CHAPTER 3: THE BREEDE RIVER COMPONENT OF THE BREEDE WMA: OVERVIEW FROM A WATER RESOURCE MANAGEMENT PERSPECTIVE

3.1 INTRODUCTION

To address the water resource management perspective within the Breede WMA, the WMA has been split into two sub-regions, namely:

- the Breede River component (see Figure 3.1)
- the Overberg component (see Figure 4.1)

This Chapter describes the water resource management perspective within the Breede River component. This encompasses the catchments of the Breede River and its tributaries of which the Riviersonderend River is the largest. Chapter 4 describes the Overberg component of the Breede WMA.

The existing water resource infrastructure is documented, after which a detailed assessment of the current and future water resource (availability), water requirements and yield balance are presented. Water quality, which plays an equally important role in the use and management of the water resource, is then addressed.

Much of the information on the Breede River component has been sourced from the following reports:

- *The Breede River Basin Study – Main Report (Ref.8)*
- *Breede WMA : Overview of Water Resources Availability and Utilisation (Ref.9)*
- *National Water Resource Strategy, First Edition (Ref.10)*

The extent of the Breede River component corresponds to the study area of the recently completed Breede River Basin Study (BRBS). That study presents the latest available assessment of water resources in the Breede River component and the information contained therein is used extensively is this chapter. The catchment areas of the Breede River and its tributaries drain the northern region of the WMA and are clearly distinguishable from the remainder of the Breede WMA to the south (the Overberg catchments).

In the NWRS, the Breede River component of the Breede WMA has been further sub-divided into three sub-areas. This sub-division has been retained in the ISP for the purpose of describing the availability, requirements and yield balance within the region. The three sub-areas as shown in Figure 3.1 are:

- The ***Upper Breede*** sub-area, consisting of 5 secondary catchments (H10-H50). This area extends from the source of the Breede River in the Skurweberg Mountains (to the north of Ceres) down to the confluence of the Breede and Riviersonderend Rivers.

- The ***Riviersonderend*** sub-area, consisting of secondary catchment H60, which extends from the source of the Riviersonderend River in the Franschhoek Mountains, upstream of Theewaterskloof Dam, to the confluence with the Breede River.
- The ***Lower Breede*** sub-area, downstream of the confluence with the Riviersonderend River, consisting of secondary catchment H70 which includes the Buffeljags River tributary.

The Breede River and its largest tributary, the Riviersonderend River, are the two main rivers in the Breede River component, draining an area of 12 600 km^2. The Breede River itself is 322 km long, rising in the Skurweberg Mountains near Ceres (H10C) and draining to the estuary mouth between Infanta and Witsand.

In its upper reach, the Breede River flows southward and is joined by a number of tributaries, namely the Wit River (H10E), the Molenaars River (H10J) and the Holsloot River (H10K). The Hex River drains the H20 catchment and joins the Breede River near Greater Brandvlei Dam (H20H).

In the middle reach, the Breede River is joined by the Kingna River (H30A to D) and extends from below Greater Brandvlei Dam to its confluence with the Riviersonderend River (H50E). The Riviersonderend River itself rises upstream of Theewaterskloof Dam (H60C), in the Hottentots Holland (H60A) and Franschhoek Mountains (H60B). Downstream of the dam, a number of small tributaries join the Riviersonderend before it reaches its confluence with the Breede River.

In the lower reach, the main tributary joining the Breede River is the Buffeljags River, which rises in the Langeberg Mountains (H70C to E) and is regulated by the Buffeljags Dam.

Figure 3.1: The Breede River Component of the Breede WMA *(ref: The Breede WMA Report)*

3.2 REGIONAL WATER SUPPLY SCHEMES IN THE BREEDE RIVER COMPONENT OF THE BREEDE WMA

3.2.1 The Riviersonderend-Berg-Eerste River Government Water Scheme

The Theewaterskloof Dam has a capacity of 434 million m^3 and is the source reservoir for the Riviersonderend-Berg-Eerste River Government Water Scheme. This is an IBT scheme supplying water for urban use to the Greater Cape Town area (including Stellenbosch), and water for agricultural use in the Eerste River and Berg River catchments. The dam stores runoff from its own catchment as well as water diverted into it during the winter months from the Berg WMA by means of a system of diversion weirs and tunnels. During summer a significant proportion of the total yield of the dam is transferred back to the Berg WMA via the same tunnel system. The scheme has a 1 in 50 year yield of 234 million m^3/a (BRBS, 2003). This is inclusive of the yields of the Banhoek and Wolwekloof tributary diversions on the Upper Berg River, and of the local yield of Kleinplaas Dam on the Eerste River in the Berg WMA.

Some 60 % of the yield has been allocated for irrigation in the Berg and Eerste River catchments, the lower Riviersonderend catchment, and for supply to the Overberg Rural Water Supply Scheme in the adjacent Overberg. The balance is allocated to the Cape Town Metropolitan Area and there is no surplus yield available from the system. On average a net transfer of about 161 million m^3/a into the Berg WMA takes place via this scheme. The only way in which the supply to the Berg WMA from this scheme could be increased, would be to supplement inflows to Theewaterskloof Dam from Greater Brandvlei Dam, via a transfer scheme which would have to be constructed between the two dams.

3.2.2 Minor Transfer Schemes

Four small schemes transfer water out of the Breede WMA. These are:

- the *Inverdoorn Canal* in which 2,5 million m^3/a of water for irrigation is diverted by means of weirs on the Spek and Valschgat Rivers (H20C) into the Inverdoorn Canal which carries it into the catchment of the Doring River (E22C) in the Olifants/Doorn WMA.

- the *Artois Canal* which transfers an estimated 4 million m^3/a of water from the Breede River (H10F) to the Klein Berg River catchment (G10E) in the Berg WMA for irrigation use by the Dwars River WUA. The town of Wolseley also has an allocation from the scheme.

- The *"Gawie se Water" Scheme*, which diverts 5 million m^3/a of water for irrigation from the Upper Wit River catchment (H10E) in the Breede WMA to the Kromme River catchment (G10D) in the Berg WMA.

- The *Du Toits River to Franschhoek* transfer (H10J) supplies approximately 0,6 million m^3/a from the Breede River catchment to the town of Franschhoek in the Upper Berg.

A small transfer of approximately 0,7 million m^3/a into the Breede WMA (Lower Breede sub-area) takes place from the Duiwenhoks River catchment in the adjacent Gouritz WMA. Approximately 145 farms within the Breede WMA, and the town of Witsand, are supplied from this transfer.

3.3 LOCAL URBAN WATER SUPPLY SCHEMES IN THE BREEDE RIVER COMPONENT

Small local supply schemes meet almost all of the urban water requirements in the Breede River component. There are a few exceptions, namely the town of Witsand (supplied out of the Gouritz WMA), and the towns of Riviersonderend and Greyton (both supplied from Theewaterskloof Dam). The current urban (26 million m^3/a) and rural (7 million m^3/a) water requirements constitute collectively less than 5% of the total local water requirement.

Augmentation of current urban supply schemes may be required in the future, depending on growth in requirements. However, all local authorities must first undertake and implement more efficient water use and water re-use from their existing resources, before consideration will be given to the development of new schemes.

Where the provision of supplementary urban water supply is unavoidable, groundwater should be seriously considered. Towns such as Witsand could also augment supplies through the desalination of water from the lower Breede River-estuary interface zone. The details of current and future supply schemes to towns within the Breede River component are addressed under the Supply to Local Authorities Strategy (12.1).

Over and above Theewaterskloof Dam, the other large dam supplying urban water users is Stettynskloof Dam (owned by the Breede Valley Municipality). This has a capacity of 15,5 million m^3, and supplies water to the town of Worcester. Through agreement with the Breede Valley Municipality, irrigators of the Holsloot WUA are also supplied from the dam. The annual volume supplied to the irrigators and the assurance of that supply is dependent on the storage in Stettynskloof Dam.

3.4 IRRIGATION SUPPLY IN THE BREEDE RIVER COMPONENT

Irrigation is by far the largest user of water in the Breede River component. Excluding transfers, it accounts for approximately 95% of the total local water use for this region of the WMA.

In 1998 there were sixty-six irrigation boards in the Breede River component. Of these, sixty-two were in the Upper Breede sub-area (H10 – H50), three in the Riviersonderend sub-area (H60) and one in the Lower Breede (H70) sub-area. The most recent available estimate of irrigated land-use is 99 100 ha (BRBS, 2003). It is estimated that approximately 25% of the total irrigated land lies outside the authority of irrigation boards or water user associations. It is important to note that in the hydrocensus carried out by the Department in the Hex River catchment (H20), the registered irrigation area (4 500 ha) compared to within 3% of that determined independently in the BRBS (using aerial photography). This adds confidence to the total areas and actual water use estimates determined in the BRBS, and adopted in this ISP as the best information available. DWAF will be verifying all water use in all quaternary catchments and determining its lawfulness. Refer to Verification of Existing Lawful Use Strategy (9.2).

The larger dams in the Breede WMA primarily supplying irrigators include:

- *The Ceres (Koekedouw) Dam* with a capacity of 22,5 million m^3. The BRBS reports a yield of 17 million m^3/a at an 85% assurance of supply. This supplies water to the Koekedouw Water User Association (WUA) for irrigation, and also supplies the town of Ceres.

- *Greater Brandvlei Dam*, an off-channel storage dam, filled to a capacity of 342 million m^3 by a canal from diversions out of the Smalblaar and Holsloot Rivers (tributaries of the Breede River). The dam has a firm yield of 155 million m^3/a (Ref 8). Unused spare storage capacity in the dam of 133 million m^3 could be utilised through increased pumping capacity (additional 15m^3/s to total 20 m^3/s) out of the Breede River. Although previously seldom operated, the existing 5m^3/s pumping facility was fully utilised for the first time in 2003, which was a particularly dry year. Where possible, farmers avoid this option due to the pumping costs associated with utilising it, but there is enough winter water available out of the Breede River should this seem necessary.

- *The Lakenvallei* and *Roode Elsberg Dams* in the Hex River catchment have a combined capacity of 18 million m^3 and a firm yield of 9 million m^3/a (Ref 8). They provide primary storage for the Hexvallei WUA (Sanddrift Government Water Scheme). The dams supply irrigators in the Hex River Valley and urban water users in the town of De Doorns. Water is transferred by means of a tunnel through the Hex River mountain range that separates the dams from the valley, and is distributed via a network of pipelines within the valley itself.

- *Keerom Dam* on the Nuy River has a capacity of 10,4 million m^3 and a firm yield of 3,8 million m^3/a (Ref 5) and is owned by the Nuy WUA.

