	- Irrigation water													
8	- Cooling water													
9	- Wastewater treated													
10	- Wastewater untreated													
11	- Losses/leakages													
12	- Other returns									-				
	(U1+U2+U3)	181.0	113.8	36.9	30.3	0.0	75.5	173.3	0.0		1361.9	444.0	355.1	248.8
	1	155.0	87.8	36.9	30.3	0.0	75.5	27.7	0.0		1.3	0.0	165.6	105.7

vater use represents users such as Iscor, Sappi, Sasol and other large industries outside the municipal areas. ents represents water used in urban areas for light industries and parks but excludes domestic requirements

TOTAL AGRIC TURE	IRRI	RRIGA	LIVES	AFFORE	FISHE		MINING	DIS IRRIG	COLLE	DISTR		HOUS	URBAN
1 RAIN (U1) 30.30.30.30.30.30.30.30.30.30.30.30.30.3	L TION		TOCK	STATIO N & ALIEN PLANTS	RIES	ENER	AND HEAVY INDUST	TRI ATIO	CTION I AND	IBUTI	SEWE RAGE	EHOL	
1 RAIN (U1) 30. TOTAL WATER ABSTRACTED (U2) 150. PERENNIAL SURFACE WATER 113. 2 - Water abstracted for own use 113. 3 - Water abstracted for delivery 0.6 GROUNDWATER 36. 4 - Water abstracted for own use 36. 4 - Water abstracted for own use 36. 5 - Water abstracted for delivery 0.6 WATER DELIVERED THROUGH MAINS (U3) 0.6 6 - WATER RETURNED (WATER DISCHARGED) (U4) WATER RETURNED (WATER DISCHARGED) (U4) 7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages	C	A	В	C	D	Е	F	OF G	H	R	ī	J	К
PERENNIAL SURFACE WATER 113.	_	0.0	0.0	30.3	0.0	0.0	0.0	0.0	0.0		111.4	0.0	0.0
2 - Water abstracted for own use 113. 2.1 - of which for irrigation 113. 3 - Water abstracted for delivery 0.6 GROUNDWATER 36. 4 - Water abstracted for own use 36. 4.1 - of which for irrigation 0.6 5 - Water abstracted for delivery 0.6 6 WATER DELIVERED THROUGH MAINS (U3) 0.6 6.1 - of which : Wastewater 0.6 WATER RETURNED (WATER DISCHARGED) (U4) 7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages	113	113.8	36.9	0.0	0.0	77.0	173.3	0.0	1421.3		0.0	5.8	0.0
2.1 - of which for irrigation 113. 3 - Water abstracted for delivery 0.0 GROUNDWATER 36. 4 - Water abstracted for own use 36. 4.1 - of which for irrigation 0.0 5 - Water abstracted for delivery 0.0 6 WATER DELIVERED THROUGH MAINS (U3) 0.0 6.1 - of which: Wastewater 0.0 WATER RETURNED (WATER DISCHARGED) (U4) 0.0 7 - Irrigation water 0.0 8 - Cooling water 0.0 9 - Wastewater treated 0.0 10 - Wastewater untreated 0.0 11 - Losses/leakages 0.0	113	113.8	0.0	0.0	0.0	77.0	173.3	0.0	1417.6		0.0	0.0	0.0
3 - Water abstracted for delivery 0.0 GROUNDWATER 36.1 4 - Water abstracted for own use 36.1 4.1 - of which for irrigation 0.0 5 - Water abstracted for delivery 0.0 6 WATER DELIVERED THROUGH MAINS (U3) 0.0 6.1 - of which: Wastewater 0.0 WATER RETURNED (WATER DISCHARGED) (U4) 7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages		113.8	0.0	0.0	0.0	77.0	173.3	0.0	0.0		0.0	0.0	0.0
4 - Water abstracted for own use 36.1 4.1 - of which for irrigation 0.6 5 - Water abstracted for delivery 0.6 6 WATER DELIVERED THROUGH MAINS (U3) 0.6 6.1 - of which: Wastewater 0.6 WATER RETURNED (WATER DISCHARGED) (U4) 7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages		113.8 0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 1417.6		0.0	0.0	0.0
4.1 - of which for irrigation 0.0 5 - Water abstracted for delivery 0.0 6 WATER DELIVERED THROUGH MAINS (U3) 0.0 6.1 - of which: Wastewater 0.0 WATER RETURNED (WATER DISCHARGED) (U4) 7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages	0.	0.0	36.9	0.0	0.0	0.0	0.0	0.0	3.7		0.0	5.8	0.0
5 - Water abstracted for delivery 0.0 6 WATER DELIVERED THROUGH MAINS (U3) 0.0 6.1 - of which : Wastewater 0.0 WATER RETURNED (WATER DISCHARGED) (U4) 7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages		0.0	36.9	0.0	0.0	0.0	0.0	0.0	0.0		0.0	5.8	0.0
6.1 - of which: Wastewater 0.0 WATER RETURNED (WATER DISCHARGED) (U4) 7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages		0.0	0.0	0. 0	0.0	0.0	0.0	0.0	0.0 3.7		0.0	0.0	0.0
WATER RETURNED (WATER DISCHARGED) (U4) 7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages	0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		341.9	355.1	259.3
7 - Irrigation water 8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages	0.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		341.9	0	0
8 - Cooling water 9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages													
9 - Wastewater treated 10 - Wastewater untreated 11 - Losses/leakages													
10 - Wastewater untreated 11 - Losses/leakages													
U U													1
12 - Other returns													
(U1+U2+U3) 181.	113	113.8	36.9	30.3	0.0	77.0	173.3	0.0	1421.3		453.3	360.9	259.3

water use represents users such as Iscor,Sappi,Sasol and other large industries outside the municipal areas. ents represents water used in urban areas for light industries and parks but excludes domestic requirements

se 1	n the Upper Vaal Water Managemen														
			IRRIGA	LIVES	AFFO	FISH	ENER			IG COLLE	DISTRS	EWE	HOUS	URBAN	
		AGRICUL			REST	ERIES	GY		IBUTI ATI		IBUTI R		EHOL	REQUIF	
		TURE	AGRICU LTURE		ATIO N &			HEAVY INDUST		AND	ON OF		DS	EMENT	R
			LIUKE		N & ALIE			RIES	Or WA	1 E	WATE			٦	E
					N			KILAS			R				
					PLAN										
					TS										ı
		A+B+C	A	В	С	D	Е	F	G	Н		I	J	K	t
1	RAIN (U1)	30.3	0.0	0.0	30.3	0.0	0.0	0.0	0.0	0.0		111.4	0.0	0.0	Ţ
		150.5	442.0	260			7 0.1	450.0		4 402 4				0.0	4
	TOTAL WATER ABSTRACTED (U2)	150.7	113.8	36.9	0.0	0.0	78.4	173.3	0.0	1483.4		0.0	5.7	0.0	+
	PERENNIAL SURFACE WATER	113.8	113.8	0.0	0.0	0.0	78.4	173.3	0.0	1479.7		0.0	0.0	0.0	1
2	- Water abstracted for own use	113.8	113.8	0.0	0.0	0.0	78.4	173.3	0.0	0.0		0.0	0.0	0.0	+
2.1	- of which for irrigation	113.8	113.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	t
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1479.7		0.0	0.0	0.0	1
	GROUNDWATER	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	3.7		0.0	5.7	0.0	1
4	- Water abstracted for own use	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	0.0		0.0	5.7	0.0	+
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	1
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7		0.0	0.0	0.0	1
6	WATER DELIVERED THROUGH MAINS (U3)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		351.4	361.0	270.3	+
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		351.4	0	0	1
	WATER RETURNED (WATER DISCHARGED) (U4)														$^{+}$
7	T : (*														1
8	- Irrigation water - Cooling water														+
9	- Wastewater treated							1							+
10	- Wastewater treated						1	1							+
11	- Vastewater untreated - Losses/leakages							1							+
12	- Other returns														+
															1
	(U1+U2+U3)	181.0	113.8	36.9	30.3	0.0	78.4	173.3	0.0	1483.4		462.8	366.8	270.3	Ī
		155.0	87.8	36.9	30.3	0.0	78.4	27.7	0.0	1.0		0.0	166.6	119.2	T

vater use represents users such as Iscor, Sappi, Sasol and other large industries outside the municipal areas. ents represents water used in urban areas for light industries and parks but excludes domestic requirements nts represents domestic use and stock watering.

ıse	in the Upper Vaal Water Manageme	nt Area	for 20	00 (r	nillio	ns of	f cub	ic met	res)					
		TOTAL AGRICUL- TURE	IRRIGA TION AGRICU L-TURE	TOCK			ENER	AND HEAVY INDUST	OF N WATE	CTION IBUTI AND ON OF	SEWER AGE		URBAN REQUIR E- MENTS	REQUIE
					& ALIE N PLAN TS			RIES	R	WATE R				
		A+B+C	A	В	С	D	Е	F	G	Н	I	J	K	L
1	RAIN (U1)	30.3	0.0	0.0	30.3	0.0	0.0	0.0	0.0	0.0	111.4	0.0	0.0	0.0
_	TOTAL WATER ABSTRACTED (U2)	150.7	113.8	36.9	0.0	0.0	79.9	173.3	0.0	1548.2	0.0	5.7	0.0	0.0
	PERENNIAL SURFACE WATER	113.8	113.8	0.0	0.0	0.0	79.9	173.3	0.0	1544.5	0.0	0.0	0.0	0.0
2.1	- Water abstracted for own use - of which for irrigation	113.8 113.8	113.8 113.8	0.0	0.0	0.0	79.9	173.3	0.0 0.0 0.0	0.0	0.0	0.0	0.0	0.0 0.0 0.0
3	- Water abstracted for delivery GROUNDWATER	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	3.7	0.0	5.7	0.0	0.0
4	- Water abstracted for own use	36.9	0.0	36.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0
5	- of which for irrigation - Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 3.7	0.0	0.0	0.0	0.0
6.1	WATER DELIVERED THROUGH MAINS (U3) - of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	361.1 361.1	367.1 0	281.8	3.7 0.0
	WATER RETURNED (WATER DISCHARGED) (U4)													
7 8 9	- Irrigation water - Cooling water - Wastewater treated													
10 11	- Wastewater untreated - Losses/leakages													
12	- Other returns													
	(U1+U2+U3)	181. 0 155. 0	113.8 87.8	36.9 36.9	30.3 30.3	0.0	79.9 79.9	173.3 27.7	0.0	1548.2 0.0	472.6 0.0	372.8 167.0	281.8 126.5	3.7 3.7

use represents users such as Iscor,Sappi,Sasol and other large industries outside the municipal areas. epresents water used in urban areas for light industries and parks but excludes domestic requirements presents domestic use and stock watering.

3.2.1 Surface water use

Table 31 provides a summary of the water use tables for the Vaal River Catchment area from 1991 to 2000.

Table 31 – Surface water use and transfers out 1991-2000 (million cubic metres)

Year	Agriculture	Energy	Mining & Heavy Industry	Urban: Domestic	Urban: Other	Transfers out: Crocodile	Transfers out: Other	Ecological	Total
1991	150.7	67.5	173.3	315.6	192.5	426.4	578.7	299.5	2 204.2
1992	150.7	68.8	173.3	321.0	201.0	455.0	629.6	299.5	2 298.9
1993	150.7	70.1	173.3	326.5	209.9	485.5	697.6	299.5	2 413.1
1994	150.7	71.4	173.3	332.1	219.2	518.1	646.4	299.5	2 228.7
1995	150.7	72.8	173.3	337.7	228.9	552.8	929.6	299.5	2 745.3
1996	150.7	74.2	173.3	343.4	238.6	587.5	777.1	299.5	2 644.3
1997	150.7	75.5	173.3	349.2	248.8	624.5	668.8	299.5	2 590.3
1998	150.7	77.0	173.3	355.1	259.3	663.7	834.5	299.5	2 813.1
1999	150.7	78.4	173.3	361.0	270.3	705.4	953.1	299.5	2 991.7
2000	150.7	79.9	173.3	367.1	281.8	749.7	801.7	299.5	2 903.7

Source: Statistics South Africa

It is important to note that the Upper Vaal WMA is managed as an integrated unit by the DWAF. The water supply to this WMA is also linked to the Tugela Pump System and the Lesotho Highlands Water Scheme. This WMA not only delivers water to its specific area but also delivers large amounts of water to the Crocodile WMA and the Lower Vaal WMA.

The amount of water used by the Agricultural sector remained the same between 1991 and 2000 as indicated in table 31 because no new irrigation schemes were allowed by DWAF over this period. Also no new afforestation was issued permits in the WMA.

Although there seems to be a small growth in the energy sector, indications are that no new electricity generation plants are to be constructed in this WMA.

The volume of water transferred in the Upper Vaal River to the Middle Vaal WMA (Transfers out) depends on the rainfall during the rain season and the volume available in the Bloemhof dam. This volume therefore appears to be very erratic.

If the sporadic transfers to the Lower Vaal WMA are ignored, the total use of water showed a steady growth over the 10 year period from 1625,5 Mm³ in 1991 to 2102 Mm³ in 2000 (table 31, p.), an increase of 29,3 % which represents an average annual growth rate of 2,9 %.

3.2.2 Groundwater use

Groundwater is mostly used by rural communities for domestic use and for animal drinking. Data is not readily available but it is generally accepted that the use of groundwater is not really expanding because the livestock sub-sector is not expanding and rural farm populations are decreasing

Table 32 - Average groundwater use (millions of cubic metres)

Year	Rural Domestic	Rural Livestock	Rural Households	Total
1991-2000	5,7	36,9	3,7	46,3

Source: Statistics South Africa

Note: Rural Households represents a groundwater scheme in the Zuurbekom area delivering groundwater to a semi rural area.

3.3 Water asset accounts: 1991-2000

This section contains the annual asset accounts for the Upper Vaal WMA for the relevant 10-year period. A summary table with a short discussion follows these accounts.