- *Elandskloof Dam* on the Elands River has a capacity of 11,4 million m^3 and a firm yield of 12 million m^3/a (Ref 5). It supplies irrigators and the town of Villiersdorp.

- *Buffeljags Dam* on the Buffeljags River has a capacity of 5,2 million m^3 and a firm yield of 11 million m^3/a (Ref 8), and supplies water for irrigation to the Buffeljags WUA.

In addition to these larger dams there are a number of smaller farm dams in the Upper Breede (particularly upstream of Ceres), the Lower Breede and the Riviersonderend sub-areas, with combined capacities of 59 million m^3, 4 million m^3 and 20 million m^3, respectively.

3.5 WATER AVAILABILITY IN THE BREEDE RIVER COMPONENT

The BRBS represents the latest available assessment of water resource availability in the Breede River component. The BRBS figures are used in this first version of the Breede ISP, and form the basis for strategic recommendations with regard to use, planning, and management. A comparison with those figures appearing in the First Edition of the NWRS is presented in Chapter 5, where the more significant differences are briefly explained, and the recommended changes are motivated.

The natural Mean Annual Runoff (MAR) and the preliminary ecological component of the Reserve are shown in Table 3.5.1.

Table 3.5.1: Mean Annual Runoff and Preliminary Ecological Water Requirements (million m^3/a)

Resource Category	Upper Breede	Riviersonderend	Lower Breede	Total
Natural MAR (1)	1092	439	272	**1803**
Preliminary Ecological Water Requirement (1) & (2)	612	170	193	**975 (3)**
Impact of Preliminary Ecological Water Requirement on Yield (Incremental) (2)	16	0	0	**16**

1) Quantities are incremental.
2) Based on the current ecological classes.
3) The preliminary Ecological Water Requirements determined in the BRBS indicates that the estuary requirement is 954 million m^3/a (53% of the natural MAR). However, in certain months, the riverine requirement is higher. That study recommends that the higher of the two requirements be allowed for, namely 975 million m^3/a.

Table 3.5.2: Water Availability in the Breede River Component (million m^3/a, Year 2000)

Resource Category	Upper Breede	Riviersonderend	Lower Breede	Total
Gross Surface Water Resource Yield	428	262	59	**749**
Less Impact on Yield of:				
Preliminary Ecological Water Requirement	16	0	0	**16**
Invasive Alien Plants	25	13	7	**45**
River Losses	5	0	0	**5**
Net Surface Water Resource	**382**	**249**	**52**	**683**
Plus Groundwater	94	5	4	**103**
Plus Return Flows	85	10	7	**102**
Total Local Yield	**561**	**264**	**63**	**888**
Transfers In (1)	0	0(3)	14(2)	**1**
TOTAL	**561**	**264**	**77**	**889**

1) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. Addition of the transfers per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA.
2) Made up as follows: **10** million m^3/a from the Upper Breede sub-area, approximately **3** million m^3/a from the Riviersonderend sub-area and about **1** million m^3/a inter-basin transfer from the Gouritz WMA.
3) Winter transfers at the Wolwekloof and Banhoek diversions into the Riviersonderend-Berg-Eerste River tunnel in the Berg WMA, are balanced by transfers via the tunnel back to the Berg WMA, in the summer months.

As shown in Table 3.5.2, the gross surface water resource in the Breede River component is estimated to be 749 million m^3/a, of which approximately 60% is provided from the major dams and 40% from minor dams and run-of-river. After allowing for the impact of the preliminary Ecological Water Requirements, the impact of invasive alien plants and river losses, the available surface water is 683 million m^3/a (at 1 in 50 year assurance of supply).

The greatest use of groundwater takes place in the Upper Breede and particularly upstream of Ceres, in the vicinity of Rawsonville, and in the Hex River valley. In the Hex River valley, surface and groundwater use are of similar magnitude (approximately 20 million m^3/a each). The present day groundwater yield from the Upper Breede sub-area is 94 million m^3/a of the total of 103 million m^3/a for the Breede River component.

Irrigation return flows in the Upper Breede also contribute substantially to the yield. However, downstream of Worcester these return flows contain high salt concentrations necessitating the need for freshening releases to improve water quality in the lower reaches (see Section 3.12). After allowing for return flows of 102 million m^3/a, the total local yield is estimated to be 888 million m^3/a. A net transfer of 1 million m^3/a takes place into the Breede River component, from the Gouritz WMA, bringing the total water availability to 889 million m^3/a.

3.5.1 Uncertainties Affecting Water Availability Estimates

In estimating water availability, the following uncertainties have been identified:

<u>Preliminary Ecological Water Requirements</u>:
The BRBS undertook a detailed investigation into preliminary Ecological Water Requirements for the Breede River and the Breede River estuary. The conclusion arising from that study was that the Breede River has one of the higher estuary requirements (53% of the natural MAR) of the large rivers in the country. This may be due to the fact that few other estuary Reserve assessments have been done in the Western Cape, and knowledge in estimating actual Ecological Water Requirements of large estuarine systems in the Western Cape is still limited.

It is important to note that despite the high preliminary Ecological Water Requirement of 975 million m^3/a, the resulting low impact of 16 million m^3/a on the yield of the present system is due to the fact that:

i The current Ecological Water Requirements for the Lower Breede River (Class "C") and its estuary (Class "B") are almost entirely met through present day flow conditions. Meeting the few seasonal shortfalls accounts for the relatively small impact on the present day yield (provided by the existing infrastructure) of 16 million m^3/a.

ii An assumption was made to keep the Riviersonderend River, at least for the interim, as a Class "E" (its present ecological status). The motivation for this decision is as follows: The current ecological class of the Riviersonderend River is a Class "E".

Were the river to be rehabilitated to a Class "D" (the scientific recommendation of the BRBS), the resulting impact on yield would be 85 million m^3/a, with much of that having to be provided through releases out of Theewaterskloof Dam. The yield from the dam is already fully allocated and compulsory licensing would be required to resolve the over-allocation. The CCT and irrigators dependent on water from the dam would then need to curtail use (cutting back on farming and other economic activity) or develop other sources to offset this impact.

In terms of (ii) above, if the Riviersonderend River were to be rehabilitated to a Class "D" River, the financial and social costs would be very high. In order to make a decision as to which ecological class is to be adopted, it will be required to develop Reserve implementation scenarios and to engage in a well-informed public participation process. However, the Reserve and Resource Quality Objectives Strategy (8.1) recommends that, in the interim, the status quo be maintained as the management class. Water resource management of the Riviersonderend River, in terms of this ISP, will therefore be based on the current class, until a more informed decision possibly suggests otherwise. Based on this interim approach, there would therefore be no further impact on the present day yield of the Riviersonderend catchment.

Hydrology

The number of and distribution of rainfall records is of some concern, particularly in the uppermost (high rainfall) regions of the Breede River catchments, where much of the runoff is generated. Improvements to the rain gauging at higher altitudes is important for understanding the recharge to the TMG aquifers, and the proper separation of baseflow contributions from shallow and deep TMG sources. DWAF's RO is arranging for additional rain gauges to be sited at higher elevations and the additional data will be utilised to improve the accuracy of future hydrological modelling calibrations.

Climate Change

It is predicted that ongoing global warming will bring about a decrease in rainfall over the Western Cape region. This could cause substantial reductions in streamflow with associated impacts on the surface and groundwater yields. Studies to date suggest a possible 10% reduction in streamflow in the Western Cape, by 2015. This means that the current estimates of available water may need to be revised downwards as a direct result of global warming. As discussed in the Water Availability Strategy (7.1), this must be taken into account when assessing future estimates of water availability.

3.6 WATER REQUIREMENTS IN THE BREEDE RIVER COMPONENT

Water requirements determined in the BRBS are considered the best synthesis of available knowledge and are used in this Section. These form the basis for the strategic recommendations in this ISP. A comparison with the figures appearing in the First Edition of the NWRS is presented in Chapter 5, where the more significant differences are briefly explained, and the recommended changes are motivated.

Table 3.6.1: Water Requirements in the Breede River Component (million m^3/a, Year 2000)

Category	Upper Breede	Riviersonderend	Lower Breede	Total
Irrigation	495	91	72	**658**
Urban (1)	23	2	1	**26**
Rural	4	2	1	**7**
Impact of Afforestation on Yield	0	1	0	**1**
Total Requirements	**522**	**96**	**74**	**692**
Transfers Out (2)	22(3)	168(4)	0	**177(5)**
TOTAL	**544**	**264**	**74**	**869**

1) Includes component of Reserve for basic human needs at 25 l/c/d.
2) Transfers into and out of sub-areas may include transfers between sub-areas as well as transfers between WMAs. Addition of the transfers per sub-area therefore does not necessarily correspond to the total transfers into and out of the WMA.
3) Made up as follows: **4** million m^3/a IBT to Berg WMA via Artois Canal, plus **5** million m^3/a IBT from "Gawie-se-water" to Berg WMA, plus **2,5** million m^3/a IBT to Olifants/Doorn WMA (via the Inverdoorn Canal), plus **10** million m^3/a surplus water from freshening releases.
4) Made up as follows: **161** million m^3/a from Theewaterskloof to Berg WMA, plus **0,6** million m^3/a to Franschhoek (Berg WMA), representing the net transfer from the Breede River component to the Berg WMA after accounting for the Wolwekloof and Banhoek Diversions in the Berg WMA, into the Breede WMA during winter months. In addition, transfers of **4** million m^3/a to Overberg, plus **2,5** million m^3/a to Lower Breede also take place.
5) Made up as follows: **161** million m^3/a IBT from Theewaterskloof to Berg WMA, plus **4** million m^3/a IBT to Berg WMA via Artois Canal, plus **5** million m^3/a IBT from "Gawie-se-water" to Berg WMA, plus **0,6** million m^3/a IBT to Franschhoek, plus **2,5** million m^3/a IBT to Olifants/Doorn WMA (Inverdoorn Canal), plus **4** million m^3/a to Overberg region.

The 22 million m^3/a freshening releases from Greater Brandvlei Dam are taken into account in the Irrigation Water Requirement in Table 3.6.1. The opportunistic use of approximately 10 million m^3/a of this, downstream of the lowest salinity management point on the Breede River, is reflected as a transfer into the Lower Breede sub-area (see Table 3.5.2).

At an equivalent 1 in 50 year assurance of supply, the estimated 99 100 ha (BRBS) of irrigated land utilises approximately 95% of the total local water requirement in the Breede River component. 75% of the total irrigation water requirement is from within the Upper Breede sub-area.