		SURFACE WATER				
		DAMS AND OTHER INTERMEDIATE STORAGE CAPACITY	TOTAL RIVER	PERENNIAL RIVER	EPHEMERAL RIVER	GROUNE
		A	B + C	В	C	Ι
CK [AS AT 1st OCT	OBER 1990]	4819.34	0			296
N	Sustainable use of which Crocodile WMA transfer Depletion of groundwater stocks	1396.8 541.0	0			47
RN FLOWS	(+)	549.8	0	0.0	0.0	0.
WS / RESIDUALS	Irrigation water Cooling water Wastewater treated Wastewater untreated Other returns	11.4 0.0 281.3 257.1 0.0	0 0 0 0			
ON (ANNUAL RUN	OFF) (+)	1345.2	0			47
SFERS IN	(+)	468.5	0.0	0.0	0.0	0.
N	Tugela - SterkfonteinUsuthuLesotho Highlands	351.7 116.8				
L TRANSFERS	(+ \-)					
PIRATION (-)		409.0	0.0			
SFERS OUT	(-)	878.2	0	0	0	,
)UT	Olifants Crocodile (included in abstraction) Middle Vaal Flood release Ecological Reserve	35.7 543.0 0.0 299.5				
ME CHANGE	(+)	709.7	0	0	0	,
ME CHANGES	Due to natural disaster Discovery Others	709.7				
CK [as at 30 Septemb	er 1991]	4667.5	0.0	0.0	0.0	29

		SURFACE WATER				
		DAMS AND OTHER INTERMEDIATE STORAGE CAPACITY	TOTAL RIVER	PERENNIAL RIVER	EPHEMERAL RIVER	GROUND
		A	B + C	В	С	D
K [AS AT 1st C	OCTOBER 1991]	4667.49	0			296
	Sustainable use (-) : of which Crocodile WMA transfer Depletion of groundwater stocks	1445.8 561.4	0			46.
FLOWS	(+)	557.8	0	0.0	0.0	0.
3 / RESIDUALS	Irrigation water Cooling water Wastewater treated Wastewater untreated Other returns	11.4 0.0 289.3 257.1 0.0	0 0 0 0			
(ANNUAL R	UN OFF) (+)	326.6	0			46.
ERS IN	(+) - Tugela - Sterkfontein - Usuthu - Lesotho Highlands	432.7 315.9 116.8	0.0	0.0	0.0	0.
ΓRANSFERS	(+\-)					
RATION (-)		409.1	0.0			
ERS OUT	(-) - Olifants - Crocodile (included in abstraction) - Middle Vaal - Flood release - Ecological Reserve	929.1 35.7 593.9 0.0 299.5	0	0	0	0
E CHANGE	(+)	699	0	0	0	0
E CHANGES	Due to natural disaster Discovery Others	699				
	ember 1992]	3338.2	0.0	0.0	0.0	296

		SURFACE WATER				
		DAMS AND OTHER INTERMEDIATE STORAGE CAPACITY	TOTAL RIVER	PERENNIAL RIVER	EPHEMERAL RIVER	GROUN
		A	B + C	В	C	
K [AS AT 1st OCTOBER 1992]		3338.22	0			25
	Sustainable use (-) : of which Crocodile WMA transfer Depletion of groundwater stocks	1497. 0 582. 6	0			4
FLOWS	(+)	566.1	0	0.0	0.0	0
7 RESIDUALS	Irrigation water Cooling water Wastewater treated Wastewater untreated Other returns	11. 4 0. 0 297. 6 257. 1 0. 0	0 0 0 0			
I (ANNUAL RUN OFF) (+)		688.1	0			4
ERS IN	(+) - Tugela - Sterkfontein - Usuthu	638.9 522.1 116.8	0.0	0.0	0.0	0
	- Lesotho Highlands					
ΓRANSFERS	(+\-)					
RATION (-)	1	409.1	0.0			
ERS OUT	(-)	997.1	0	0	0	
Т	Olifants Crocodile (included in abstraction) Middle Vaal Flood release Ecological Reserve	35.7 661.9 0.0 299.5				
E CHANGE	(+)	741.6	0	0	0	
E CHANGES	Due to natural disaster Discovery Others	741.6				
K [as at 30 Septem	her 1993]	2487.1	0.0	0.0	0.0	29

		SURFACE WATER				
		DAMS AND OTHER INTERMEDIATE STORAGE CAPACITY	TOTAL RIVER	PERENNIAL RIVER	EPHEMERAL RIVER	GROUN
		A	B + C	В	C	
AS AT 1st OCTO	OBER 1993]	2487.03	0			2
	Sustainable use (-) : of which Crocodile WMA transfer Depletion of groundwater stocks	1550.5 604.5	0			4
LOWS	(+)	574.6	0	0.0	0.0	
RESIDUALS	Irrigation water Cooling water Wastewater treated Wastewater untreated Other returns	11.4 0.0 306.1 257.1 0.0	0 0 0 0			
ANNUAL RUN (OFF) (+)	2220.6	0			
RS IN	(+) - Tugela - Sterkfontein - Usuthu - Lesotho Highlands	634.0 517.2 116.8	0.0	0.0	0.0	
ANSFERS	(+\-)					
ATION (-)	<u> </u>	409.2	0.0			
is out	Olifants Crocodile (included in abstraction) Middle Vaal Flood release Ecological Reserve	763.8 35.7 428.7 0.0 299.5	0	0	0	
CHANGE	(+)	826.3	0	0	0	
CHANGES	Due to natural disaster Discovery Others	826.3				
as at 30 September	er 1994l	3414.5	0.0	0.0	0.0	

	water resources in the Upper	SURFACE WATER				
		DAMS AND OTHER INTERMEDIATE STORAGE CAPACITY	TOTAL RIVER	PERENNIAL RIVER	EPHEMERAL RIVER	GROUND
		A	B + C	В	C	D
K [AS AT 1st OC	TOBER 1994]	3414.49	0			296
	Sustainable use : of which Crocodile WMA transfer Depletion of groundwater stocks	1606.5 627.3	0			46.7
FLOWS	(+)	583.3	0	0.0	0.0	0.0
3 / RESIDUALS	Irrigation water Cooling water Wastewater treated Wastewater untreated Other returns	11.4 0.0 314.9 257.1 0.0	0 0 0 0			
(ANNUAL RUN	NOFF) (+)	662. 6	0			46.3
ERS IN	(+)	630.0	0.0	0.0	0.0	0.0
	Tugela - SterkfonteinUsuthuLesotho Highlands	513.2 116.8				
FRANSFERS	(+\-)					
RATION	(-)	409.2	0.0			
ERS OUT	(-)	1229.1	0	0	0	0
Т	 Olifants Crocodile (included in abstraction) Middle Vaal Flood release Ecological Reserve 	35.7 893.9 0.0 299.5				
E CHANGE	(+)	788. 4	0	0	0	0
E CHANGES	Due to natural disaster Discovery Others	788.4				
K [as at 30 September 1995]		2206.7	0.0	0.0	0.0	296.

		SURFACE WATER				
		DAMS AND OTHER INTERMEDIATE STORAGE CAPACITY	TOTAL RIVER	PERENNIAL RIVER	EPHEMERAL RIVER	GROUN
		A	B + C	В	C	
AS AT 1st OCT	OBER 1995]	2206.73	0			29
	Sustainable use (-) : of which Crocodile WMA transfer Depletion of groundwater stocks	1662.4 650.1	0			4
Lows	(+)	592.1	0	0.0	0.0	0
RESIDUALS	Irrigation water Cooling water Wastewater treated Wastewater untreated Other returns	11.4 0.0 323.6 257.1 0.0	0 0 0 0			
ANNUAL RUN	OFF) (+)	9423.1	0			4
S IN	(+)	646.6	0.0	0.0	0.0	0
	Tugela - SterkfonteinUsuthuLesotho Highlands	529.8 116.8				
ANSFERS	(+\-)					
ATION	(-)	409.2	0.0			
S OUT	(-)	657 5.4	0	0	0	
	Olifants Crocodile (included in abstraction) Middle Vaal Flood release Ecological Reserve	35.7 741.4 5498.8 299.5				
CHANGE	(+)	928.6	0	0	0	
CHANGES	Due to natural disaster Discovery Others	928.6				
as at 30 Septemb	er 1996	4500.0	0.0	0.0	0.0	29

	r water resources in the Uppe	SURFACE WATER				
		DAMS AND OTHER INTERMEDIATE STORAGE CAPACITY	TOTAL RIVER	PERENNIAL RIVER	EPHEMERAL RIVER	GROUNDV
		A	B + C	В	C	D
AS AT 1st OCT	OBER 1996]	4499.98	0			296.
	Sustainable use (-) : of which Crocodile WMA transfer Depletion of groundwater stocks	1720.8 673.7	0			46.5
LOWS	(+)	601.1	0	0.0	0.0	0.0
RESIDUALS	Irrigation water Cooling water Wastewater treated Wastewater untreated Other returns	11.4 0.0 332.6 257.1 0.0	0 0 0 0			
ANNUAL RUN OFF) (+)		5009.5	0			46.5
RS IN	(+)	646.4	0.0	0.0	0.0	0.0
	Tugela - SterkfonteinUsuthuLesotho Highlands	529.6 116.8				
ANSFERS	(+\-)					
TION	(-)	409.3	0.0			
S OUT	(-)	3523.7	0	0	0	0
	Olifants Crocodile (included in abstraction) Middle Vaal Flood release Ecological Reserve	35.7 633.1 2555.4 299.5				
CHANGE	(+)	913.4	0	0	0	0
CHANGES	Due to natural disaster Discovery Others	913.4				
as at 30 Septemb	er 1997]	5342.8	0.0	0.0	0.0	296.

		SURFACE WATER				
		DAMS AND OTHER INTERMEDIATE STORAGE CAPACITY	TOTAL RIVER	PERENNIAL RIVER	EPHEMERAL RIVER	GROUNDW
		A	B + C	В	C	D
K [AS AT 1st OC	TOBER 1997]	5342.82	0			296.7
	Sustainable use (-) : of which Crocodile WMA transfer Depletion of groundwater stocks	1781.7 698.1	0			46.4
FLOWS	(+)	610.3	0	0.0	0.0	0.0
7 / RESIDUALS	Irrigation water Cooling water Wastewater treated Wastewater untreated Other returns	11. 4 0. 0 341. 9 257. 1 0. 0	0 0 0 0			
(ANNUAL RU	NOFF) (+)	2871.6	0			46.4
ERS IN	(+) - Tugela - Sterkfontein - Usuthu - Lesotho Highlands	798.0 411.2 116.8 270.0	0.0	0.0	0.0	0.0
TRANSFERS	(+\-)					
RATION	(-)	409.3	0.0			
ERS OUT	(-)	2401.4	0	0	0	0
Т	Olifants Crocodile (included in abstraction) Middle Vaal Flood release Ecological Reserve	35.7 798.8 1267.4 299.5				
E CHANGE	(+)	636.7	0	0	0	0
E CHANGES	Due to natural disaster Discovery Others	636.7				
K [as at 30 Septen	hon 10001	4968.9	0.0	0.0	0.0	296.7

STORAGE CAPACITY			SURFACE WATER				
S AS AT 1st OCTOBER 1998				TOTAL RIVER	PERENNIAL RIVER	EPHEMERAL RIVER	GROUNDV
Sustainable use (-) 1845.2 0 3				B + C	В	C	D
Solution Constraint Const	K [AS AT 1st OC	TOBER 1998] (+)	4968.87	0			296.
S RESIDUALS Irrigation water 11.4 0 0 0 0		: of which Crocodile WMA transfer		0			46.4
Cooling water 0.0 0 0 0 0 0 0 0 0	FLOWS	(+)	619.8	0	0.0	0.0	0.0
Tugela - Sterkfontein	7 RESIDUALS	Cooling water Wastewater treated Wastewater untreated	0. 0 351. 4 257. 1	0 0 0			
- Tugela - Sterkfontein	(ANNUAL RUN OFF) (+)		2447.5	0			46.4
- Usuthu	ERS IN			0.0	0.0	0.0	0.0
RATION (-) 409.4 0.0		- Usuthu	116.8				
ERS OUT (-) 1300.4 0 0 0 T - Olifants	ΓRANSFERS	(+\-)					
T - Olifants - Crocodile (included in abstraction) - Middle Vaal - Flood release - 83.4 - Ecological Reserve 299.5 E CHANGE (+) 347.8 0 0 0 E CHANGES Due to natural disaster Discovery Others 347.8	RATION	(-)	409.4	0.0			
- Crocodile (included in abstraction) - Middle Vaal - Flood release - Ecological Reserve E CHANGE Due to natural disaster Discovery Others 347.8	ERS OUT	(-)	1300.4	0	0	0	0
E CHANGES Due to natural disaster Discovery Others 347.8	Т	 Crocodile (included in abstraction) Middle Vaal Flood release 	881.7 83.4				
Discovery Others 347.8	E CHANGE	(+)	347.8	0	0	0	0
V [ag at 30 Santamban 1000] 4955 0 0.0 0.0 0.0 0.0	E CHANGES	Discovery	347.8				
	Z for at 30 Sert	han 1000l	4855.9	0.0	0.0	0.0	296.