The CCT and irrigators along the Berg and Eerste Rivers are partially reliant on water supplied from the Breede River component. Section 3.2 describes these transfers in some detail. The main transfer takes place from the Riviersonderend sub-area, out of Theewaterskloof Dam. This varies annually depending on the operation of the Western Cape Water Supply System (WCWSS), averaging at the moment 161 million m^3/a.

3.6.1 Uncertainties Affecting Water Requirement Estimates

In estimating water requirements, the following uncertainties have been identified:

Climate Change

In addition to predicted decline in rainfall, increased temperatures in the Western Cape would further result in increased evaporation and an increase in irrigation requirements. Although this has no impact on current water requirement estimates, the impact of climate change must be taken into consideration when developing planning scenarios for future water requirements (refer to Water Requirements Strategy – 7.2).

Current Irrigation Water Use

The irrigation water requirement supplied from outside of controlled irrigation areas (government schemes and WUAs) is estimated to be in the order of 25% of the total irrigation requirement in the Breede River component. These sources include run of river, farm dams and boreholes. Herein lies some degree of uncertainty. However the hydrocensus undertaken by the Department in the Hex River Valley has shown that registered water use figures (WARMS) in that area compare favourably with the actual water requirement estimates undertaken for the BRBS. By extrapolation it is reasonable to assume that the BRBS requirement values for the whole Breede River component of the Breede WMA are reasonably accurate. The registration process will be followed up with a verification of the extent of the lawfulness of that use which has been registered. This is further addressed under the Verification of Existing Lawful Use Strategy (9.2).

Changes in Land-use

The decommissioning of commercial forestry will result in small areas of state owned land becoming available for alternative land-uses in the Breede River component. There is currently only 1500 ha of forestry in the catchment with an estimated impact on yield of only 1,5 million m^3/a, much of which is in the Riviersonderend sub-area. Clearing will increase runoff and the yield of the system. Future land-use such as the establishment of emerging forestry growers or emerging farmers may introduce new demands. Refer to the Changing Land-Use: Forestry Strategy (9.5).

The priority areas for clearing invasive plants are identified in the Clearing of Invasive Alien Plants Strategy (9.6) and briefly described under the Reconciliation Interventions in Section 3.9.

The Impact of Implementing WC/DM

In this ISP, estimates of future urban water requirements are based on the assumption that a 30% saving will be achieved through the implementation of WC/DM by local authorities. Little progress has been made to date and appropriate monitoring will be necessary to determine actual success in achieving this. The WSDPs provide the platform for the Department to encourage and assist local authorities in the implementation of WC/DM.

In the agricultural sector significant savings could be achieved through the upgrading and programmed maintenance of distribution infrastructure (pipelines and canals), although this would be capital intensive. A reduction in saline return flows would also reduce the need for freshening releases from Brandvlei Dam, and thus increase water availability. Currently, freshening releases of about 22 million m^3/a are made out of Greater Brandvlei Dam. Future water resource planning will need to continually incorporate the progress made in this regard. To date, the introduction of more efficient irrigation systems (drip, microjet) represents the only significant steps towards implementing WC/DM in the agricultural sector.

Savings could be made through :

- interception of saline return flows to reduce salinity levels and required freshening volumes.
- improved (more efficient) management of irrigation and freshening releases.
- repair to ageing conveyance systems.

WC/DM is further discussed under Section 3.9 (Reconciliation Interventions) and in the WC/DM Strategies, 10.1 and 10.2.

3.7 RECONCILIATION OF WATER REQUIREMENTS AND AVAILABILITY IN THE BREEDE RIVER COMPONENT

Table 3.7.1 provides a reconciliation of the current water requirements with the available resource for the Year 2000. The reconciliation figures presented in Table 3.7.1 are based on the recommended availability and requirement figures described previously.

Table 3.7.1: Reconciliation of Water Requirements and Availability in the Breede River Component (million m^3/a, Year 2000)

Description		ISP SUB-AREAS			Total
		Upper Breede	Riviersonderend	Lower Breede	
Available Water	Local Yield	561	264	63	**888**
	Transfers In	0	0	14 (1)	**1 (1)**
	Total	**561**	**264**	**77**	**889**
Water Requirements	Local Requirements	522	96	74	**692**
	Transfers Out	22	168 (2)	0	**177(3)**
	Total	**544**	**264**	**74**	**869**
Balance		**17**	**0**	**3**	**20**

1) Transfers into the Lower Breede sub-area include transfers between sub-areas as well as the IBT from the Gouritz WMA. The net transfer into the Breede River component being the IBT from the Gouritz WMA (0,7 million m^3/a).

2) Made up as follows: **161** million m^3/a from Theewaterskloof to Berg WMA, plus **0,6** million m^3/a to Franschhoek (Berg WMA), representing the net transfer from the Breede River component to the Berg WMA after accounting for the Wolwekloof and Banhoek Diversions in the Berg WMA, into the Breede WMA during winter months. In addition, transfers of **4** million m^3/a to Overberg, plus **2,5** million m^3/a to Lower Breede also take place.

3) Made up as follows: **161** million m^3/a IBT from Theewaterskloof to Berg WMA, plus **4** million m^3/a IBT to Berg WMA via Artois Canal, plus **5** million m^3/a IBT from "Gawie-se-water" to Berg WMA, plus **0,6** million m^3/a IBT to Franschhoek, plus **2,5** million m^3/a IBT to Olifants/Doorn WMA (Inverdoorn Canal), plus **4** million m^3/a to Overberg region.

The Reserve and Resource Quality Objectives Strategy (8.1) recommends that until otherwise concluded (through more detailed analysis and public participation), the Lower Breede River and the estuary should be managed according to their current ecological classes. This is in line with the recommendations of the BRBS. The one exception to the BRBS recommendation is that this strategy recommends that the Riviersonderend River be retained at its current Class "E", whereas the scientific recommendation in the BRBS is that it be upgraded to a Class "D". Were it to be upgraded to Class "D", the 85 million m^3/a impact on the yield of Theewaterskloof Dam would have severe social and economic impacts on many irrigators and on the City of Cape Town [see also 3.5.1 (ii)].

Taking these strategic recommendations into account, the current surplus water available in the Breede River component is 20 million m^3/a, as shown in Table 3.7.1. This is primarily available from currently unexercised allocations in the Upper and Lower Breede sub-areas out of the following dams:

<u>Upper Breede sub-area (17 million m^3/a)</u>

- 3 million m^3/a unused out of Koekedouw Dam which serves both irrigators and the town of Ceres (H10C)
- 14 million m^3/a unused out of Stettynskloof and Fairy Glen Dams serving Worcester (H10K)

<u>Lower Breede sub-area (3 million m^3/a)</u>

- 3 million m^3/a unused out of Buffeljags Dam (H70E) which otherwise serves local irrigators

3.7.1 Allocating the Current Available Surplus

It will be shown in Section 3.8 that future urban water requirements in the Breede River component are estimated to increase by 17 million m^3/a by 2030. Noting that the currently available "surplus", which whilst not yet in use, has in fact been allocated, the following recommendations are made in terms of planning for the future disposition of this 20 million m^3/a:

- the 3 million m^3/a surplus available out of Koekedouw Dam, in the Upper Breede sub-area should be utilised towards meeting future urban needs of Ceres, as well as for meeting the Reserve requirements of the Koekedouw River, downstream of the dam.
- the 14 million m^3/a shown as being available out of the Stettynskloof and Fairy Glen Dams (one system), should be set aside for the anticipated growth in the urban water requirements of Worcester. Both dams are owned by the Breede Valley Municipality. Under agreement between the town and the Holsloot WUA, some of this surplus is utilised for irrigation, as Worcester does not yet have the need for it. The WMA is entitled to store water in the dam, if surplus capacity is available. Weekly monitoring of inflow (m^3/s) determines how much the WUA is entitled to store. Estimates of annual volumetric use by the WUA from this source were not determined in the BRBS. This estimate should be undertaken to evaluate the actual available surplus in the dam, whilst

this agreement is in place. Worcester must first reassess its anticipated growth in urban water requirements. Any likely surplus should then be allocated towards addressing inequity through the further establishment of resource poor farmers in the area. The vehicle for this is the Co-ordinating Committee for Agricultural Water (CCAW), formerly known as the Irrigation Action Committee (IAC).

- Worcester also receives water out of the Lower Hex River via a diversion at Sesbek. This is used for irrigating sportsfields at Worcester and could potentially be traded with irrigators in the Hex River Valley, to improve the assurance of supply in that area. The annual volume received by Worcester from this diversion should be established as it is currently not monitored.
- the surplus of 3 million m^3/a available in the Lower Breede sub-area out of Buffeljags Dam, should be allocated to the establishment of resource poor farmers.

DWAF will be in a position to influence the allocation of the available surplus through the Water Service Development Plans (WSDPs) of the relevant local authorities. It is strongly suggested that any long-term surpluses be made available for use by resource poor farmers.

3.7.2 Water to Resource Poor Farmers

In the Breede River component, there are meaningful opportunities to address poverty through agricultural water use and related activities. There is some measure of own production in and around villages and townships. However, there have not been many examples of historically disadvantaged people emerging from their current situation into dramatically or even incrementally improved livelihoods based on agricultural water use or related business opportunities. Institutions in a position to facilitate the availability of land, water, and the many services related to the agricultural sector, need to work together to plan and support new farmer development. In the Western Cape, the planning and implementation of irrigation developments is co-ordinated through the CCAW. This is further addressed in the Support to Resource Poor Farmers Strategy (11.1).

In terms of land acquisition, a large number of resource poor farmer developments in the Breede River catchments have been registered with the Department of Land Affairs. Of these developments, 15 projects had been approved by March 2002, benefiting in excess of 1000 participants on some 2 200 hectares. The BRBS highlighted that access to information is not readily available on how much of this land is irrigated and whether or not that which is irrigated is from existing allocations.

A further 29 projects benefiting 1 700 participants on 1 900 hectares are in the process of implementation. Information as to the extent of access to water on these projects is also not readily available.

The establishment of resource poor farmers from current sources of supply is limited to the areas in which some surplus water is available. To optimise access to the currently available surplus (in a short time frame), financial, technical and training support to resource poor farmers would need to be provided by the government, with the CCAW as facilitating agent.

An alternative option would be to create opportunities for the establishment of resource poor farmers by encouraging the formation of joint venture partnerships between emerging farmers and existing commercial farmers where new irrigation developments are undertaken. This could be achieved through the implementation of a licensing strategy that would favour the issuing of new licences for irrigation water use to such joint partnerships. The benefit of this option would be that new entrants would receive technical and operational skills support from established farmers, already familiar with the challenges of commercial farming in the Breede WMA, and this approach is favoured by the Department.