K [AS AT 1st OCT	Sustainable use (-) : of which Crocodile WMA transfer Depletion of groundwater stocks (+) Irrigation water Cooling water	DAMS AND OTHER INTERMEDIATE STORAGE CAPACITY A 4855.91 1911.5 749.7	TOTAL RIVER B + C 0 0	PERENNIAL RIVER B	EPHEMERAL RIVER C	D 296.7
FLOWS	Sustainable use (-) : of which Crocodile WMA transfer Depletion of groundwater stocks (+) Irrigation water Cooling water	4855.91 1911.5 749.7 629.6	0	В	С	296.7
FLOWS	Sustainable use (-) : of which Crocodile WMA transfer Depletion of groundwater stocks (+) Irrigation water Cooling water	1911.5 749.7 629.6	0			
	: of which Crocodile WMA transfer Depletion of groundwater stocks (+) Irrigation water Cooling water	749.7 629.6				46.3
	Irrigation water Cooling water		0			
3 / RESIDUALS	Cooling Water		ı ,	0.0	0.0	0.0
	Wastewater treated Wastewater untreated Other returns	11.4 0.0 361.1 257.1 0.0	0 0 0 0 0			
I (ANNUAL RUN	NOFF) (+)	5865.5	0			46.3
ERS IN	(+) - Tugela - Sterkfontein	835.0 118.2	0.0	0.0	0.0	0.0
	- Usuthu - Lesotho Highlands	116.8 600.0				
FRANSFERS	(+\-)					
RATION	(-)	409. 4	0.0			
ERS OUT	(-)	3951.4	0	0	0	0
Т	Olifants Crocodile (included in abstraction) Middle Vaal Flood release	35.7 766.0 2850.2				
	- Ecological Reserve	299.5				
E CHANGE	(+)	408	0	0	0	0
E CHANGES	Due to natural disaster					
	Discovery Others	408				
K [as at 30 Septem]	l ber 2000]	5572.1	0.0	0.0	0.0	296.7

The storage capacity in the Upper Vaal WMA consists of the following dams:

<u>Name</u>	Full capacity (Millions of cubic metres)
Vaal	2603,4
Grootdraai	354,7
Sterkfontein	2616,9
Barrage	47,0
Smalldams	<u>183,5</u>
Total capacity	<u>5805,5</u>

Outside the WMA, the following dams act as storage dams for various water augmentation schemes that supplement supply in the Upper Vaal WMA:

Lesotho Highlands Water Scheme

<u>Name</u>	Full capacity (Millions of cubic metres)
Katse	1950
Mohale	<u>938</u>
Total	<u>2888</u>

Tugela

<u>Name</u>	Full capacity (Millions of cubic metres)
Woodstock	380,8
Killburn	35,7
Driel Barrage	10,3
Zaaihoek	193,0
Total	<u>619,8</u>

It was decided to use only the volumes of the dams in the Upper Vaal WMA itself for the asset account because of the following:

- Dam levels are available on a daily basis.
- Water from dams outside the Upper Vaal WMA is not only used in the WMA.
- Water from the Katse and Mohale dams is also used to supplement water in the Orange River if necessary.

Table 43 represents the Dam levels in the Upper Vaal WMA from 1990 to 2000.

Table 43 - Dam levels (Hydrology year is from 1 October to 30 September)

	Date	Vaaldam	Grootdraai	Sterkfontein	Barrage	Smalldams	Total stock	Percentage of
								full capacity
Opening stock	1/10/90	2145.89	300.64	2173.48	47	152.33	4819.3	83.01 %
Closing stock	30/9/91	1748.47	280.39	2444.09	47	147.54	4667.4	80.40 %
Opening stock	1/10/91	1748.47	280.39	2444.09	47	147.54	4667.4	80.40 %
Closing stock	30/9/92	440.18	178.82	2566.69	47	105.53	3338.2	57.50 %
Opening stock	1/10/92	440.18	178.82	2566.69	47	105.53	3338.2	57.50 %
Closing stock	30/9/93	458.41	201.78	1701.21	47	78.63	2487.0	42.84 %
Opening stock	1/10/93	458.41	201.78	1701.21	47	78.63	2487.0	42.84 %
Closing stock	30/9/94	824.54	323.14	2111.87	47	107.94	3414.4	58.81 %
Opening stock	1/10/94	824.54	323.14	2111.87	47	107.94	3414.4	58.81 %
Closing stock	30/9/95	365.09	321.24	1403.63	47	69.77	2206.7	38.01 %
Opening stock	1/10/95	365.09	321.24	1403.63	47	69.77	2206.7	38.01 %
Closing stock	30/9/96	2405.04	319.99	1585.71	47	142.24	4499.9	77.51 %
Opening stock	1/10/96	2405.04	319.99	1585.71	47	142.24	4499.9	77.51 %
Closing stock	30/9/97	2738.6	354.9	2033.44	47	168.88	5342.8	92.03 %
Opening stock	1/10/97	2738.6	354.9	2033.44	47	168.88	5342.8	92.03 %
Closing stock	30/9/98	2105.57	295.74	2363.5	47	157.06	4968.8	85.59 %
Opening stock	1/10/98	2105.57	295.74	2363.5	47	157.06	4968.8	85.59 %
Closing stock	30/9/99	2064	275.71	2315.71	47	153.09	4855.9	83.64 %
Opening stock	1/10/99	2064	275.71	2315.71	47	153.49	4855.9	83.64 %
Closing stock	30/9/00	2668.41	329.63	2350.93	47	176.12	5572.0	95.98 %

Source: Statistics South Africa

The following table 44 on page 50 represents the annual runoff, mean annual runoff, transfers in and return flows to provide annual supply without taking into consideration dams' stocks over the relevant 10 year period.

Table 44 - Water supply 1991-2000 (millions cubic metres)

Year	Annual	Mean annul	Transfers in	Return flow	Annual
	runoff	runoff			supply
1991	1580.5	2422.7	463.5	549.8	2593.8
1992	565.7	2422.7	427.7	557.8	1551.2
1993	1046.5	2422.7	633.9	566.1	2246.5
1994	2571.8	2422.7	629	574.6	3775.4
1995	966	2422.7	625	583.3	4597
1996	9558.9	2422.7	641.6	592.1	10792.6
1997	5261.2	2422.7	641.4	601.1	6503.7
1998	3124.6	2422.7	793	610.3	4527.9
1999	2701.4	2422.7	745.3	619.8	4066.5
2000	6119.9	2422.7	830	629.6	7579.2

Source: Statistics South Africa

The following should be noted about data in table 44.

- <u>Annual Runoff</u>: Water Research Commission Report: No. 298/1/94 Surface Water Resources of South Africa 1990, provides runoff data for the period 1920-1989. There is at present an ongoing project to update the official data to 2000. The data used here were calculated using direct and indirect data received from DWAF Hydrology Unit. The updated official data is expected to be available in 2003.
- <u>Mean Annual Runoff</u>: The 70 year Mean Annual Runoff for the Upper Vaal WMA is 2422,7 x 10⁶m³ while the average for this 10 year period is 3349,6 x 10⁶m³, which means the rainfall was higher than average. In the first 5 years of the study period the runoff was below average with the last five years being very wet.

4. Monetary water accounts

This section utilizes the physical water accounts previously discussed to derive a set of monetary accounts relating to water. The economic benefits that arise from the usage of water from the Upper Vaal WMA, as well as the delivery costs, tariffs and consequent subsidies/overrecoveries pertaining to this usage, will be discussed.

The main intention in this section is to supply as much data as possible concerning the following:

- Contribution to value added of water used per sector in the Upper Vaal WMA (1991-2000).
- Contribution to employment of water used per sector in the Upper Vaal WMA (1991-2000).
- Delivery costs of water used per sector in the Upper Vaal WMA (1991-2000).
- Revenue from water tariffs per sector in the Upper Vaal WMA (1991-2000).
- Subsidies and overrecoveries of water used per sector in the Upper Vaal WMA (2000).

Cognisance should be taken of the fact that reliable delivery costs and tariffs are only available for the year 2000. The true nature and magnitude of subsidies/overrecoveries for the Upper Vaal WMA were only determined for a single year. For the other years no reliable tariffs and delivery costs are available hence subsidies/overrecoveries were not calculated to avoid a misrepresentation of the water pricing policy.

4.1 Economic benefits

The construction of water resource accounts in physical units for the Upper Vaal WMA lends itself to determining the economic benefits arising from the water usage in this particular WMA. These benefits are measured in terms of –

- Value added
- Employment

In a water-scarce country, the provision of water must always be considered in terms of the socio-economic benefits that a specific water user contributes. Value added indicates the magnitude of economic activities that result from water use and is also an important indicator of incomes generated. On the other hand, employment opportunities provide an indicator of the level of participation in the economy.

4.1.1 Value added

The contribution of each use sector to value added, on an annual basis from 1991 to 2000, is provided in table 45 on page 52 to table 54 on page 61.

Value added is one approach to derive Gross Domestic Product. It is a method which entails summing the values added at each stage of the production process and successive values added to the original raw material in different stages of production.

		sed per	IRRIGA	LIVEST	AFFORE	FISHERI	ENERG	MINING	DISTRIE	IRRIGA	COLLE		SEWE	HOUSE	URBAN	RURAL
		AGRICUL TURE	TION AGRICU LTURE	OCK	- STATIO N & ALIEN PLANTS	ES	Y	AND HEAVY INDUST RIES	UTION OF	TION WATER	CTION AND	IBUTI ON OF WATE R			REQUIR E- MENTS	REQUIR EMENT S
		A+B+C	A	В	С	D	E	F	G		Н		I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	5629.3	13604.9	0.0		0.0		0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	5629.3	13604.9	0.0		0.0		0.0	0.0	0.0	0.0
2 2.1 3	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	49.7 49.7 0.0	49.7 49.7 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	5629.3 0.0 0.0	13604.9 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0		0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
	GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
4 4.1 5	Water abstracted for own use of which for irrigation Water abstracted for delivery	357. 4 0. 0 0. 0	0.0 0.0 0.0	357. 4 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0		0.0 0.0 0.0		0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
6 6.1	WATER DELIVERED THROUGH MAINS - of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	63505.8 0.0	0.0
	WATER RETURNED (WATER DISCHARG	ED)														
7 8	- Irrigation water - Cooling water															
9 10 11	- Wastewater treated - Wastewater untreated - Losses/leakages															
12	- Other returns												_			
P)		407.0	49.7	357.4	0.0	0.0	5629.3	13604.9	0.0		0.0		0.0	0.0	63505.8	0.0

		TOTAL			AFFORE	FISHERI	ENERG	MINING	DISTRIB IRRIGA					URBAN		RES
		AGRICUL TURE	TION AGRICU LTURE	OCK	- STATIO N & ALIEN PLANTS	ES	Y	AND HEAVY INDUST RIES	UTION TION OF WATER	AND	UTION OF WATER	AGE	HOLDS	REQUIRE- MENTS	REQUIR E- MENTS	OF ' WO
		A+B+C	A	В	С	D	Е	F	G	Н		I	J	K	L	1
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.
	TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	5736.8	13604.9	0.0	0.0		0.0	0.0	0.0	0.0	0
	PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	5736.8	13604.9	0.0	0.0		0.0	0.0	0.0	0.0	0
2	- Water abstracted for own use - of which for irrigation	49.7 49.7	49.7 49.7	0.0	0.0	0.0	5736.8 0.0	13604.9 0.0	0.0 0.0	0.0		0.0	0. 0 0. 0	0.0	0.0	0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0
	GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0
4	- Water abstracted for own use - of which for irrigation	357.4 0.0	0.0	357.4 0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	66320.6	0.0	0
5.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0
	WATER RETURNED (WATER DIS	CHARGED)													
7	- Irrigation water - Cooling water															
9	- Wastewater treated															
l0 l1	- Wastewater untreated - Losses/leakages															1
12	- Other returns															
DP)	407.0	49.7	357.4	0.0	0.0	5736.8	13604.9	0.0	0.0		0.0	0.0	66320.6	0.0	0.

	AGRICUL TURE		OCK	AFFORE - STATIO N & ALIEN PLANTS	ES	Y		DISTRIB UTION IRRIGA OF TION	COLLE DISTRII CTION UTION AND OF				RURAL REQUIR E-
				PLANIS			INDUST RIES	WATER	WATER			MENTS	MENTS
	A+B+C	A	В	C	D	E	F	G	Н	I	J	K	L
RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	5846.4	13604.9	0.0	0.0	0.0	0.0	0.0	0.0
PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	5846.4	13604.9	0.0	0.0	0.0	0.0	0.0	0.0
Water abstracted for own use of which for irrigation Water abstracted for delivery	49.7 49.7 0.0	49.7 49.7 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	5846.4 0.0 0.0	13604.9 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	357.4 0.0 0.0	0. 0 0. 0 0. 0	357.4 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
WATER DELIVERED THROUGH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69260.1	0.0
- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RETURNED (WATER DISC	CHARGED)												
- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns													
V	ERENNIAL SURFACE WATER Water abstracted for own use of which for irrigation Water abstracted for delivery GROUNDWATER Water abstracted for own use of which for irrigation Water abstracted for delivery VATER DELIVERED THROUGH MAINS of which: Wastewater VATER RETURNED (WATER DISC Irrigation water Cooling water Wastewater treated Wastewater untreated Losses/leakages	ERENNIAL SURFACE WATER - Water abstracted for own use - of which for irrigation - Water abstracted for delivery - Water abstracted for delivery - Water abstracted for own use - Of which for irrigation - Water abstracted for own use - Of which for irrigation - Of which for irrigation - Water abstracted for delivery - Water Alliver Deliver Delivery - Water RETURNED (WATER DISCHARGED) - Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages	Page 2017 Page 2018 Page	Water abstracted for own use 49.7 49.7 0.0	Page 1	Page 1	ERENNIAL SURFACE WATER 49.7 49.7 0.0 0.0 5846.4 - Water abstracted for own use 49.7 49.7 0.0 0.0 0.0 5846.4 - of which for irrigation 49.7 49.7 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for own use 357.4 0.0 357.4 0.0 0.0 0.0 - of which for irrigation 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 - Water abstracted for delivery 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.	ERENNIAL SURFACE WATER	ERENNIAL SURFACE WATER	ERENNIAL SURFACE WATER	ERENNIAL SURFACE WATER 49.7 49.7 0.0 0.0 5846.4 13604.9 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	ERENNIAL SURFACE WATER 49.7 49.7 0.0 0.0 0.0 5846.4 13604.9 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	ERENNIAL SURFACE WATER 49.7 49.7 0.0 0.0 0.0 5846.4 13604.9 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0

	ion to value added of water u													Tarin
		TOTAL AGRICULTU RE		TOCK			ENERG Y	MINING AND HEAVY INDUST RIES	IBUTI IRRIG ON ATIO	AND OF WATE	N AGE	HOUSE		REQUIR E-
		A+B+C	A	В	С	D	E	F	G	Н	I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	5958.1	13604.9	0.0	0.0	0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	5958.1	13604.9	0.0	0.0	0.0	0.0	0.0	0.0
2 2.1 3	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	49.7 49.7 0.0	49.7 49.7 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	5958.1 0.0 0.0	13604.9 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
	GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 4.1 5	Water abstracted for own use of which for irrigation Water abstracted for delivery	357. 4 0.0 0.0	0.0 0.0 0.0	357.4 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
6 5. 1	WATER DELIVERED THROUGH MAINS - of which: Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	72329.9 0.0	0.0
	WATER RETURNED (WATER DISCHARG	ED)												
7 8	- Irrigation water - Cooling water													
9 10 11	- Wastewater treated - Wastewater untreated - Losses/leakages													
12 (P)	- Other returns	407.0	49.7	357.4	0.0	0.0	5958.1	13604.9	0.0	0.0	0.0	0.0	72329.9	0.0