Information must be obtained by DWAF from which the progress of land reform and the current and future access to water can be documented and regularly updated. This should clearly outline:

- i Where the land is situated? (Some information is available).
- ii How much is currently under irrigation?
- iii Whether this relies on existing (allocated water) or new water needs?
- iv Whether this involves a JV arrangement and if so with whom?
- v Where future demands for land (and water) are expected?

3.8 FUTURE WATER REQUIREMENTS

3.8.1 Potential In-catchment Urban Requirements

The BRBS has identified that without implementing WC/DM, the current urban water requirement of 26 million m^3/a is expected to increase to 61 million m^3/a by 2030.

Effective water demand management measures are not being implemented in the urban sector, and significant water savings can still be achieved. According to national estimates provided in the draft WC/DM Strategy for the Water Services Sector, potential savings of up to 40% of existing consumption can be realised in urban areas through the implementation of water demand management measures. In line with the BRBS, the Water Services: WC/DM Strategy (10.1) of this ISP, sets the objective of achieving at least a 30% saving in water use by the urban sector. This will limit the urban water requirement to 43 million m^3/a by 2030, a net increase of 17 million m^3/a, much of which will be in the larger urban centres, such as Worcester, where there is currently sufficient surplus available towards meeting these requirements.

3.8.2 Potential In-catchment Irrigation Expansion

Based on commercial lending rates (i.e. without government subsidy), it has been determined in the BRBS that viable irrigation expansion up to an additional water requirement of 140 million m^3/a could take place in the Breede River component, should it be possible to make this additional water available. This assessment took into account the cost of the land development, the cost associated with the development of the water resource to supply that requirement, and was based on a conservative view of foreign exchange rates (i.e. a strong Rand). It is important to note that the 140 million m^3/a potential irrigation water requirement was determined independently from the potential additional yield scenarios, one of which (Scenario3) happens to be of the same numerical value (see Section 3.10).

3.8.3 Potential Water Transfers out of the Breede River Component

Despite the anticipated completion of the Berg Water Project in 2007 (additional 81 million m^3/a yield to the Western Cape Water Supply System (WCWSS)) the Western Cape System will again be in deficit soon after 2010, even with the implementation of effective WC/DM measures. Options for further potential yield development in the Berg WMA are few, and these carry high financial and environmental costs.

In the DWAF ISP for the Berg WMA, it was identified that future water requirements of the WCWSS would increase from 405 million m^3/a (2000) to 668 million m^3/a by 2025. This equates to an increase of 263 million m^3/a. Furthermore irrigation expansion in the Berg WMA will come to a complete halt, as all allocations from Government Water Schemes will soon be fully utilised. Both the agricultural and urban sectors will therefore be under pressure for resources. This suggests that affordable options for augmenting the WCWSS from the Breede River component would be an attractive option for urban users in the Berg WMA, particularly the City of Cape Town (CCT). It will be shown (see Section 3.10) that all the potential yield that could be developed in the Breede River component could be fully utilised just in meeting future water requirements in the Berg WMA, without any further allocations to in-catchment agriculture being made in the Breede WMA. However, in terms of cost-effective scheme development, not all of the potential scheme locations in the Breede WMA would be suited to supplying the Berg WMA, and some sharing of the Breede's resources is in any event recommended.

3.9 RECONCILIATION INTERVENTIONS

It has been illustrated that potential water requirements, both in-catchment and for the WCWSS out of the Breede River component, are significant. To meet these potential requirements it will be necessary to develop additional yield in the Breede River. However there are a number of other important reconciliation interventions that must be also be considered, and these are discussed below. The development of potential (additional) yield is discussed in Section 3.10.

3.9.1 Verification of Existing Lawful Use

As noted previously, registered water use by irrigators in the Breede River component of this WMA, is expected to be reasonably accurate. Nevertheless, the verification process must be concluded and this may bring about small volumes of water that can be returned to the system.

3.9.2 Water Conservation and Demand Management (WC/DM)

Urban Sector

Virtually no existing WC/DM measures are being applied in the urban sector (BRBS). Savings of between 30 and 40% are achievable and local authorities such as the CCT (in the Berg WMA) and the Overstrand Municipality (Overberg sub-area) serve as examples for others to follow. DWAF can achieve a great deal by promoting the principles of WC/DM and lending technical support to those local authorities that are most in need. WC/DM is an intervention that the Department not only encourages but also sees as a prerequisite before the licensing of any new schemes for local authorities. Realistic WC/DM targets need to be identified in the WSDPs of local authorities and progress needs to be closely monitored to establish its implementation success. This is further addressed under the WC/DM: Water Services Strategy (10.1).

Based on the urban water requirement (only 5% of the total local water requirement), the use of treated effluent from wastewater treatment works (WWTWs) forms a relatively small component of potential available water. Nevertheless there is potential for the re-use of water in the larger urban centres, either directly or via an exchange with irrigation. Worcester's treated effluent, for example, is indirectly re-used. It is discharged into the Breede River, becoming available for abstraction further downstream. Water re-use is further addressed under the Water Services WC/DM Strategy (10.1).

Agricultural Sector

Irrigation in the Breede River component constitutes 95% of the in-catchment water requirement making this the most important sector on which to focus savings. The BRBS refers to an earlier study undertaken by the Water Research Commission (1986-1988). That study found that in a typical irrigation district within the Robertson area, less than 50% of the water diverted into Greater Brandvlei Dam actually reaches the farm boundaries. Whilst this Study may be 15 years old, there is still significant scope to improve water use efficiency within the agricultural sector.

There are a number of opportunities to implement WC/DM, such as:

- upgrading the irrigation conveyance and distribution systems to reduce losses;
- improved scheduling at irrigation schemes;
- the improved timing of releases, through for example, the introduction of short-term demand projections by farmers;
- improved monitoring of abstraction within irrigation schemes;
- over-irrigation to leach out salts (typically on new farms) can be reduced by appropriately siting new irrigation developments on less saline soils (licence conditions);
- improved techniques to manage salinity (interceptor drains for example) and reduce the quantities of freshening releases required.

Efficient irrigation systems (drip and microjet) are used by most irrigators in the Breede River component. WC/DM in the agricultural sector is further addressed under the Agricultural

WC/DM Strategy (10.2). Implementation of WC/DM remains more cost-effective than the development of new schemes and needs to be entrenched at all user levels through technical support, public awareness and education.

3.9.3 Trading of Water

Trading of existing authorisations is a way of shifting water towards more beneficial or higher paying use, without increasing total volume demand. Typically, urban demands can be met by sourcing water from agricultural users.

3.9.4 Clearing of Invasive Alien Plants

An estimated 46 000 ha of the land area in the Breede River catchments has been invaded by alien plant species. The actual area invaded is much larger but this is expressed as an equivalent area of 100% invasion density. When compared to the cost of constructing new water supply schemes, the elimination of invasive alien plants often represents an economical means of unlocking water resources. The BRBS has estimated that through the removal of all invasive alien plants in the Breede River component an additional system yield of some 45 million m^3/a could become available in the following sub-areas:

- Upper Breede: 25 million m^3/a
- Riviersonderend: 13 million m^3/a
- Lower Breede: 7 million m^3/a

If the growth of invasive alien plants were to continue unchecked, the invaded areas could triple in size by 2020, and cover about 250 000 ha by 2040, with disastrous impacts on available water resources. Although the ideal of total removal is not realistic, very important gains can be made through the clearing programme. The Changing Land-Use – Clearing of Invasive Alien Plants Strategy (9.6), presents a suggested priority for clearing. The main recommendations of that strategy are that existing clearing programmes in the Riviersonderend (particularly in the catchment area of Theewaterskloof Dam) and Upper Breede sub-areas should be continued, and preferably intensified. Early attention should also be given to clearing efforts in the catchments with lighter infestations, particularly the Cogmanskloof, Ceres and Middle Breede areas, before these areas become densely invaded. Bio-control has proven to be a cost-effective measure against many species and should be introduced wherever possible. This presents the most certain, cost-effective and sustainable form of control. The progress and benefits of clearing invasive alien plants will need to be monitored and water resource availability assessments adjusted accordingly.

3.9.5 Development of Groundwater Potential

It is possible that some of the potential yield that could be developed in the Breede River catchments could be developed from groundwater sources in the Upper Breede sub-area, as an alternative to surface water development (described in Section 3.9.6). The approach, however, is toward the development of surface water yield, with groundwater providing yet more yield.

The potential of the surface water resource depends not only on good catchment management (notably clearing of invasive alien plants) but also on groundwater abstraction. Groundwater abstracted from river beds, close to streams, and from shallow alluvial aquifers will have a very direct influence on surface water yields, and should be seen as equivalent to surface water use. Despite this caveat there is a great deal of groundwater which has only very weak links to surface water and which can be abstracted without significantly impacting on surface water yields. Development and use of this water would for the most part be very localised, i.e. with use close to source. Some of the surface water yield potential could therefore be harvested as "groundwater" but the preferred approach is to limit further groundwater abstraction from the zone of direct interaction and to focus on harvesting groundwater where this is most likely to yield additional water. This allows surface and groundwater to be viewed as additive, with groundwater significantly increasing the development potential in the Breede River component of the WMA.

The current estimate of actual groundwater use in the Breede River catchments is 103 million m^3/a, much of which is abstracted out of the alluvial aquifers, and the Bokkeveld and Karoo fractured rock aquifers. The Table Mountain Group (TMG) aquifers of the Upper Breede sub-area are a potential source of supply, both for in-catchment use and for supply to the Berg WMA. The supply of water to the CCT out of the TMG from within the Breede River catchments has been identified as one of the viable reconciliation interventions for the Berg WMA, and is being investigated by the CCT. Although there is potential to develop the groundwater resource in the Breede River catchments, the H10A-C group of quaternaries in the Ceres catchment is an exception. The BRBS has shown that in terms of aquifer recharge and contribution to surface water base flow, the current groundwater use in that area exceeds the estimates of sustainable supply volumes from the groundwater resource.

Within the Hex River catchment (H20) the current registered groundwater abstraction is 20 million m^3/a. In terms of contribution to baseflow and recharge, the BRBS concludes that there is still some potential for sustainable groundwater abstraction in the Hex River catchment. However, the extent of current abstraction is impacting on the availability of surface water to other users in that catchment. As a result of the impact on other users, further groundwater abstraction in the Hex River catchment should be cautiously considered. The further development of surface water resources, such as the proposed Osplaas Dam, is being investigated by the WUAs to supplement existing sources in the Hex River Valley.

The sustainable abstraction potential of groundwater between the base of Michell's Pass (H10D) to the Greater Brandvlei Dam is estimated at approximately 94 million m^3/a of which about 32 million m^3/a is the current registered use. 80 million m^3/a of the potential is from within the TMG. Approximately 11 million m^3/a is from the fractured rock aquifers of the Bokkeveld and Karoo groups and the remaining 3 million m^3/a, from within the alluvium. Similarly, in the area between Worcester and the Nuy Valley, the potential for sustainable abstraction is estimated at 15 million m^3/a and current use only at 2,5 million m^3/a.

The CCT is currently undertaking a feasibility study into the potential for augmenting the City's water supplies out of the TMG Aquifer. There is a complex interaction in terms of the recharge dynamics of the alluvial aquifers, from the TMG and from summer baseflow in the rivers, which in turn is also largely provided from the TMG. The recharge dynamics of the alluvial aquifers vary significantly from one site to the next and as such, site specific monitoring is important in order to support any new applications for abstraction authorisations, particularly out of the alluvium. It is clear that abstraction from the alluvium affects surface water baseflow and must to this extent be regarded as equivalent to surface water use.

Essentially, the use of groundwater from more distant, disconnected sources draws on invisible storage which recharges over time when there is surplus water within the system (just as a dam would fill), and this can be seen as "available water". The BRBS has estimated that after allowing for the contribution of groundwater to the Reserve, the potential groundwater availability in the Breede River component of this WMA is estimated at > 300 million m^3/a. Table 7.4.1 of the Groundwater Utilisation Strategy (7.4) sets out the potential within each of eleven groundwater resource units and indicates the aquifer type. Full utilisation of this potential will not be realised due to the following practical constraints :

- It becomes financially less viable to abstract groundwater from depths in excess of 100 m due to the associated infrastructure, drilling and pumping requirements.
- Access to remote and inaccessible areas is often not possible due to the rugged terrain within the Breede River catchment.
- In order to abstract large volumes of groundwater, wellfields consisting of many individual boreholes are required and this has associated cost implications.
- The availability of groundwater may not be congruent with irrigable land or other potential uses. The financial cost of pipelines and pump stations to convey the water from its source to the users may be too high for the purpose of irrigation.

3.9.6 Development of Surface Water Yield Potential

The development of the potential additional yield in the Breede River component was investigated during the BRBS. The existing Breede River system was configured in the Water Resources Yield Model, and the yields associated with three potential ecological classification scenarios were investigated. The added yield potential for each scenario was based on an assessment of between 100 and 800 million m^3 of storage in the Breede River component. The assessment concluded that the development of up to 400 million m^3 of additional storage could be cost effectively developed. Ultimately, decisions on the selection of ecological classes for the rivers and the estuary will involve further study and public participation.

The three scenarios investigated during the BRBS and the resulting potential yields associated with each are shown in Table 3.9.1 and graphically in Figure 3.9.1.

Table 3.9.1: River Classification Scenarios Investigated in the BRBS

Site	The Current Class	Recommended Classes(1) and Existing IAPs	Reduced Classes and Existing IAPs	Recommended Classes (1) and Complete IAP Removal
	(Status Quo)	(Scenario 1)	(Scenario 2)	(Scenario 3)
1. Upper Breede River (H10F)	D/E	D	D	D
2. Molenaars River (H10J)	B	B	B	B
3. Middle Breede River (H40F)	C/D	C/D	C/D	C/D
4. Lower Breede River (H70G)	C	B/C	B/C	B/C
5. Riviersonderend River (H60F)	E	(E)(2)	E	(E) 2
6. Breede River Estuary	B	B	C	B
Resulting Yield Potential within the Breede River component (million m^3/a) for additional storage of 400 million m^3.		**90** million m^3/a	**115** million m^3/a	**140** million m^3/a

(1) "Recommended Classes" are those scientific recommendations of the BRBS.
(2) The exception in this scenario being that the Riviersonderend River is retained at its current Class "E", although the recommendation from a scientific perspective was that it should be rehabilitated to a Class "D".

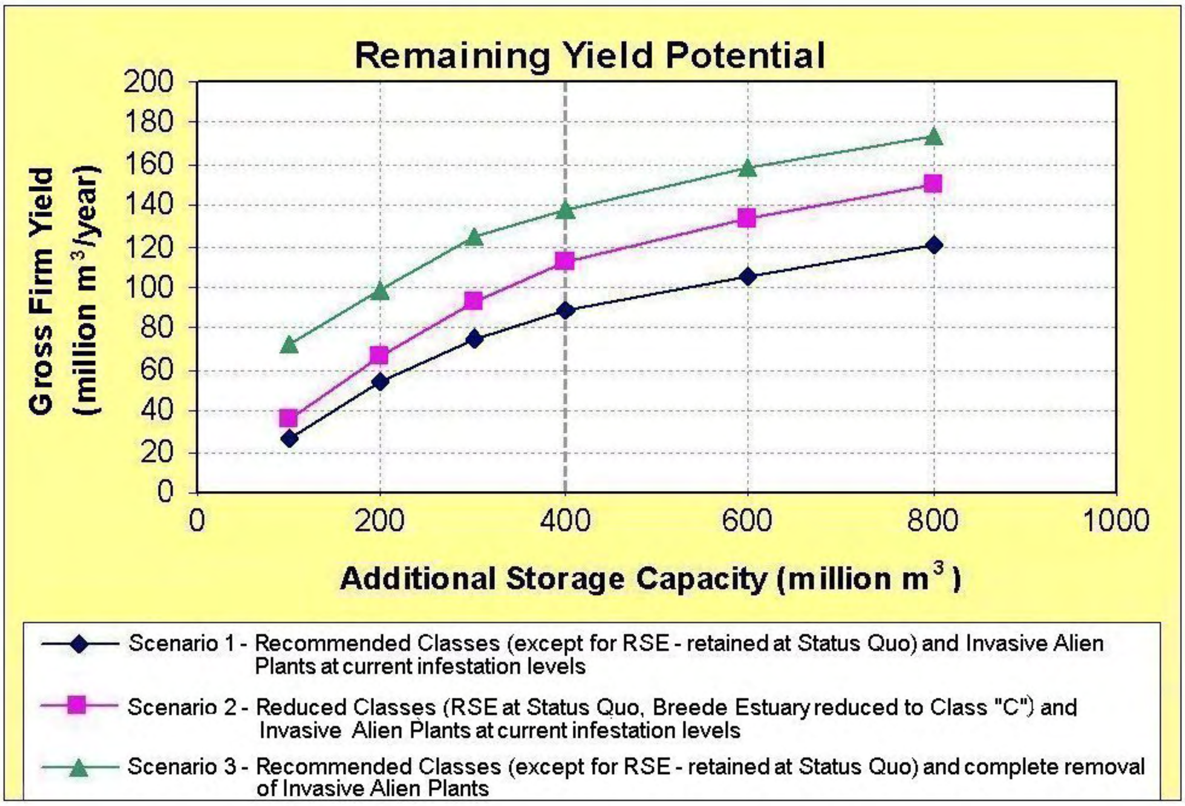

Figure 3.9.1: The impacts of two ecological class scenarios and one invasive alien plant removal scenario on potential yield

An explanation of the three scenarios investigated in the BRBS follows.

Scenario 1 – Recommended Ecological Classes

As shown in Table 3.9.1, the scientific recommendations are such that the current classes (status quo) would be improved in the upper reaches of the Breede River, in the Riviersonderend River and in the Lower Breede River. The scientific recommendation in terms of the Molenaars River, Middle Breede and the Breede River estuary is that they be maintained at their current levels. The result of this scenario using scientific recommended classes would be that the potential yield that could be achieved would be in the order of 90 million m^3/a, through the use of additional storage of 400 million m^3. Of the 400 million m^3, 133 million m^3 is already available in Greater Brandvlei Dam, but at present the dam can not be filled to its full capacity. To achieve this yield however, the Riviersonderend River would need to be retained at its current Class "E" and not upgraded to a Class "D". Furthermore, the extent of invasive alien plant infestation is assumed to be maintained at current levels.

Scenario 2 - Reduced Ecological Classes

Under this scenario, the most significant changes from the recommended classes are the Riviersonderend (retained at current Class "E") and the Breede River Estuary (reduced to a Class "C"). This scenario also assumes that the invasive alien plant infestation is maintained at current levels. The potential yield from additional storage of 400 million m^3 is approximately 115 million m^3/a.

Scenario 3 - Recommended Ecological Classes and Removal of Invasive Alien Plants

This scenario is the same as Scenario 1, with the exception that it assumes the complete removal of all invasive alien plants in the Breede River component of the WMA. The infestation has a current impact on yield of about 45 million m^3/a. Although complete removal is considered unlikely, this scenario is nevertheless of relevance, as it defines an upper limit of the yield potential, taking the scientific recommendations of the BRBS (with the exception only of the Riviersonderend River) into account.

The BRBS considered many possible individual schemes from which to develop potential yield in the catchment. These schemes were all assessed on an individual basis. The impact on the yield potential of an existing or proposed downstream scheme, from the development of one or more upstream schemes was not investigated. The BRBS should be referred to for detail on all of the options considered. Only those options ranked in that study as most preferable will be described in this ISP, and briefly at that. The assessment undertaken in the BRBS was essentially conducted for two development options, namely:

- In-catchment development of irrigation
- Water for transfers to the Berg WMA

Whilst it has been shown that either option could exclusively make full use of the yield potential within the Breede River component, the discussion that follows is based on the point of departure that:

- ⇨ the development of yield for increasing the transfers into the Berg WMA will be considered;
- ⇨ some combination of water for transfer and in-catchment development will be the most probable implementation scenario.

The application of two possible Reserve scenarios and one invasive alien plant removal scenario described in this ISP each show different yield development potential (90, 115 and 140 million m^3/a). In Sections 3.10.1 and 3.10.2 recommendations are made in terms of which schemes appear more favourable for in-catchment development, and which for water transfer into the Berg WMA. Within each Reserve scenario described above, the relative impacts of schemes on one another will need to be investigated. This would be part of the Western Cape Reconciliation Study, to be undertaken by the Department towards the end of 2004.

The potential yields associated with each of the three scenarios are based on the assumption that the use of groundwater potential from areas within or close to river channels, is considered as equivalent to the use of surface water. Potential groundwater abstraction out of the TMG from sites at which there is not a direct interaction with surface water flow is not included. The CCT is currently investigating this potential as part of its feasibility study into the TMG, as a potential source to augment Cape Town's water supply. Further abstraction from the TMG is therefore not considered a Breede WMA resource for purposes of this ISP.