		TOTAL	IRRIGA	LIVES	AFFORE-	FISHERI	ENERG	MINING	DISTRIE	3	COLLECT	IDISTRIB	SEWER	HOUSE	URBAN	RURAL	RES
				TOCK	STATION & ALIEN PLANTS	ES	Y		UTION				AGE		REQUIR E- MENTS	REQUIR E-	
		A+B+C	A	В	С	D	E	F	G		Н		I	J	K	L	
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0
	TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	6071.9	13604.9	0.0		0.0		0.0	0.0	0.0	0.0	0
	PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	6071.9	13604.9	0.0		0.0		0.0	0.0	0.0	0.0	0
2	- Water abstracted for own use - of which for irrigation	49.7 49.7	49.7 49.7	0.0	0.0	0.0	6071.9 0.0	13604.9 0.0	0.0		0.0 0.0		0.0	0.0	0.0	0.0	0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0
	GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0
4	- Water abstracted for own use	357.4 0.0	0.0	357.4 0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	Č
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	75535.8	0.0	0
5.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	(
	WATER RETURNED (WATER DIS	SCHARGED)														
7	- Irrigation water - Cooling water																Ħ
9 10	- Wastewater treated - Wastewater untreated																
l1 l2	- Losses/leakages - Other returns																
DF	<u> </u>	407.0	49.7	357.4	0.0	0.0	6071.9	13604.9	0.0		0.0		0.0	0.0	75535.8	0.0	0

	TOTAL	IDDICA	LIVES	AFFORE	Uppe fisheri	ENERC	MINING	DISTRIB	COLLE	DISTRIB	CEWED		URBAN	DIIDAI
	AGRICULTU RE		TOCK		ES	Y		UTION IRRIGA	CTION AND		AGE			REQUIRE MENTS
	A+B+C	A	В	С	D	E	F	G	Н		I	J	K	L
RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	6185.7	13604.9	0.0	0.0		0.0	0.0	0.0	0.0
PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	6185.7	13604.9	0.0	0.0		0.0	0.0	0.0	0.0
- Water abstracted for own use - of which for irrigation	49.7 49.7	49.7 49.7	0.0	0.0	0.0	6185.7 0.0	13604.9 0.0	0.0 0.0	0.0		0.0	0.0	0.0	0.0
- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
- Water abstracted for own use - of which for irrigation	357.4 0.0	0.0	357.4 0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	78741.7	0.0
- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
WATER RETURNED (WATER DISC	CHARGED)													
- Irrigation water - Cooling water														
- Wastewater treated - Wastewater untreated														
- Losses/leakages - Other returns														
<u> </u> 	407.0	49.7	357.4	0.0	0.0	6185.7	13604.9	0.0	0.0		0.0	0.0	78741.7	0.0

bu	tion to value added of v	vater us	ed per	sector	r in the	е Ирре	er Vaa	l Wate	er Manage	ment A	Area fo	or 199	7 (R n	nillions)		
		TOTAL AGRICUL TURE	IRRIGA	LIVEST OCK	AFFORE STATIO N & ALIEN PLANTS				DISTRIB UTION IRRIC	COLLE CTION AND	DISTRIB		HOUSE		REQUIR	REST OF TI WOR
_		A+B+C	A	В	C	D	E	F	G	Н		I	J	K	L	M
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0. (
	TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	6301.6	13604.9	0.0	0.0		0.0	0.0	0.0	0.0	0. (
_	PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	6301.6	13604.9	0.0	0.0		0.0	0.0	0.0	0.0	0. (
2 2.1 3	Water abstracted for own use of which for irrigation Water abstracted for delivery	49.7 49.7 0.0	49.7 49.7 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	6301.6 0.0 0.0	13604.9 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. (0. (0. (
	GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0. (
4.1	Water abstracted for own use of which for irrigation Water abstracted for delivery	357. 4 0.0 0.0	0.0 0.0 0.0	357.4 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. (0. (0. (
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	82083.6	0.0	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0
_	WATER RETURNED (WATER DISC	CHARGED)														
7 8 9 10 11 12	- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns															
GDI)	407.0	49.7	357.4	0.0	0.0	6301.6	13604.9	0.0	0.0		0.0	0.0	82083.6	0.0	0. (

					AFFORE		ENERG	MINING			DISTRIB			URBAN	
		TURE	TION AGRICU LTURE		- STATIO N & ALIEN PLANTS	RIES		AND HEAVY INDUST RIES		AND	UTION OF WATER	AGE	HOLDS	REQUIR E- MENTS	E-
		A+B+C	A	В	С	D	E	F	G	Н		I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	6419.7	13604.9	0.0	0.0		0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	6419.7	13604.9	0.0	0.0		0.0	0.0	0.0	0.0
2 .1 3	Water abstracted for own use of which for irrigation Water abstracted for delivery	49.7 49.7 0.0	49.7 49.7 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0	6419.7 0.0 0.0	13604.9 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0		0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0
	GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
4	- Water abstracted for own use - of which for irrigation	357.4 0.0	0.0	357.4 0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0. 0	0.0	0.0		0.0	0.0	85567.4	0.0
5.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHARGED)	<u> </u>													
7 8	- Irrigation water - Cooling water														
9	- Wastewater treated - Wastewater untreated														
11 12	- Losses/leakages - Other returns														
DP		407.0	49.7	357.4	0.0	0.0	6419.7	13604.9	0.0	0.0		0.0	0.0	85567.4	0.0

ibu	tion to value added of v	vater used	per se	ector i	in the l	Upper	Vaal '	Water	Manag	gemei	nt Ar	ea for	1999	(R mi	llions)	
		TOTAL AGRICULTU RE	IRRIGA	LIVEST OCK	AFFORE - STATIO N & ALIEN PLANTS	FISHERI ES	ENERG Y	MINING	DISTRIB UTION II OF T	RRIGA 'ION	COLL ECTI ON	DISTRIB	SEWER	HOUSE	URBAN	RURAL REQUIR E- MENTS
		A+B+C	A	В	С	D	E	F	G		Н		I	J	K	L
1	RAIN	0.0	0. 0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	6540.0	13604.9	0.0		0.0		0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	6540.0	13604.9	0.0		0.0		0.0	0.0	0.0	0.0
2 2.1 3	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	49.7 49.7 0.0	49.7 49.7 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	6540.0 0.0 0.0	13604.9 0.0 0.0	0.0 0.0 0.0		0. 0 0. 0 0. 0		0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
	GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
4 4.1 5	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	357. 4 0. 0 0. 0	0. 0 0. 0 0. 0	357.4 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0		0. 0 0. 0 0. 0		0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	89199.1	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISC	HARGED)														
7 8 9 10 11 12	- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns															
GDP)	407.0	49.7	357.4	0.0	0.0	6540.0	13604.9	0.0		0.0		0.0	0.0	89199.1	0.0

outio		TOTAL	IDDICATI	LIVESTO	AFFORES	FIGURDIE	ENERGY	MINING	DISTID	COL DIST	CEW	HOUSE	TIDRAN	DIIDA
		AGRICUL TURE		CK	TATION & ALIEN PLANTS	S S	ENERGI	AND HEAVY INDUST	RIB RI UTI GA	LEC RIBU TIONTION	ERA			REQU
		A+B+C	A	В	С	D	E	F	G	Н	I	J	К	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	407.0	49.7	357.4	0.0	0.0	6662.6	13604.9	0.0	0.0	0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	49.7	49.7	0.0	0.0	0.0	6662.6	13604.9	0.0	0.0	0.0	0.0	0.0	0.0
2	- Water abstracted for own use	49.7	49.7	0.0	0.0	0.0	6662.6	13604.9	0.0	0.0	0.0	0.0	0.0	0.0
2.1	- of which for irrigation	49.7	49.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	GROUNDWATER	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	- Water abstracted for own use	357.4	0.0	357.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92984.8	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHARGED)													
7	- Irrigation water													
8	- Cooling water													
9	- Wastewater treated													
10	- Wastewater untreated													
11	- Losses/leakages													
12	- Other returns													
DP)		407.0	49.7	357.4	0.0	0.0	6662.6	13604.9	0.0	0.0	0.0	0.0	92984.8	0.0

From table 45 to table 54, it is apparent that only certain water use sectors make a contribution towards value added. These are –

- Irrigation agriculture
- Livestock
- Energy
- Mining and heavy industries
- Urban requirements

The other water use sectors are not considered direct contributors to value added either due to the fact that they did not use water in the first instance or because including them in value added would imply double-counting in the system, for an example households and the environment.

Table 55 summarizes the contribution to value added per water use sector on an annual basis.

Table 55 - Annual contribution to value added of water used per sector in the Upper Vaal WMA (1991 – 2000) (R millions, 2000 prices)

	Irrigation	Livestock	Energy	Mining &	Urban	Total
	agriculture			heavy	requirements	(annual)
				industries		
1991	50	357	5,629	13,605	63,506	83,147
1992	50	357	5,737	13,605	66,321	86,069
1993	50	357	5,846	13,605	69,260	89,118
1994	50	357	5,958	13,605	72,330	92,300
1995	50	357	6,072	13,605	75,536	95,620
1996	50	357	6,186	13,605	78,742	98,939
1997	50	357	6,302	13,605	82,084	102,397
1998	50	357	6,420	13,605	85,567	105,999
1999	50	357	6,540	13,605	89,199	109,751
2000	50	357	6,663	13,605	92,985	113,659

Source: Statistics South Africa

According to table 55, the contribution to value added of water used per sector in the Upper Vaal WMA increased by approximately 37 % from R83,1 billion in 1991 to R113,7 billion in 2000 (in constant 2000 prices). The water use sectors that contribute most towards value added are urban requirements, mining and heavy industries and energy.

It is clear that the contribution to value added is predominantly a result of water usage due to urban requirements. Urban requirements represent water used in urban areas such as light industries and parks but exclude domestic requirements. According to table 55 this holds true for each of the relevant years. Mining and heavy industries also contribute a small portion of 12 % of total value added.

Another important feature of table 55 is the constant contributions towards value added made by certain water use sectors. The constant values for irrigation agriculture are due to restrictions imposed through DWAF not allowing expansions in the hectares under irrigation along the Upper Vaal WMA. As far as the contribution towards value added of livestock is concerned, the argument is that this sector has reached its peak and no expansion is expected. It should also be noted that table 55 reflects sectoral contributions to value added in constant prices.

4.1.2 EmploymentThe contribution of each use sector to employment is provided in table 56 on page 64 to table 65 on page 73 on an annual basis from 1991 to 2000.

buti	on to employment of wa	ter used														yee
		TOTAL			AFFORE	FISHERI	ENERG		DISTR IRRIG							REST
		AGRICUL TURE	TION AGRICU LTURE	OCK	- STATIO N & ALIEN	ES	Y	AND HEAVY INDUST RIES	ON N	AND	UTION OF WATER	AGE	EHOL DS	REQUIRE- MENTS	REQUIR E- MENTS	OF T WOI
					PLANTS											
1		A+B+C	A	В	С	D	E	F	G	Н		I	J	K	L	N
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.
	TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	18059.9	62919.7	0.0	0.0		0.0	0.0	0.0	0.0	0.
	PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	18059.9	62919.7	0.0	0.0		0.0	0.0	0.0	0.0	0.
2 2.1	- Water abstracted for own use - of which for irrigation	2902.3 2902.3	2902.3 2902.3	0.0	0.0	0.0	18059.9 0.0	62919.7 0.0	0.0	0.0		0.0	0.0	0.0	0.0	0. 0.
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.
	GROUNDWATER	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.
4.1	- Water abstracted for own use - of which for irrigation	28468.1	0.0	28468.1 0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0. 0.
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	749667.8	0.0	0.
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.
	WATER RETURNED (WATER DISCH	HARGED)														
7	- Irrigation water															
9	- Cooling water - Wastewater treated															
10 11	- Wastewater untreated - Losses/leakages															
12	- Other returns															
PPORT	TUNITIES	31370.5	2902.3	28468.1	0.0	0.0	18059.9	62919.7	0.0	0.0		0.0	0.0	749667.8	0.0	0.