3.10 POTENTIAL NEW SCHEMES

3.10.1 Developing Yield for In-catchment Use

Of the larger regional development options considered in the BRBS, a process of multi-criteria decision analysis clearly identified the following two options as the preferred options for in-basin irrigation development:

- Augmentation of Greater Brandvlei Dam
- Raising Buffeljags Dam

<u>Augmentation of Greater Brandvlei Dam</u>
From an in-catchment perspective, taking advantage of the existing spare capacity in Greater Brandvlei Dam (133 million m^3) is the optimum development option for irrigation expansion in the Breede River component. Within this option many possible permutations were considered in terms of where to divert or abstract the water for storing in the dam, how to convey it into the dam, and what the environmental impacts and financial costs would be.

The conveyance and pumping capacity is already in place to deliver $5m^3/s$ from the existing Papenkuils pump station on the Breede River. Further development of the pumping capacity of this scheme would be the most favourable for in-catchment irrigation development. The current abstraction capacity of $5m^3/s$ equates to a yield of 11 million m^3/a out of Greater Brandvlei Dam. Prior to 2003, this was seldom utilised to its full capacity. However, during 2003 and 2004 this pumping scheme was fully utilised. As such, the yield delivered at the 5 m^3/s pumping rate should not be considered as available surplus as this is included in the existing yield.

By increasing the pumping capacity by 15m^3/s to 20 m^3/s (for which the existing pump station makes provision to house additional pumps) to pump surplus winter water from the Breede River into Greater Brandvlei Dam, the yield of the dam could be increased by an additional 33 million m^3/a (over and above the 11 million m^3/a from current 5 m^3/s installed pumping capacity). This would allow for new in-catchment development without affecting the use or assurance of existing users. This is after allowance for the recommended ecological water requirements of the Breede River and its estuary, as determined in the BRBS. A further benefit of this option is that a balancing weir would not be necessary and the risk of inundating the Papenkuils wetland would be avoided. Together with the installation of additional pumps, minor modifications to the existing pumping sump would enable more efficient pumping.

Unit Reference Values (URVs) are used for a comparative assessment of the financial costs of scheme options. The lower the URV, the more affordable the scheme. The Papenkuils Pumpstation Scheme (increasing the capacity by 15m^3/s) is estimated to have a capital cost of approximately R38 million and a URV of R0,15/m^3. This cost excludes costs that will have to be incurred to distribute additional water from Brandvlei Dam.

It should be noted that diversions from Michell's Pass into Greater Brandvlei Dam via a 40km canal or pipeline were also considered. This did not prove to be a cost-effective option for in-basin development with the URV for the canal option at R1,04/m^3, and R2,45/m^3 for the pipeline. Options for increasing diversions from the Molenaars River were investigated, but were also considered to be less attractive than the Papenkuils Scheme.

The location of the Greater Brandvlei Augmentation Scheme (Papenkuils Pumpstation) for in-catchment development is shown on Figure 3.10.1.

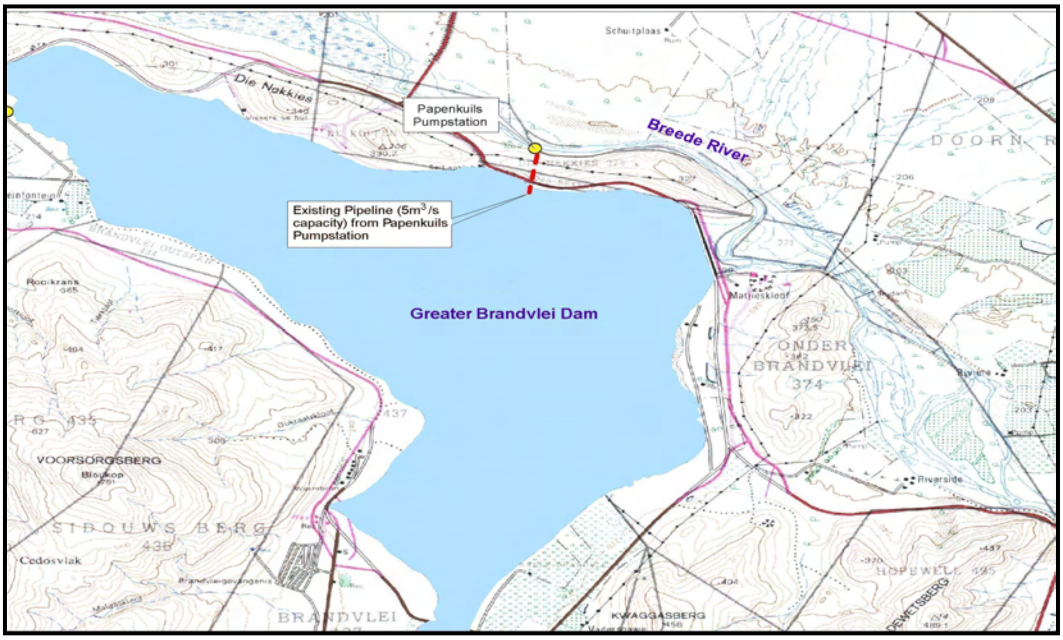

Figure 3.10.1: The Potential Brandvlei Augmentation Scheme

Upstream scheme development such as the potential Michell's Pass and Molenaars Diversion transfer schemes (described in Section 3.10.2) would have some impact on the present day yield of Brandvlei Dam and on the potential yield of the Brandvlei Augmentation Scheme. The extent of these impacts will be assessed in the Western Cape Reconciliation Strategy, and various pumping options at Papenkuils will be investigated to offset the impacts of potential upstream schemes.

<u>Raising Buffeljags Dam</u>

The second most favourable development option for in-catchment supplies appears to be the raising of the existing Buffeljags Dam by 10m, doubling its current yield from 11 to 22 million m^3/a (after allowing for ecological flow releases to the Lower Breede and the Estuary). The water, which is of good quality, could be used to expand irrigation downstream, offering potential to establish resource poor farmers in the area. The capital cost to implement this scheme is estimated to be approximately R80 million, with a URV of R0,75/m^3. The possible scheme layout is shown on Figure 3.10.2.

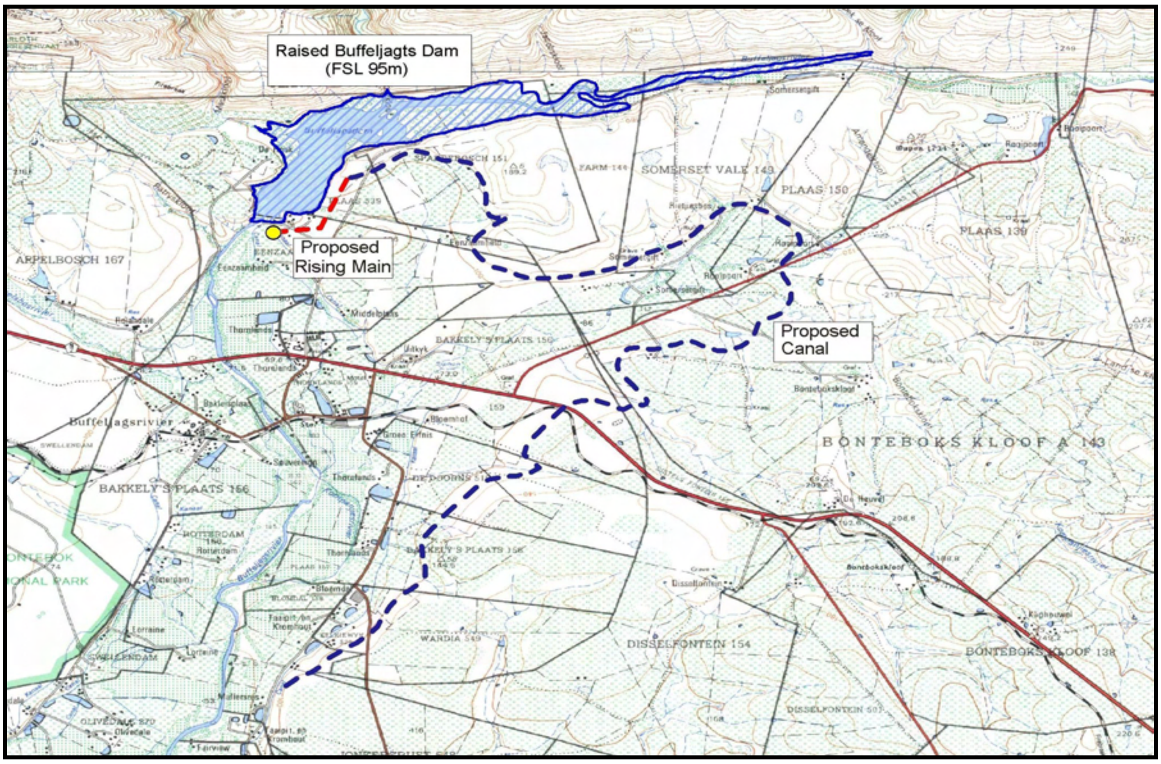

Figure 3.10.2: The Potential Raising of Buffeljags Dam

The Greater Brandvlei Augmentation Scheme and the raising of Buffeljags Dam are not mutually exclusive and there is sufficient water to implement both options. There are also numerous smaller potential schemes with individual yields of less than 5 million m^3/a. It is conceivable that some of these schemes could be developed in conjunction with scaled-down versions of the Greater Brandvlei Augmentation Scheme and the raising of Buffeljags Dam.

3.10.2 Developing Yield for Transfer

Three large schemes were identified in the BRBS for the potential additional transfer of water into the Berg WMA. These are:

1) Augmenting Theewaterskloof Dam out of Greater Brandvlei Dam
2) The Michell's Pass Diversion
3) The Upper Molenaars Diversion

Theewaterskloof Dam and the tunnel system supplying water to the WCWSS already draws on the maximum available yield from the Upper Riviersonderend catchment. To increase the yield of Theewaterskloof Dam, it would be necessary to transfer water from Greater Brandvlei Dam. Pumping out of the Breede River by means of an enlarged pumping capacity would take place into Greater Brandvlei Dam, from where the water would be transferred to Theewaterskloof Dam by a system of pump stations, pipelines and canals. The potential yield of this scheme for transfer is expected to be similar to that for in-catchment development (see Section 3.10.1). To verify this it would be necessary to integrate the Breede System models with that of the Western Cape System, so as to determine the marginal yield benefit to the Western Cape System. A URV of R1,14/m^3 was determined for this option.

Concern has however been raised from a water quality perspective in terms of introducing more turbid water from Greater Brandvlei Dam into Theewaterskloof Dam. This scheme would also preclude the usage of additional water pumped into Greater Brandvlei Dam for in-catchment development. Consequently the two preferred options for water transfer were identified as:

- The Michell's Pass Diversion
- The Upper Molenaars Diversion

<u>The Michell's Pass Diversion</u>

A 10m high weir on the Dwars River (Upper Breede) would divert winter water only, via a 9km canal across the catchment divide and into a tributary of the Klein Berg River. From the Klein Berg River, the existing diversion weir and canal would divert the water into Voëlvlei Dam. Alternatively, the water could continue to the Berg River, for diversion and use in the West Coast area. The possible scheme layout is shown on Figure 3.10.3.

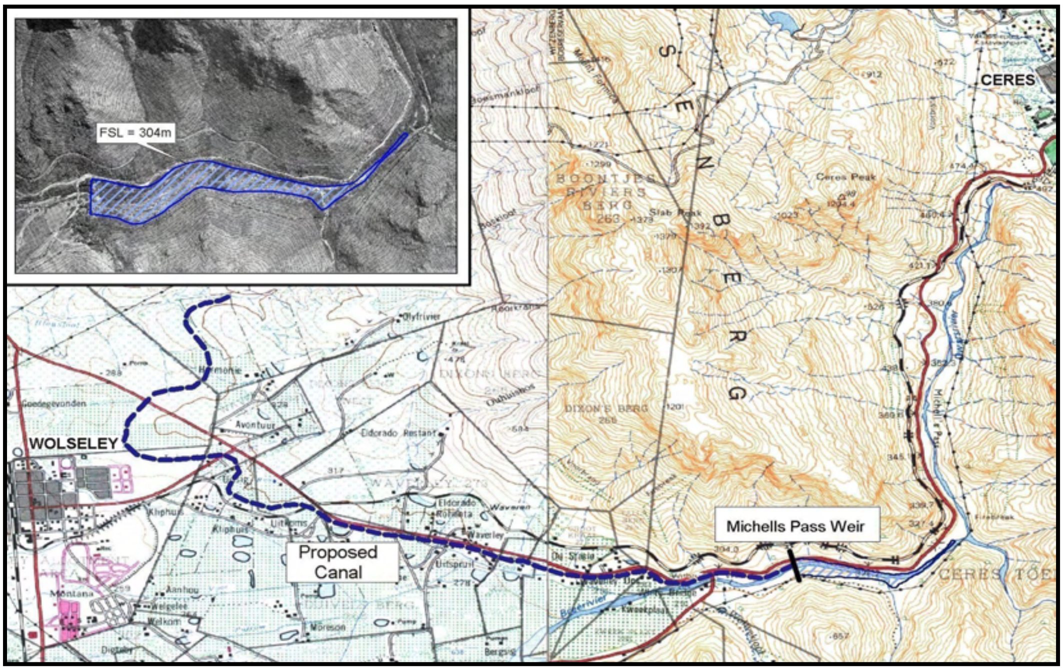

Figure 3.10.3: The Potential Michell's Pass Diversion Transfer Scheme

The capital cost of the Michell's Pass Scheme (2003) to the first point of delivery (Voëlvlei Dam) is R56 million. This equates to a URV of R0,11/m^3. The substantial potential yield arising from the scheme (53 million m^3/a) will probably require that a second pipeline to Cape Town be constructed from Voëlvlei Dam, involving additional costs which would substantially increase the URV. The Michell's Pass Scheme remains a favourable option to augment the WCWSS and supply to Cape Town. Although a URV has not been calculated to alternatively convey this water to the West Coast, this also looks very promising. It is possible that both the CCT and the West Coast could be supplied through a sharing of the resource.

The impact of the Michell's Pass Diversion on the potential yield of the Greater Brandvlei Augmentation Scheme did not form part of the scope of the BRBS, although some preliminary assessments of the impacts were undertaken for the West Coast Study. That study found that, for example, a 1 m^3/s diversion at Michell's Pass would have an impact on the yield of Greater Brandvlei Dam of about 6 million m^3/a. In order to recover this yield, the rate of abstraction at the Papenkuils Pump Station would need to be increased from 5 m^3/s to 6,4 m^3/s. The impacts of a range of abstraction rates at the potential Michell's Pass Diversion, on the yield of Greater Brandvlei Dam, will be investigated during the Western Cape Reconciliation Strategy Study. Furthermore, the yields quoted above may not translate into equivalent yield benefits to the Western Cape System, as the critical drought period in the Breede WMA may not coincide exactly with the critical drought period in the Berg WMA. This will need to be investigated as part of the Western Cape Reconciliation Strategy Study.

The Upper Molenaars River Diversion

During the construction of the Huguenot Tunnel, provision was made for the transfer of water from the Upper Molenaars River via a pipeline installed along the length of the tunnel. From a pump station located downstream of the confluence of the Molenaars and Elands Rivers, winter water would be pumped to the east portal. From there it would gravitate via the existing pipeline through the tunnel, and then via a new pipeline from the west portal to Wemmershoek Dam. As an alternative, a similar option would be possible for gravitating the water to the Berg River Dam. The capital cost of the scheme would be approximately R213 million, providing 27 million m^3/a of additional yield at a URV of R0,82/m^3 (for delivery to Wemmershoek Dam). The CCT is currently investigating the additional costs associated with linking their existing bulk water infrastructure to the Berg Water Project, currently being developed. The investigation will take account of the possibility of integrating the Upper Molenaars Diversion Scheme layout shown on Figure 3.10.4.

The Molenaars Scheme would have some impact on the existing diversions into Brandvlei Dam and on the potential additional yield of the dam. The impact was not determined during the BRBS and will be investigated during the Western Cape Reconciliation Strategy Study.

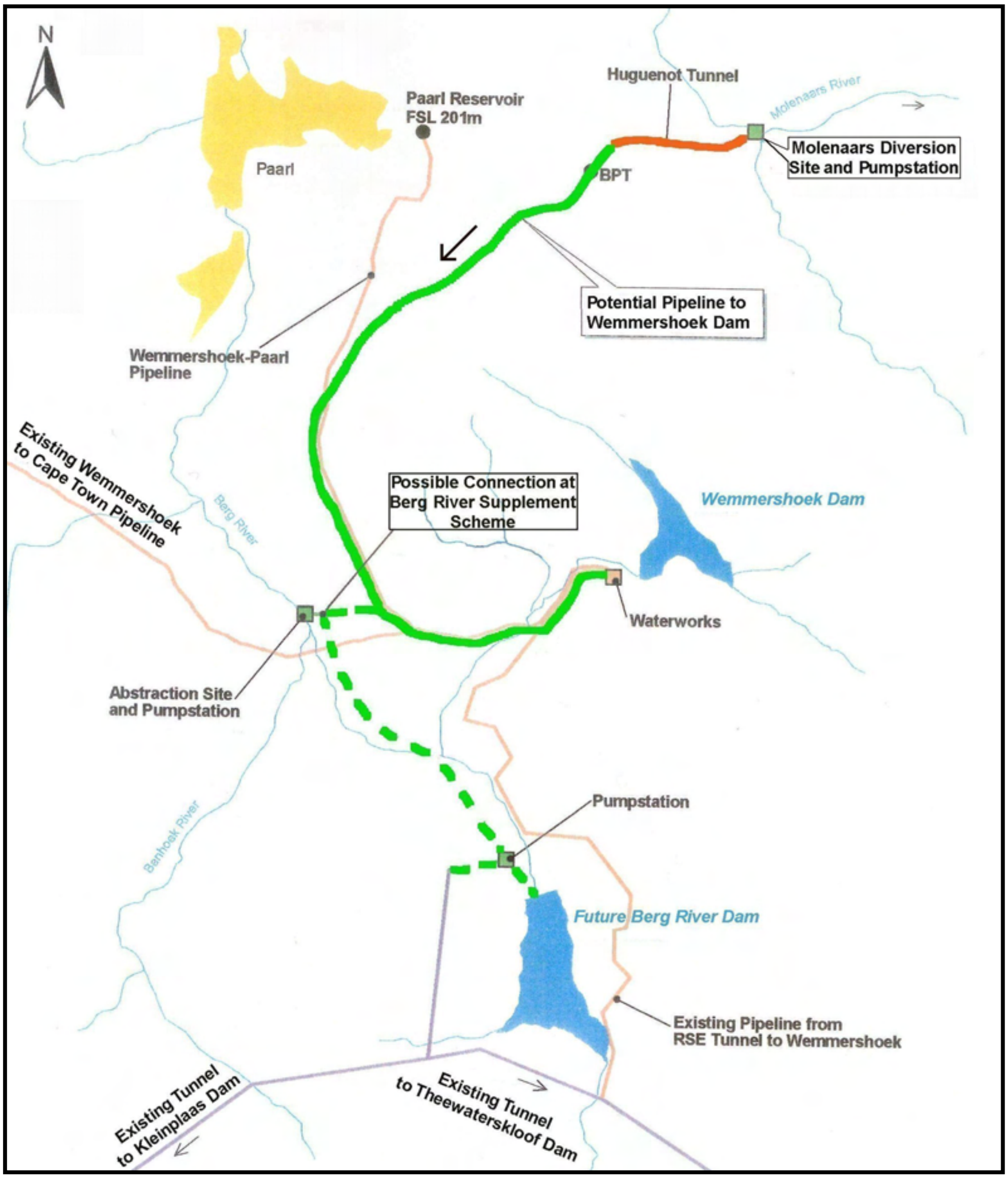

Figure 3.10.4: The Potential Upper Molenaars Diversion Transfer Scheme

3.11 ALLOCATING FUTURE DEVELOPED YIELD

Table 3.11.1 summarises the suggested scheme developments and allocations, based on the best available information. These should be viewed as interim options on which to base water resource planning until the Western Cape Reconciliation Strategy Study provides more informed strategic direction. It does not suggest that all of these schemes will necessarily be developed. As better information becomes available, these interim options will be updated, improved and revised.

Table 3.11.1: Potential Yield Development Options

<table>
<tr><th>Potential Yield Development</th><th>Comments</th><th>Potential Schemes - Max Yields (million m^3/a)</th></tr>
<tr><td>Scenario 1
(90 million m^3/a)</td><td>Scenario 1 assumes the recommended ecological classes with the Riviersonderend retained at its current Class "E".</td><td rowspan="3"><u>In-catchment Development</u>
⇨ Greater Brandvlei Augmentation (33)
⇨ Raise Buffeljags Dam (11)
⇨ Smaller schemes (16)

<u>Transfer Schemes</u> (1)
⇨ Michell's Pass Diversion (53)
⇨ Molenaars Diversion (27)</td></tr>
<tr><td>Scenario 2
(115 million m^3/a)</td><td>Scenario 2 assumes a reduced ecological class for the Breede River Estuary from that recommended in the BRBS. The Riviersonderend is also retained at its current Class "E".</td></tr>
<tr><td>Scenario 3
(140 million m^3/a)</td><td>Scenario 3 assumes a contribution to the 140 million m^3/a, of 45 million m^3/a from clearing of all invasive alien plants. The Riviersonderend is also retained at its current Class "E".</td></tr>
</table>

(1) The yields of the potential transfer schemes do not take account of the mitigating measures, such as the Greater Brandvlei Augmentation Scheme, which may be required to restore the existing yield of Brandvlei Dam.