bu	tion to employment of wa	ater used	d per s	ector	in the	Upper	Vaal								emplo	yees
		TOTAL AGRICUL TURE		OCK	AFFORE - STATIO N & ALIEN PLANTS	FISHERI ES	Y	MINING AND HEAVY INDUST RIES	N	RRIG CTIO TIO AND VATE	E DISTRIB N UTION OF WATER	SEWER AGE		URBAN REQUIRE- MENTS	RURAL REQUIR E- MENTS	
		A+ B + C	A	В	С	D	E	F	G	Н		I	J	K	L	M
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	0.0	0.0	0.0	0.0	0.(
	TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	18404.8	62919.7	0.0	0.0)	0.0	0.0	0.0	0.0	0. (
_	PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	18404.8	62919.7	0.0	0.0)	0.0	0.0	0.0	0.0	0. (
2 2.1 3	Water abstracted for own use of which for irrigation Water abstracted for delivery	2902.3 2902.3 0.0	2902.3 2902.3 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	18404.8 0.0 0.0	62919.7 0.0 0.0	0.0 0.0 0.0	0.0)	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. (0. (0. (
_	GROUNDWATER	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0	l	0.0	0.0	0.0	0.0	0.(
4.1	Water abstracted for own use of which for irrigation Water abstracted for delivery	28468.1 0.0 0.0	0. 0 0. 0 0. 0	28468.1 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0		0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. (0. (0. (
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0. 0	0.0	0.0	0.0	0.0	ı	0.0	0.0	782895.4	0.0	0. (
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0)	0.0	0.0	0.0	0.0	0.(
	WATER RETURNED (WATER DISCHA	RGED)														
7 8 9 10 11 12	Irrigation water Cooling water Wastewater treated Wastewater untreated Losses/leakages Other returns															
PPC	RTUNITIES	31370.5	2902.3	28468.1	0.0	0.0	18404.8	62919.7	0.0	0.0)	0.0	0.0	782895.4	0.0	0. (

uı	ion to employment of wa	TOTAL							DISTRIB IRRIGA					RURAL I
		AGRICUL TURE		OCK	AFFORE STATIO N & ALIEN PLANTS	FISHERI ES	ENERG Y	MINING AND HEAVY INDUST RIES	UTION TION	CTION UTION	AGE	HOUSE		RURAL II REQUIR (E- MENTS
		A+B+C	A	В	С	D	E	F	G	Н	I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	18756.3	62919.7	0.0	0.0	0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	18756.3	62919.7	0.0	0.0	0.0	0.0	0.0	0.0
2 2.1 3	Water abstracted for own use of which for irrigation Water abstracted for delivery	2902.3 2902.3 0.0	2902.3 2902.3 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	18756.3 0.0 0.0	62919.7 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0
	GROUNDWATER	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 4.1 5	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	28468.1 0.0 0.0	0.0 0.0 0.0	28468.1 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	817595.7	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISC	HARGED)												
7 8 9 10 11 12	- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns													
OR	TUNITIES	31370.5	2902.3	28468.1	0.0	0.0	18756.3	62919.7	0.0	0.0	0.0	0.0	817595.7	0.0

bι	ition to employment of wa													
		TOTAL AGRICUL TURE		OCK	AFFORE STATIO N & ALIEN PLANTS	FISHERI ES	ENERG Y		IBUTI TION ON WATER		SEWER AGE	HOUSE HOLDS		RURAL F REQUIR C E- MENTS
		A+B+C	A	В	С	D	E	F	G	Н	I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	19114.6	62919.7	0.0	0.0	0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	19114.6	62919.7	0.0	0.0	0.0	0.0	0.0	0.0
2 2.1 3	Water abstracted for own use of which for irrigation Water abstracted for delivery	2902.3 2902.3 0.0	2902.3 2902.3 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	19114.6 0.0 0.0	62919.7 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0
	GROUNDWATER	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.1	Water abstracted for own use of which for irrigation Water abstracted for delivery	28468.1 0.0 0.0	0. 0 0. 0 0. 0	28468.1 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	853833.9	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHA	RGED)												
7 8 9 10 11 12	- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns													
PPC	DRTUNITIES	31370.5	2902.3	28468.1	0.0	0.0	19114.6	62919.7	0.0	0.0	0.0	0.0	853833.9	0.0

buti	on to employment of water	used per	secto	r in th	e Uppo	er Va	al Wa	iter M	anagement	Area for 1	1995 (n	umbe	er of em	ployee
	• •	TOTAL AGRICUL TURE	IRRIGA	LIVEST OCK	AFFORE	FISHE RIES	ENERG Y	MINING AND HEAVY INDUST RIES	DISTRIB UTION IRRIGA OF TION	COLL DISTR	IB SEWER AGE	HOUS		RURAL
		A+B +C	A	В	С	D	E	F	G	Н	I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	19479.7	62919.7	0.0	0.0	0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	19479.7	62919.7	0.0	0.0	0.0	0.0	0.0	0.0
2.1	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	2902.3 2902.3 0.0	2902.3 2902.3 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	19479.7 0.0 0.0	62919.7 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0. 0 0. 0 0. 0
	GROUNDWATER	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 4.1 5	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	28468.1 0.0 0.0	0.0 0.0 0.0	28468.1 0.0 0.0	0. 0 0. 0 0. 0	0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0. 0 0. 0 0. 0
6 6.1	WATER DELIVERED THROUGH MAINS - of which: Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	891678.4 0.0	0.0
	WATER RETURNED (WATER DISCHARG	ED)												
7 8 9 10 11 12	- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns													
PPORT	TUNITIES	31370.5	2902.3	28468.1	0.0	0.0	19479.7	62919.7	0.0	0.0	0.0	0.0	891678.4	0.0

ution to employment of w	ater us	ed per	sector	in the	e Uppe	er Vaal	Water	· Manageme	nt Area fo	r 1996 (num	ber of e	mploy	ees)
			LIVEST OCK	AFFORE - STATIO N & ALIEN PLANTS	FISHERI ES	ENERGY	MINING AND HEAVY INDUST RIES		COLLE DISTR CTION UTION AND OF WATI	N AGE			RURAL REQUIR EMENT S	OF T
	A+B+C	A	В	С	D	E	F	G	Н	I	J	K	L	M
RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	19844.8	62919.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	19844.8	62919.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Water abstracted for own use 1 - of which for irrigation - Water abstracted for delivery	2902.3 2902.3 0.0	2902.3 2902.3 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	19844.8 0.0 0.0	62919.7 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.1 0.1 0.1
GROUNDWATER	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
- Water abstracted for own use 1 - of which for irrigation - Water abstracted for delivery	28468.1 0.0 0.0	0.0 0.0 0.0	28468.1 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.1
WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	929522.9	0.0	0.0
1 - of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WATER RETURNED (WATER DISCI	HARGED)													
- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns														
ORTUNITIES	31370.5	2902.3	28468.1	0.0	0.0	19844.8	62919.7	0.0	0.0	0.0	0.0	929522.9	0.0	0.0

		TOTAL	IRRIGA	LIVEST	AFFORE	FISHERI	ENERG	MINING	DISTRIB	COLLE	DISTRIB	SEWER	HOUS	URBAN	RURAL
		AGRICUL TURE	TION AGRICU LTURE	OCK	- STATIO N & ALIEN PLANTS	ES	Y	AND HEAVY INDUST RIES	UTION IRR OF ATI N WA R	O AND	UTION OF WATER	AGE		REQUIRE- MENTS	REQUIF E- MENTS
		A+B+C	A	В	С	D	E	F	G	Н		I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	20216.7	62919.7	0.0	0.0		0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	20216.7	62919.7	0.0	0.0		0.0	0.0	0.0	0.0
2 2.1 3	Water abstracted for own use of which for irrigation Water abstracted for delivery	2902.3 2902.3 0.0	2902.3 2902.3 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	20216.7 0.0 0.0	62919.7 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0
	GROUNDWATER	28468.1	0. 0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
4 4.1	- Water abstracted for own use - of which for irrigation	28468.1 0.0	0.0	28468.1 0.0	0. 0 0. 0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	968973.6	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISC	HARGED)													
7 8 9	- Irrigation water - Cooling water - Wastewater treated														
10 11	- Wastewater untreated - Losses/leakages														
12	- Other returns														
PORT	TUNITIES	31370.5	2902.3	28468.1	0.0	0.0	20216.7	62919.7	0.0	0.0		0.0	0.0	968973.6	0.0

rihn	tion to employment of wate	or used no	or soct	or in t	he I In	ner V	Vaal W	Vator I	Managaman	t Area fo	r 100	9 (n)	umber e	famn	love
IIVU	tion to employment of water								DISTRIB IRRIGA					RURAL	
		AGRICULTU RE		оск	AFFORE STATIO N & ALIEN PLANTS	RIES	Y	AND	UTION TION OF WATER	ECTI IBUTI	RAGE				
		A+B+C	A	В	C	D	E	F	G	Н	I	J	K	L	M
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0. (
	TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	20595.6	62919.7	0.0	0.0	0.0	0.0	0.0	0.0	0.(
	PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	20595.6	62919.7	0.0	0.0	0.0	0.0	0.0	0.0	0.(
2	- Water abstracted for own use	2902.3	2902.3	0.0	0.0	0.0	20595.6	62919.7	0.0	0.0	0.0	0.0	0.0	0.0	0.(
2.1	- of which for irrigation	2902.3	2902.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.(
	GROUNDWATER	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.(
4	- Water abstracted for own use	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0. (
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0. (
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1010098.6	0.0	0. (
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHAR	GED)													
_															
7 8	- Irrigation water										1	1			₩
9	- Cooling water - Wastewater treated														₩
10	- Wastewater treated									1	1				\vdash
11	- Losses/leakages	1								1		1			t
12	- Other returns														
									,						$oxed{oxed}$
OPPO	RTUNITIES	31370.5	2902.3	28468.1	0.0	0.0	20595.6	62919.7	0.0	0.0	0.0	0.0	1010098.6	0.0	0.0

bι	ition to employment of wa													
		TOTAL AGRICUL TURE		оск		FISHE RIES	ENERGY	MINING AND HEAVY INDUST RIES	DISTRIB IRRIGA UTION TION OF WATER	CTION UTIO	ON AGE	EHOL	URBAN REQUIRE MENTS	RURAL I REQUIR EMENT S
		A+B+C	A	В	C	D	E	F	G	Н	I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	20981.6	62919.7	0.0	0.0	0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	20981.6	62919.7	0.0	0.0	0.0	0.0	0.0	0.0
2 2.1 3	Water abstracted for own use of which for irrigation Water abstracted for delivery	2902.3 2902.3 0.0	2902.3 2902.3 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	20981.6 0.0 0.0	62919.7 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0
	GROUNDWATER	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4.1	Water abstracted for own use of which for irrigation Water abstracted for delivery	28468.1 0.0 0.0	0. 0 0. 0 0. 0	28468.1 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1052969.1	0.0
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHA	ARGED)												
7 8 9 10 11 12	- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns													
PPC	DRTUNITIES	31370.5	2902.3	28468.1	0.0	0.0	20981.6	62919.7	0.0	0.0	0.0	0.0	1052969.1	0.0

ntribution to employment of water used per sector in the Upper Vaal Water Management Area for 2000 (number apployees)

aploy	ees)																
		TOTAL					ENERGY										REST
		AGRICUL	TION	OCK		RIES						IBUTI	AGE			REQUIR	
		TURE	AGRICU		ATIO			HEAVY			ON	ON		DS	MENTS	EMENT	WOR
			LTURE		N &			INDUST		WATE	AND	OF				s	
					ALIE N			RIES		R		WATE R					
					PLAN							K					
					TS												
		A+B +C	A	В	С	D	Е	F	G		Н		I	J	K	L	M
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0.0
+																	
;	TOTAL WATER ABSTRACTED	31370.5	2902.3	28468.1	0.0	0.0	21374.8	62919.7	0.0		0.0		0.0	0.0	0.0	0.0	0.(
1	PERENNIAL SURFACE WATER	2902.3	2902.3	0.0	0.0	0.0	21374.8	62919.7	0.0		0.0		0.0	0.0	0.0	0.0	0. (
2	- Water abstracted for own use	2902.3	2902.3	0.0	0.0	0.0	21374.8	62919.7	0.0		0.0		0.0	0.0	0.0	0.0	0. (
2.1	- of which for irrigation	2902.3	2902.3	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0. (
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0. (
	GROUNDWATER	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0. (
4	- Water abstracted for own use	28468.1	0.0	28468.1	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0. (
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0. (
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0. (
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	1097659.0	0.0	0. (
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	0. (
_	WATER RETURNED (WATER DISCHARGED)															<u> </u>
7	- Irrigation water																_
8	- Cooling water																\vdash
9	- Wastewater treated																
10	- Wastewater untreated																
11	- Losses/leakages																
1 12	- Other returns																
OPPOR	TUNITIES	31370.5	2902.3	28468.1	0.0	0.0	21374.8	62919.7	0.0		0.0		0.0	0.0	1097659.0	0.0	0.(
		1															
					<u> </u>			<u> </u>						L			—

As in the case of value added, only some water use sectors make a contribution towards employment. These are –

- Irrigation agriculture
- Livestock
- Energy
- Mining and heavy industries
- Urban requirements

The primary reason for not including all the water use sectors in the determination of the contribution towards employment is the risk of double-counting which exists.

Table 66 - The annual contribution to employment of water used per sector in the Upper Vaal River WMA (1991-2000)

Year	Irrigation	Livestock	Energy	Mining &	Urban	Total (annual)
	Agriculture			heavy	requirements	
				industries		
1991	2 902	28 468	18 060	62 920	74 9668	862 018
1992	2 902	28 468	18 405	62 920	782 895	895 590
1993	2 902	28 468	18 756	62 920	817 596	930 642
1994	2 902	28 468	19 115	62 920	853 834	967 239
1995	2 902	28 468	19 480	62 920	891 678	1 005 448
1996	2 902	28 468	19 845	62 920	929 523	1 043 658
1997	2 902	28 468	20 217	62 920	968 974	1 083 480
1998	2 902	28 468	20 596	62 920	1 010 099	1 124 984
1999	2 902	28 468	20 982	62 920	1 052 969	1 168 241
2000	2 902	28 468	21 375	62 920	1 097 659	1 213 324

Source: Statistics South Africa

According to table 66 the contribution of water used to employment was 1 213 324 employees in the year 2000. This is almost 41 % higher than the estimate for 1991. The water use sector that contributes mostly to employment, is urban requirements. However, mining and heavy industries also contribute significantly towards employment. This is demonstrated in table 67 for 1991 and 2000. Employment in the irrigation agriculture and livestock sectors is constant throughout the period reflecting data limitations. Mining and heavy industries shows a slight decrease in growth.