With the exception of the Buffeljags Scheme and possibly some smaller regional schemes, the other potential schemes may be mutually exclusive. The relative impacts on the yields of one another, will be investigated in the Western Cape Reconciliation Strategy Study. Furthermore, the yield development options in the Breede WMA will have to be aligned with the Berg WMA development strategies.

It should be noted that the direct effects of invasive alien plants on the potential schemes themselves would be small, as most of the schemes would divert water during the winter months when evapotranspiration by invasive alien plants is very small. On the other hand invasive alien plants will reduce summer runoff into existing dams, and remove water from the rivers. This will result in less water being available for abstraction from on-channel dams and from rivers (including the Breede River). The impact on the yields of potential schemes through the clearing of invasive alien plants will form part of the Western Cape Reconciliation Strategy Study.

In terms of developing future yield potential, one of the most important challenges facing water resource managers in the Western Cape is how to allocate future yield, developed within the region, between competing users. Irrigation expansion in the Breede River component remains an important part of the economic growth potential, not only within the catchment but also within the Western Cape region as a whole.

In the Berg WMA, industrial and urban expansion will introduce increasing demands for water. In this regard, options for augmenting the WCWSS from within the Berg WMA are becoming scarce and ever more expensive to develop. Whilst more affordable options from within the Breede WMA have been identified, there will be significant competition for any future available water by the following three sectors:

- Urban and industrial users within the Breede River component
- Urban users within the Berg WMA (most notably the CCT)
- Irrigators within Breede River component.

The potential yields for each of the three Ecological Water Requirement scenarios could be fully utilised in the Breede River component for irrigation development alone. These same yields could equally well be fully utilised by urban water users in the Berg WMA. The key question arises as to which Ecological Water Requirement scenario will ultimately be adopted, how the potential yield should best be allocated, and which schemes might best be developed to supply such allocation. The answer cannot be prescribed at this stage and will become more apparent after the findings of the Western Cape Reconciliation Strategy study, currently being implemented by the Department, become available.

However, on the basis of information available through studies completed to date, the Department must make the best possible decisions and utilise the available information to allocate water in the short-term until the Reconciliation Strategy Study is completed. As such, a strategic approach is proposed to guide the Department in this regard. This will be revisited in subsequent ISPs using the output of the Reconciliation Strategy Study, and refined as more informed decision-making becomes possible. As a point of departure, the allocation of water from the potential yield that could be developed in the Breede River component, should be based on the following strategies:

i The provision of 17 million m^3/a for meeting the estimated increase in urban water requirements (2030) within the Breede River component will receive first priority. This will to some extent be met through the current surpluses in the Koekedouw (Ceres), Stettynskloof and Fairy Glen Dams (Worcester). It will be supplemented by groundwater schemes and/or small urban allocations which would need to be traded out of irrigation schemes unless the verification process finds some additional water. The town of De Doorns would be served out of Osplaas Dam and Robertson out of Greater Brandvlei Dam, for example.

ii The option to provide water to the WCWSS out of the Breede River catchment should not be unnecessarily compromised. In this regard the Michell's Pass (53 million m^3/a potential) and Molenaars Diversion (27 million m^3/a potential) schemes appear to be the most suitable options.

iii Irrigation expansion within the Breede River component could possibly be supported through the Brandvlei Augmentation Scheme and the possible raising of Buffeljags

Dam, or a combination of smaller schemes with suitably down-scaled versions of the two larger ones. Firstly however, the impact of the potential transfer schemes on the current and potential yield of Greater Brandvlei Dam must be investigated. A high priority will be to ensure a fair allocation of any water becoming available for in-catchment development towards improved equity, such as the establishment of resource poor farmers and job creation.

Future studies will need to take the effects of climate change into account. In the Western Cape, there is the prospect of a reduction in mean annual runoff of 10% by 2015 (as a result of global warming). The impact of this is likely to be increased drought duration, with reduced assurances of supply from schemes.

The selection of which schemes to implement and at what scale, depends on which Reserve scenario is ultimately implemented. The scheme combinations and their relative impacts on one another will be assessed for a number of Reserve scenarios in the Reconciliation Strategy Study. At present no firm decision can be made. However, it is reasonable to consider those schemes in Table 3.11.1 to be the most likely prospects for development. The potential provision of some water for transfer to the Berg WMA will not be excluded from whichever Reserve scenario may ultimately prevail.

In terms of future allocation to irrigation expansion, first priority will be towards achieving economic upliftment of those persons previously disadvantaged. DWAF recognises that much of the current water resource is in the hands of historically advantaged (white) farmers and would like to see this imbalance redressed. To this end water that is available at the present time will be allocated to resource poor farmers.

The development of additional resources will be dependent on significant use being made of that water to redress inequity. Much will depend on who funds the resource development but the opportunity must first go to the previously disadvantaged sector. The Department encourages the sharing of the water resource. Joint ventures are viewed favourably because they allow the established agricultural sector to support disadvantaged farmers with technical and management skills (and perhaps financial backing), and all parties stand to gain from the available water. The CCAW should be informed of opportunities so as to identify potential emerging farmer groups in areas where water may become available in the future.

3.11.1 Reconciliation in 2025

It should be noted that in this ISP no reconciliation of potential water requirements and availability is provided for the Breede River catchments on account of the uncertainties about the combined potential yields of the various schemes that may be required, and the potential future allocations between the WCWSS and the Breede WMA. These uncertainties should be resolved by the future Western Cape Reconciliation Strategy Study.

3.12 WATER QUALITY

3.12.1 Salinity

Surface water quality in the Breede River component is primarily affected by salinity, resulting from the diffuse return flows from irrigated farmland and from leaching of the naturally saline geology. This is most prevalent in the middle and lower reaches of the Breede River, with salinity levels progressively increasing in a downstream direction.

From the geological perspective the water generated in the sandstone areas (typically the Table Mountain Group ranges) is of a high quality with a low dissolved salt content. The quality deteriorates in the main river channel due to the impact of more saline water arising from the lowlands, where the shales and mudstones are predominant. This is further aggravated during the dry summer months when dilution is less effective and irrigation return flows predominate (as described below), with qualities resulting in adverse impacts on downstream irrigators.

Agricultural practices aggravate the extent of the salinity problem, through the wash-off of fertilisers and through the leaching of natural salts. Irrigation causes the release of natural salts much faster than would be the case under normal conditions. Of particular influence is the intentional leaching of natural salts where new lands are cleared and soils purposefully leached to prepare those lands for irrigation. This is most apparent where new land is cleared on the higher lying ground. Under these conditions the leaching of soils creates flow paths through existing lands, further exacerbating the leaching effect.

Whilst the ecology and riverine health has adapted to high levels of salinity over geological time, the current increase in levels through irrigation practices is the primary concern in terms of water quality for irrigation out of the Breede River, and in terms of the ecology of the river and estuary.

3.12.2 Managing Salinity in the Breede River Component

Salinity levels in the middle and lower reaches of the Breede River are currently managed through freshening releases (approximately 22 million m^3/a) out of Greater Brandvlei Dam. Salinity is managed as far downstream as the Zanddrift Canal off-take, just upstream of the Cogmanskloof River confluence (H30E / H40L). Although salinity levels are currently still within the target limits at the off-take, this will change should irrigation development continue. Farmers below the Zanddrift Water User Association canal off-take are already receiving water that does not comply with the prescribed limits.

Some distance downstream of the canal off-take, a degree of naturally occurring freshening takes place where the Riviersonderend and Buffeljags River tributaries enter the Breede River. This is because the water arising from those tributaries is of better quality than the water in the middle Breede River itself. To date no freshening releases into the Riviersonderend River from Theewaterskloof Dam have been considered necessary.

The Water Quality Strategy (8.3) makes recommendations regarding possible remedial measures such as the use of interceptor drains to limit the saline return flows entering the river. The demarcation of saline soils and the issuing of water use licences with conditions as to where new lands can be established, is another option. By reducing the salinity levels in the river through appropriate management, the volumes of freshening releases could potentially be reduced and the availability of water to meet other important needs improved.

Other more extreme (and costly) alternatives include the construction of high-level canal systems (totalling up to 580km), to convey water directly from Greater Brandvlei Dam to irrigators along the Breede River in the Brandvlei Government Water Scheme. Water released from the dam would not be affected by saline return flows and the river channel would no longer serve to convey water to downstream irrigators from the Government Scheme. This option would have the impact that the Breede River would become even more exposed to the effects of saline return flows, and possibly place farmers downstream of the Government Water Scheme in an even worse position than at present. Canal conveyance losses could also be significant. Other options investigated include the construction of a drainage canal to convey the saline return flows downstream, or the construction of holding dams for the later release of saline water during periods of high flow.

The BRBS concluded that salinity modelling of the more favourable options should be undertaken, taking into account the technical feasibility, environmental impacts, Reserve requirements and financial costs. In the interim, the current management of salinity through freshening releases should be continued. As previously mentioned, of practical importance is the appropriate siting of any new irrigation developments so as to best avoid exacerbating the salinity problem. This may be difficult given the need to provide water for resource poor farmers in areas where water can be made available. However, the risks of salinisation must be a critical component of all irrigation development planning.

3.12.3 Other Water Quality Concerns

In the Breede River component, point source pollution such as the discharge of inadequately treated wastewater effluent from WWTWs, and irrigation with untreated winery and other industrial effluent are further concerns. Most municipal WWTWs and larger industries are in general making the necessary effort to become compliant with the conditions of their water use authorisations. However, the cumulative effect of many smaller operators irrigating with effluent which does not meet the GA requirement, remains a concern. Whilst the practice of water re-use must be encouraged, the minimum water quality standards set through licences and GAs must be maintained. Compliance monitoring must be put in place through co-operative governance between DWAF, local authorities, and WUAs.

Diffuse pollution from poorly serviced informal settlements and the use of soak-aways on the banks of the Lower Breede River are also of concern. These concerns, and steps to remedy them, are addressed in the Water Quality Strategy (8.3).