Table 67 - Percentage contribution to employment of water used per sector in the Upper Vaal WMA (1991 & 2000)

Sector	1991	2000
Irrigation agriculture	0.3	0.2
Livestock	3.3	2.3
Energy	2.1	1.8
Mining & heavy industries	7.3	5.2
Urban requirements	87.0	90.5
Total	100%	100%

Source: Statistics South Africa

Interesting to note is that the contribution of urban requirements towards employment has increased from 87,0 % in 1991 to 90,5 % in 2000. This is an indication of the large-scale urbanisation which characterized the Upper Vaal River WMA over the last few decades.

4.2 Delivery Costs, Tariffs and Subsidies

In this section, the cost of water delivery to the various use sectors, the tariffs they pay and the subsidization of their water delivery costs are analysed. The new water price policy for South Africa forms the basis of the water delivery costs and tariffs that are used in this study. However, it is important to note that historic water cost and tariff data are not available. Tariffs and costs are only available for 1998. The 1998 tariffs and costs were applied for the remaining years. In other words, other years are analysed as if the new water policy was in place during that time and the 1998 costs and tariffs were in effect. The result is that the analyses over time does not reflect relative tariff and cost changes per physical unit of water. The cross subsidisation is calculated by subtracting the tariff revenue per sector from the cost of providing water to the relevant sector.

4.2.1 Delivery costs

The delivery costs of water used per sector in the Upper Vaal WMA from 1991 to 2000 are provided in table 68 on page 76 to table 77 on page 85.

					Water	FISHEDI			DISTRIB IRRIG	COLLE		SEWED	HOUSE	URBAN	RIIRAI
		AGRICUL TURE		OCK	- STATIO N &	ES	Y	AND	UTION TION					REQUIR E- MENTS	REQUI E-
			LIUKE		ALIEN PLANTS			RIES			WATE R			MENIS	MENTS
		A+B+C	A	В	С	D	E	F	G	Н		I	J	K	L
R	AIN	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
Т	OTAL WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	38.8	99.7	0.0	0.0		0.0	0.0	0.0	0.0
P.	ERENNIAL SURFACE WATER	65.4	65.4	0.0	0.0	0.0	38.8	99.7	0.0	0.0		0.0	0.0	0.0	0.0
	Water abstracted for own use of which for irrigation	65.4 65.4	65.4 65.4	0.0	0.0	0.0	38.8 0.0	99.7 0.0	0.0	0.0		0.0	0.0	0.0	0.0
	Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
G	ROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
_	Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	of which for irrigation Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
W	VATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	181.5	110.7	2.1
1 -	of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
W	VATER RETURNED (WATER DISCHARGE	ED)													
	Irrigation water Cooling water														
-	Wastewater treated Wastewater untreated														
-	Losses/leakages Other returns														
1		82.9	65.4	0.0	17.4	0.0	38.8	99.7	0.0	0.0		0.0	181.5	110.7	2.1

	TOTAL	IDDICA	LIMBOT	AFFORE	DIGITE	ENEDC	MINING	DICTO	COLLE	DICTRID	CEWED	HOUSE	URBAN	DIDAT
	AGRICUL		OCK		RIES		AND	IBUTI IRRIGA				HOLDS	REQUIR	
	TURE	AGRICU	OCK	STATIO	KIES	Y		ON TION		OF	AGE	HOLDS	E-	KEQUI
	TUKE	LTURE		N &			INDUST			WATER			MENTS	MENT
		LIUKE		ALIEN			RIES	OF WATER		WAILK			MENTS	MEN
				PLANTS			KIES							
				PLANIS										
	A L D L C	A	В	C	D	Е	F	G	Н		ī	J	K	L
	A+B+C	A	В	U	ע	E	r	G	н		1	J	K	L
RAIN	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
TOTAL WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	39.5	99.7	0.0	0.0		0.0	0.0	0.0	0.0
PERENNIAL SURFACE WATER	65.4	65.4	0.0	0.0	0.0	39.5	99.7	0.0	0.0		0.0	0.0	0.0	0.0
PERENNIAL SURFACE WATER	05.4	06.4	0.0	0.0	0.0	39.5	99.1	0.0	0.0		0.0	0.0	0.0	0.0
- Water abstracted for own use	65.4	65.4	0.0	0.0	0.0	39.5	99.7	0.0	0.0		0.0	0.0	0.0	0.0
- of which for irrigation	65.4	65.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0		0.0	0.0	0.0	0.0
- Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	184.6	115.6	2.1
- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
WATER RETURNED (WATER DISCHARGED)														
WATER RETURNED (WATER DISCHARGED)														
- Irrigation water														
- Cooling water														1
- Wastewater treated														1
- Wastewater untreated														
- Losses/leakages														
- Other returns														
														1
	82.9	65.4	0.0	17.4	0.0	39.5	99.7	0.0	0.0		0.0	184.6	115.6	2.1

water used per sector in	the Upper V	aal W	ater N	Manag	ement	Are	a for	1993 (R	million	ıs)				
•	TOTAL	IRRIGA	LIVEST	AFFORE	FISHERI	ENER	MINI	DISTRIB	COLLE	DISTRIB	SEWE	HOUSE	URBAN	RURA
	AGRICULTU RE		оск	- STATIO N & ALIEN	ES	GY	NG AND HEAV Y	UTION IRRI OF ATIO N WAT	G CTION AND			HOLDS	REQUIR E- MENTS	REQU E-
				PLANTS			INDU STRIE S							
	A+B+C	A	В	С	D	Е	F	G	Н		I	J	K	L
	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	40.3	99.7	0.0	0.0		0.0	0.0	0.0	0.0
NIAL SURFACE WATER	65.4	65.4	0.0	0.0	0.0	40.3	99.7	0.0	0.0		0.0	0.0	0.0	0.0
r abstracted for own use	65.4	65.4	0.0	0.0	0.0	40.3	99.7	0.0	0.0		0.0	0.0	0.0	0.0
ich for irrigation	65.4	65.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
r abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
NDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
r abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
ich for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
r abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
R DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	187.7	120.7	2.1
ich : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
R RETURNED (WATER DISCHARGED)													
ation water						l	l							1
ng water		1	1		1	1	1				1	1	1	1
ewater treated		1	1		1	1	1				1	1	1	1
ewater untreated						i i	1	1			1	l l		1
s/leakages						1	1				1			1
returns														
	82.9	65.4	0.0	17.4	0.0	40.3	99.7	0.0	0.0		0.0	187.7	120.7	2.
ng w ewat ewat s/lea	ater er treated er untreated .kages	rater er treated er untreated klages urns	rater er treated er untreated kages urns	rater er treated er untreated kages urns	rater er treated er untreated klages urns	rater er treated er untreated lkages uurns	rater er treated er untreated lkages uurns	rater er treated er untreated lkages uurns	rater er treated er untreated er untreated kages uurns	rater er treated er untreated lkages urns	rater er treated er untreated lkages urns	rater er treated er untreated er untreated lkages uurns	rater er treated er untreated lkages urns	rater er treated er untreated er untreated lkages uurns er untreated e

cost of water used per sector	in the Uj	pper V	<u>'aal Wa</u>	ter Ma	anager	nent A	Area fo	or 199	4 (R m						
	TOTAL AGRICUL TURE		LIVESTOC K	AFFORE - STATIO N & ALIEN PLANTS	FISHERI ES	ENERG Y	AND	UTION OF	IRRIGA	COLLE CTION AND	DISTRIB UTION OF WATER			REQUIR E-	RURAL REQUIR E- MENTS
	A+B+C	A	В	С	D	E	F	G		Н		I	J	K	L
RAIN	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
TOTAL WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	41.1	99.7	0.0		0.0		0.0	0.0	0.0	0.0
PERENNIAL SURFACE WATER	65.4	65.4	0.0	0.0	0.0	41.1	99.7	0.0		0.0		0.0	0.0	0.0	0.0
- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	65.4 65.4 0.0	65.4 65.4 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	41.1 0.0 0.0	99.7 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0		0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0
GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
Water abstracted for own use of which for irrigation Water abstracted for delivery	0. 0 0. 0 0. 0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0		0.0 0.0 0.0		0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0
WATER DELIVERED THROUGH MAINS - of which: Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	190.9 0.0	126.0 0.0	2.1
WATER RETURNED (WATER DISCHARGED))														
- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns															
	82.9	65.4	0.0	17.4	0.0	41.1	99.7	0.0		0.0		0.0	190.9	126.0	2.1

	TOTAL	IRRIGA	LIVEST	AFFORE		ENERG	MINING	DISTR IRRIGA	COLLEC	DISTRIB	SEWER	HOUSE	URBAN	RUR
		TION AGRICU LTURE	оск	STATIO N & ALIEN PLANTS	FISHERI ES	Y		IBUTI TION ON WATER OF	AND	UTION OF WATER	AGE	HOLDS	REQUIR E- MENTS	E-
	A+B+C	A	В	С	D	E	F	G	Н		I	J	K	I
RAIN	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.
TOTAL WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	41.9	99.7	0.0	0.0		0.0	0.0	0.0	0.0
PERENNIAL SURFACE WATER	65.4	65.4	0.0	0.0	0.0	41.9	99.7	0.0	0.0		0.0	0.0	0.0	0.
Water abstracted for own use of which for irrigation Water abstracted for delivery	65.4 65.4 0.0	65.4 65.4 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	41.9 0.0 0.0	99.7 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0		0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0.
GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.
- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0		0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0. 0.
WATER DELIVERED THROUGH MAINS - of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	194. 2 0.0	131.6 0.0	2.
- of which : wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.1
WATER RETURNED (WATER DISCHARGED)														
- Irrigation water - Cooling water - Wastewater treated														-
- Wastewater untreated - Losses/leakages														
- Other returns														上
Т	82.9	65.4	0.0	17.4	0.0	41.9	99.7	0.0	0.0		0.0	194.2	131.6	2.

_	cost of water used per sector i				AFFORE						DISTRIB	SEWER	HOUSE	URBAN	RURAI
		AGRICUL TURE		оск		RIES	Y	AND HEAVY INDUST RIES	UTION OF	CTION		AGE	HOLDS	REQUIR EMENT S	REQU
		A+B +C	A	В	С	D	E	F	G	Н		I	J	K	L
1	RAIN	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	42.6	99.7	0.0	0.0		0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	65.4	65.4	0.0	0.0	0.0	42.6	99.7	0.0	0.0		0.0	0.0	0.0	0.0
2.1	- Water abstracted for own use - of which for irrigation	65.4 65.4	65.4 65.4	0.0 0.0 0.0	0.0	0.0 0.0 0.0	42.6	99.7	0.0	0.0		0.0	0.0	0.0 0.0 0.0	0.0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
4	- Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	197.5	137.2	2.1
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHARGED))													
7	- Irrigation water														
8	- Cooling water													1	
9	- Wastewater treated		1		1			1	1					1	1
10 11	- Wastewater untreated	1	1					-						1	
12	- Losses/leakages - Other returns														
		82.9	65.4	0.0	17.4	0.0	42.6	99.7	0.0	0.0		0.0	197.5	137.2	2.1

ry	cost of water used per sector in									(R mi	llions)				
		TOTAL	IRRIGA	LIVEST	AFFORE	FISHE	ENERG	MINING	DISTR	COLLE	DISTRIB	SEWER	HOUSE	URBAN	RURAL
			TION	OCK	Ļ		Y	AND	IBUTI IRRIG	CTION	UTION	AGE	HOLDS	REQUIR	REQUIR
		TURE	AGRICU		STATIO			HEAVY		AND	OF			E-	E-
			LTURE		N &			INDUST			WATER			MENTS	MENTS
					ALIEN			RIES	WATE						
					PLANTS				R						
		ļ													_
		A+B+C	A	В	С	D	Е	F	G	Н		I	J	K	L
1	RAIN	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	43.4	99.7	0.0	0.0		0.0	0.0	0.0	0.0
	PERENNIAL SURFACE WATER	65,4	65.4	0.0	0.0	0.0	43.4	99.7	0.0	0.0		0.0	0.0	0.0	0.0
	PEREINIAL SURFACE WATER	05.4	05.4	0.0	0.0	0.0	43.4	99.1	0.0	0.0		0.0	0.0	0.0	0.0
2	- Water abstracted for own use	65.4	65.4	0.0	0.0	0.0	43.4	99.7	0.0	0.0		0.0	0.0	0.0	0.0
2.1	- of which for irrigation	65.4	65.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
4	- Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	200.8	143.0	2.1
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHARGED)														
7	- Irrigation water		-												
8	- Cooling water														
9	- Wastewater treated													İ	
10	- Wastewater untreated														
11	- Losses/leakages														
12	- Other returns														
		82.9	65.4	0.0	17.4	0.0	43.4	99.7	0.0	0.0		0.0	200.8	143.0	2.1

		TOTAL	IRRIG	LIVEST	AFFORE	FISHERI	ENER	MINING	DISTR	IRRIG	COLLE	DISTR	SEWE	HOUS	URBAN	RURA
		AGRICUL			L		GY		IBUTI						REQUIR	
		TURE	N		STATIO						AND	ON		DS	E-	E- `
			AGRI		N &			INDUST		WATE		OF			MENTS	MEN'
			CULT		ALIEN			RIES		R		WATE				
			URE		PLANTS							R				
		A+ B + C	A	В	С	D	E	F	G		Н		I	J	K	L
	DATA	17.4	0.0		15.4	0.0	0.0	0.0	0.0				0.0	0.0	0.0	
	RAIN	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
_	TOTAL WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	44.3	99.7	0.0		0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ADSTRACTED	05.4	05.4	0.0	0.0	0.0	44.3	99.1	0.0		0.0		0.0	0.0	0.0	0.1
_	PERENNIAL SURFACE WATER	65.4	65.4	0.0	0.0	0.0	44.3	99.7	0.0		0.0		0.0	0.0	0.0	0.0
	- Water abstracted for own use	65.4	65.4	0.0	0.0	0.0	44.3	99.7	0.0		0.0		0.0	0.0	0.0	0.0
l	- of which for irrigation	65.4	65.4	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.
	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	† ·
	- Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
l	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.
	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.
	NATION DEL NYENER MARKET MARKET	0.0	0.0	0.0		0.0	0.0	0.0	0.0				0.0	20.4.2	140.1	
l	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	204.2	149.1	2.
	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.4
	WATER RETURNED (WATER DISCHARGED)															
	- Irrigation water															↓
	- Cooling water															1
	- Wastewater treated															
	- Wastewater untreated															
	- Losses/leakages												ļ			↓
	- Other returns															1
		82.9	65.4	0.0	17.4	0.0	44.3	99.7	0.0		0.0		0.0	204.2	149.1	2.

L

		TOTAL					ent Ai		DISTRIB IRRIG		SEWE	HOUS	URBAN	RUR
		AGRICUL TURE	ATIO N AGRI CULT URE		STATIO N & ALIEN PLANTS		Y	AND	UTION ATIO OF N WATE	ECTI IBUTI ON ON	RAGE			REC
		A+ B + C	A	В	С	D	E	F	G	Н	I	J	K	
1	RAIN	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
	TOTAL WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	45.1	99.7	0.0	0.0	0.0	0.0	0.0	(
	PERENNIAL SURFACE WATER	65.4	65.4	0.0	0.0	0.0	45.1	99.7	0.0	0.0	0.0	0.0	0.0	(
2	- Water abstracted for own use	65.4	65.4	0.0	0.0	0.0	45.1	99.7	0.0	0.0	0.0	0.0	0.0	
2.1	- of which for irrigation - Water abstracted for delivery	65.4 0.0	65.4 0.0	0. 0 0. 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4	- Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
4.1 5	- of which for irrigation - Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(
	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	207.6	155.4	2
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
	WATER RETURNED (WATER DISCHARGED)													
7	- Irrigation water - Cooling water													
9	- Wastewater treated													
10 11	- Wastewater untreated - Losses/leakages													\vdash
12	- Other returns													L
		82.9	65.4	0.0	17.4	0.0	45.1	99.7	0.0	0.0	0.0	207.6	155.4	2

		TOTAL AGRICUL TURE	IRRIGATI ON AGRICUL TURE	LIVEST OCK	AFFORE - STATIO N & ALIEN PLANTS	FISHERI ES	ENERG Y	NG	IBUTI ATIO ON N	COLL DISTR ECTI IBUTI ON ON AND OF WATE R		EHOL	REQUIR		REST OF THE WORLD	
		A+B+C	A	В	С	D	E	F	G	Н	I	J	K	L	M	N
	RAIN	17.4	0.0	0.0	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	TOTAL WATER ABSTRACTED	65.4	65.4	0.0	0.0	0.0	45.9	99.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
T	PERENNIAL SURFACE WATER	65.4	65.4	0.0	0.0	0.0	45.9	99.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
:	- Water abstracted for own use	65.4	65.4	0.0	0.0	0.0	45.9	99.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	- of which for irrigation	65.4	65.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ŀ	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
,	- Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	211.1	162.0	2.1	431.1	0.0
1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
+	WATER RETURNED (WATER DISC	HARGED)														0.0
7	- Irrigation water															0.0
3	- Cooling water															0.0
,	- Wastewater treated															0.0
0	- Wastewater untreated															0.0
1	- Losses/leakages															0.0
2	- Other returns															0.0
		82.9	65.4	0.0	17.4	0.0	45.9	99.7	0.0	0.0	0.0	211.1	162.0	2.1	431.1	0.0

Table 78 - Annual delivery costs of water per sector in the Upper Vaal River WMA (1991 – 2000) - R million in 2000 prices

Year		Afforestation & alien plants	8.	Mining & heavv				Rest of the World	Total (annual)
		•		industries		•	•		
1991	65	17	39	100	181	111	2	245	761
1992	65	17	40	100	185	116	2	262	786
1993	65	17	40	100	188	121	2	279	813
1994	65	17	41	100	191	126	2	298	841
1995	65	17	42	100	194	132	2	318	870
1996	65	17	43	100	197	137	2	338	900
1997	65	17	43	100	201	143	2	359	931
1998	65	17	44	100	204	149	2	382	964
1999	65	17	45	100	208	155	2	406	998
2000	65	17	46	100	211	162	2	431	1 035

Source: Statistics South Africa

According to table 78, the cost of supplying raw water amounted to approximately R1 billion in 2000. The water use sectors with the highest delivery costs are:

- Rest of the world (all other WMAs except Upper Vaal WMA)
- Households and
- Urban requirements

Due to a constant supply of water to most sectors as well as a fixed cost to supply water used due to data limitations, most sectors exhibit a constant trend of supply costs from 1999-2001.

4.2.2 Tariffs

The revenues derived from water tariffs for different water use sectors are provided from 1991 to 2000 in table 79 on page 87 to table 88 on page 96.

	TOTAL	IKKIG	LIVEST	AFFORE	FISHERI	ENERG	MINING	DISTRIE	3 IRRIGA	COLLE	DISTRIB	SEWER	HOUSE	URBAN	RURA
	AGRICU LTURE			- STATIO N & ALIEN PLANTS	ES	Y	AND HEAVY INDUST RIES		TION WATER	CTION			HOLDS	REQUIR E- MENTS	E-
	A+B +C	A	В	С	D	E	F	G		Н		I	J	K	L
RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
TOTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	64.0	164.4	0.0		0.0		0.0	6.1	0.0	0.0
PERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	64.0	164.4	0.0		0.0		0.0	0.0	0.0	0.0
- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	3.2 3.2 0.0	3.2 3.2 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	64.0 0.0 0.0	164.4 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0		0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0
GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	6.1	0.0	0.0
Water abstracted for own use of which for irrigation Water abstracted for delivery	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0		0.0 0.0 0.0		0. 0 0. 0 0. 0	6.1 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0
WATER DELIVERED THROUGH MAINS - of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	299.3 0.0	182.5 0.0	3.5
WATER RETURNED (WATER DISCHARGED)															
- Irrigation water - Cooling water - Wastewater treated															
- Wastewater untreated - Losses/leakages - Other returns															

		TOTAL	IRRIG	LIVEST	AFFORE	FISHERI	ENERG	MINING	DISTRIB	COLLE	DISTRIB	SEWER	HOUSE	URBAN	RURAL
		AGRICUL TURE	ATIO N AGRI CULT URE	оск	- STATIO N & ALIEN PLANTS	ES	Y	AND HEAVY INDUST RIES		AND	UTION OF WATER	AGE		REQUIR E- MENTS	
		A+B+C	A	В	С	D	E	F	G	Н		I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	65.2	164.4	0.0	0.0		0.0	6.0	0.0	0.0
	PERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	65.2	164.4	0.0	0.0		0.0	0.0	0.0	0.0
2 2.1 3	Water abstracted for own use of which for irrigation Water abstracted for delivery	3.2 3.2 0.0	3.2 3.2 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	65.2 0.0 0.0	164. 4 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	6.0	0.0	0.0
4 4.1 5	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0	6. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	304.5	190.6	3.5
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCI	HARGED)													
7 8 9	- Irrigation water - Cooling water - Wastewater treated														
10 11 12	Wastewater untreated Losses/leakages Other returns														

ue	from water tariffs per sector in	ı the Up	per \	Vaal	Water	· Man	ageme									
		TOTAL AGRICUL TURE			AFFORE - STATIO	FISHERI ES	ENERG Y	MINING AND HEAVY	DISTRIE UTION OF	ATIO	COLLE CTION AND	DISTRIB UTION OF		HOUSE HOLDS	REQUIR	RURAL REQUIR E-
			N AGRI CULT URE		N & ALIEN PLANTS			HEAVY INDUST RIES	OF	WATE R	AND	WATER			E- MENTS	
		A+B+C	A	В	С	D	E	F	G		Н		I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	66.5	164.4	0.0		0.0		0.0	5.9	0.0	0.0
	PERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	66.5	164.4	0.0		0.0		0.0	0.0	0.0	0.0
2	- Water abstracted for own use	3.2	3.2	0.0	0.0	0.0	66.5	164.4	0.0		0.0		0.0	0.0	0.0	0.0
3	- of which for irrigation - Water abstracted for delivery	3.2 0.0	3.2 0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	5.9	0.0	0.0
4	- Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	5.9	0.0	0.0
5	- of which for irrigation - Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	309.7	199.1	3.5
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHARGED)															
7	- Irrigation water															
<u>8</u> 9	- Cooling water															
10	- Wastewater treated - Wastewater untreated															
11	- Losses/leakages															
12	- Other returns															
C		3.2	3.2	0.0	0.0	0.0	66.5	164.4	0.0		0.0		0.0	315.6	199.1	3.5

e from water tariffs per sector in the Upper Vaal Water Management Area for 1994 (R millions)

		TOTAL AGRICUL TURE	IRRIGA TION AGRICU LTURE	OCK	AFFORE - STATIO N & ALIEN PLANTS	FISHERI ES	ENERG Y	MINING AND HEAVY INDUST RIES	UTION	B IRRIGA TION WATER	CTION	DISTRIB UTION OF WATER			URBAN REQUIR E- MENTS	E-	
		A+B+C	A	В	C	D	E	F	G		Н		I	J	K	L	Ł
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	F
	TOTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	67.8	164.4	0.0		0.0		0.0	5.8	0.0	0.0	E
	PERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	67.8	164.4	0.0		0.0		0.0	0.0	0.0	0.0	L
2.1	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	3.2 3.2 0.0	3.2 3.2 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	67.8 0.0 0.0	164. 4 0. 0 0. 0	0.0 0.0 0.0		0.0 0.0 0.0		0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	5.8	0.0	0.0	l
4 1.1 5	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0		0.0 0.0 0.0		0.0 0.0 0.0	5.8 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	
	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	315.0	207.9	3.5	l
5.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	F
	WATER RETURNED (WATER DISCHA	ARGED)															E
7 8 9 10 11	- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns																
		3.2	3.2	0.0	0.0	0.0	67.8	164.4	0.0		0.0		0.0	320.8	207.9	3.5	I

e fi	rom water tariffs per sector in th															
		TOTAL AGRICULTU RE					ENER GY	AND	UTION	IRRIGA TION WATER	CTION	DISTRIB UTION OF WATER	SEWER AGE	HOUSE HOLDS	URBAN REQUIR E- MENTS	REQUIR E-
			CULT URE		ALIEN PLANTS			RIES				WAIEK			MENTS	WENTS
		A+B+C	A	В	С	D	Е	F	G		Н		I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	69.0	164.4	0.0		0.0		0.0	5.8	0.0	0.0
	PERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	69.0	164.4	0.0		0.0		0.0	0.0	0.0	0.0
2.1	- Water abstracted for own use	3.2	3.2	0.0	0.0	0.0	69.0 0.0	164.4	0.0		0.0		0.0	0.0	0.0	0.0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	5.8	0.0	0.0
4.1	- Water abstracted for own use - of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	5.8 0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	320.4	217.1	3.5
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHARGED)	<u> </u> 														
7	- Irrigation water - Cooling water															
9	- Wastewater treated															
10 11	- Wastewater untreated - Losses/leakages															
12	- Other returns															
C		3.2	3.2	0.0	0.0	0.0	69.0	164.4	0.0		0.0		0.0	326.1	217.1	3.5

	TOTAL AGRICUL TURE		LIVEST OCK	AFFORE STATIO	FISHERI ES	ENERG Y		DISTR IBUTI IRRIGA		SEWER AGE	HOUSE	URBAN	
				N & ALIEN PLANTS				ON TION	AND ON OF WATI		HOLDS	REQUIR E- MENTS	E- `
	A+B +C	A	В	С	D	E	F	G	Н	I	J	K	L
AIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	70.3	164.4	0.0	0.0	0.0	5.7	0.0	0.0
ERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	70.3	164.4	0.0	0.0	0.0	0.0	0.0	0.0
Water abstracted for own use of which for irrigation Water abstracted for delivery	3.2 3.2 0.0	3.2 3.2 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	70.3 0.0 0.0	164. 4 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0
ROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0
Water abstracted for own use of which for irrigation Water abstracted for delivery	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	5.7 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0
ATER DELIVERED THROUGH MAINS of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	325.7 0.0	226.3 0.0	3.5
ATER RETURNED (WATER DISCHARGED)												
Irrigation water Cooling water Wastewater treated Wastewater untreated Losses/leakages Other returns													
F	RENNIAL SURFACE WATER Water abstracted for own use of which for irrigation Water abstracted for delivery ROUNDWATER Water abstracted for own use of which for irrigation Water abstracted for delivery ATER DELIVERED THROUGH MAINS of which: Wastewater ATER RETURNED (WATER DISCHARGED irrigation water Cooling water Wastewater treated Wastewater untreated Losses/leakages	RENNIAL SURFACE WATER 3.2 Water abstracted for own use 3.2 of which for irrigation 3.2 Water abstracted for delivery 0.0 ROUNDWATER 0.0 Water abstracted for own use of which for irrigation Water abstracted for delivery 0.0 ATER DELIVERED THROUGH MAINS of which: Wastewater ATER RETURNED (WATER DISCHARGED) Irrigation water Cooling water Wastewater treated Wastewater untreated Losses/leakages	RENNIAL SURFACE WATER 3.2 3.2 3.2	RENNIAL SURFACE WATER 3.2 3.2 0.0	RENNIAL SURFACE WATER 3.2 3.2 0.0 0.0	RENNIAL SURFACE WATER 3.2 3.2 0.0 0.0 0.0	RENNIAL SURFACE WATER 3.2 3.2 0.0 0.0 0.0 70.3	RENNIAL SURFACE WATER 3.2 3.2 0.0 0.0 70.3 164.4	RENNIAL SURFACE WATER 3.2 3.2 0.0 0.0 0.0 70.3 164.4 0.0	RENNIAL SURFACE WATER 3.2 3.2 0.0 0.0 0.0 70.3 164.4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	RENNIAL SURFACE WATER 3.2 3.2 0.0 0.0 0.0 70.3 164.4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	RENNIAL SURFACE WATER 3.2 3.2 0.0 0.0 0.0 70.3 164.4 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	RENNIAL SURFACE WATER 3.2 3.2 0.0 0.0 0.0 70.3 164.4 0.0 0.0 0.0 0.0 0.0 0.0 0.0

ue	from water tariffs per sector									R millions)			
		TOTAL AGRICUL TURE		OCK	AFFORE - STATIO N & ALIEN PLANTS	ES	Y	AND	DISTRIB UTION IRRIGA OF TION WATER	AND ON	AGE	HOUSE HOLDS	URBAN REQUIR E- MENTS	REQUI E-
_		A+B +C	A	В	С	D	E	F	G	Н	I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0. 0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	71.7	164.4	0.0	0.0	0.0	5.6	0.0	0.0
_	PERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	71.7	164.4	0.0	0.0	0.0	0.0	0.0	0.0
2.1	- Water abstracted for own use - of which for irrigation - Water abstracted for delivery	3.2 3.2 0.0	3.2 3.2 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	71.7 0.0 0.0	164. 4 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0
4.1	Water abstracted for own use of which for irrigation Water abstracted for delivery	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0. 0 0. 0 0. 0	5.6 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0
6 6.1	WATER DELIVERED THROUGH MAINS - of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	331. 2 0.0	235.9	3.5
	WATER RETURNED (WATER DISCHARGED)												
7 8 9 10 11 12	- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leakages - Other returns													
E		3.2	3.2	0.0	0.0	0.0	71.7	164.4	0.0	0.0	0.0	336.8	235.9	3.5

ue	from water tariffs per sector in t	he Upper	·Vaa	al Wa	ater M	lanage	men	t Area	for 1998 (R millions)				
		TOTAL	IRRIG	LIVES	AFFORE	FISHERI	ENER	MINING	DISTRIB IRRIG	COLLE DISTRI	BSEWE	HOUSE	URBAN	RURAL
		AGRICUL	ATIO	TOCK	_	ES		AND		CTION UTION		HOLDS	REQUIR	
		TURE	N		STATIO			HEAVY		AND OF			E-	E-
		1012	AGRI		N &			INDUST	WATE		: I		MENTS	MENTS
			CULT		ALIEN			RIES	R	,,,,,,	1			
			URE		PLANTS			KILA						
			CKE		LZINIS									
		A+B+C	A	В	C	D	E	F	G	Н	1 1	J	К	L
		III B I C			-				<u>.</u>		Ť			
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	73.0	164.4	0.0	0.0	0.0	5.5	0.0	0.0
	PERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	73.0	164.4	0.0	0.0	0.0	0.0	0.0	0.0
2	- Water abstracted for own use	3.2	3.2	0.0	0.0	0.0	73.0	164.4	0.0	0.0	0.0	0.0	0.0	0.0
2.1	- of which for irrigation	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0
4	- Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	336.8	246.0	3.5
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	WATER RETURNED (WATER DISCHARGED)													
7	- Irrigat ion water					1		1						
8	- Cooling water		1	1			1				1			
9	- Wastewater treated				1						1			1
10	- Wastewater in cated		1	1			1				1			
11	- Losses/leakages		1	1			1				1			l
12	- Other returns		1	1	1		1			1	1			
14	- Other rearins				1									1
C		3.2	3.2	0.0	0.0	0.0	73.0	164.4	0.0	0.0	0.0	342.3	246.0	3.5

ue	from water tariffs per sector	in the U	pper						rea fo	r 1999	(R ı	million	s)				
		TOTAL AGRICUL TURE			AFFORE - STATIO N & ALIEN PLANTS	FISHE RIES	ENERG Y		UTION	IRRIGA		DISTRIB UTION OF WATER				REQUIR E-	RE OF W
_		A+B +C	A	В	С	D	E	F	G		Н		I	J	К	L	
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	0.0	0.0	0.0	
_	TOTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	74.4	164.4	0.0		0.0		0.0	5.4	0.0	0.0	
_	PERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	74.4	164.4	0.0		0.0		0.0	0.0	0.0	0.0	E
2.1	Water abstracted for own use of which for irrigation Water abstracted for delivery	3.2 3.2 0.0	3.2 3.2 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	74.4 0.0 0.0	164. 4 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0		0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	
=	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	5.4	0.0	0.0	
4.1	Water abstracted for own use of which for irrigation Water abstracted for delivery	0.0 0.0 0.0	0. 0 0. 0 0. 0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0	0.0 0.0 0.0		0.0 0.0 0.0		0.0 0.0 0.0	5. 4 0. 0 0. 0	0.0 0.0 0.0	0. 0 0. 0 0. 0	
6 6.1	WATER DELIVERED THROUGH MAINS - of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	342.5 0.0	256.4 0.0	3.5	·
	WATER RETURNED (WATER DISCHARGED)															
7 8 9 10 11 12	- Irrigation water - Cooling water - Wastewater treated - Wastewater untreated - Losses/leaLages - Other returns																
E		3.2	3.2	0.0	0.0	0.0	74.4	164.4	0.0		0.0		0.0	347.9	256.4	3.5	-

ue fro	om water tariffs per sector in the Upper	Vaal Wa	ater M	lanag	geme	nt A	rea f	or 200	00 (R mil	lions)				
		TOTAL AGRICUL TURE	IRRIGA TION AGRICU LTURE		AFFO REST ATIO N & ALIE N PLAN TS		$\mathbf{G}\mathbf{Y}$	MINING AND HEAVY INDUST RIES		ECTI ON E AND	RAGE	HOUS	URBAN REQUIR EMENT S	
		A+B+C	A	В	С	D	Е	F	G	Н	I	J	K	L
1	RAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	TOTAL WATER ABSTRACTED	3.2	3.2	0.0	0.0	0.0	75.8	164.4	0.0	0.0	0.0	5.4	0.0	0.0
	PERENNIAL SURFACE WATER	3.2	3.2	0.0	0.0	0.0	75.8	164.4	0.0	0.0	0.0	0.0	0.0	0.0
2	- Water abstracted for own use	3.2	3.2	0.0	0.0	0.0	75.8	164.4	0.0	0.0	0.0	0.0	0.0	0.0
2.1	- of which for irrigation	3.2	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	GROUNDWATER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0
4	- Water abstracted for own use	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0
4.1	- of which for irrigation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	- Water abstracted for delivery	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	WATER DELIVERED THROUGH MAINS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	348.2	267.3	3.5
6.1	- of which : Wastewater	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	WATER RETURNED (WATER DISCHARGED)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	- Irrigation water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	- Cooling water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	- Wastewater treated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	- Wastewater untreated	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	- Losses/leakages	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	- Other returns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E		3.2	3.2	0.0	0.0	0.0	75.8	164.4	0.0	0.0	0.0	353.6	267.3	3.5

Table 89 – Annual revenue from water tariffs per sector in the Upper Vaal River WMA (1991-2000) – R million in 2000 prices

Year	Irrigation	Afforestation &	Energy	Mining &	Househlods	Urban	Rural	Rest of the	Total
	agriculture	alien plants		heavy		requirement	requirement	World	(annual)
				industries					
1991	3	3	64	164	305	183	4	404	1 128
1992	3	3	65	164	310	191	4	432	1 169
1993	3	3	66	164	316	199	4	461	1 213
1994	3	3	68	164	321	208	4	491	1 259
1995	3	3	69	164	326	217	4	524	1 308
1996	3	3	70	164	331	226	4	557	1 356
1997	3	3	72	164	337	236	4	592	1 408
1998	3	3	73	164	342	246	4	630	1 462
1999	3	3	74	164	348	256	4	669	1 519
2000	3	3	76	164	354	267	4	711	1 579

Source: Statistics South Africa

From table 89 it is apparent that the total revenue from water tariffs amounted to almost R1,6 billion in 2000, increasing by 40 % from R1,1 billion in 1991 (in constant 2000 prices). In 2000, 67 % of the total annual revenue is from the rest of the world (all other WMAs except the Upper Vaal WMA) and households. Irrigation agriculture, heavy industries and rural requirements remain constant because water usage in those sectors is static.

4.2.3 Subsidies and Over Recoveries

Table 90 presents an exposition of sectoral subsidization/overrecoveries with regard to the delivery costs of water to various sectors for the year 2000.

Table 90 – Subsidies/ Over-recoveries of water used per sector in the Upper Vaal River WMA

Sector	Subsidies (+)/Overrecoveries (-) (2000, R million)
Irrigation agriculture	62,2
Livestock	0
Afforestation & alien plants	17,4
Fisheries	-
Energy	-29,8
Mining & heavy industries	-64,7
Households	-142,5
Urban requirements	-105,3
Rural requirements	-1,4
Rest of the world	-280,0
Total	-544,0

Source: Statistics South Africa

According to table 90 it is evident that irrigation agriculture and afforestation and alien plants are the only sectors in which subsidization takes place. On the contrary, the rest of the sectors are paying more than they should. The overall amount of overrecovery is R544 million and therefore results in a subsidization of some sectors.

5. Glossary

Account

An account is a tool is which records, for a given aspects of economic life, (a) the uses and resources or (b) the changes in assets and the changes in liabilities and\or (c) the stock of assets and liabilities existing at a certain time; the transaction accounts include a balancing item which is used to equate the two sides of the accounts (e.g. resources and uses) and which is meaningful measure of economic performance in itself.

Catchment

A catchment is an area on which rain falls and the water thus run into a particular river.

Compensation of employees

Compensation of employees is defined as the total remuneration, in cash or in kind, payable by an enterprise to an employee in return for work done by the latter during the accounting period. Compensation of employees does not include any taxes payable by the employer on the wage and salary bill

Evapotranspiration

Evapotranspiration is the combined loss of water by evaporation from the soil or surface water and transpiration from the plants and animals.

Groundwater

Groundwater is freshwater beneath the earth's surface (usually in aquifers) supplying wells and springs.

Human capital

Human capital is productive wealth embodied in labour, skill and knowledge.

Intermediate consumption

Intermediate consumption consists of the value of the goods and services consumed as inputs by a process of production, excluding fixed assets whose consumption is recorded as consumption of fixed capital. The goods or services may be either transformed or used up by the production process. Some inputs re-emerge after having been transformed and incorporated into the outputs. Other inputs are completely consumed or used up. Intermediate consumption includes the rentals paid on the use of fixed assets.

Mean annual runoff

Mean annual runoff is the average annual flow under natural conditions. (This definition is dependent on the runoff regime for each river basin).

Mineral exploration

Mineral exploration consists of the value of expenditures on exploration for petroleum and natural gas and for non-petroleum deposits; it includes pre-license costs, license and acquisition costs, appraisal costs and the costs of actual test drilling and boring, as well as the costs aerial and other surveys, transportation costs, etc, incurred to make it possible to carry out the tests.

Natural Resource Accounting

Natural Resource Accounting is an accounting system that deals with stocks and stock changes of natural assets, comprising biota (produced or wild), subsoil assets (proved reserves), water and land with their aquatic and terrestrial ecosystems. It is frequently used in the sense of physical accounting as distinguished from monetary (environmental) accounting.

Natural Resources

Natural assets (raw materials) occurring in nature that can be used for economic production or consumption.

Physical Accounting

Natural resource and environmental accounting of stocks and changes in stocks in physical (non-monetary) units, for example, weight, area or number. Qualitative measures, expressed in terms of quality classes, types of uses or ecosystem characteristics, may supplement quantitative measures. The combined changes in asset quality and quantity are called volume changes.

Precipitation

Precipitation is a) rain or snow falling from the atmosphere and deposited on land or water surfaces; (b) forced removal of particles from flue gases or waste water.

Run-off

Run-off is a portion of rainfall, melted snow or irrigation water that flows across the ground's surface and is eventually returned to streams. Run-off can pick up pollutants from air or land and carry them to receiving waters.

Satellite accounts or systems

Satellite accounts or systems is an additional or parallel accounting system that expands the analytical capacity of national accounts, without overburdening or disrupting the central system. It may provide additional information, apply complementary or alternative concepts, extend the coverage of costs and benefits of human activities and link physical with monetary data.

Sustainability

Sustainability is the concept refers to (a) use of the biosphere by present generation while maintaining its potential yield (benefit) for future generations; and/or (b) non-declining trends of economic growth and development that might be impaired by natural resource depletion and environmental degradation.

System of integrated Environmental and Economic Accounting System of National Accounts

Satellite system of the System of National Accounts (SNA) proposed by the United Nations (1993a) for the incorporation of environment concerns (environmental costs, benefits and assets) into national accounts.

System of National Account revised (1993) system adopted worldwide for conventional economic (national) accounting (Commission of the European Communities and others, 1993).

Water management area

A water management are is an area defined for specific water management Purposes.

ABBREVIATIONS AND ACRONYMS

AR Annual Runoff

CMA Catchment Management Area

DWAF Department of Water Affairs and Forestry

LSU Large Stock Unit
MAR Mean Annual Runoff

NRA Natural Resource Accounting RSA Republic of South Africa Stats SA Statistics South Africa

SEEA System of Environmental and Economic Accounting

UN United Nations

WMA Water Management Area
WRA Water Resource Accounting

VA Value Added

SNA System of National Accounting

GDP Gross National Product SU-tables Supply and Use tables